ENVIRONMENTAL IMPACT ASSESSMENT REPORT

For

PROPOSED POLY PROPYLENE UNIT (PPU) OF CAPACITY 360KTPA

At

M/s NUMALIGARH REFINERY LIMITED

Village: Pankagrant
Tehsil: Bokakhat
District: Golaghat
State: Assam

By

M/s. NUMALIGARH REFINERY LIMITED, ASSAM

ToR Issued on 15 Jul 2022

(Proposal Number: IA/AS/IND2/280558/2022)

Baseline Monitoring Period – (December 2022 to February 2023)

[Project termed under Schedule 5(c) Category 'A' – Petro-chemical complexes (industries based on processing of petroleum fractions & natural gas and/or reforming to aromatics) as per EIA Notification 2006 and its Amendments]

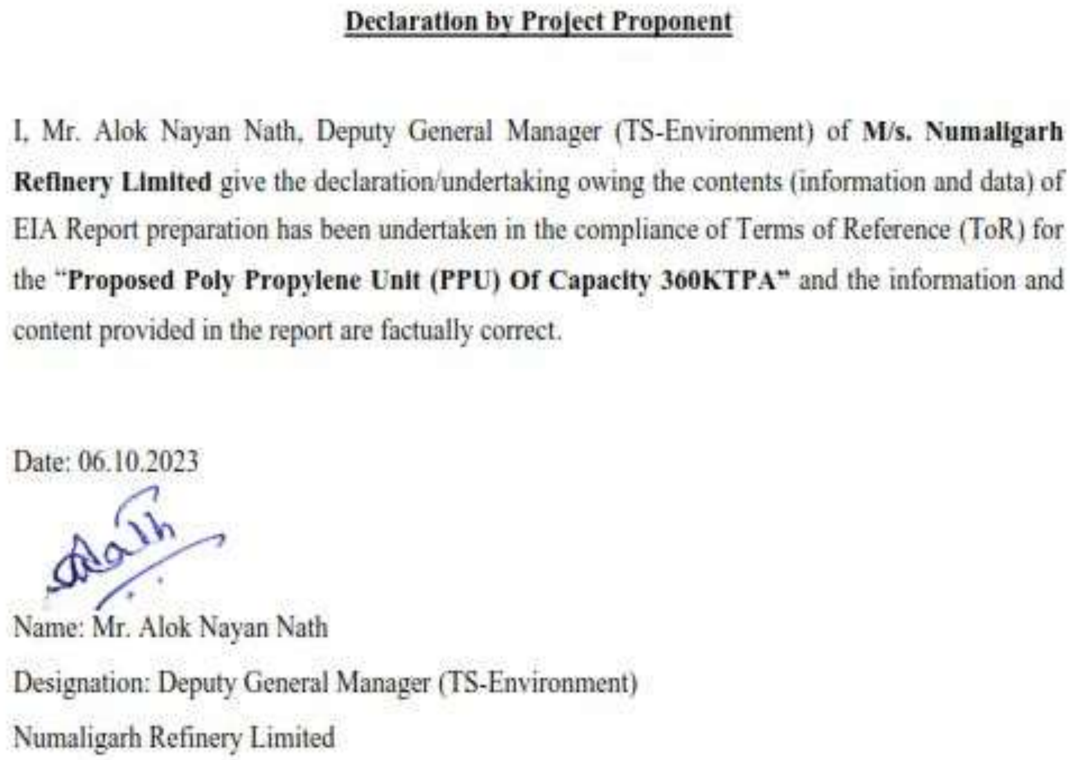
By

EIA CONSULTANT:

M/s. Hubert Enviro Care Systems (p) Limited

NABET/EIA/2224/SA 0190 dated 06.03.2023 valid till 27.07.2024
NABL Certificate Number: TC-5786 dated 30.04.2022 valid till 29.04.2024

October 2023

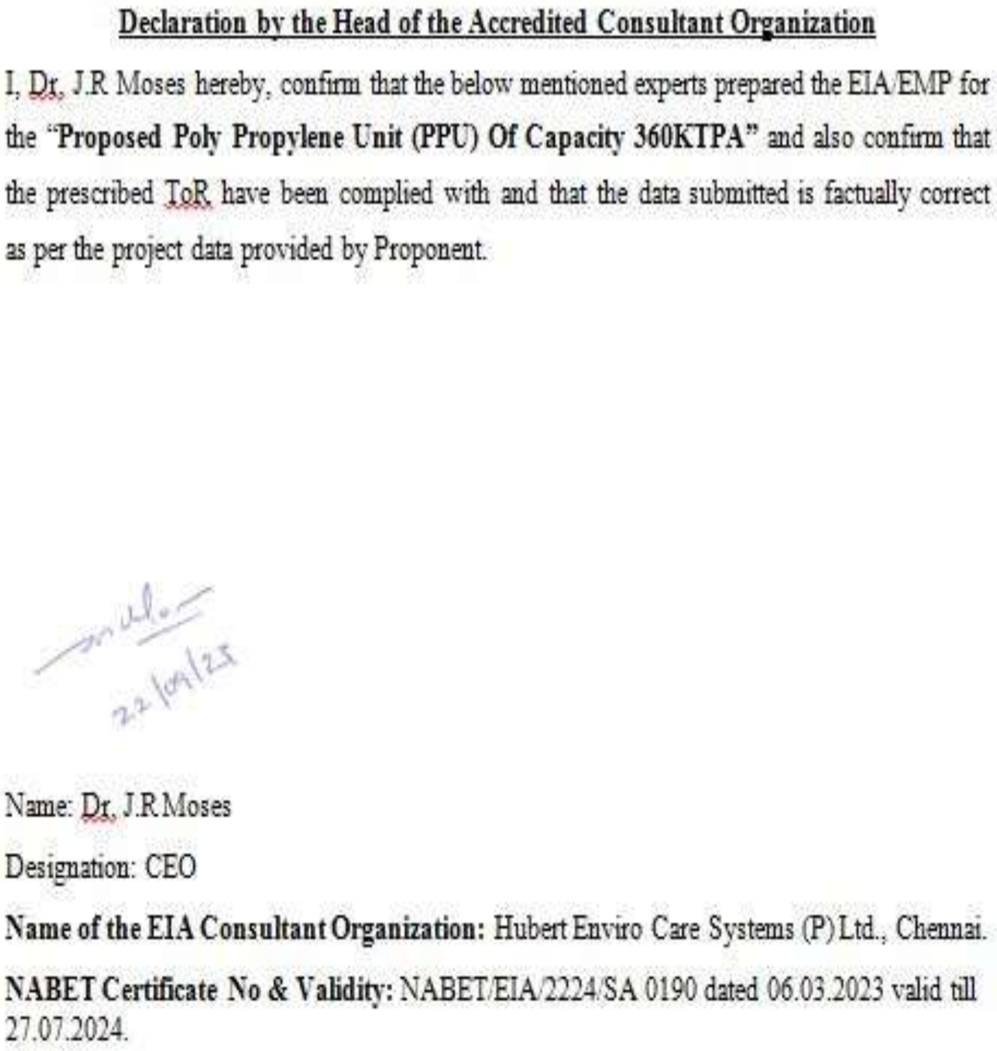


Declaration by Project Proponent

I, Mr. Alok Nayan Nath, Deputy General Manager (TS-Environment) of **M/s. Numaligarh Refinery Limited** give the declaration/undertaking owing the contents (information and data) of EIA Report preparation has been undertaken in the compliance of Terms of Reference (ToR) for the "**Proposed Poly Propylene Unit (PPU) Of Capacity 360KTPA**" and the information and content provided in the report are factually correct.

Date: 06.10.2023

Name: Mr. Alok Nayan Nath
Designation: Deputy General Manager (TS-Environment)
Numaligarh Refinery Limited



Declaration by the Head of the Accredited Consultant Organization

I, Dr. J.R Moses hereby, confirm that the below mentioned experts prepared the EIA/EMP for the "**Proposed Poly Propylene Unit (PPU) Of Capacity 360KTPA**" and also confirm that the prescribed ToR have been complied with and that the data submitted is factually correct as per the project data provided by Proponent.

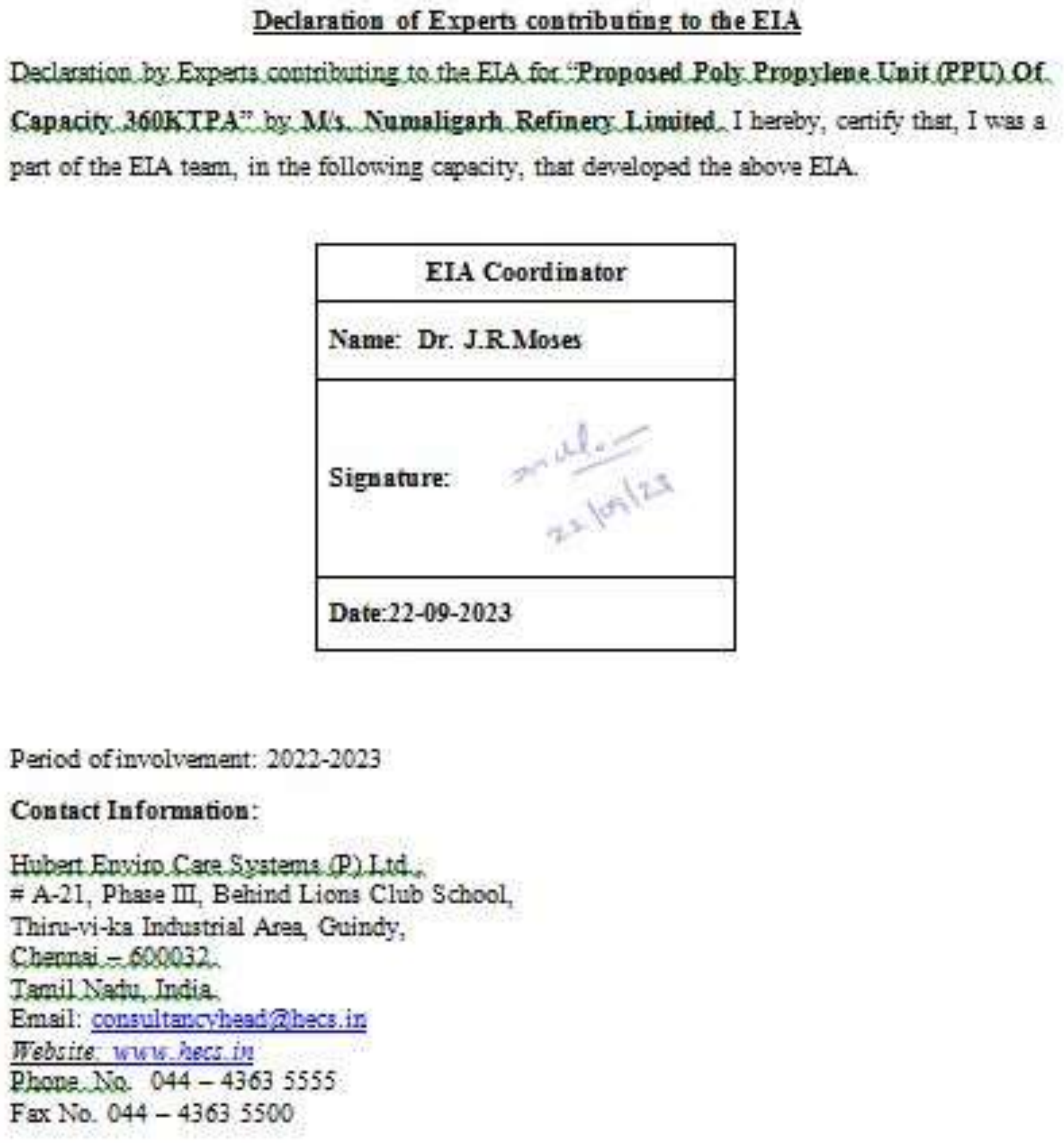
22/09/23

Name: Dr. J.R Moses

Designation: CEO

Name of the EIA Consultant Organization: Hubert Enviro Care Systems (P) Ltd., Chennai.

NABET Certificate No & Validity: NABET/EIA/2224/SA 0190 dated 06.03.2023 valid till 27.07.2024.



Declaration of Experts contributing to the EIA

Declaration by Experts contributing to the EIA for **"Proposed Poly Propylene Unit (PPU) Of Capacity 360KTPA"** by **M/s. Numaligarh Refinery Limited**. I hereby, certify that, I was a part of the EIA team, in the following capacity, that developed the above EIA.

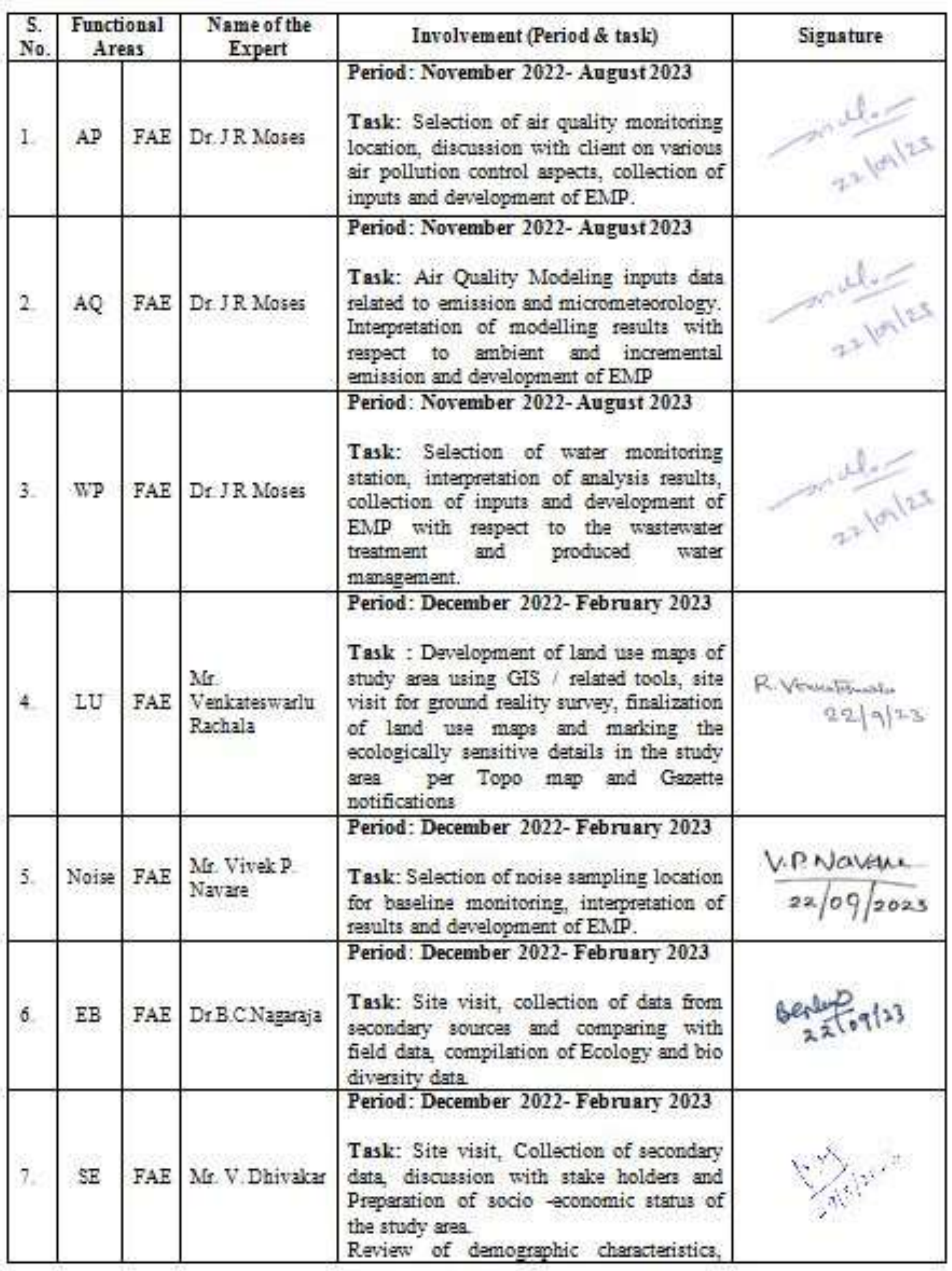
EIA Coordinator
Name: Dr. J.R.Moses
Signature: 22/09/23
Date:22-09-2023

Period of involvement: 2022-2023

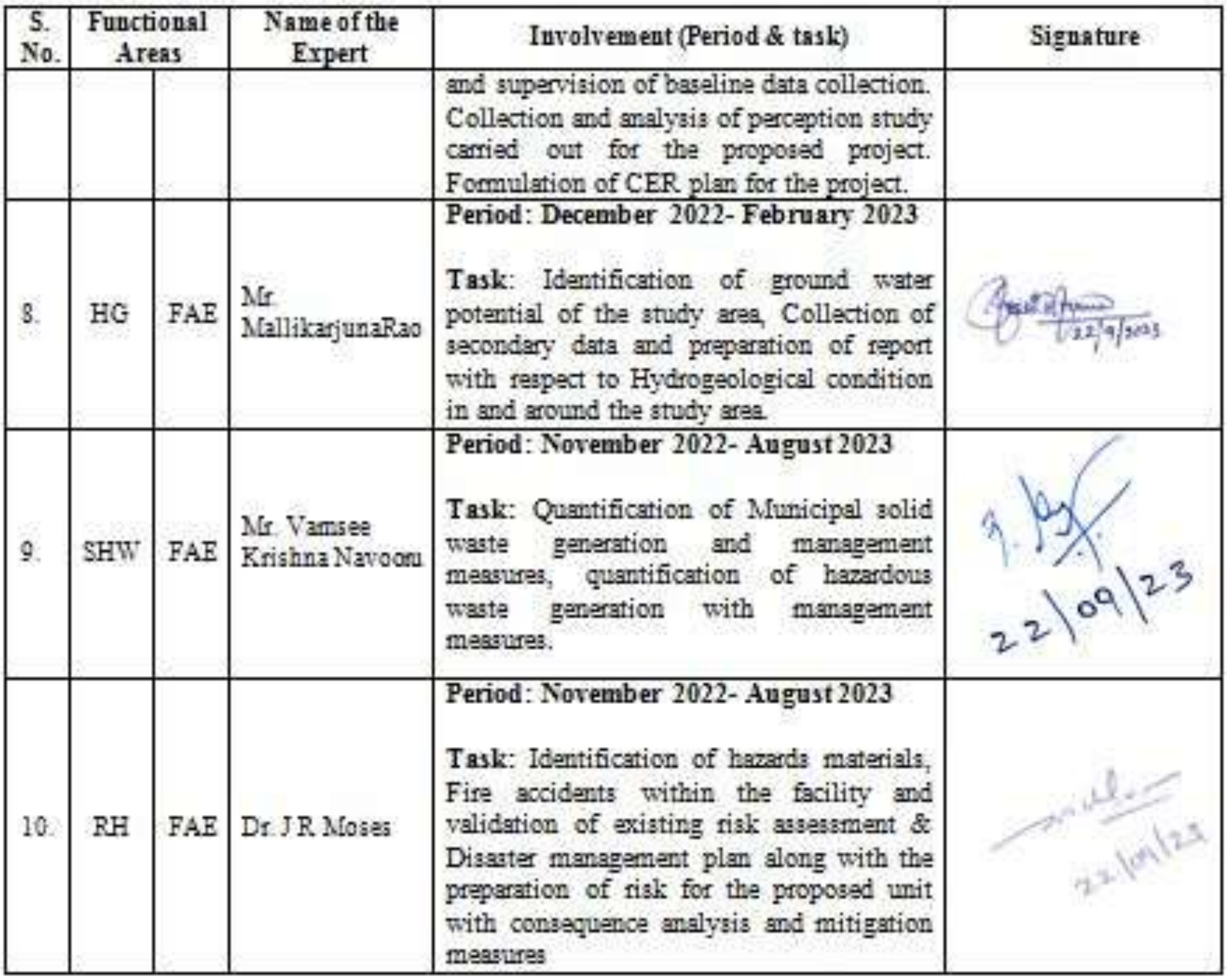
Contact Information:

Hubert Enviro Care Systems (P) Ltd.,
A-21, Phase III, Behind Lions Club School,
Thiru-vi-ka Industrial Area, Guindy,
Chennai – 600032.
Tamil Nadu, India.
Email: consultancyhead@hecs.in
Website: www.hecs.in
Phone. No. 044 – 4363 5555
Fax No. 044 – 4363 5500

Functional Area Experts (FAEs):



S. No.	Functional Areas		Name of the Expert	Involvement (Period & task)	Signature
1.	AP	FAE	Dr. J R Moses	**Period: November 2022- August 2023** **Task:** Selection of air quality monitoring location, discussion with client on various air pollution control aspects, collection of inputs and development of EMP.	22/09/23
2.	AQ	FAE	Dr. J R Moses	**Period: November 2022- August 2023** **Task:** Air Quality Modeling inputs data related to emission and micrometeorology. Interpretation of modelling results with respect to ambient and incremental emission and development of EMP	22/09/23
3.	WP	FAE	Dr. J R Moses	**Period: November 2022- August 2023** **Task:** Selection of water monitoring station, interpretation of analysis results, collection of inputs and development of EMP with respect to the wastewater treatment and produced water management.	22/09/23
4.	LU	FAE	Mr. Venkateswarlu Rachala	**Period: December 2022- February 2023** **Task** : Development of land use maps of study area using GIS / related tools, site visit for ground reality survey, finalization of land use maps and marking the ecologically sensitive details in the study area per Topo map and Gazette notifications	R. Venkateswarlu 22/9/23
5.	Noise	FAE	Mr. Vivek P. Navare	**Period: December 2022- February 2023** **Task:** Selection of noise sampling location for baseline monitoring, interpretation of results and development of EMP.	V.P. Navare 22/09/2023
6.	EB	FAE	Dr.B.C.Nagaraja	**Period: December 2022- February 2023** **Task:** Site visit, collection of data from secondary sources and comparing with field data, compilation of Ecology and bio diversity data.	22/09/23
7.	SE	FAE	Mr. V. Dhivakar	**Period: December 2022- February 2023** **Task:** Site visit, Collection of secondary data, discussion with stake holders and Preparation of socio -economic status of the study area. Review of demographic characteristics,	



S. No.	Functional Areas		Name of the Expert	Involvement (Period & task)	Signature
				and supervision of baseline data collection. Collection and analysis of perception study carried out for the proposed project. Formulation of CER plan for the project.	
8.	HG	FAE	Mr. MallikarjunaRao	**Period: December 2022- February 2023** **Task**: Identification of ground water potential of the study area, Collection of secondary data and preparation of report with respect to Hydrogeological condition in and around the study area.	22/9/2023
9.	SHW	FAE	Mr. Vamsee Krishna Navooru	**Period: November 2022- August 2023** **Task**: Quantification of Municipal solid waste generation and management measures, quantification of hazardous waste generation with management measures.	22/09/23
10.	RH	FAE	Dr. J R Moses	**Period: November 2022- August 2023** **Task**: Identification of hazards materials, Fire accidents within the facility and validation of existing risk assessment & Disaster management plan along with the preparation of risk for the proposed unit with consequence analysis and mitigation measures	22/09/23

AP -Air pollution monitoring, prevention and control
AQ - Meteorology, air quality mod lling and prediction
WP - Water pollution monitoring, prevention and control
SE - Socio-economics
EB - Ecology and biodiversity
HG - Hydrology, ground water and water conservation
NV - Noise and vibration
LU - Land use
RH - Risk assessment and hazards management
SC – Soil conservation
SHW -Solid and Hazardous Waste Management

Acknowledgement

The following personnel are gratefully acknowledged for their fullest support in collection, compilation of needful data regarding the project and kind cooperation in fulfilling the report on EIA/ EMP for “**Proposed Poly Propylene Unit (PPU) Of Capacity 360KTPA”** by M/s. Numaligarh Refinery Limited.

M/s. Numaligarh Refinery Limited.

1. Mr. AlokNayanNath - Deputy General Manager (TS)

M/s. Hubert Enviro Care Systems (P) Ltd.

1. Dr.J.R.Moses – CEO
2. Dr.Rajkumar Samuel – Director Technical
3. Mr. Vamsee Krishna Navooru – Consultancy Head and EIA Coordinator

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LIST OF ABBREVIATION

NREP	Numaligarh Refinery Expansion Project
NRL	Numaligarh Refinery Limited
PPU	Proposed Poly Propylene Unit
AP	Air pollution monitoring, prevention and control
AQ	Meteorology, air quality mod lling and prediction
WP	Water pollution monitoring, prevention and control
SE	Socio-economics
EB	Ecology and biodiversity
HG	Hydrology, ground water and water conservation
NV	Noise and vibration
LU	Land use
RH	Risk assessment and hazards management
SC	Soil conservation
SHW	Solid and Hazardous Waste Management
QCI	Quality Council of India
LPG	Liquefied Petroleum Gas
NDZ	Non Developmental Zone
FIBC	Flexible Intermediate Bulk Container
SPCB	State Pollution Control Board
CPCB	Central Pollution Control Board
MSL	Mean Sea Level
IMD	India Meteorological Department
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
DO	Dissolved Oxygen
COD	Chemical Oxygen Demand
BOD	Biological Oxygen Demand
IVI	Importance Value Index

BNHS	Bombay Natural History Society
BMP	Biodiversity Management Plan
LDAR	Leak Detection and Repair
VOC	Volatile Organic Carbon
PFCCU	Petrochemical Fluidized Catalytic Cracking Unit
PRU	Propylene Recovery Unit
NABL	National Accreditation Board for Testing and Calibration Laboratories
PP	Polypropylene
RWTP	Raw Water Treatment Plant
RODM	Reverse Osmosis De-Mineralized Process
CPU	Condensate Polishing Unit
CPP	Captive Power Plant
OSBL	Outside Battery Limit

Executive Summary

Project Description

Numaligarh Refinery Limited (NRL) is planning to set up a Polypropylene Unit along with its associated facilities at Numaligarh beside the existing refinery in the state of Assam to meet the increasing demand of polypropylene in the North eastern region. Under this NREP project a high severity PFCCU unit with a capacity of 1.955 MMTPA is being implemented. The LPG that will be generated in the high severity mode will contain asignificant potential of propylene which can be recovered for value addition.

NRL intends to explore the feasibility of putting up a PP unit in the refinery complex from Polymer grade propylene feed from PFCC unit along with associated utilities and offsite facilities.

The Polypropylene Unit is to be designed as a single train with a capacity of 360,000 TPA of Homo-polymer grades of Polypropylene (PP) product with a target annualized product split discussed elsewhere in the report. The capacity stated is inclusive of off spec (low value) products produced during transition from one grade to another.

M/s Numaligarh Refinery Limited proposes Environmental Clearance for "Proposed Poly Propylene Unit (PPU) Of Capacity 360KTPA" Schedule 5(c) Category 'A' – "Petro-chemical complexes (industries based on processing of petroleum fractions & natural gas and/or reforming to aromatics)" as per EIA Notification 2006 and its Amendments.

The Polymer Grade Propylene produced in the PRU section of the PFCC Unit of NREP is further processed in the downstream unit i.e. PP unit to produce Homo-polymer grade Polypropylene product.

Geographical coordinates of the project site

S.No	Latitude	Longitude
1	26°35'7.26"N	93°47'15.39"E
2	26°35'0.04"N	93°46'26.33"E
3	26°35'7.59"N	93°46'26.49"E
4	26°35'11.66"N	93°46'25.09"E
5	26°35'13.63"N	93°46'22.00"E
6	26°35'20.48"N	93°46'24.29"E
7	26°35'22.25"N	93°46'24.46"E
8	26°35'28.72"N	93°46'31.38"E
9	26°35'28.35"N	93°46'34.52"E
10	26°35'27.96"N	93°46'35.81"E
11	26°35'23.39"N	93°46'49.73"E
12	26°35'23.31"N	93°46'52.21"E
13	26°35'25.21"N	93°46'54.53"E
14	26°35'26.24"N	93°46'56.57"E
15	26°35'26.47"N	93°46'58.23"E
16	26°35'25.57"N	93°47'0.76"E
17	26°35'24.69"N	93°47'6.17"E
18	26°35'23.58"N	93°47'11.76"E

Environmental Sensitive Areas

Environmentally Sensitive Areas within 15km from Project Boundary

<table>
<tr><th>S.No</th><th>Areas</th><th>Distance & Direction from project boundary</th></tr>
<tr><td>1</td><td>Monuments</td><td>Nil</td></tr>
<tr><td>2</td><td>Waterbodies</td><td>
<table>
<tr><th>S.No</th><th>Water Bodies</th><th>Distance (~km)</th><th>Direction</th></tr>
<tr><td>1.</td><td>Dhansiri River</td><td>0.80</td><td>N</td></tr>
<tr><td>2.</td><td>Kaliani River</td><td>1.36</td><td>WNW</td></tr>
<tr><td>3.</td><td>Doygurn River</td><td>4.61</td><td>ESE</td></tr>
<tr><td>4.</td><td>Deuri Nadi</td><td>6.54</td><td>SSW</td></tr>
<tr><td>5.</td><td>Disai Nadi</td><td>9.41</td><td>N</td></tr>
<tr><td>6.</td><td>Dhala Jan</td><td>11.55</td><td>SSE</td></tr>
<tr><td>7.</td><td>Brahmaputra River</td><td>12.62</td><td>NNW</td></tr>
<tr><td>8.</td><td>Pora Jan</td><td>14.50</td><td>SSW</td></tr>
<tr><td>9.</td><td>Kaliyani RF</td><td>14.50</td><td>SSW</td></tr>
</table>
</td></tr>
<tr><td>3</td><td>State, National boundaries</td><td>Nil</td></tr>
<tr><td>4</td><td>Nearest Highway</td><td>➢ NH-129(Dimapur-Numaligarh) at a distance of ~1.31km towards SW
➢ SH-1(Kamargaon-Joypur) at a distance of ~3.12 km towards N</td></tr>
<tr><td>5</td><td>Nearest Railway station</td><td>➢ Khumtai Railway Station, ~7.38km , ENE</td></tr>
<tr><td>6</td><td>Defence installations</td><td>Nil</td></tr>
<tr><td>7</td><td>Nearest Town</td><td>Golaghat, ~16.50km towards ESE</td></tr>
<tr><td>8</td><td>Nearest City</td><td>Jorhat, ~39km, ENE</td></tr>
<tr><td>9</td><td>Nearest Airport</td><td>Jorhat Airport,~39.57 km, ENE</td></tr>
<tr><td>10</td><td>Nearest Villages</td><td>
<table>
<tr><th>S.No</th><th>Villages</th><th>Distance</th><th>Directions</th><th>Populations</th></tr>
<tr><td>1.</td><td>Pankagaon</td><td>0.01km</td><td>W</td><td>250</td></tr>
<tr><td>2.</td><td>Telgaram</td><td>0.36km</td><td>SSW</td><td>2,500</td></tr>
<tr><td>3.</td><td>Rajabari</td><td>0.37km</td><td>N</td><td>557</td></tr>
<tr><td>4.</td><td>Letekujan</td><td>0.38km</td><td>E</td><td>3,000</td></tr>
<tr><td>5.</td><td>Numaligarh Township</td><td>1.80km</td><td>WNW</td><td>1,000</td></tr>
</table>
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<table>
<tr>
<td>11</td>
<td>Manmade</td>
<td>
<table>
<tr><th>S.No</th><th>School</th><th>Dist(km)</th><th>Direc</th></tr>
<tr><td>1.</td><td>Ponka Senior Basic School</td><td>0.32</td><td>W</td></tr>
<tr><td>2.</td><td>Borgoria LP School</td><td>0.74</td><td>N</td></tr>
<tr><td>3.</td><td>Ouguri L P School</td><td>0.76</td><td>E</td></tr>
<tr><td>4.</td><td>Delhi Public School Numaligarh</td><td>2.57</td><td>W</td></tr>
<tr><td>5.</td><td>Deithor Govt Hr Sec School</td><td>5.75</td><td>W</td></tr>
<tr><td>6.</td><td>Bokial High School</td><td>6.75</td><td>S</td></tr>
<tr><td>7.</td><td>Bholaguri Kamalamiri Higher Secondary School</td><td>8.99</td><td>NE</td></tr>
<tr><td>8.</td><td>Rongagorah Govt LP School</td><td>9.04</td><td>SSW</td></tr>
<tr><td>9.</td><td>Balijan Sankarjyoti High School</td><td>12.31</td><td>SSE</td></tr>
<tr><td>10.</td><td>Jawahar Navodaya Vidyalaya School</td><td>12.43</td><td>ESE</td></tr>
</table>
<table>
<tr><th>Colleges</th><th>Dist(km)</th><th>Direc</th></tr>
<tr><td>Deithor Govt Model Degree College</td><td>3.84</td><td>W</td></tr>
<tr><td>Harlongbi Velongbi College</td><td>4.49</td><td>W</td></tr>
<tr><td>Marangi Mahavidyalaya Junior College</td><td>5.61</td><td>SE</td></tr>
<tr><td>Joya Gogoi College</td><td>5.62</td><td>ENE</td></tr>
<tr><td>Kamargaon College</td><td>6.10</td><td>NNW</td></tr>
</table>
<table>
<tr><th>Hospitals</th><th>Dist(km)</th><th>Direc</th></tr>
<tr><td>Numaligarh PHC</td><td>1.27</td><td>SW</td></tr>
<tr><td>Numaligarh Veterinary Dispensary</td><td>1.30</td><td>SW</td></tr>
<tr><td>Vivekanand Kendra-NRL Hospital</td><td>2.33</td><td>W</td></tr>
<tr><td>Khumtai Model Hospital</td><td>5.65</td><td>ENE</td></tr>
<tr><td>Numaligarh T.E Hospital</td><td>5.83</td><td>NE</td></tr>
<tr><td>Deihori Karabi Model Hospital</td><td>7.09</td><td>SW</td></tr>
<tr><td>Dholaguri Hospital</td><td>8.11</td><td>SE</td></tr>
<tr><td>Behora Hospital</td><td>8.41</td><td>NW</td></tr>
<tr><td>Mahuramukh MPHC</td><td>9.33</td><td>N</td></tr>
<tr><td>Naharchalla MPHC</td><td>10.87</td><td>S</td></tr>
<tr><td>Borfollong Hospital</td><td>12.63</td><td>E</td></tr>
</table>
<table>
<tr><th>Government Buildings</th><th>Dist(km)</th><th>Direc</th></tr>
<tr><td>CISF Unit NRL Numaligarh</td><td>1.33</td><td>ESE</td></tr>
<tr><td>Kachupather Gaon Post Office</td><td>4.69</td><td>NNE</td></tr>
<tr><td>Kamargaon Police Station</td><td>5.19</td><td>N</td></tr>
<tr><td>Khumtai Police Station</td><td>5.37</td><td>ENE</td></tr>
<tr><td>Khumtai PWD Office</td><td>6.26</td><td>E</td></tr>
<tr><td>Bokial Branch Post Office</td><td>6.44</td><td>S</td></tr>
<tr><td>Numaligarh Gram Panchayat office</td><td>6.48</td><td>NW</td></tr>
</table>
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</table>

Office of the Superintendent Customs Preventive Force Numaligarh	6.62	NW
Rajabari Gram Panchayat office	11.13	WNW

Religious Places	Dist(km)	Direc
CSI Church	0.38	SSW
Borgoria Jame Masjid	0.77	N
Kanaighat Jama Masjid	1.70	W
Hanuman Mandir	1.70	W
Baba Than Lord Shiva Temple	4.45	WNW
Believers Eastern Church	6.32	W
Kaliani Baptist Church	6.76	SW
Khumtai Shiv Temple	6.85	NE
Mowkhowa Masjid Mosque	10.67	E
Buddhist Monastery Of Bhitar Kalioni	11.81	S
Shiva Temple	12.08	WNW

Industries	Dist(km)	Direc
Numaligarh Refinery	Adjacent to Site	S
Lattakoojan Tea Estate	2.13	ESE
Tanay Tea Factory	3.66	S
NR Tea Factory	3.97	S
Numaligarh Tea Factory	5.97	NW
Sirajuli Tea Factory	6.54	SE
Badulipar Ltd Khumtai Tea Estate Factory	6.87	ENE
Radhabari Tea Estate	8.58	N
Bukhial Tea Estate	8.65	S
Borchapori Tea Factory	9.77	WNW
Bijulee Tea Estate	11.48	S
Shyamraipore Tea Factory	12.42	SSE
Sanjiv Tea Industry Pvt Ltd	12.85	SE
Aegle Tea Factory	13.65	SE

Project Description

Brief description of project

<table>
<tr><th>S.No</th><th>Particulars</th><th>Details</th></tr>
<tr><td>1.</td><td>Brief Description about Project</td><td>Proposed Poly Propylene Unit (PPU) Of Capacity 360KTPA by M/s Numaligarh Refinery Limited</td></tr>
<tr><td>2.</td><td>Products with capacities for the proposed project</td><td>The Polymer Grade Propylene produced in the PRU section of the PFCC Unit of NREP is further processed in the downstream unit i.e. PP unit to produce Homo-polymer grade Polypropylene product.
<table>
<tr><th>S.No.</th><th>Name of the Unit</th><th>Unit Configuration</th></tr>
<tr><td>1</td><td>Poly propylene unit</td><td>360 KTPA</td></tr>
</table>
Proposed Products
<table>
<tr><th>Name of the Product</th><th>Proposed Quantity (KTPA)</th><th>Mode of storage</th><th>Storage capacity</th></tr>
<tr><td>Raffia Grade</td><td>190</td><td>Bags in Ware house</td><td rowspan="4">Inpellet form & is stored in ware house before dispatch.
The ware house will be sized corresponding to twenty one (21) days of storage requirement corresponding to 100% through put of the unit</td></tr>
<tr><td>Non–Woven Spun Bond Grade</td><td>90</td><td>Bags in Ware house</td></tr>
<tr><td>Non-Woven Melt Blown Grade</td><td>25</td><td>Bags in Ware house</td></tr>
<tr><td>Injection Moulding Homo-polymer Grade</td><td>55</td><td>Bags in Ware house</td></tr>
</table></td></tr>
<tr><td>3.</td><td>Plot area</td><td>The total Plot no. 11 area is 600 Bigha (8, 02,681.92 sq.m) (80.27 Ha). Out of which Total plot area required for the PP Unit and its associated facility is 348093sq.m (34.8 Ha). The plant area is 232821sq.m (23.28Ha) and Greenbelt area is 115272 sq.m (11.52 Ha) i.e, (33.1 % of total area) at Plot No.11 located at North side of the Numaligarh Refinery. The remaining 454588.92 sq.m (45.45 Ha) will be utilized for future project activities.</td></tr>
<tr><td>4.</td><td>% of green belt provided</td><td>Green belt area is 115272 sq.m i.e, 11.52 Ha (33.1 % of total area).</td></tr>
<tr><td>5.</td><td>Land use change required</td><td>For NREP, a total of 11 plots were identified requiring NDZ clearance, out of which Forest Department, Govt. of Assam had recommended 9 plots including Plot no.11 (Rajabari TE). However, out of the 9 plots, 8 plots of Land were shortlisted by NRL for NREP related activities.
Now, the proposed PP unit will be installed in Plot no.11 which comes under NDZ zone and the site has been under the 9 recommended plots by Forest Dept. of Assam and has been recommended for Project activities.</td></tr>
<tr><td>6.</td><td>Sources of Air & Noise Pollution</td><td>Source of air pollution- Process emission (discontinuous), Off-gas - Purge Gas Recovery (continuous) , Extruder Vacuum Unit (continuous), Emg D.G. sets &Transportation emission- Trucks-70</td></tr>
</table>

<table>
<tr><td></td><td></td><td>nos./day
Source of noise pollution –D.G. sets, compressors</td></tr>
<tr><td>7.</td><td>Estimated Project Cost (INR)</td><td>7231 Crores*
<i>Note:</i><i>*In Form-1 it is mentioned as 4735Cr and it has been revised as 7231Cr.</i></td></tr>
<tr><td>8.</td><td>EMP Cost (INR)</td><td>Capital cost- 402.36 lakhs Recurring cost-85 lakhs</td></tr>
<tr><td>9.</td><td>CER Cost (INR)</td><td>36.155 Crores</td></tr>
<tr><td>10.</td><td>Manpower (No)</td><td>
<table>
<tr><th colspan="2">Description</th><th>Construction Phase</th><th>Operation Phase</th></tr>
<tr><th rowspan="2">Proposed</th><th>Permanent</th><td>0</td><td>17</td></tr>
<tr><th>Contract</th><td>1750</td><td>36</td></tr>
<tr><th colspan="2">Total (A)</th><td>1750</td><td>53</td></tr>
<tr><th colspan="2">Period of employment in days (B)</th><td>1080</td><td>365</td></tr>
<tr><th colspan="2">Total Man-days(A*B)</th><td>1080*1750=18,90,000</td><td>19,345</td></tr>
</table>
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</table>

Solid waste Management

Solid waste generation in construction phase

S. No	Description	Proposed Quantity (Kg/day)	Method of Disposal
1	Organic	472.5	Municipal Bins
2	Inorganic	315	Disposed to PCB authorized recyclers
Total		**787.5**	

Solid waste generation in operation phase

S. No	Description	Proposed (Kg/day)	Method of Disposal
1	Organic	14.31	Municipal Bins
2	Inorganic	9.54	Disposed to PCB authorized recyclers
Total		**23.85**	

Hazardous waste Management

Hazardous waste materials will be properly disposed as per the Hazardous Wastes (Management, Handling and Transboundary Movement) Rules 2016; Hazardous waste authorization will be obtained**.** The process effluent generation from PPU unit is very negligible and the same will not have any impact on NREP ETP effluent and subsequent sludge generation. However, note that estimated sludge generation from NREP ETP will be 30 m3/hr-oily and (chemical) and 20 m3/hr (bio sludge).

List of Hazardous waste generated are given in **Chapter 2**, **Section 2.7.2.21** of the EIA report.

Wastewater generation and Management

Wastewater Management

Description	Proposed(m^3/hr)	Disposal Method & Facility Details (m^3/hr)
Effluent generation		
Cooling tower blowdown	50	Cooling tower blowdown from PP unit will be diverted to RO plant (Design: 600 m3/hr) under existing NREP ETP Package.
Process effluent	0.23	PP process effluent to be treated in existing NREP

Description	Proposed(m^3/hr)	Disposal Method & Facility Details (m^3/hr)
		ETP (Design: 450 m3/hr and normal flow is 360 m3/hr
Sub-Total	**50.23**	
Sewage	0.212	Diverted to existing NREP ETP for treatment
Total waste water generation	**50.442**	

Decommissioning or Rehabilitation of a Completed Project

One of the important components in the process of environmental impact assessment is identification of significant impacts as it leads to other elements such as quantification and evaluation of impacts. Any change in environment whether adverse or beneficial, wholly or partially, resulting from impacting activity is called Environmental Impact. Each individual activity with respect to each environmental parameter will have its own impact potential. Proposed project activities will be carried out in such a way so that potential adverse/negative impacts are avoided, wherever possible. While for remaining impacts which are inevitable, practicable mitigation measures will be recommended to minimize the adverse impacts.

The prediction of impacts helps to develop and implement mitigation measures/environment management plan in such a way that the developmental activity will minimize the deterioration of environmental quality

Production Capacity

The Polymer Grade Propylene produced in the PRU section of the PFCC Unit of NREP is further processed in the downstream unit i.e. PP unit to produce Homo-polymer grade Polypropylene product.

Production Capacity

S.No.	Name of the Unit	Unit Configuration
1	Poly propylene unit	360 KTPA

Proposed Products

Production Products

Name of the Product	Proposed Quantity (KTPA)	Mode of storage	Storage capacity
Raffia Grade	190	Bags in Ware house	Inpellet form & is stored in ware house before dispatch. The ware house will be sized corresponding to twenty one (21) days of storage requirement corresponding to 100% through put of the unit
Non–Woven Spun Bond Grade	90	Bags in Ware house	
Non-Woven Melt Blown Grade	25	Bags in Ware house	
Injection Moulding Homo-polymer Grade	55	Bags in Ware house	

Description of the Environment

The baseline environmental studies were carried out during **December 2022 to February 2023**

S. No	Parameters	Observation
1.	Temperature	Max Temperature : 29^{0}C Min Temperature : 8^{0}C Avg Temperature : 20.95^{0}C
2.	Average Relative Humidity	74.24%
3.	Average Wind Speed	1.27 m/s
4.	Predominant Wind Direction	East

Air environment

Ambient Air Quality (AAQ) was measured at Eight (08) locations in the study area

Parameter	Minimum & Maximum baseline Concentration Range	Units	NAAQ Standards	Remarks
	Study area			
PM_{10}	58.34 to 72.58	µg/m³	100	Meets National Ambient Air Quality Standards.
$PM_{2.5}$	26.49 to 41.63	µg/m³	60	
SO_2	9.90 to 19.38	µg/m³	80	
NO_2	19.14 to 28.57	µg/m³	80	

Noise Environment

Noise level monitoring at all the proposed well locations in and around 10 km radius from the block boundary shows that at most of the locations the noise levels are well within the permissible limit as prescribed by CPCB.

Parameter	Range of Noise Levels dB (A)				Remarks
	Day	Standard	Night	Standard	
Study area [Industrial]	52.2	75	45.2	70	Noise levels meets the CPCB Limits
Study area [Residential]	47.9 - 53.9	55	40.2 - 42.2	45	

Soil Environment

Soil samples were collected from different location so as to cover all the block where production is proposed. In total 8locations were selected in each block of PML .The summary of analysis is given below:

Parameter	Units	Study area Observation
pH	-	4.25 to 4.48
Phosphorous	mg/kg	8.9 to 10.5
Potassium	mg/kg	106.9 to 126.2
Conductivity	µmhos/cm	542.0to 873.0
Nitrogen	mg/kg	213.7 to 252.4

Surface water Environment

Surface water samples were collected from the 8 location based on the availability of the water in water bodies. The results of surface water analysis were compared with the **IS2296:1992.** Based on the values, the best use of the water can be determined.

Parameter	Units	Study area Observation	Remarks
pH	-	6.89 - 7.68	Meets IS 2296:1992 Surface water standards
Total hardness	mg/l	77 - 126	
TDS	mg/l	151- 205	
BOD	mg/l	BLQ (LOQ 1.0) -3.0	
COD	mg/l	8.0 - 24.0	

Ground water quality

8 samples were collected from different sources within the study area and some important parameters including heavy metal analysis was carried out for depicting the baseline status of the study area.

Parameter	Units	Study area	Remarks
pH	-	6.88 - 7.87	Meets IS 10500:2012 drinking water standards
TDS	mg/l	166 - 220	
Fluoride	mg/l	0.21 - 0.28	
Hardness	mg/l	81 - 105	

Anticipated Environmental Impacts and mitigation measures

Air environment

For this PP unit, only Emergency DG will be proposed and operated only during power failure. In addition to the above, the additional Process emission (discontinuous), Off-gas - Purge Gas Recovery (continuous), Extruder Vacuum Unit (continuous), due to PPU will be routed to existing Flare in NREP and Vent Streams of proposed PP unit to Atmosphere is given below:

Emissions to Flare

Source of Emission	Name	Mode of Operation	Frequency	Flow Rate approx. [Nm^3 / h]	Flow Rate approx. [kg / h]	Temperature BL [°C]	Pressure at BL [Kg/cm2(g)]	Composition
1P39-R-1171, Propylene Treater (COS, Arsine, Phosphine)	Regeneration Gas	Discontinuous during bed replacement only	Once / 3 yrs.	**(Note 1)**		ambient	counter pressure flare system	Nitrogen with traces of Hydrocarbons (Propylene), COS, Arsine, Phosphine

Source of Emission	**Name**	**Mode of Operation**	**Frequency**	**Flow Rate approx. [Nm^3 / h]**	**Flow Rate approx. [kg / h]**	**Temperature BL [°C]**	**Pressure at BL [Kg/cm2(g)]**	**Composition**
1P39-R-1172A/B, Propylene Treater (H2O, Oxygenates, Methanol)	Regeneration Gas	Discontinuous for regeneration only	Once / 17 days For 60 hrs **(Note 1)**	4319 **(Note 1)**	-	35 - 250	counter pressure flare system	Nitrogen with traces of Hydrocarbons (Propylene), H2O, Oxygenates, Methanol
1P39-R-1173A/B, Propylene Treater (CO)	Regeneration Gas	Discontinuous for regeneration only	Once / 180 days For 28 hrs **(Note 1)**	1400 **(Note 1)**	-	35 - 200	counter pressure flare system	Nitrogen with traces of Hydrocarbons (Propylene), CO
1P39-R-1174, Propylene Treater (MAPD, Acetylene)	Regeneration Gas	Discontinuous during bed replacement only	Once / 5 yrs.	**(Note 1)**	-	ambient	counter pressure flare system	Nitrogen with traces of Hydrocarbons (Propylene), MAPD, Acetylene
1P39-VV-1131, Propylene Seal Gas Drum	Liquid Drain	Discontinuous	NNF	NNF	-	ambient	counter pressure flare system	Hydrocarbons (propylene)
1P39-VV-1331, White Oil Preparation Vessel	Off-Gas	Discontinuous during filling of Preparation Vessel	Once / week for 1 to 3 hr	< 1	-	ambient	counter pressure flare system	Nitrogen with traces of White Oil
1P39-R-1571, Hydrogen Treater (CO, CO2)	Regeneration Gas	Discontinuous during bed replacement only	Once / 5 yrs.	(**Note 1)**	-	ambient	counter pressure flare system	Nitrogen with traces of Hydrogen, CO, CO2
1P39-R-1572A/B, Hydrogen Dryer (H2O)	Regeneration Gas	Discontinuous for regeneration only	Once / 19 days For 24 hrs **(Note 1)**	26 **(Note 1)**	-	35 - 235	counter pressure flare system	Nitrogen with traces of Hydrogen, H2O

Source of Emission	**Name**	**Mode of Operation**	**Frequency**	**Flow Rate approx. [Nm^3 / h]**	**Flow Rate approx. [kg / h]**	**Temperature BL [°C]**	**Pressure at BL [Kg/cm2(g)]**	**Composition**
Nitrogen Treater O2 Removal (N2 Purification Package for TEA system	Regeneration Gas	Discontinuous during bed replacement only	Once / 3 yrs.	**(Note 1)**	-	ambient	counter pressure flare system	Nitrogen
Nitrogen H2O Dryer (N2 Purification Package for TEA system	Regeneration Gas	Discontinuous for regeneration only	Once / 7 days For 30 hrs **(Note 1)**	113 **(Note 1)**	-	35 - 288	counter pressure flare system	Nitrogen
1P39-BL-1681, Regeneration Recycle N2 Blower	Nitrogen	Discontinuous for regeneration only	NNF	NNF	-	120	counter pressure flare system	Nitrogen
1P39-VV-1733, Waste White Oil Tank	Off-Gas	Discontinuous during filling of tank	Once / year up to few minutes	< 1	-	ambient.	counter-pressure flare system	Nitrogen with traces of White Oil, Isopropanol.
1P39-VV-1931, Silane Holding Tank	Off-gas	Discontinuous during filling of holding tank	5 times / year- for 30 min	1.5	-	ambient.	counter pressure flare system	Nitrogen with traces of Silane
1P39-RB-3121, Reactor via S/D cyclone 1P39-CY-3173	Vent gas	Discontinuous	emergency shutdown	-	50,000 for 25 min. (Peak for 5 min.)	80	counter pressure flare system	Propylene, Propane, Hydrogen
1P39-VV-3134, Powder K. O. Drum	Vent gas	Discontinuous	**(Note 2)**	-	75 **(Note 2)**	20 - 60	counter pressure flare system	Hydrocarbons, Nitrogen, traces of PP fines

Source of Emission	**Name**	**Mode of Operation**	**Frequency**	**Flow Rate approx. [Nm^3 / h]**	**Flow Rate approx. [kg / h]**	**Temperature BL [°C]**	**Pressure at BL [Kg/cm2(g)]**	**Composition**
1P39-VV-3131, RG Compressor Suction Drum	Liquid Drain	discontinuous	NNF	-	NNF Before start-up	70	counter pressure flare system	Propylene, Propane, Hydrogen
1P39-VV-3433A/B, Purge Silos	Purge Gas	Discontinuous (In case of 1P39-Z-6581 shutdown)	Continuously during membrane unit shutdown	-	1339	73	counter-pressure flare system	Nitrogen, Propylene, Propane, Hydrogen, Ethane
1P39-VV-3432, Powder Drop out pot	Vent gas	Discontinuous	Once / month for 30 min **(Note 3)**	-	<5 **(Note 3)**	50	counter pressure flare system	Hydrocarbons, Nitrogen, traces of PP fines
1P39-Z-6081, Carrier Gas Compressor suction	Carrier Gas	Discontinuous (In case of 1P39-Z-6081 shutdown)	Continuously during CG compressor or emergency shutdown	-	11,251	121	counter pressure flare system	Propylene, Ethane, Propane, Nitrogen, Hydrogen
1P39-EE-6057, Carrier Gas Cooler	Carrier Gas	Discontinuous	NNF	-	NNF	70	counter pressure flare system	Propylene, Ethane, Propane, Nitrogen, Hydrogen
1P39-Z-6581, Purge Gas Recovery (Membrane Unit)	Off-gas	Continuous	8000 h / year	-	128	20	counter pressure flare system	Nitrogen, with traces of methane, ethane,Propylene, Propane
1P39-Z-6681, Extruder Vacuum Unit	Off-gas	Continuous	8000 h / year	-	20 - 66	50	counter pressure flare system	Nitrogen, Methane, Water, Hydrocarbons, Organics (acetone, tert. butanol)

Source of Emission	Name	Mode of Operation	Frequency	Flow Rate approx. [Nm^3 / h]	Flow Rate approx. [kg / h]	Temperature BL [°C]	Pressure at BL [Kg/cm2(g)]	Composition
1P39-VV-9331 Flare K.O. Drum	Vent Gas	discontinuous	-	<1	-	60	counter pressure flare system	Hydrocarbon, N2, PP fines (Traces)

Notes:

(1) Dependent on dryer & treater requirements for regeneration.

(2) Dependent on filter maintenance (e.g., twice per year) & powder sampling frequency (e.g., once per hour)

(3) Used for special PP grades only; depends on BOPP production

(*) The values and data in this table are estimates only, actual values and data may differ, depending on the equipment used and the operation methods

Vent Streams to Atmosphere at safe location

Source of Emission	Name	Mode of Operation	Frequency / Time	Flow Rate approx. [Nm^3 / h]	Composition	Concentration
1P39-R-1173A/B, Propylene Treater (CO)	Off-gas	Discontinuous for catalyst oxidation only	Once / 3 years For 24 hrs **(Note 1)**	1475 **(Note 1)**	Nitrogen	-
TEAL Container unloading (Via TEA Vent Pot 1P39-VV-1731)	Off-gas	discontinuous during filling of holding tank	24 times per year (max.) for 30 min.	10	Nitrogen with traces of White oil	Max. 50 mg/Nm^3
1P39-VV-2131, Peroxide Holding Tank	Off-gas	continuous	8000 h / year	0.5	Nitrogen with traces of Peroxide	max 120 mg/Nm^3
1P39-VV-2231, Additive Feed Hopper Vent Pot	Vent	Continuous	8000 h / year	< 1	Nitrogen with Traces of White Oil	max. 10 mg/Nm^3
1P39-ZFA-2292, Additive Vent Fan	Vent	Discontinuous during filling of Solid Additives	5 times / day for 1 bags of 500 kg	500 (By vendor)	Air with Stabilizer Powder	max. 10 mg/Nm^3

Source of Emission	Name	Mode of Operation	Frequency / Time	Flow Rate approx. [Nm^3 / h]	Composition	Concentration
1P39-ZWF-2291, GMS Additive loss in weight feeder	Vent	Continuous	8000 h / year	< 1	Nitrogen Stabilizer Powder (Traces)	max. 10 mg/Nm^3
1P39-ZWF-2290A/B, Talcum / Silica Additive loss in weight feeder	Vent	Continuous	8000 h / year	< 1	Nitrogen Stabilizer Powder (Traces)	max. 10 mg/Nm^3
1P39-ZWF-22890A/B, Additive loss in weight feeder	Vent	Continuous	8000 h / year	< 1	Nitrogen Stabilizer Powder (Traces)	max. 10 mg/Nm^3
1P39-VV-3033, Catalyst Vent Pot	Vent	Discontinuous	1 time /day for 30 min	10	Nitrogen with Traces of White Oil	max. 10 mg/Nm^3
1P39-ZGN-3684, Extruder Feed Vent Filter	Vent	Continuous	8000 h / year	67	Nitrogen with propylene Polypropylene dust / Stabilizer powder	max. 100 mg/Nm^3 HC max. 10 mg/Nm^3 particles
1P39-ZFA-3789, Drying Air Exhaust Fan	Off-gas	Continuous	8000 h / year	18700 (By Extrusion package vendor)	Air with moisture and traces of Hydrocarbons	max. 50 mg / Nm^3 H2O max. 10 mg / Nm^3 HC
1P39-Z-6681, Extruder Vacuum Unit	Off-gas	discontinuous (in case of Oxygen detection in off-gas line to flare)	NNF. for approx. 2 hr until the oxygen level is reduced	20 – 66 kg/h	Nitrogen with moisture and organics	4 mol% H2O 15 mol% organics
1P39-ZGN-7185A/B, Silo Exhaust Filter	Vent	Continuous	8,000 h / year	12400 (By Conveying Package vendor)	Air with polypropylene dust	max. 150 mg/Nm^3 HC max. 17 mg/Nm^3 particles

Source of Emission	**Name**	**Mode of Operation**	**Frequency / Time**	**Flow Rate approx. [Nm^3 / h]**	**Composition**	**Concentration**
1P39-ZCY-7583, Elutriator Cyclone	Vent	Continuous	8,000 h / year	7100 (By Conveying Package vendor)	Air with polypropylene dust	max. 150 mg/Nm³ HC max. 17 mg/Nm³ particles

Notes:

(1) Dependent on dryer & treater requirements for regeneration.

(*) The values and data in this table are estimates only, actual values and data may differ, depending on the equipment used and the operation methods.

Most of the continuous streams to vent are actually purge gases comprising of Nitrogen with traces of hydrocarbon having minimal flowrate.

Flare Stack is not a part of PP unit scope of work. This is considered under NREP only.

•Provision of stack of sufficient height as required by per CPCB's guidelines for the proposed DG sets.
•01 no. CAAQMS will be proposed for PP unit. NRL already having 02 CAAQMS and one more will come as a part of NREP. NRL already having 3 manual monitoring station within 10 km range and 01 in Kaziranga National Park

•Monitoring of fugitive emissions from NRL with the help of VOC (Volatile Organic Carbon), LDAR (Leak Detection and Repair) program will be done annually with the help of an external agency. Thus observed leaks will beidentified and rectified.

Noise environment

- The major noise generating equipment like Compressors, pumps etc. will be enclosed in an acoustic enclosure designed for an insertion loss of 25 dB (A) and silencers to other equipment etc.
- Acoustic design with sound proof glass paneling will be provided for critical operator cabins / control rooms of individual modules as well as central control facilities.

- Periodic maintenance of the equipment to be used in the developmental works will be carried out. Worn out parts will be replaced and rotating parts will be lubricated to minimize noise emissions.

- Implementation of greenbelt for noise attenuation will be undertaken: shrub plantation; landscaping with horticulture; and Tree plantation at vehicle parking areas and along approach roads.

- Low vibration generating machines/equipment will be selected to meet international standards and foundations will be so designed to minimize vibrations and secured properly.

- Vibration dampers will be provided around the source of generation.

Water & Wastewater Management:

Only effluent generation of 50.23 m3/hr and sewage of 0.212 m3/hr will be generated due to this proposed project and treated in the existing NREP ETP.

Description	Proposed(m^3/hr)	Disposal Method & Facility Details (m^3/hr)
Effluent generation		
Cooling tower blowdown	50	Cooling tower blowdown from PP unit will be diverted to RO plant (Design: 600 m3/hr) under existing NREP ETP Package.
Process effluent	0.23	PP process effluent to be treated in existing NREP ETP (Design: 450 m3/hr and cnormal flow is 360 m3/hr
Sub-Total	**50.23**	
Sewage	0.212	Diverted to existing NREP ETP for treatment
Total waste water generation	**50.442**	

The sewage generated will be routed to the existing NREP ETP for further treatment.. The processeffluent from PP unit will be routed to NREP ETP for treatment.The treated effluent from NREP ETP is planned to be reused in cooling tower, fire water and Horticulture (greenbelt).

- Recycling/reusing/recovering materials where possible and thereby neglecting or reducing the disposal requirements.
- Separation of construction material for reuses either to be used on onsite filling or can be used as public fill.
- Training the staff in waste minimizing practices.
- Chemical waste should be stored in a locked area so as to avoid leaching of harmful chemicals in the soil or nearby water bodies (If any).

Details of Liquid Effluent from the proposed project

Source	Name	Mode of Operation	Frequency	Quantity	Composition	Treatment (OSBL)
1P39-VV1632, Nitrogen Regeneration Recycle K.O. Vessel	Waste Water	discontinuous	1 time per year	Approx. 0.6 m^3 **(Note 1)**	Condensed moisture during regeneration	Sewer
1P39-Z-3681, Extruder Pelletizer	Waste Water	Discontinuous	during start-up during emptying	max. 1 m^3 / Start-up max. 40 m^3 for 1 min. (by Extrusion package vendor)	Clean water with polypropylene pellets and powder (fines)	Separation of solids in waste water basin (designed with separator)

Source	Name	Mode of Operation	Frequency	Quantity	Composition	Treatment (OSBL)
1P39-ZVV-3783, Pellet Water Tank	Wastewater	Discontinuous	during start-up during emptying of tank (maintenance)	max. 1 m^3 / Start-up max. 25 m^3 during emptying of tank (by Extrusion package vendor)	Demin. Water with PP Solids	Separation of Solids
1P39-VV-6631, Phase Separator	Wastewater	Continuous	8,000 h / year	max 0.23 m^3/h	Water; pH = 6-9 Typical average value COD (chemical oxyge demand) < 500 BOD (5 day) < 350 TOC < 600 mg/l Typical organic conta - Acetone (~10%) - Isopropanol (~20%) - Terbutanol (~70%)	Separation of insoluble Organic Compounds
Waste Water Collection Pit	Waste Water / Rain Water	discontinuous / continuous			Water; pH = 6-9	Separation of insoluble Organic Compounds

Solid waste Management

During construction phase:

S. No	Description	Proposed Quantity (Kg/day)	Method of Disposal
1	Organic	472.5	Municipal Bins
2	Inorganic	315	Disposed to PCB authorized recyclers
Total		**787.5**	

During operation phase:

S. No	Description	Proposed (Kg/day)	Method of Disposal
1	Organic	14.31	Municipal Bins
2	Inorganic	9.54	Disposed to PCB authorized recyclers
Total		**23.85**	

Hazardous waste Management

The process effluent generation from PPU unit is very negligible and the same will not have any impact on NREP ETP effluent and subsequent sludge generation. However, note that estimated sludge generation from NREP ETP will be 30 m3/hr-oily and (chemical)and 20 m3/hr (bio sludge).In addition, spent oil/ Used oil which will be generated from the emergency DG will be minimal which will be disposed to authorized recyclers.

Other Hazardous waste generated

Source	Name	Mode of Operation	Frequency	Quantity approx.	Composition	Treatment (OSBL)
1P39-R-1171, Propylene Treater (Arsine, Phosphine, COS)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	18,600 kgs (2,120 kg) **(Note 1)**	Clariant Actisorb®401 or equal **(Note 1)**	Secured Landfill/Disposal to recyclers
1P39-R-1172A/B Propylene Treater (H2O, Oxygenates, MeOH)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	2 x 31,752 kgs (2 x 6,000 kgs) **(Note 1)**	Porocel Dynocel650 or equal **(Note 1)**	Secured Landfill/Disposal to recyclers
1P39-R-1173A/B Propylene Treater (CO)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	2 x 5,040 kgs (2 x 1,420 kgs) **(Note 1)**	Clariant Actisorb®310 or equal **(Note 1)**	Secured Landfill/Disposal to recyclers
1P39-R-1174 Propylene Treater (MAPD, Acetylene)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	3,312 kgs (1,060 kgs) **(Note 1)**	Clariant Polymax®303 or equal **(Note 1)**	Secured Landfill/Disposal to recyclers
1P39-R-1571 Hydrogen Treater (CO, CO2)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	80 kgs (18 kgs) **(Note 1)**	Clariant Meth®150 or equal **(Note 1)**	Secured Landfill/Disposal to recyclers
1P39-R-1572A/B Hydrogen Treater (H2O)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	2 x 120 kgs (2 x 26 kgs) **(Note 1)**	BASF – 4A Mol. Sieve or equal **(Note 1)**	Secured Landfill/Disposal to recyclers
1P39-Z-1683 Nitrogen Treater (O2 Removal)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	630 kgs (76 kgs) **(Note 1)**	Clariant Polymax®301 or equal **(Note 1)**	Secured Landfill/Disposal to recyclers
1P39-Z-1683 Nitrogen Treater (H2O Removal)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	2 x 500 kgs (2 x 200 kgs) **(Note 1)**	Porocel Dynocel 641S or equal **(Note 1)**	Secured Landfill/Disposal to recyclers
1P39-Z-6581 Purge Gas Dryer (H2O Removal)	Spent Adsorbents	Replacement	by Membrane unit vendor	by Membrane unit vendor	Drying agent (molecular sieve)	Secured Landfill/Disposal to recyclers
1P39-MGN-1175A/B Propylene Filter	Spent Filter Cartridge	Replacement of Filter Elements	once / 2 years	5 kg (each Filter)	Filter Elements (PP) & treater filling particles	Secured Landfill/Disposal to recyclers
1P39-MGN-1371A/B White Oil Filter	Spent Filter Cartridge	Replacement of Filter Elements	once / 2 years	2 kg (each Filter)	Filter Elements (PP)	Secured Landfill/Disposal to recyclers

Source	Name	Mode of Operation	Frequency	Quantity approx.	Composition	Treatment (OSBL)
1P39-MGN-1575A/B, Hydrogen Filter	Spent Filter Cartridge	Replacement of Filter Elements	once / 2 years	2 kg (each Filter)	Filter Elements (PP) & treater filling particles	Secured Landfill/Disposal to recyclers
1P39-MGN-1671A/B, LP Nitrogen Filter	Spent Filter Cartridge	Replacement of Filter Elements	once / 2 years	5 kg (each Filter)	Filter Elements (PP)	Secured Landfill/Disposal to recyclers
1P39-MGN-1672A/B, Regeneration Recycle N2 Filter	Spent Filter Cartridge	Replacement of Filter Elements	once / 2 years	5 kg (each Filter)	Filter Elements (PP) & treater filling particles	Secured Landfill/Disposal to recyclers
1P39-MGN-1971A/B, Silane Filter	Spent Filter Cartridge	Replacement of Filter Elements	once / 2 years	2 kg (each Filter)	Filter Elements (PP)	Secured Landfill/Disposal to recyclers
1P39-ZGN-2282, Additive Vent Filter	Spent Filter Bags	Replacement of Filter Elements	once / 2 years	5 kg (each Filter)	Filter Elements (PP)	Secured Landfill/Disposal to recyclers
1P39-MGN-3175A/B, RG Filter	Spent Filter Bags	Replacement of Filter Elements	≤ 2 times/year	10 kg (each Filter) 2335 kg (by vendor)	Filter Elements (PP) & PP Solids	Secured Landfill/Disposal to recyclers
1P 9-VV-3132, Powder Collector (via 1P39-CY-3173)	PP Powder	Upset Conditions	≤ 6 times/year	45 kg	PP Solids	Secured Landfill/Disposal to recyclers
1P39-VV-3 34, Powder K.O. Drum	PP Powder	Upset Conditions	once / year	60 kg	PP Solids	Secured Landfill/Disposal to recyclers
1P39-VV-3432, Drop Out Pot (for special products only)	PP Powder	Special operation	once / month	50 kg	PP Solids	Secured Landfill/Disposal to recyclers
1P39-MGN-3471, Carrier Gas Filter	Spent Filter Bags	Replacement of Filter Elements	once / year	150 kg each	PP Filter Bags & PP Solids	Secured Landfill/Disposal to recyclers
1P39-MGN-3472A/B, Purge Silo Filter	Spent Filter Bags	Replacement of Filter Elements	once / year	60 kg each	PP Filter Bags & PP Solids	Secured Landfill/Disposal to recyclers
1P39-ZEX-3682, Extruder / Pelletizer	Start-up Material	Discontinuous	Cold Start-up Warm Start-up	2,520 kg for 7 min. 1,080 kg for 3 min.	PP (Melt)	Secured Landfill/Disposal to recyclers
1P39-ZGN-3684, Extruder Feed Vent Filter	Spent Filter Bags	Replacement of Filter Elements	once / year	40 kg (by vendor)	PP Filter Bags & PP Solids	Secured Landfill/Disposal to recyclers
1P39-ZVV-3783, Pellet Water Tank	PP Dust	Discontinuous	once / month	36 kg	PP (Fines)	Secured Landfill/Disposal to recyclers **(Note 2)**

Source	**Name**	**Mode of Operation**	**Frequency**	**Quantity approx.**	**Composition**	**Treatment (OSBL)**
1P39-ZSR-3784, Pellet Water Start-Up Screen	PP Pellets	Discontinuous Start-Up of Extruder	-	600 kg per event	PP	Secured Landfill/Disposal to recyclers **(Note 2)**
1P39-ZSR-3784, Pre-Separation Sieve	PP Pellets & Agglomerates	Discontinuous, Extruder start-up	once / week	11 kg each	PP (agglomerates)	Secured Landfill/Disposal to recyclers **(Note 2)**
1P39-ZCL-3787, Pellet Classifier	PP Pellets & Agglomerates	Discontinuous, Under-/Oversized Pellets	once / week	5 kg each 37 kg each	PP Pellets undersized PP Pellets oversized	Secured Landfill/Disposal to recyclers **(Note 2)**
Conveying Air Compress. Suction / Discharge Filter 1P39-ZGN-7086A/B 1P39-ZGN-7088A/B 1P39-ZGN-7087A/B 1P39-ZGN-7089A/B 1P39-ZGN-7094A/B 1P39-ZGN-7095A/B 1P39-ZGN-7096A/B 1P39-ZGN-7097A/B	Spent Filter Bags	Replacement of Filter Elements	every 6 months years **(Note 1)**	25 kg each **(Note 1)**	PP Filter Bags & PP Solids	Secured Landfill/Disposal to recyclers
1P39-ZGN-7185A/B, Silo Exhaust Filter	Spent Filter Bags	Replacement of Filter Elements	every 6 months years **(Note 1)**	25 kg each **(Note 1)**	PP Filter Bags & PP Solids	Secured Landfill/Disposal to recyclers
1P39-ZGN-7584A/B, Elutriator Blower Filter	Spent Filter Bags	Replacement of Filter Elements	once / year	(Note 1)	PP Filter Bags	Secured Landfill/Disposal to recyclers
1P39-ZCY-7583, Elutriator Cyclone	PP Fines	Continuous	8,000 h / year	0.5 kg/h (by vendor)	PP (Fines)	Secured Landfill/Disposal to recyclers
Wastes from Sampling (e.g., 1P39-VV-3133 Powder Sampling Pot)	PP Powder & Pellets	Discontinuous	once / day	60 kg (Note 3)	PP (Pellets and Powder)	Secured Landfill/Disposal to recyclers **(Note 2)**
Packaging Material of Additives	Bags	Discontinuous	once / day	approx. 20 kg	Paper, PP/PE	Disposal to recyclers
Packaging Material of Bagging section	Bags	Discontinuous	once / day	approx. 20 kg	Paper, PP/PE	Disposal to recyclers

Source	Name	Mode of Operation	Frequency	Quantity approx.	Composition	Treatment (OSBL)
1P39-VV-1733, Waste White Oil Tank	Waste White Oil	Discontinuous emptying of tank	1 time per year	approx. 660 kg	White Oil, Isopropanol, Alcoholate	Disposal to Recycler
1P39-VV-2231, Additive Feed Hopper Vent Pot	Waste White Oil	Discontinuous	1 time per year	60 l	White Oil	Disposal to Recycler
1P39-VV-3033, Catalyst Vent Pot	Waste White Oil	Discontinuous	1 time per year	80 l	White Oil	Disposal to Recycler
1P39-VV-6631, Phase Separator	Oily Waste	Discontinuous	30 times per year	max. 80 kg	Mixed Organic Components. Heating Value approx. 41000 kJ / kg	Bioremediation/ Disposal to Recycler
Gear Boxes of Machinery	Waste Lube Oil	Discontinuous	1 time per year	approx. 5 t	Lubrication Oils (100%)	Disposal to recyclers

Notes:

(1) Dependent on requirements.

(2) PP pellets & PP blocks from extruder start-up can be sold to special converters.

(3) Dependent on Sampling frequency.

(*) The values and data in this table are estimates only; actual values and data may differ during detailed engineering, depending on the equipment used and the operation methods.

Biological environment

There are no National Parks/ Wildlife sanctuaries within 10 km radius from the site.
There are Schedule-I- Species in study area i.e.,

Mammal: Slow Loris (Nycticebus bengalensis), Leopard (Panthera pardus), Asiatic Elephant (Elephas maximus)

The proponent has proposed a sum of Rs.8, 20,000/-for the “Schedule – I species conservation plan

Socio economic

There will be temporary employment for manpower required during construction phase available from local communities. Overall socioeconomic effect of construction phase will be positive due to direct and indirect employment opportunity for the local population.

Environmental Management Plan

The detailed breakup of Expenditure on Environmental measures:

Budget for Expenditure on Environmental measures.

S.No	Equipment	Capital cost (Lakhs)	Recurring Cost (Lakhs) per Annum
1	**Air Environment**		
1.1	Additional Plantation Activities (Trees and Shrubs)	207.36	50

1.2	Air quality monitoring	100	20
2	**Noise Environment**		
2.1	Additional Plantation Activities	Included in 1.1	Included in 1.1
2.2	Audiometric tests	5	2
3	**Water Environment**		
3.1	Rain water Harvesting pits	50	3
3.2	Storm Water Management	20	-
4	**Land Environment**		
4.1	Additional Plantation Activities	Included in 1.1	Included in 1.1
4.2	Solid waste management	20	10
5	**Biological environment**		
5.1	Additional plantation activities	Included in 1.1	Included in 1.1
Total INR		**402.36**	**85**

Risk Assessment

Risk Assessment is performed for the instrument leaks and failure for different scenarios.

Project benefits

Polypropylene (PP) is very versatile product and can be used for injection moulding, fibre, film, and other extrusion processes. It is used in a wide range of market segments including packaging, consumer products, automotive, textile and building and construction. The followings are the benefits of the proposed PP project:

- Value addition of propylene content of LPG for production of high value polypropylene (PP)
- This project will meet the domestic PP demand, reduce import and reduce outgoing of foreign currency.
- Employment generation
- Increase petrochemicals domestic market share
- Helps in achieving the dream of "AatamNirbhar Bharat" by having self-sufficient production of PP and further value addition to make the finished products, which are specifically made from Polypropylene (PP).
- In view of expected growth in demand for petrochemicalsproducts in India and to remain competitive in the market with products self sufficiency
- Major applications are in the medical industry, fashion and sports industry, automotive industry and consumer products industry (housewares, toys, luggage etc.)

Improvements in the physical infrastructure:

No major physical infrastructural change or improvement has been envisaged due to establishmentof the proposed project. All the required infrastructural facilities such as township, hospital, school etc.are readily available in Golaghat to support the establishmentof proposed project.

Improvement in social infrastructure

Economic infrastructure is essential for improving the productive capacity of the nation. But social infrastructure is also required to improve the quality of human resources. It consists of services like education, medical facilities, sanitation, housing, drinking water supply etc.these altogether constitute the social infrastructure of an economy. Various CSR activities will be done by NRL every year to satisfy the basic requirements of the social infrastructure.

Employment Potential – skilled; semi-skilled and unskilled

The project will provide employment potential for construction Labour during implementation phase. During operational phase, this project will also generate Direct & Indirect employment in the form of contractors, workers, transporters, marketing and ancillary facilities and general utility services.

Corporate Environment Responsibility

The company is aware of the obligations towards the Environment and to fulfill the social obligations. As per OM F. No: 22-65/2017-IA.III dated 1st May 2018 M/s. NRL will Allocate 0.5% of the project cost (7231Crores) towards CER i.e. 0.5% of 7231Crores = 36.155Crores.

After completion of public hearing, CER budget allocation will be made in the Action Plan to address the issues raising during public hearings

CHAPTER 1

INTRODUCTION

1 INTRODUCTION

1.1 Purpose of Report

The Government of India, Ministry of Environment Forest and Climate Change (MoEF&CC), New Delhi, vide notification no. S. O. 1533 dated 14th September, 2006, and its amendments, has made it mandatory to obtain 'Prior Environmental Clearance (EC)' for New projects listed in the schedule, Expansion and Modernization of existing projects listed in the schedule, any change in product mix in the existing manufacturing unit falling within the schedule to that notification from MoEF&CC (for Category A projects).

The EIA submission at MoEF&CC pertains to "**Proposed Poly Propylene Unit (PPU) Of Capacity 360KTPA"** Schedule 5(c) Category 'A' – "Petro-chemical complexes (industries based on processing of petroleum fractions & natural gas and/or reforming to aromatics)" as per EIA Notification 2006 and its Amendments.

1.2 Identification of Project& Project Proponent

Numaligarh Refinery Limited (NRL), a subsidiary of M/s OIL India Limited is a public sector undertaking under the Ministry of Petroleum and Natural Gas. The refinery located at Golaghat District in Assam was commissioned in the year 2000 with a crude processing capacity of 3 million tonnes per annum (MMTPA) to process indigenous crude of Assam. The refinery primarily produces MS & HSD conforming to BS-VI specification.

NRL is installing a parallel new refinery of crude processing capacity of 6 MMTPA to expand its capacity from present 3 MMTPA to 9 MMTPA. The project is integrated with a new crude oil pipeline from Paradip (Odisha) to Numaligarh (Assam) and a product pipeline from Numaligarh to Siliguri where NRL has its own Marketing Terminal for distribution ofproduct. The crude oil considered for the design of new refinery train is Arabmix crude. MS (Gasoline) & HSD produced from the new train shall meet the BS-VI specification. The project has been named as Numaligarh Refinery Expansion Project (NREP).

Under this NREP project a high severity PFCCU unit with a capacity of 1.955 MMTPA is being implemented. The LPG that will be generated in the high severity mode will contain asignificant potential of propylene which can be recovered for value addition. Potential existsto explore the possibilities of setting up of a Poly-Propylene Unit to produce high value polymers by considering feed stocks available from the refinery PFCCU.

Considering the above and in view of expected growth in demand for petrochemical products in India and to remain competitive in the market with product self-sufficiency, NRL intends to explore the feasibility of putting up a PP unit in the refinery complex from Polymer grade propylene feed from PFCC unit along with associated utilities and offsite facilities.

For this proposed project, The Polypropylene Unit is to be designed as a single train with a capacity of 360,000 TPA of Homo-polymer grades of Polypropylene (PP) product with a target annualized product split discussed elsewhere in the report. The capacity stated is inclusive of off spec (low value) products produced during transition from one grade to another.

Project Proponent

M/s. Numaligarh Refinery Limited.
Address for correspondence:
Numaligarh Refinery Complex,
Plot No. 93 &94 ,Patta No. 2, Pankagrant village
Golaghat District, Assam Pin-785699.

Contact Person:
Name: Mr. AlokNayanNath
Designation: Deputy General Manager (TS)
Address for correspondence:
Numaligarh Refinery Complex,
Plot No. 93 &94 ,Patta No. 2, Pankagrant village
Golaghat District, Assam Pin-785699
Email: alok.n.nath@nrl.co.in
Telephone :+ 91-9435152836

1.3 Brief description of the project

1.3.1 Nature

M/s Numaligarh Refinery Limited as a part of the compliance to the regulatory requirement i.e., to obtain Environmental Clearance from MoEF& CC, has appointed M/s.HubertEnviro Care Systems (P) Limited (HECS),Chennai as EIA Consultant who is accredited by National Accreditation Board for Education and Training (NABET)-Quality Council of India (QCI), New Delhi for Schedule 5(c) “Petro-chemical complexes (industries based on processing of petroleum fractions & natural gas and/or reforming to aromatics)" as per EIA Notification 2006 and its Amendments."

1.3.2 Size

The total Plot no. 11 area is 600 Bigha (8,02,681.92 sq.m) (80.27 Ha). Out of which Total plot area required for the PP Unit and its associated facility is 348093 SQM (34.8 Ha). The plant area is 232821 sq.m (23.28Ha) and Greenbelt area is 115272 sq.m (11.52 Ha) i.e, (33.1 % of total area) at Plot No.11 located at North side of the Numaligarh Refinery. The remaining 454588.92 sq.m (45.45 Ha) will be utilized for future project activities.

1.3.3 Location

The existing Numaligarh Refinery complex is located at Plot No. 93 &94, Patta No. 2, Pankagrant village, Golaghat District, Assam Pin-785699. The proposed PP unit will be set up at a Green field land Plot No.11 located at North side of the Numaligarh Refinery.

1.3.4 Importance to the Country & Region

Under NREP project a high severity PFCCU unit with a capacity of 1.955 MMTPA is being implemented. The LPG that will be generated in the high severity mode will contain a significant potential of propylene which can be recovered for value addition. Potential exists to explore the possibilities of setting up of a Poly-Propylene Unit to produce high value polymers by considering feed stocks available from the refinery PFCCU.

Considering the above and in view of expected growth in demand for petrochemicals products in India and to remain competitive in the market with products self sufficiency, NRL planned to set up a PP Unit along with its associated facilities at Numaligarh beside the NREP refinery.

1.4 Scope of the study & Methodology Adopted

EIA is the process of identifying, predicting, evaluating and mitigating the biophysical, social and other relevant effects of development proposals prior to major decisions being taken and Commitments made. These studies integrate the environmental concerns of developmental activities into the process of decision – making.

An Environmental Impact Assessment (EIA) is an assessment of the possible impact, whether positive or negative, that a proposed project may have on the environment, together consisting of the natural, social and economic aspects, i.e., aiming at "Sustainable Development" due to the project activities.

1.4.1 Objective of the EIA Report

- To ensure environmental considerations are explicitly addressed and incorporated into the development decision-making process.
- To anticipate and avoid, minimize or offset the adverse significant biophysical, social and other relevant effects of the above project proposal.
- To protect the productivity and capacity of natural systems and the ecological processes which maintain their respective functions.
- To promote development that is sustainable and optimizes resource use as well as management opportunities.
- To fully recognize the scope and requirements of the TOR and comply with the same.

1.4.2 Scope of Work

The scope of the work mentioned includes an assessment study of proposed petrochemical complex and their impact on the region. This study puts forward the most effective ways to protect the environment form increasing pollution caused by the burgeoning industrial development and recommendations for environmental-friendly development initiatives in the region.

This EIA report presents the existing baseline scenario and the assessment and evaluation of the environmental impacts that may rise during the construction and operational phases of the project. This report also highlights the Environmental Monitoring Program during the construction and operation phases of the project and the post project monitoring program. In terms of the EIA Notification of the MoEF&CC dated 14th September 2006 and subsequent amendments the generic structure of the EIA document will be as under:

Chapter 1: Introduction

Introductory information is presented in this Chapter. The introduction chapter provides background to the project, project proponent and describes the objective of this document. The purpose and organization of the report is also presented in this chapter.

Chapter 2: Project Description

This Chapter includes Project Description and Infrastructure Facilities delineating all the industrial and environmental aspect of the industry of Numaligarh Refinery Limited existing utilities as well as process details of proposed project.

Chapter 3: Description of the Environment

This Chapter provides baseline environmental status of Environmental Components (Primary data) delineating meteorological details of the project site and surrounding area.

Chapter 4: Anticipated Environmental Impacts & Mitigation Measures

This Chapter presents the analysis of impacts on the environmental and social aspects of the project as a result of establishment of plan and thereby suggesting the mitigation measures.

Chapter 5: Analysis of Alternatives (Technology and Sites)

This chapter includes the justification for the selection of the project site from an Environmental point of view as well as from an Economic point of view.

Chapter 6: Environmental Monitoring Program

This chapter will include the technical aspects of monitoring, the effectiveness of mitigation measures which will include the measurement methodologies, frequency, location, data analysis, reporting schedules etc.

Chapter 7: Additional Studies

This chapter will detail about the Public Consultation requirement regarding the project. It will also identify the risks of the Project in relation to the general public and the surrounding environment during construction and operation phases of the plant and thereby presents Disaster Management Plan, Social impact assessment and R&R action plans.It will aslo include details about Non Developmental Zone (NDZ) clearance.

Chapter 8: Project Benefits

This chapter deals with improvement in physical and social infrastructures, employment potential and other tangible benefits by way of reduction in imports.

Chapter 9: Environmental Cost Benefit Analysis

Not Recommended in Scoping Stage.

Chapter 10: Environmental Management Plan

This is the key Chapter of the report and presents the mitigation plan, covering the institutional and monitoring requirements to implement environmental mitigation measures and to assess their adequacy during project implementation.

Chapter 11: Summary and Conclusion

This chapter summarizes the information given in this EIA/EMP report and the Conclusion based on the environmental study, impact identification, mitigation measures andthe environmental management plan.

Chapter 12: Disclosure of the Consultant

Names of consultants engaged in the preparation of the EIA/EMP report along with their brief resume and nature of Consultancy rendered are included in this Chapter.

1.4.3 Detailed Methodology adopted for the EIA Study

The Environmental Impact Assessment (EIA) report has been prepared based on the methods and guidelines suggested by MoEF&CC, to address all the specific conditions stipulated in the Terms of Reference issued by MoEF&CC. Baseline data was collected during Dec 2022 to Feb 2023.

Ambient Air Quality (AAQ) was measured at Eight (08) locations in the study area as per the methods and procedures recommended by Central Pollution Control Board (CPCB) Air quality sampling was undertaken for a period of 12 weeks with a total of 24 samples per site were taken as per the MoEF&CC guidelines. All 8 Parameters as per ToR obtained vide No.J-11011/274/2015-IA-II(I) dated 15 Jul 2022 were analysed. The measured ambient air quality data was compared with that of the prevailing NAAQ Standards.

Hydro-geological status was studied based on the secondary published long-term data. Data on sub-surface soil profile and also bore-log data in the study area was obtained. In addition, a preliminary study on the regional and local aquifer status was studied based on primary and secondary data.

Ground water samples from eight (08) locations were analysed, as per the terms of reference for all the designated parameters. The measured values were compared with drinking water standards. Secondary data on the regional ground water status was also collected from the Central Ground Water Board and the State Ground Water Board.

All seasonal streams, rivers and water bodies located within the study area were mapped through latest remote sensing data under land use and land cover study. Walkthrough survey was also undertaken to assess the current status of the water resources. Details about the major cropping pattern and irrigation methods etc were collected from local village offices and also published district census data. Details of the surface water quality in the study area were also collected and analysed for designated physicochemical, elemental and biological parameters.

Land use and land cover was mapped using remote satellite imagery. The data was processed using applicable software models and level 2 land use classification within the study area was developed. A walkthrough survey was also undertaken near the forest boundaries, major settlements and plantation area to verify the land use, as a part of the ground truth survey procedures.

Soil samples were also collected at Eight (08) locations and all relevant parameters such as texture, nutrients, heavy metals and other parameters were analysed in the soil samples.

Flora and Fauna survey was undertaken in the study area. Bio-diversity density and abundance were estimated. Walkthrough surveys near forest area and its environs were also undertaken to assess the ecology around the forest areas and dependency of the local people on the forest produce.

Secondary socio- economic survey was undertaken in the study area to capture the socio -economic conditions, major occupation of the people, drinking water and sanitation facilities, transportation and other amenities in the study area, with a specific reference to the villages located within five (5) km radius (Category-I) of the project site and villages located within 5 to 10Km radius (Category-II) of the project site.

In addition to the above, district level census data published by National Informatics Centre (NIC) was also collected for a detailed analysis on the socio -economic aspects. Since, there are no settlements at the proposed project site, detailed Rehabilitation and Resettlement studies are not envisaged under this study; Also, the indirect impacts on the local and regional community due to land acquisition is not applicable for this Project, since the proposed expansion project is planned within the existing Project Site.

A typical review on various pollution control systems proposed, details of wastes and discharges that are envisaged from the proposed project were also undertaken. Such inputs are adopted while predicting various environmental impacts due to operation of the facility and also to suggest an appropriate environmental management plan and environmental monitoring plan.

As a part of the environmental impact assessment study, an attempt was made to predict the possible and likely impacts on background environment. Likely air quality impacts due to release of emissions from DG stacks were modelled using AERMOD model. Ground level concentration of criteria pollutants such as Particulate Matter, Sulphur Dioxide, and Oxides of Nitrogen were estimated using MoEF&CC approved AERMOD model. Maximum ground level concentrations were predicted and concentration isopleths of the above mentioned pollutants were plotted.

The predicted ground level concentrations of the respective pollutants were added to the prevailing baseline concentrations of the designated pollutants to assess the likely cumulative post project scenario and such values were compared with the National Ambient Air Quality Standards.

In addition to the above aspects, the positive environmental benefits arising from community development plans, ecological and biodiversity enhancement aspects due to development of plantation and green-cover development in the project site were also studied.

Based on a detailed environmental impact assessment study, a comprehensive report on the environmental management plan was developed, covering the following aspects:construction phase environmental management plan, air quality management plan, noise and water quality management plan, wastewater disposal programme, socioe-conomic and community development plan, ecological and biodiversity enhancement plan. An outline of the proposed environmental management systems, environmental cell and environmental monitoring programme were also presented in this report.

A preliminary risk assessment study and Disaster Management study, was undertaken to assess the residual risks, if any, Due to Proposed Poly Propylene Unit (PPU) Of Capacity 360KTPA. Based on the risk assessment study, a preliminary fire safety and occupational health management plan was suggested. A road map for onsite emergency and disaster management plan was suggested.The EIA process followed for this EIA report is composed of the following stages:

1. Study of project information
2. Screening & Scoping environmental pre-feasibility study & application for approval of ToR
3. Collection of detailed project management plan/report
4. Baseline data collection
5. Impact identification, Prediction & Evaluation
6. Mitigation measures & delineation of EMP
7. Risk assessment and safety & disaster management plan
8. Review & finalization of EIA Report based on the ToR requirements
9. Submission of EIA report for implementation of mitigation measures & EMP as well as necessary clearances from relevant Authority.

The EIA Cycle based on the above stages has been illustrated as per the ToR obtained vide J-11011/274/2015-IA-II(I) dated 15-07-2022, in **Figure 1-1**.

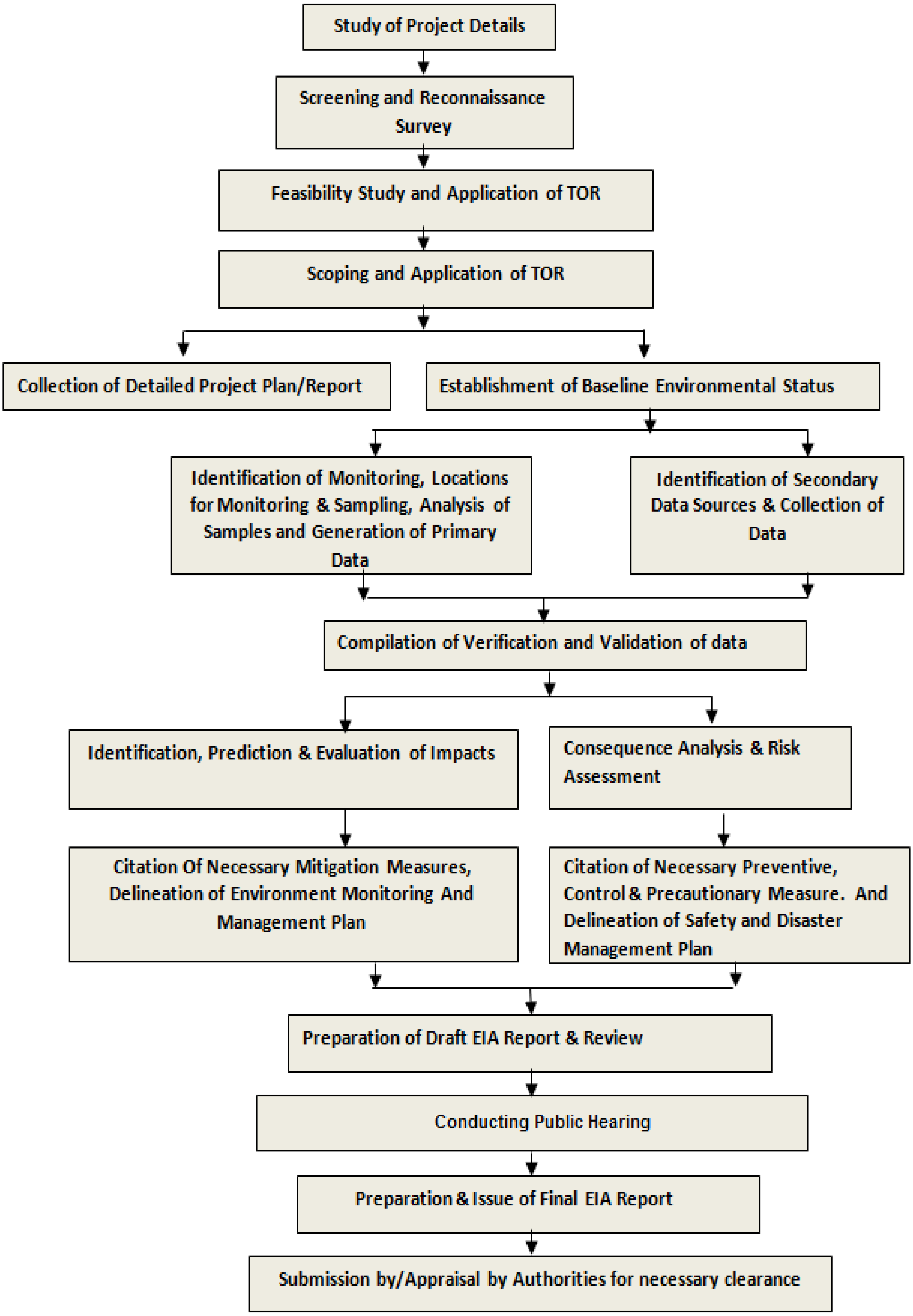


Figure 1-1 EIA Process

1.4.4 Objective of the Study

The major objective of this study is to prepare a detailed Environmental Impact AssessmentStudy within the study area i.e. 10 km radius from the project.

1.4.5 Applicable Regulatory Framework

The following are some of the acts and rules related to environment which are applicable for the proposed project:

i. EIA Notification 2006 and its amendments
ii. Manufacture Storage and Import of Hazardous Chemicals Rules,1989and its subsequent amendments
iii. Water (Prevention and Control of Pollution) Act,1974and its subsequent amendments
iv. Air (Prevention and Control of Pollution) Act,1981and its subsequent amendments
v. Hazardous Waste (Management, Handling and Transboundary movement) Rules,2016 and its subsequent amendments
vi. Public Liability InsuranceAct,1991 and its subsequent amendments
vii. Environmental (Protection)Rules,1986 and its subsequent amendments
viii. The Noise Pollution (Regulation and control) rules, 2000
ix. Factories Rules 1950 and its subsequent amendments
x. Petroleum Act, 1934
xi. Explosive Act,1884
xii. Central Motor Vehicle Act, 1988

The details of applicable Acts and Rules and the applicability to the project are given in **Table 1-1.**

Table 1-1 Applicable Acts and Rules for the proposed project

S. No	Act and Rules applicable	Purpose	Objective	Applicability
1.	EIA Notification 2006 and its amendments.	New projects, Expansion modernization, change of product mix of the existing project	Protection and Improvement of the Environment	As the proposal is for compliance to petro-chemical complex, Environmental clearance from Ministry of Environment, Forest and Climate Change (MoEF&CC) is applicable
2.	The Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 and its amendments	Handling of Hazardous Chemicals	Regulate the manufacture, storage and import of Hazardous Chemicals	Preparation/ update of On-site Emergency Preparedness Plan and submission to Factory inspectorate. Preparation/ update of Safety Report and submit to Factory inspectorate. Preparation of Material Safety Data Sheet.
3.	The Water (Prevention and Control of Pollution) Act, 1974 and its amendments.	New projects, Expansion modernization, change of product mix of the existing project, Existing plants	Prevention, control and abatement of water pollution	Consent to Establish and Consent to Operate from State Pollution Control Board to be obtained.

S. No	Act and Rules applicable	Purpose	Objective	Applicability
4.	The Air (Prevention and Control of Pollution) Act, 1981 and its amendments.	New projects, Expansion /modernization, change of product mix of the existing project, Existing industries	Prevention, control and abatement of air pollution	Consent to Establish and Consent to Operate from State Pollution Control Board to be obtained.
5.	The Hazardous and other wastes (Management, Handling and Transboundary Movement Rules) 2016 and Solid Waste Management Rules 2016.	Management, Handling and Transboundary Movement of Hazardous waste	Prevention, Control and abatement of pollution	Hazardous waste Authorization from State Pollution Control Board to be obtained.
6.	The Environmental (Protection)Rules ,1986 and its Amendments	New projects, Expansion/modernization change of product mix of the existing project, Existing industries	Protection and Improvement of the Environment	Environmental Standards as specified are to be complied. Submission of Environment Statement on yearly basis to PCB
7.	The Noise Pollution (Regulation and Control) Rules, 2000	New projects, Expansion/modernization change of product mix of the existing project, Existing industries	To protect the workers and public from noise related problems	Noise control measure. Comply with Noise standards and submission of Quarterly report to PCB

S. No	Act and Rules applicable	Purpose	Objective	Applicability
8.	The Public Liability Insurance Act, 1991 and its amendments	Transportation of Hazardous Substance.	To provide immediate relief to persons affected by accident involving hazardous substances and also for Establishing an Environmental Relief fund	Provision of Liability Insurance Policy.
9.	Factories Rules 1950 and its amendments.	Newprojects, Expansion/modernization change of product mix of the existing project, Existing industries.	Control of workplace environment, and providing for good health and safety of workers.	Factory License from Factory inspectorate.
10.	The Petroleum Act, 1934	New projects, Expansion/modernization change of product mix of the existing project, Existing industries	Production, Storage and import of petroleum and provides the regulations for the safety and environmental measures	License to be acquired for storage and adequate safety measures are in place.

S. No	Act and Rules applicable	Purpose	Objective	Applicability
11.	The Explosive Act, 1884	New projects, Expansion/modernization change of product mix of the existing project, Existing industries	Production, Storage and import of explosive substance in and around the project and provides the regulations for the safety and environmental measures	Safety measures are to be complied for the storage of chemicals in the plant as per PESO guidelines.
12.	The Central Motor Vehicle Act, 1988	New projects, Expansion/modernization change of product mix of the existing project, existing industries	Check the pollution load of vehicles inside the plant	Adequate environmental measures are put in place to check the vehicular emissions.

1.5 ToR Compliance

<table>
<tr><th>S.No</th><th>Terms of Reference</th><th>Compliance</th></tr>
<tr><td colspan="3">SPECIFIC TERMS OF REFERENCE FOR EIA STUDIES FOR PETROCHEMICAL COMPLEXES (INDUSTRIES BASED ON PROCESSING OF PETROLEUM FRACTIONS & NATURAL GAS AND/OR REFORMING TOAROMATICS)</td></tr>
<tr><td colspan="3">GENERIC TERMS OF REFERENCE</td></tr>
<tr><td>1</td><td>Executive Summary</td><td><u>I.PROJECT DESCRIPTION</u>
<table>
<tr><th>S.No</th><th>Particulars</th><th>Details</th></tr>
<tr><td>1.</td><td>Brief Description about Project</td><td>Proposed Poly Propylene Unit (PPU) Of Capacity 360KTPA by M/s Numaligarh Refinery Limited</td></tr>
<tr><td>2.</td><td>Products with capacities for the proposed project</td><td>The Polymer Grade Propylene produced in the PRU section of the PFCC Unit of NREP is further processed in the downstream unit i.e. PP unit to produce Homo-polymer grade Polypropylene product.
<table>
<tr><th>S.No.</th><th>Name of the Unit</th><th>Unit Configuration</th></tr>
<tr><td>1</td><td>Poly propylene unit</td><td>360 KTPA</td></tr>
</table>
Proposed Products
<table>
<tr><th>Name of the Product</th><th>Proposed Quantity (KTPA)</th><th>Mode of storage</th><th>Storage capacity</th></tr>
<tr><td>Raffia Grade</td><td>190</td><td>Bags in Ware house</td><td rowspan="4">Inpellet form & is stored in warehouse before dispatch.
The warehouse will be sized corresponding to twenty one(21) days of storage requirement corresponding to 100% throughput of the unit</td></tr>
<tr><td>Non–Woven Spun Bond Grade</td><td>90</td><td>Bags in Ware house</td></tr>
<tr><td>Non-Woven Melt Blown Grade</td><td>25</td><td>Bags in Ware house</td></tr>
<tr><td>Injection Moulding</td><td>55</td><td>Bags in Ware house</td></tr>
</table>
</td></tr>
</table>
</td></tr>
</table>

		Homo-polymer Grade
3.	Plot area	The total Plot no. 11 area is 600 Bigha (8, 02,681.92 sq.m) (80.27 Ha). Out of which Total plot area required for the PP Unit and its associated facility is 348093sq.m (34.8 Ha). The plant area is 232821sq.m (23.28Ha) and Greenbelt area is 115272 sq.m (11.52 Ha) i.e, (33.1 % of total area) at Plot No.11 located at North side of the Numaligarh Refinery. The remaining 454588.92 sq.m (45.45 Ha) will be utilized for future project activities.
4.	% of green belt provided	Green belt area is 115272 SQM i.e, 11.52 Ha (33.1 % of total area).
5.	Land use change required	For NREP, a total of 11 plots were identified requiring NDZ clearance, out of which Forest Department, Govt. of Assam had recommended 9 plots including Plot no.11 (Rajabari TE). However, out of the 9 plots, 8 plots of Land were shortlisted by NRL for NREP related activities. Now, the proposed PP unit will be installed in Plot no.11 which comes under NDZ zone and the site has been under the 9 recommended plots by Forest Dept. of Assam and has been recommended for Project activities.
6.	Sources of Air & Noise Pollution	Source of air pollution- Process emission (discontinuous), Off-gas - Purge Gas Recovery (continuous) , Extruder Vacuum Unit (continuous), Emg D.G. sets &Transportation emission- Trucks-70 nos./day Source of noise pollution –D.G. sets, compressors
7.	Estimated Project Cost (INR)	7231 Crores* ***Note:***In Form-1 it is mentioned as 4735Cr and it has been revised as 7231Cr.*
8.	EMP Cost (INR)	Capital cost- 402.36 lakhs Recurring cost-85 lakhs
9.	CER Cost (INR)	36.155 Crores

10.	Manpower (No)

Description		Construction Phase	Operation Phase
Proposed	**Permanent**	0	17
	Contract	1750	36
Total (A)		1750	53
Period of employment in days (B)		1080	365
Total Man-days(A*B)		1080*1750=18,90,000	19,345

S.No.	Particulars	Units	Details
11.	Water Consumption	m3/hr	
12.	Source of water	-	Treated Raw water for the PP complex will be provided from existing NREP treated raw water header. The source of raw water for existing and NREP is River Dhansiri.
13.	Permission from CGWA or any other agency	-	Not Applicable

S.No	Unit	Normal - m3/hr	Maximum-m3/hr
1.	CoolingwaterMake up	205	244 (Note-1)
2	PP Unit	5	6
Total Treated Raw Water Demand; 3		210	250 (Note-2)

Notes:

1. Maximum cooling water makeup corresponds to the installed capacity of the cooling tower.

2. Maximum raw water demand is considering 20% Design margin on normal raw water requirement. This will also take care of the maximum requirement of any of the above stream at a time along with the normal requirements of other streams.

<table>
<tr><td></td><td></td><td>14.</td><td>Energy Consumption</td><td>-</td><td>
<table>
<tr><th>Description</th><th>Unit</th><th>Proposed</th><th>Source</th></tr>
<tr><td>Power requirement</td><td>MW</td><td>26</td><td>Grid</td></tr>
<tr><td>Emergency DG</td><td>KW</td><td>750</td><td>-</td></tr>
<tr><td colspan="4">No Fuel Requirement for the NRL PP project*</td></tr>
<tr><td>Diesel for DG</td><td>Kg/hr</td><td>-</td><td>Existing NREP fuel</td></tr>
</table>
<i>Note:*The fuel requirement of 125 kg/hr for the Emergency DG will be utilised from the existing NREP fuel requirement</i>
</td></tr>
<tr><td></td><td></td><td>15.</td><td>Kind of Fuel used</td><td>-</td><td>No additional Fuel Requirement for the NRL PP Project.</td></tr>
<tr><td></td><td></td><td>16</td><td>Quantity of fuel used</td><td>-</td><td>No additional Fuel Requirement for the NRL PP Project.</td></tr>
<tr><td></td><td></td><td>11.</td><td>Wastewater generated/day</td><td>m3/hr</td><td>
<table>
<tr><th>Description</th><th>Proposed(m³/hr)</th><th>Disposal Method & Facility Details (m³/hr)</th></tr>
<tr><td colspan="3">Effluent generation</td></tr>
<tr><td>Cooling tower blowdown</td><td>50</td><td>Cooling tower blowdown from PP unit will be diverted to RO plant (Design: 600 m3/hr) under existing NREP ETP Package.</td></tr>
<tr><td>Process effluent</td><td>0.23</td><td>PP process effluent to be treated in existing NREP ETP (Design: 450 m3/hr and cnormal flow is 360 m3/hr</td></tr>
<tr><td>Sub-Total</td><td>50.23</td><td></td></tr>
<tr><td>Sewage</td><td>0.212</td><td>Diverted to existing NREP ETP for treatment</td></tr>
<tr><td>Total waste water generation</td><td>50.442</td><td></td></tr>
</table>
The sewage generated will be routed to the existing NREP ETP for further treatment. The processeffluent from PP unit will be routed to NREP ETP for treatment.The treated effluent from NREP ETP is planned to be reused in cooling tower, fire water and Horticulture (greenbelt).
</td></tr>
<tr><td></td><td></td><td>12.</td><td>Treatment facility with capacity and</td><td>m3/hr</td><td>
<table>
<tr><th>Description</th><th>Existing</th></tr>
<tr><td>Existing ETP capacity</td><td>450</td></tr>
</table>
</td></tr>
</table>

	current operational capacity		Design capacity of NREP ETP is 450 m3/hr and normal flow is 360 m3/hr . Treated effluent generation from NREP ETP is 415 m3/hr under normal operating conditions
13.	Mode of discharge	-	No effluent from PP unit shall be discharged and will be diverted to NREP ETP for further treatment.

Raw Material /Chemicals Used:

S.no.	Raw-Material	Unit	Proposed quantity	Mode of Transport	Source	Storage Facility (M3)
1	Polymer Grade Propylene	KTPA	368.6	Pipeline	Petro FCC Unit of NREP	3 nos (2W+1S) of Mounted Bullet with Dia 8m & Height 80m
2	Hydrogen Gas	KTPA	0.032	Pipeline	NREP Hydrogen network	Nil

S.no.	Raw-Material	Unit	Proposed quantity	Mode of Transport	Source	Storage Facility (M3)
1	Polymerization catalyst	TPA	21.8	Truck via road	Licensor-proprietary item	Catalyst and chemical warehouse-OSBL: 25 m X 25m Catalyst and chemical warehouse-ISBL: 20 m X 20 m Peroxide storage-ISBL: 10m X 15m
2	Co-catalyst: TEA	TPA	97.2	Truck via road	Open market	
3	Donor: Silane	TPA	5.26	Truck via road	Open market	
4	Peroxide	TPA	151.7	Truck via road	Open market	
5	Solid additives	TPA	652.3	Truck via road	Open market	

II.DESCRIPION OF ENVIRONMENT

The baseline study was carried out during December 2022 to February 2023.

Meteorological Data for the Study Period (December 2022 to February 2023)		
S. No	**Parameter**	**Observation**
1.	Temperature	Max Temperature : 29^0C Min Temperature : 8^0C Avg Temperature : 20.95^0C
2.	Average Relative Humidity	74.24%
3.	Average Wind Speed	1.27 m/s
4.	Predominant Wind Direction	East

Air Environment

The Ambient air Quality in the study area is given below:

Ambient Air Quality (AAQ) was measured at Eight (08) locations in the study area

Parameter	**Minimum & Maximum baseline Concentration Range**	**Units**	**Remarks**
	Study area		
PM10	48.65 to 86.25	µg/m³	Meets National Ambient Air Quality Standards.
PM2.5	22.09 to 49.47	µg/m³	
SO2	8.25 to 23.03	µg/m³	
NOx	15.96 to 33.95	µg/m³	

Noise levels monitoring results at 8 locations within the study area

Noise level monitoring at all the proposed well locations in and around 10 km radius from the block boundary shows that at most of the locations the noise levels are well within the permissible limit as prescribed by CPCB.

Site	**Day Time (dB(A))**		**Night Time (dB(A))**	
	Results	**Standards**	**Results**	**Standards**
Industrial areas (Project site)	52.2	75	45.2	70
Residential area	47.9 - 53.9	55	40.2 - 42.2	45

Surface water quality of nearby River

Surface water samples were collected from the 8 location based on the availability of the water in water bodies. The results of surface water analysis were compared with the IS2296:1992. Based on the values, the best use of the water can be determined.

Parameter	**Surface water sample**	**Standard Limit**				
		Class A	**Class B**	**Class C**	**Class D**	**Class E**

pH	6.89-7.68	8.5	8.5	8.5	8.5	8.5
Total Dissolved Solids (TDS)	151-205	500	-	1500	-	2100
Hardness	77-126	300	-	-	-	-
BOD	BLQ (LOQ 1.0) - 3.0	2	3	3	-	-
COD	8.0-24.0	-	-	-	-	-

Ground water monitoring results at 8 locations

8 samples were collected from different sources within the study area and some important parameters analysis carried out for depicting the baseline status of the study area are shown below.

Parameter	Range of Results	Standard Limit	
		Acceptable Limit	Permissible Limit
pH	6.88 - 7.87	6.5-8.5	No Relaxation
Total Dissolved Solids (TDS)	166 - 220	500mg/l	2000 mg/l
Fluoride	0.21 - 0.28	1mg/l	1.5 mg/l
Hardness	81 - 105	200mg/l	600 mg/l

Soil characteristics as per CPCB guidelines

Parameter	Units	Study area Observation
pH	-	4.25 to 4.48
Phosphorous	mg/kg	8.9 to 10.5
Potassium	mg/kg	106.9 to 126.2
Conductivity	µmhos/cm	542.0to 873.0
Nitrogen	mg/kg	213.7 to 252.4

II.ANTICIPATED ENVIRONMENTAL IMPACTS & MITIGATION MEASURES

	Physical				Biological		Socio-Economic	
Activity	**Ambient air Quality**	**Groud/ Surface water (Quality/Quantity)**	**Ambient Noise**	**Land (Land use Topography & drainage, soil)**	**Flora**	**Fauna**	**Livelihood & Occupation**	**Infrastructure**
Construction Phase								
Site Preparation	✓		✓	✓	✓	✓	✓	
Civil Works	✓		✓			✓	✓	
Heavy Equipments operation			✓				✓	
Disposal of construction waste				✓				
Generation/disposal of sewage		✓		✓				
Transportation of materials	✓		✓					
Operational Phase								
Commissioning of process units, utilities & offsite	✓	✓	✓					
Product handling & storage	✓							
Emission & Waste Management-Air, liquid and solid waste	✓	✓		✓				

MITTIGATION MEASURES:

Air Environment:
For this PP unit, only Emergency DG will be proposed and operated only during power failure.

In addition to the above, the additional emission from the proposed project are given in **Chapter 4, Section 4.1.2** of the EIA report

- Provision of stack of sufficient height as required by per CPCB’s guidelines for the proposed DG sets.
- 01 no. CAAQMS will be proposed for PP unit. NRL already having 02 CAAQMS and one more will come as a part of NREP. NRL already having 3 manual monitoring station within 10 km range and 01 in Kaziranga National Park
- Monitoring of fugitive emissions from NRL with the help of VOC (Volatile Organic Carbon), LDAR (Leak Detection and Repair) program will be done annually with the help of an external agency. Thus observed leaks will beidentified and rectified

Noise Environment:

- The major noise generating equipment like Compressors, pumps etc. will be enclosed in an acoustic enclosure designed for an insertion loss of 25 dB (A) and silencers to other equipment etc.
- Acoustic design with sound proof glass paneling will be provided for critical operator cabins / control rooms of individual modules as well as central control facilities.
- Periodic maintenance of the equipment to be used in the developmental works will be carried out. Worn out parts will be replaced and rotating parts will be lubricated to minimize noise emissions.
- Implementation of greenbelt for noise attenuation will be undertaken: shrub plantation; landscaping with horticulture; and Tree plantation at vehicle parking areas and along approach roads.
- Low vibration generating machines/equipment will be selected to meet international standards and foundations will be so designed to minimize vibrations and secured properly.
- Vibration dampers will be provided around the source of generation.

Water & Wastewater Management:

Only effluent generation of 50.23 m3/hr and sewage of 0.212 m3/hr will be generated due to this proposed project and treated in the existing NREP ETP.

Description	Proposed(m^3/hr)	Disposal Method & Facility Details (m^3/hr)
Effluent generation		

Cooling tower blowdown	50	Cooling tower blowdown from PP unit will be diverted to RO plant (Design: 600 m3/hr) under existing NREP ETP Package.
Process effluent	0.23	PP process effluent to be treated in existing NREP ETP (Design: 450 m3/hr and cnormal flow is 360 m3/hr
Sub-Total	**50.23**	
Sewage	0.212	Diverted to existing NREP ETP for treatment
Total waste water generation	**50.442**	

The sewage generated will be routed to the existing NREP ETP for further treatment. The processeffluent from PP unit will be routed to NREP ETP for treatment.The treated effluent from NREP ETP is planned to be reused in cooling tower, fire water and Horticulture (greenbelt).

Details of Liquid Effluent from the proposed project are given **Chapter 2, Table 2-14** in the EIA report.

- Recycling/reusing/recovering materials where possible and thereby neglecting or reducing the disposal requirements.
- Separation of construction material for reuses either to be used on onsite filling or can be used as public fill.
- Training the staff in waste minimizing practices.
- Chemical waste should be stored in a locked area so as to avoid leaching of harmful chemicals in the soil or nearby water bodies (If any).

Solid waste Management:

During construction phase:

S. No	Description	Proposed Quantity (Kg/day)	Method of Disposal
1	Organic	472.5	Municipal Bins
2	Inorganic	315	Disposed to PCB authorized recyclers
Total		**787.5**	

During operation phase:

S. No	Description	Proposed (Kg/day)	Method of Disposal
1	Organic	14.31	Municipal Bins
2	Inorganic	9.54	Disposed to PCB authorized recyclers

Total	23.85	

Hazardous waste Management

The process effluent generation from PPU unit is very negligible and the same will not have any impact on NREP ETP effluent and subsequent sludge generation. However, note that estimated sludge generation from NREP ETP will be 30 m3/hr-oily and (chemical)and 20 m3/hr (bio sludge).In addition, spent oil/ Used oil which will be generated from the emergency DG will be minimal which will be disposed to authorized recyclers.

The details of other hazardous waste generated are given in **Chapter 2, Table 2-19** of EIA report.

IV. ENVIRONMENTAL MONITORING PROGRAM

S. No	Details of Location	Frequency and reporting schedules	Parameters for data analysis
1.	**Air pollution monitoring**		
	Ambient air quality within the premises	Continuous	PM, SO_x, NO_X , CO and VOC
	Ambient air quality within the premises	Twice in a week	All 12 parameters as given in NAAQS
	Ambient air quality at 1 location in Prevalent Down Wind Direction	Twice in a week	All 12 parameters as given in NAAQS
	Ambient air quality at 1 location in Up Wind Direction	Twice in a week	All 12 parameters as given in NAAQS
2.	**Noise monitoring**		
	At two locations within the premises	Once in 2 months	Noise Levels in dB(A)
3.	**Ground water quality monitoring**		
	One location at site	Quarterly	Physicochemical properties and Heavy

			Metals The groundwater results are compared with the acceptable and permissible water quality standards as per IS: 10500 (2012)
4.	**Soil Quality monitoring**		
	One location near Hazardous waste storage area at site and one location outside site	Annually	Physicochemical properties, Nutrients, Heavy metals as per IS 2720 (All Parts)
5.	**Effluent Quality Monitoring**		
	Inlet and outlet of ETP in Refinery area	Once a month	pH, Temp, TDS, TSS, Chloride, Sulphide, Sulphate, fluoride, ammoniacal Nitrogen, Sodium, Copper, Zinc, Phenolic compounds, Oil and Grease, Boron, BOD, COD, Total Residual Chlorine, Arsenic, Cadmium, Total Chromium, Hexavalent Chromium, Lead, Selenium, Mercury, Pesticides, Alpha emitters, Free Ammonia, Dissolved Phosphates, Total Kjeldhal nitrogen, Cyanide, Nickel, Residual Sodium Carbonate. All the Parameters are to be verified as per CPCB Standard Guidelines.
6.	Work place Monitoring	Quarterly	Noise, VOC, Lux levels

V.ADDITIONAL STUDIES

Public consulatation

The project is falling under ‘A’ category as per EIA Notification 2006 and Public Hearing is mandatory as per ToR obtained. Hence draft EIA report has been prepared as per the ToR vide **F. No.J-11011/274/2015- IA II(I),** Dated 15July 2022.

Risk Assessment

The Risk assessement has been carried out by using the PHAST software. The Risk assessment report is attached as **Annexure 6**

VI. PROJECT BENEFITS

Improvements in Physical Infrastructure

No major physical infrastructural change or improvement has been envisaged due to establishmentof the proposed project. All the required infrastructural facilities such as township, hospital, school etc.are readily available in Golaghat to support the establishmentof proposed project.

Improvements in Social Infrastructure

Economic infrastructure is essential for improving the productive capacity of the nation. But social infrastructure is also required to improve the quality of human resources. It consists of services like education, medical facilities, sanitation, housing, drinking water supply etc.these altogether constitute the social infrastructure of an economy. Various CSR activities will be done by NRL every year to satisfy the basic requirements of the social infrastructure.

Employment Potential-Skilled, Semi-Skilled & unskilled

The project will provide employment potential for construction Labour during implementation phase.

During operational phase, thisprojectwillalsogenerate Direct &Indirectemployment in the form of contractors, workers, transporters, marketing and ancillary facilities and general utility services.

VII.ENVIRONMENTAL MANAGEMENT PLAN

Air Environment:

For this PP unit, only Emergency DG will be proposed and operated only during power failure.

In addition to the above, the additional emission from the proposed project are given in **Chapter 4, Section 4.1.2** of the EIA report.

Provision of stack of sufficient height as required by per CPCB's guidelines for the proposed DG sets.

•01 no. CAAQMS will be proposed for PP unit. NRL already having 02 CAAQMS and one more will come as a part of NREP. NRL already having 3 manual monitoring station within 10 km range and 01 in Kaziranga National Park

•Monitoring of fugitive emissions from NRL with the help of VOC (Volatile Organic Carbon), LDAR (Leak Detection and Repair) program will be done annually with the help of an external agency. Thus observed leaks will beidentified and rectified

Water Environment:

The total water requirement will be 210 m3/hr for the proposed PP

Source: Treated Raw water for the PP complex will be provided from existing NREP treated raw water header. The source of water for existing refinery and NREP is River Dhansiri.

S.No	Unit	Normal -m3/hr	Maximum-m3/hr
1.	CoolingwaterMake up	205	244 (Note-1)
2	PP Unit	5	6
Total Treated Raw Water Demand; m^3/hr		210	250 (Note-2)

Notes:

1. Maximum cooling water makeup corresponds to the installed capacity of the cooling tower.

2. Maximum raw water demand is considering 20% Design margin on normal raw water requirement. This will also take care of the maximum requirement of any of the above stream at a time along with the normal requirements of other streams.

Waste water Management:

Only effluent generation of 50.23 m3/hr and sewage of 0.212 m3/hr will be generated due to this proposed project and treated in the existing NREP ETP.

Description	Proposed(m^3/hr)	Disposal Method & Facility Details (m^3/hr)
Effluent generation		
Cooling tower blowdown	50	Cooling tower blowdown from PP unit will be diverted to RO plant (Design: 600 m3/hr) under existing NREP ETP Package.
Process effluent	0.23	PP process effluent to be treated in existing NREP ETP (Design: 450 m3/hr and cnormal flow is 360 m3/hr
Sub-Total	**50.23**	
Sewage	0.212	Diverted to existing NREP ETP for treatment
Total waste water generation	**50.442**	

The sewage generated will be routed to the existing NREP ETP for further treatment.. The processeffluent from PP unit will be routed to NREP ETP for treatment.The treated effluent from NREP ETP is planned to be reused in cooling tower, fire water and Horticulture (greenbelt).

Details of Liquid Effluent from the proposed project are given **Chapter 2, Table 2-14** in the EIA report.

Solid waste Management:

During construction phase:

S. No	Description	Proposed Quantity (Kg/day)	Method of Disposal
1	Organic	472.5	Municipal Bins
2	Inorganic	315	Disposed to PCB authorized recyclers
Total		**787.5**	

During operation phase:

S. No	Description	Proposed (Kg/day)	Method of Disposal
1	Organic	14.31	Municipal Bins
2	Inorganic	9.54	Disposed to PCB authorized recyclers
Total		**23.85**	

Hazardous waste Management:

The process effluent generation from PPU unit is very negligible and the same will not have any impact on NREP ETP effluent and subsequent sludge generation. However, note that estimated sludge generation from NREP ETP will be 30 m3/hr-oily and (chemical)and 20 m3/hr (bio sludge).In addition, spent oil/ Used oil which will be generated from the

<table>
<tr><td></td><td></td><td>emergency DG will be minimal which will be disposed to authorized recyclers.
The details of other hazardous waste generated are given in Chapter 2, Table 2-19 of EIA report.</td></tr>
<tr><td>2</td><td colspan="2">Introduction</td></tr>
<tr><td></td><td>i. Details of the EIA Consultant including NABET accreditation</td><td>M/s. Hubert Enviro Care Systems (P) Ltd., Chennai
NABET/EIA/2224/SA 0190dated 06.03.2023 valid till 27.02.2024</td></tr>
<tr><td></td><td>ii. Information about the Project Proponent</td><td>Project Proponent
M/s. Numaligarh Refinery Limited.
<i>Address for correspondence:</i>
Numaligarh Refinery Complex,
Plot No. 93 & 94 , Patta No. 2, Pankagrant village
Golaghat District, Assam Pin-785699.

Contact Person:
Name: Mr. Alok Nayan Nath
Designation: Deputy General Manager (TS-Environment)
Address for correspondence:
Numaligarh Refinery Complex,
Plot No. 93 & 94 , Patta No. 2, Pankagrant village
Golaghat District, Assam Pin-785699
Email: alok.n.nath@nrl.co.in
Telephone :+ 91-9435152836</td></tr>
<tr><td>3</td><td colspan="2">Project Description</td></tr>
<tr><td></td><td>i. Cost of project and Time of completion</td><td>The cost of the project is Rs.7231 Crores.
Time of completion: Expected by December, 2027.
<table>
<tr><th>S. No.</th><th>Particulars</th><th>Time Schedule</th></tr>
<tr><td>1</td><td>EC</td><td>May 2024</td></tr>
<tr><td>2</td><td>Consent to Establish from PCB</td><td>August 2024</td></tr>
<tr><td>3</td><td>Erection & Installation of Machinery</td><td>2024-27</td></tr>
<tr><td>4</td><td>Consent to Operate from PCB</td><td>2025-26</td></tr>
<tr><td>5</td><td>Commissioning</td><td>2026-27</td></tr>
</table></td></tr>
<tr><td></td><td>ii. Products with capacities for the proposed project. If expansion project, details of existingproducts with capacities and whether adequate land is available for</td><td>The Polymer Grade Propylene produced in the PRU section of the PFCC Unit of NREP is further processed in the downstream unit i.e. PP unit to produce Homo-polymer grade Polypropylene product.
<table>
<tr><th>S.No.</th><th>Name of the Unit</th><th>Unit Configuration</th></tr>
<tr><td>1</td><td>Poly propylene unit</td><td>360 KTPA</td></tr>
</table></td></tr>
</table>

expansion, reference of earlier EC if any.

Proposed Products

Name of the Product	Proposed Quantity (KTPA)	Mode of storage	Storage capacity
Raffia Grade	190	Bags in Ware house	In pellet form & is stored in warehouse before dispatch. The warehouse will be sized corresponding to twenty one (21) days of storage requirement corresponding to 100% throughput of the unit
Non–Woven Spun Bond Grade	90	Bags in Ware house	
Non-Woven Melt Blown Grade	25	Bags in Ware house	
Injection Moulding Homo-polymer Grade	55	Bags in Ware house	

iii. List of Raw materials and their source along with mode of transportation

S.no.	Raw-Material	Unit	Proposed quantity	Mode of Transport	Source	Storage Facility (M3)
1	Polymer Grade Propylene	KTPA	368.6	Pipeline	Petro FCC Unit of NREP	3 nos (2W+1S) of Mounted Bullet with Dia 8m & Height 80m
2	Hydrogen Gas	KTPA	0.032	Pipeline	NREP Hydrogen network	Nil

iv. Other chemicals and materials required with quantities and storage capacities

S.no.	Raw-Material	Unit	Proposed quantity	Mode of Transport	Source	Storage Facility (M3)
1	Polymerization catalyst	TPA	21.8	Truck via road	Licensor-proprietary item	Catalyst and chemical warehouse-OSBL: 25 m X 25m Catalyst and chemical warehouse-ISBL: 20 m X 20 m Peroxide storage-ISBL: 10m X 15m
2	Co-catalyst: TEA	TPA	97.2	Truck via road	Open market	
3	Donor: Silane	TPA	5.26	Truck via road	Open market	
4	Peroxide	TPA	151.7	Truck via road	Open market	
5	Solid additives	TPA	652.3	Truck via road	Open market	

v. Details of emission, effluents, hazardous waste generation and their management. Requirement of water, power, with source of supply, status of approval, water balance diagram, man-power requirement (regular and contract)

1. Proposed Emission:

Point source Emission:

S.No	Source	Fuel Type	Stack Details					Emission(g/s)		
			No.of stacks	**Height(m)**	**Dia(m)**	**Temp(° C)**	**Exit velocity(m/s)**	**PM**	**SO2**	**NOX**
1	EMDG 750 KW	HSD	1	14	0.05	220	9.8	0.0115	0.0107	0.1632
Total(g/s)								**0.0115**	**0.0107**	**0.1632**

Line Source Emission:

S.no	Type of Vehicle	No.of.Vehicle	Emission(g/s)	
			PM	**NOX**
1	Truck	70	2.92E-04	1.34E-02
Total(g/s)			**2.92E-04**	**1.34E-02**

Cumulative Emission:

S.No	Source	Fuel Type	Stack Details					Emission(g/s)		
			No.of stacks	**Height(m)**	**Dia(m)**	**Temp(°C)**	**Exit velocity(m/s)**	**PM**	**SO2**	**NOX**
1	EMDG 750 KW	HSD	1	14	0.05	220	9.8	0.0115	0.0107	0.1632
Transportations										
S.No	**Type of Vehicle**	**No.of.Vehicle**						**PM**	**SO2**	**NOX**
1	Truck	70						2.92E-04	-	1.34E-02
Total(g/s)								**0.0118**	**0.0107**	**0.1766**

In addition to the above, the additional emission from the proposed project is given below :

Emissions to Flare

Source of Emission	**Name**	**Mode of Operation**	**Frequency**	**Flow Rate approx. [Nm^3 / h]**	**Flow Rate approx. [kg / h]**	**Temperature BL [°C]**	**Pressure at BL [Kg/cm2(g)]**	**Composition**
1P39-R-1171, Propylene Treater (COS, Arsine, Phosphine)	Regeneration Gas	Discontinuous during bed replacement only	Once / 3 yrs.	**(Note 1)**		ambient	counter pressure flare system	Nitrogen with traces of Hydrocarbons (Propylene), COS, Arsine, Phosphine
1P39-R-1172A/B, Propylene Treater (H2O, Oxygenates, Methanol)	Regeneration Gas	Discontinuous for regeneration only	Once / 17 days For 60 hrs **(Note 1)**	4319 **(Note 1)**		35 - 250	counter pressure flare system	Nitrogen with traces of Hydrocarbons (Propylene), H2O, Oxygenates, Methanol
1P39-R-1173A/B, Propylene Treater (CO)	Regeneration Gas	Discontinuous for regeneration only	Once / 180 days For 28 hrs **(Note 1)**	1400 **(Note 1)**		35 - 200	counter pressure flare system	Nitrogen with traces of Hydrocarbons (Propylene), CO
1P39-R-1174, Propylene Treater (MAPD, Acetylene)	Regeneration Gas	Discontinuous during bed replacement only	Once / 5 yrs.	**(Note 1)**		ambient	counter pressure flare system	Nitrogen with traces of Hydrocarbons (Propylene), MAPD, Acetylene
1P39-VV-1131, Propylene Seal Gas Drum	Liquid Drain	Discontinuous	NNF	NNF		ambient	counter pressure flare system	Hydrocarbons (propylene)

		1P39-VV-1331, White Oil Preparation Vessel	Off-Gas	Discontinuous during filling of Preparation Vessel	Once / week for 1 to 3 hr	< 1		ambient	counter pressure flare system	Nitrogen with traces of White Oil
		1P39-R-1571, Hydrogen Treater (CO, CO2)	Regeneration Gas	Discontinuous during bed replacement only	Once / 5 yrs.	(**Note 1)**		ambient	counter pressure flare system	Nitrogen with traces of Hydrogen, CO, CO2
		1P39-R-1572A/B, Hydrogen Dryer (H2O)	Regeneration Gas	Discontinuous for regeneration only	Once / 19 days For 24 hrs **(Note 1)**	26 **(Note 1)**		35 - 235	counter pressure flare system	Nitrogen with traces of Hydrogen, H2O
		Nitrogen Treater O2 Removal (N2 Purification Package for TEA system	Regeneration Gas	Discontinuous during bed replacement only	Once / 3 yrs.	**(Note 1)**		ambient	counter pressure flare system	Nitrogen
		Nitrogen H2O Dryer (N2 Purification Package for TEA system	Regeneration Gas	Discontinuous for regeneration only	Once / 7 days For 30 hrs **(Note 1)**	113 **(Note 1)**		35 - 288	counter pressure flare system	Nitrogen
		1P39-BL-1681, Regeneration Recycle N2 Blower	Nitrogen	Discontinuous for regeneration only	NNF	NNF		120	counter pressure flare system	Nitrogen
		1P39-VV-1733, Waste White Oil Tank	Off-Gas	Discontinuous during filling of tank	Once / year up to few minutes	< 1		ambient.	counter-pressure flare system	Nitrogen with traces of White Oil, Isopropanol.

		1P39-VV-1931, Silane Holding Tank	Off-gas	Discontinuous during filling of holding tank	5 times / year- for 30 min	1.5		ambient.	counter pressure flare system	Nitrogen with traces of Silane
		1P39-RB-3121, Reactor via S/D cyclone 1P39-CY-3173	Vent gas	Discontinuous	emergency shutdown		50,000 for 25 min. (Peak for 5 min.)	80	counter pressure flare system	Propylene, Propane, Hydrogen
		1P39-VV-3134, Powder K. O. Drum	Vent gas	Discontinuous	**(Note 2)**		75 **(Note 2)**	20 - 60	counter pressure flare system	Hydrocarbons, Nitrogen, traces of PP fines
		1P39-VV-3131, RG Compressor Suction Drum	Liquid Drain	discontinuous	NNF		NNF Before start-up	70	counter pressure flare system	Propylene, Propane, Hydrogen
		1P39-VV-3433A/B, Purge Silos	Purge Gas	Discontinuous (In case of 1P39-Z-6581 shutdown)	Continuously during membrane unit shutdown		1339	73	counter-pressure flare system	Nitrogen, Propylene, Propane, Hydrogen, Ethane
		1P39-VV-3432, Powder Drop out pot	Vent gas	Discontinuous	Once / month for 30 min **(Note 3)**		<5 **(Note3)**	50	counter pressure flare system	Hydrocarbons, Nitrogen, traces of PP fines
		1P39-Z-6081, Carrier Gas Compressor suction	Carrier Gas	Discontinuous (In case of 1P39-Z-6081 shutdown)	Continuously during CG compressor emergency shutdown		11,251	121	counter pressure flare system	Propylene, Ethane, Propane, Nitrogen, Hydrogen
		1P39-EE-6057, Carrier Gas Cooler	Carrier Gas	Discontinuous	NNF		NNF	70	counter pressure flare system	Propylene, Ethane, Propane, Nitrogen, Hydrogen

1P39-Z-6581, Purge Gas Recovery (Membrane Unit)	Off-gas	Continuous	8000 h / year		128	20	counter pressure flare system	Nitrogen, with traces of methane, ethane,Propylene, Propane
1P39-Z-6681, Extruder Vacuum Unit	Off-gas	Continuous	8000 h / year		20 - 66	50	counter pressure flare system	Nitrogen, Methane, Water, Hydrocarbons, Organics (acetone, tert. butanol)
1P39-VV-9331 Flare K.O. Drum	Vent Gas	discontinuous		<1		60	counter pressure flare system	Hydrocarbon, N2, PP fines (Traces)

Notes:

(1) Dependent on dryer & treater requirements for regeneration.

(2) Dependent on filter maintenance (e.g., twice per year) & powder sampling frequency (e.g., once per hour)

(3) Used for special PP grades only; depends on BOPP production

(*) The values and data in this table are estimates only, actual values and data may differ, depending on the equipment used and the operation methods

Vent Streams to Atmosphere at safe location

Source of Emission	**Name**	**Mode of Operation**	**Frequency / Time**	**Flow Rate approx. [Nm^3 / h]**	**Composition**	**Concentration**
1P39-R-1173A/B, Propylene Treater (CO)	Off-gas	Discontinuous for catalyst oxidation only	Once / 3 years For 24 hrs **(Note 1)**	1475 **(Note 1)**	Nitrogen	
TEAL Container unloading (Via TEA Vent Pot 1P39-VV-1731)	Off-gas	discontinuous during filling of holding tank	24 times per year (max.) for 30 min.	10	Nitrogen with traces of White oil	Max. 50 mg/Nm^3

1P39-VV-2131, Peroxide Holding Tank	Off-gas	continuous	8000 h / year	0.5	Nitrogen with traces of Peroxide	max 120 mg/Nm^3
1P39-VV-2231, Additive Feed Hopper Vent Pot	Vent	Continuous	8000 h / year	< 1	Nitrogen with Traces of White Oil	max. 10 mg/Nm^3
1P39-ZFA-2292, Additive Vent Fan	Vent	Discontinuous during filling of Solid Additives	5 times / day for 1 bags of 500 kg	500 (By vendor)	Air with Stabilizer Powder	max. 10 mg/Nm^3
1P39-ZWF-2291, GMS Additive loss in weight feeder	Vent	Continuous	8000 h / year	< 1	Nitrogen Stabilizer Powder (Traces)	max. 10 mg/Nm^3
1P39-ZWF-2290A/B, Talcum / Silica Additive loss in weight feeder	Vent	Continuous	8000 h / year	< 1	Nitrogen Stabilizer Powder (Traces)	max. 10 mg/Nm^3
1P39-ZWF-22890A/B, Additive loss in weight feeder	Vent	Continuous	8000 h / year	< 1	Nitrogen Stabilizer Powder (Traces)	max. 10 mg/Nm^3
1P39-VV-3033, Catalyst Vent Pot	Vent	Discontinuous	1 time /day for 30 min	10	Nitrogen with Traces of White Oil	max. 10 mg/Nm^3
1P39-ZGN-3684, Extruder Feed Vent Filter	Vent	Continuous	8000 h / year	67	Nitrogen with propylene Polypropylene dust / Stabilizer powder	max. 100 mg/Nm^3 HC max. 10 mg/Nm^3 particles
1P39-ZFA-3789, Drying Air Exhaust Fan	Off-gas	Continuous	8000 h / year	18700 (By Extrusion package vendor)	Air with moisture and traces of Hydrocarbons	max. 50 mg / Nm^3 H2O max. 10 mg / Nm^3 HC

1P39-Z-6681, Extruder Vacuum Unit	Off-gas	discontinuous (in case of Oxygen detection in off-gas line to flare)	NNF. for approx. 2 hr until the oxygen level is reduced	20 – 66 kg/h	Nitrogen with moisture and organics	4 mol% H2O 15 mol% organics
1P39-ZGN-7185A/B, Silo Exhaust Filter	Vent	Continuous	8,000 h / year	12400 (By Conveying Package vendor)	Air with polypropylene dust	max. 150 mg/Nm^3 HC max. 17 mg/Nm^3 particles
1P39-ZCY-7583, Elutriator Cyclone	Vent	Continuous	8,000 h / year	7100 (By Conveying Package vendor)	Air with polypropylene dust	max. 150 mg/Nm^3 HC max. 17 mg/Nm^3 particles

Notes:

(1) Dependent on dryer & treater requirements for regeneration.

(*) The values and data in this table are estimates only, actual values and data may differ, depending on the equipment used and the operation methods.

Most of the continuous streams to vent are actually purge gases comprising of Nitrogen with traces of hydrocarbon having minimal flowrate.

Flare Stack is not a part of PP unit scope of work. This is considered under NREP only.

2. Proposed Effluents details:

Only effluent generation of 50.23 m3/hr and sewage of 0.212 m3/hr will be generated due to this proposed project and treated in the existing NREP ETP.

Description	Proposed(m^3/hr)	Disposal Method & Facility Details (m^3/hr)
Effluent generation		
Cooling tower blowdown	50	Cooling tower blowdown from PP unit will be diverted to RO plant (Design: 600 m3/hr) under existing NREP ETP Package.
Process effluent	0.23	PP process effluent to be treated in existing NREP ETP (Design: 450 m3/hr and cnormal flow is 360 m3/hr

Sub-Total	**50.23**	
Sewage	0.212	Diverted to existing NREP ETP for treatment
Total waste water generation	**50.442**	

The sewage generated will be routed to the existing NREP ETP for further treatment.. The processeffluent from PP unit will be routed to NREP ETP for treatment.The treated effluent from NREP ETP is planned to be reused in cooling tower, fire water and Horticulture (greenbelt).

Details of Liquid Effluent from the proposed project

Source of Emission	Name	Mode of Operation	Frequency	Quantity	Composition	Treatment (OSBL)
1P39-VV1632, Nitrogen Regeneration Recycle K.O. Vessel	Waste Water	discontinuous	1 time per year	Approx. 0.6 m^3 **(Note 1)**	Condensed moisture during regeneration	Sewer
1P39-Z-3681, Extruder Pelletizer	Waste Water	Discontinuous	during start-up during emptying	max. 1 m^3 / Start-up max. 40 m^3 for 1 min. (by Extrusion package vendor)	Clean water with polypropylene pellets and powder (fines)	Separation of solids in waste water basin (designed with separator)
1P39-ZVV-3783, Pellet Water Tank	Wastewater	Discontinuous	during start-up during emptying of tank (maintenance)	max. 1 m^3 / Start-up max. 25 m^3 during emptying of tank (by Extrusion package vendor)	Demin. Water with PP Solids	Separation of Solids

1P39-VV-6631, Phase Separator	Wastewater	Continuous	8,000 h / year	max 0.23 m^3/h	Water; pH = 6-9 Typical average values COD (chemical oxygen demand) < 500 mg/l BOD (5 day) < 350 m TOC < 600 mg/l Typical organic contamina - Acetone (~10%) - Isopropanol (~20%) - Terbutanol (~70%)	Separation of insoluble Organic Compounds
Waste Water Collection Pit	Waste Water / Rain Water	discontinuous / continuous			Water; pH = 6-9	Separation of insoluble Organic Compounds

3. Proposed Hazardous waste

The process effluent generation from PPU unit is very negligible and the same will not have any impact on NREP ETP effluent and subsequent sludge generation. However, note that estimated sludge generation from NREP ETP will be 30 m3/hr-oily and (chemical)and 20 m3/hr (bio sludge).

Other Hazardous waste generated

Source	Name	Mode of Operation	Frequency	Quantity approx.	Composition	Treatment (OSBL)
1P39-R-1171, Propylene Treater (Arsine, Phosphine, COS)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	18,600 kgs (2,120 kg) **(Note 1)**	Clariant Actisorb®401 or equal **(Note 1)**	Secured Landfill/Disposal to recyclers

		1P39-R-1172A/B Propylene Treater (H2O, Oxygenates, MeOH)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	2 x 31,752 kgs (2 x 6,000 kgs) **(Note 1)**	Porocel Dynocel650 or equal **(Note 1)**	Secured Landfill/Disposal to recyclers
		1P39-R-1173A/B Propylene Treater (CO)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	2 x 5,040 kgs (2 x 1,420 kgs) **(Note 1)**	Clariant Actisorb®310 or equal **(Note 1)**	Secured Landfill/Disposal to recyclers
		1P39-R-1174 Propylene Treater (MAPD, Acetylene)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	3,312 kgs (1,060 kgs) **(Note 1)**	Clariant Polymax®303 or equal **(Note 1)**	Secured Landfill/Disposal to recyclers
		1P39-R-1571 Hydrogen Treater (CO, CO2)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	80 kgs (18 kgs) **(Note 1)**	Clariant Meth®150 or equal **(Note 1)**	Secured Landfill/Disposal to recyclers
		1P39-R-1572A/B Hydrogen Treater (H2O)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	2 x 120 kgs (2 x 26 kgs) **(Note 1)**	BASF – 4A Mol. Sieve or equal **(Note 1)**	Secured Landfill/Disposal to recyclers

		1P39-Z-1683 Nitrogen Treater (O2 Removal)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	630 kgs (76 kgs) **(Note 1)**	Clariant Polymax®301 or equal **(Note 1)**	Secured Landfill/Disposal to recyclers
		1P39-Z-1683 Nitrogen Treater (H2O Removal)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	2 x 500 kgs (2 x 200 kgs) **(Note 1)**	Porocel Dynocel 641S or equal **(Note 1)**	Secured Landfill/Disposal to recyclers
		1P39-Z-6581 Purge Gas Dryer (H2O Removal)	Spent Adsorbents	Replacement	by Membrane unit vendor	by Membrane unit vendor	Drying agent (molecular sieve)	Secured Landfill/Disposal to recyclers
		1P39-MGN-1175A/B Propylene Filter	Spent Filter Cartridge	Replacement of Filter Elements	once / 2 years	5 kg (each Filter)	Filter Elements (PP) & treater filling particles	Secured Landfill/Disposal to recyclers
		1P39-MGN-1371A/B White Oil Filter	Spent Filter Cartridge	Replacement of Filter Elements	once / 2 years	2 kg (each Filter)	Filter Elements (PP)	Secured Landfill/Disposal to recyclers
		1P39-MGN-1575A/B, Hydrogen Filter	Spent Filter Cartridge	Replacement of Filter Elements	once / 2 years	2 kg (each Filter)	Filter Elements (PP) & treater filling particles	Secured Landfill/Disposal to recyclers
		1P39-MGN-1671A/B, LP Nitrogen Filter	Spent Filter Cartridge	Replacement of Filter Elements	once / 2 years	5 kg (each Filter)	Filter Elements (PP)	Secured Landfill/Disposal to recyclers

		1P39-MGN-1672A/B, Regeneration Recycle N2 Filter	Spent Filter Cartridge	Replacement of Filter Elements	once / 2 years	5 kg (each Filter)	Filter Elements (PP) & treater filling particles	Secured Landfill/Disposal to recyclers
		1P39-MGN-1971A/B, Silane Filter	Spent Filter Cartridge	Replacement of Filter Elements	once / 2 years	2 kg (each Filter)	Filter Elements (PP)	Secured Landfill/Disposal to recyclers
		1P39-ZGN-2282, Additive Vent Filter	Spent Filter Bags	Replacement of Filter Elements	once / 2 years	5 kg (each Filter)	Filter Elements (PP)	Secured Landfill/Disposal to recyclers
		1P39-MGN-3175A/B, RG Filter	Spent Filter Bags	Replacement of Filter Elements	≤ 2 times/year	10 kg (each Filter) 2335 kg (by vendor)	Filter Elements (PP) & PP Solids	Secured Landfill/Disposal to recyclers
		1P 9-VV-3132, Powder Collector (via 1P39-CY-3173)	PP Powder	Upset Conditions	≤ 6 times/year	45 kg	PP Solids	Secured Landfill/Disposal to recyclers
		1P39-VV-3 34, Powder K.O. Drum	PP Powder	Upset Conditions	once / year	60 kg	PP Solids	Secured Landfill/Disposal to recyclers

1P39-VV-3432, Drop Out Pot (for special products only)	PP Powder	Special operation	once / month	50 kg	PP Solids	Secured Landfill/Disposal to recyclers
1P39-MGN-3471, Carrier Gas Filter	Spent Filter Bags	Replacement of Filter Elements	once / year	150 kg each	PP Filter Bags & PP Solids	Secured Landfill/Disposal to recyclers
1P39-MGN-3472A/B, Purge Silo Filter	Spent Filter Bags	Replacement of Filter Elements	once / year	60 kg each	PP Filter Bags & PP Solids	Secured Landfill/Disposal to recyclers
1P39-ZEX-3682, Extruder / Pelletizer	Start-up Material	Discontinuous	Cold Start-up Warm Start-up	2,520 kg for 7 min. 1,080 kg for 3 min.	PP (Melt)	Secured Landfill/Disposal to recyclers
1P39-ZGN-3684, Extruder Feed Vent Filter	Spent Filter Bags	Replacement of Filter Elements	once / year	40 kg (by vendor)	PP Filter Bags & PP Solids	Secured Landfill/Disposal to recyclers
1P39-ZVV-3783, Pellet Water Tank	PP Dust	Discontinuous	once / month	36 kg	PP (Fines)	Secured Landfill/Disposal to recyclers **(Note 2)**
1P39-ZSR-3784, Pellet Water Start-Up Screen	PP Pellets	Discontinuous Start-Up of Extruder	-	600 kg per event	PP	Secured Landfill/Disposal to recyclers **(Note 2)**

		1P39-ZSR-3784, Pre-Separation Sieve	PP Pellets & Agglomerates	Discontinuous, Extruder start-up	once / week	11 kg each	PP (agglomerates)	Secured Landfill/Disposal to recyclers **(Note 2)**
		1P39-ZCL-3787, Pellet Classifier	PP Pellets & Agglomerates	Discontinuous, Under-/Oversized Pellets	once / week	5 kg each 37 kg each	PP Pellets undersized PP Pellets oversized	Secured Landfill/Disposal to recyclers **(Note 2)**

		Conveying Air Compress. Suction / Discharge Filter 1P39-ZGN-7086A/B 1P39-ZGN-7088A/B 1P39-ZGN-7087A/B 1P39-ZGN-7089A/B 1P39-ZGN-7094A/B 1P39-ZGN-7095A/B 1P39-ZGN-7096A/B 1P39-ZGN-7097A/B	Spent Filter Bags	Replacement of Filter Elements	every 6 months years **(Note 1)**	25 kg each **(Note 1)**	PP Filter Bags & PP Solids	Secured Landfill/Disposal to recyclers
		1P39-ZGN-7185A/B, Silo Exhaust Filter	Spent Filter Bags	Replacement of Filter Elements	every 6 months years **(Note 1)**	25 kg each **(Note 1)**	PP Filter Bags & PP Solids	Secured Landfill/Disposal to recyclers

1P39-ZGN-7584A/B, Elutriator Blower Filter	Spent Filter Bags	Replacement of Filter Elements	once / year	(Note 1)	PP Filter Bags	Secured Landfill/Disposal to recyclers
1P39-ZCY-7583, Elutriator Cyclone	PP Fines	Continuous	8,000 h / year	0.5 kg/h (by vendor)	PP (Fines)	Secured Landfill/Disposal to recyclers
Wastes from Sampling (e.g., 1P39-VV-3133 Powder Sampling Pot)	PP Powder & Pellets	Discontinuous	once / day	60 kg (Note 3)	PP (Pellets and Powder)	Secured Landfill/Disposal to recyclers **(Note 2)**
Packaging Material of Additives	Bags	Discontinuous	once / day	approx. 20 kg	Paper, PP/PE	Disposal to recyclers
Packaging Material of Bagging section	Bags	Discontinuous	once / day	approx. 20 kg	Paper, PP/PE	Disposal to recyclers
1P39-VV-1733, Waste White Oil Tank	Waste White Oil	Discontinuous emptying of tank	1 time per year	approx. 660 kg	White Oil, Isopropanol, Alcoholate	Disposal to Recycler
1P39-VV-2231, Additive Feed Hopper Vent Pot	Waste White Oil	Discontinuous	1 time per year	60 l	White Oil	Disposal to Recycler

1P39-VV-3033, Catalyst Vent Pot	Waste White Oil	Discontinuous	1 time per year	80 l	White Oil	Disposal to Recycler
1P39-VV-6631, Phase Separator	Oily Waste	Discontinuous	30 times per year	max. 80 kg	Mixed Organic Components. Heating Value approx. 41000 kJ / kg	Bioremediation/ Disposal to Recycler
Gear Boxes of Machinery	Waste Lube Oil	Discontinuous	1 time per year	approx. 5 t	Lubrication Oils (100%)	Disposal to recyclers

Notes:

(1) Dependent on requirements.

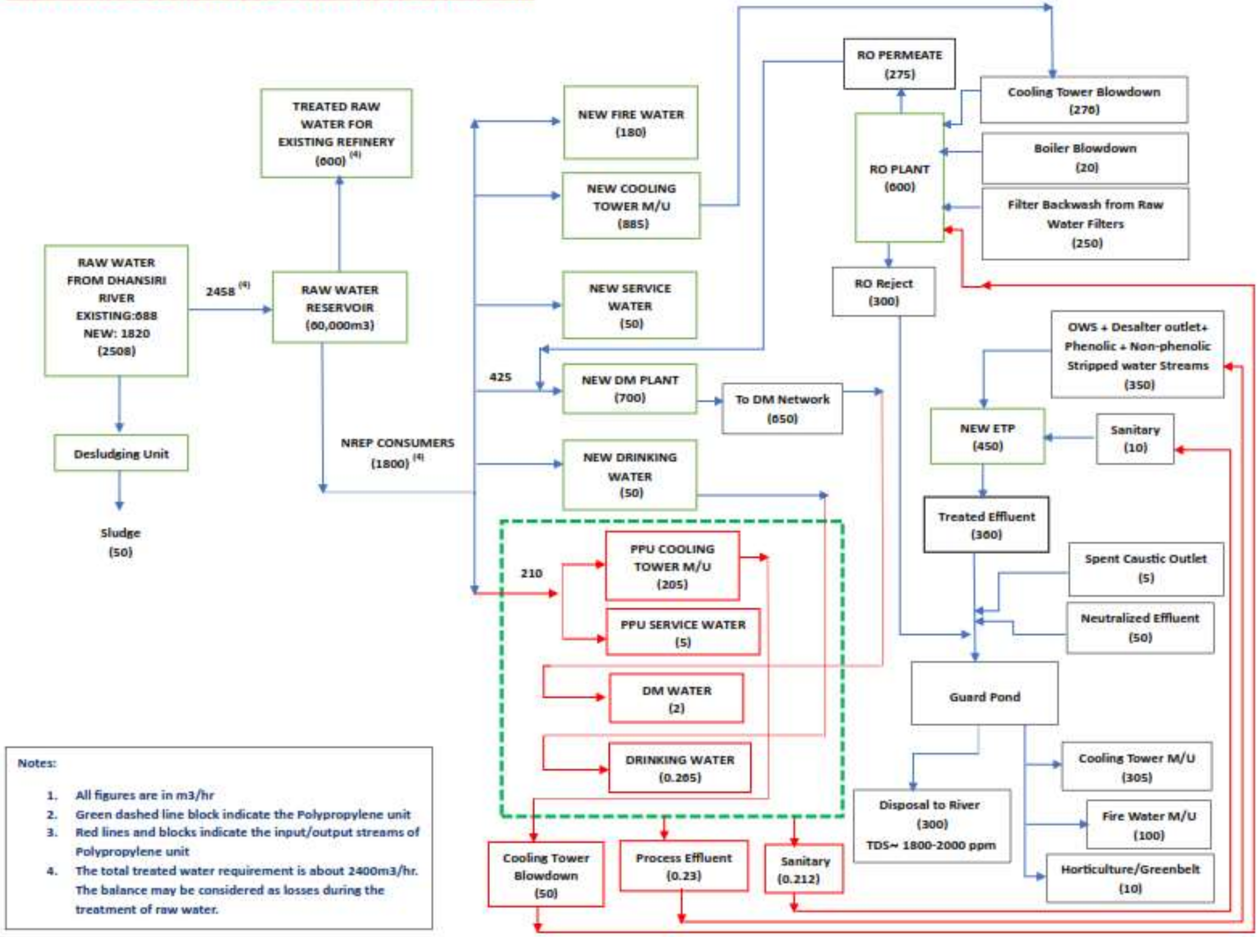
(2) PP pellets & PP blocks from extruder start-up can be sold to special converters.

(3) Dependent on Sampling frequency.

(*) The values and data in this table are estimates only; actual values and data may differ during detailed engineering, depending on the equipment used and the operation methods.

b.Water balance diagram

Water Balance of Refinery post NREP-Polypropylene unit



Notes:

1. All figures are in m3/hr
2. Green dashed line block indicate the Polypropylene unit
3. Red lines and blocks indicate the input/output streams of Polypropylene unit
4. The total treated water requirement is about 2400m3/hr. The balance may be considered as losses during the treatment of raw water.

c. Requirement of power

Description	Unit	Proposed	Source
Power requirement	MW	26	Grid
Emergency DG	KW	750	-

d. Requirement of manpower

Description		**Construction Phase**	**Operation Phase**
Proposed	**Permanent**	0	17
	Contract	1750	36
Total (A)		1750	53
Period of employment in days (B)		1080	365
Total Man-days(A*B)		1080*1750=18,90,000	19,345

vi. Process description along with major equipment's and machineries, process flow sheet (quantitative) from raw material to products to be provided

a.Process description

The Polymer Grade Propylene produced in the PRU section of the PFCC Unit of NREP is further processed in the downstream unit i.e. PP unit to produce Homo-polymer grade Polypropylene product.

Proposed Facility

S.No.	Name of the Unit	Unit Configuration
1	Poly propylene unit	360 KTPA

Technology & Process Description

Base Case: Base case corresponds to 6 MMTPA Refinery with PFCCU operating in low severity mode and propylene produced from PRU is absorbed in the LPG product streamand no propylene sale is envisaged. No Polypropylene unit.

Max Propylene + PP Case: Expansion case corresponds to 6 MMTPA Refinery withPFCCU operating in propylene maximization mode or high severity mode and with Polypropylene (PP) unit in operation. PP Unit taking feed propylene from upstream PFCC unit and producing poly propylene which will be sold as final product.
Under NREP a high severity PFCC unit with a capacity of 1.955MMTPA is being implemented. The LPG that will

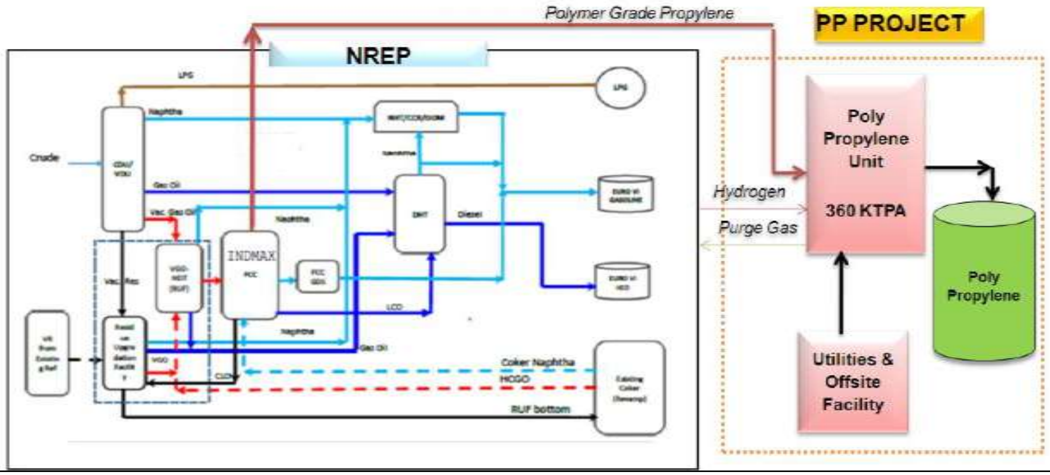
be generated in the high severity mode will contain a significant potential of propylene which can be recovered for value addition. The Polymer Grade Propylene produced in the PRU section of the PFCC Unit is further processed in the downstream unit i.e. PP unit to produce Homo-polymer grade Polypropylene product

b.List of major equipment:

Sl. no.	Description
Treaters	
1	Propylene Treater
2	Propylene Treater
3	Hydrogen Treater
4	Hydrogen Dryer
5	Propylene Treater
Vessels,Tanks,Drums	
1	HP Nitrogen Buffer Vessel
2	Regeneration Recycle N2 KO Drum
3	Tea Holding Tank
4	Tea Vent Pot
5	Waste White Oil Tank
6	Silane Holding Tank
7	Additive Feed Hopper Vent Pot
8	Catalyst Preparation Vessel
9	Catalyst Metering Vessel
10	Catalyst Vent Pot
11	RG Compressor Suction Drum
12	Powder Collector
13	Flare K.O Drum
14	Degassing Vessel
15	Chase Gas Buffer Vessel
16	Phase Separator
17	Condensate Drum
18	Dry Flare K.O.Drum
Silo	
1	Purge Silo
2	Pellet Blending Silos
3	Bagging Silo
Cyclone	

1	RG Cyclone
2	Shutdown Cyclone
3	Carrier Gas Cyclone
Reactor	
1	Polymerisation Reactor
Exchanger	
1	Hydrogen Pre-heater
2	Hydrogen Cooler
3	Regeneration Recycle N2 Heater
4	Regeneration Recycle N2 Cooler 1
5	Regeneration Recycle N2 Cooler 2
6	RG Condenser
7	Carrier Gas Cooler
8	Extruder Off Gas Condenser
9	Vent Condenser
10	Hydrogen Preheater
11	Hydrogen Cooler
12	Regeneration Recycle N2 Heater
13	Regeneration Recycle N2 Cooler 1
14	Regeneration Recycle N2 Cooler 2
15	RG Condenser
16	Carrier Gas Cooler
17	Extruder Off Gas Condenser
Pump	
1	Tea Metering Pump
2	White Oil Drum Pump
3	Isopropanol Drum Pump
4	Silane Metering Pump
5	Silane Drum Pump
6	Peroxide Metering Pump
7	Catalyst Suspension Metering Pump
8	White Oil Drum Pump
9	Recycle Pump
10	Condensate Pump
11	Waste Water Pump
Compressor/Blower	

1	Regeneration Recycle N2 Blower
2	RG Compressor
3	Hydrogen Compressor
4	Nitrogen Compressor
5	Carrier Gas Compressor
Agitator	
1	Waste Oil Oil Tank Agitator
2	Catalyst Preparation Vessel Agitaor
3	Catalyst Metering Vessel Agitaor
4	Polymerisation Reactor Agitator
Packages	
1	Solid Additive Package
2	Bag Additive Discharge and Feeding System
3	Talcum/Silica Additive Discharge and Feeding System
4	GMS Additive Discharge & Feeding system
5	Extrusion Package/ Extruder
6	Purge gas Recovery Unit
7	Extruder Vacuum Unit
8	Pellet Pneumatic Conveying System
9	Bagging Line
10	Peroxide Dosing skid

		c.Flow diagram of PP process: 
	vii.Hazard identification and details of proposed safety systems	A detailed Hazard Identification and Risk Assessment (HIRA) study has been conducted for the facility and contours for different scenarios have been prepared using PHAST software and the analysis along with HIRA matrix is given in the report, which is attached as **Annexure 6** The scope of the study mainly involves: ➢ Identifications of Hazards ➢ Consequence modelling of: • Dispersion of Vapour cloud • Flash fire • Pool fire • Jet fire ➢ Impact limits identifications ➢ Contour mapping of the risk on the layouts. ➢ Mitigating measures for handling and storage to reduce impacts & prevent incidents. The details of the chemicals used are given below:

- Propylene
- Triethyl aluminium
- Silane
- Peroxide
- Hydrogen

. The following data were collected to envisage scenarios:

- Chemical storage conditions (Operating temperature, pressure)
- Capacity of the storage containers and process pipelines
- Atmospheric conditions viz. Temperature, Humidity and Wind direction

In addition to this, a detailed HIRA study has also been conducted and major hazards & recommendations, especially for the construction phase, are given in the report.

A detailed Disaster Management Plan has also been prepared for the following emergencies:

- Fire
- Explosion
- Toxic gas release
- Large Spills or release of toxic/corrosive/flammable chemicals
- Natural Calamities like Earthquake, Flood, cyclone etc.

The plan identifies the roles and responsibilities of key personnel along with details of procedures to be followed and communication system during emergencies.

The following pro-active steps have been taken to reduce the overall risk rating.

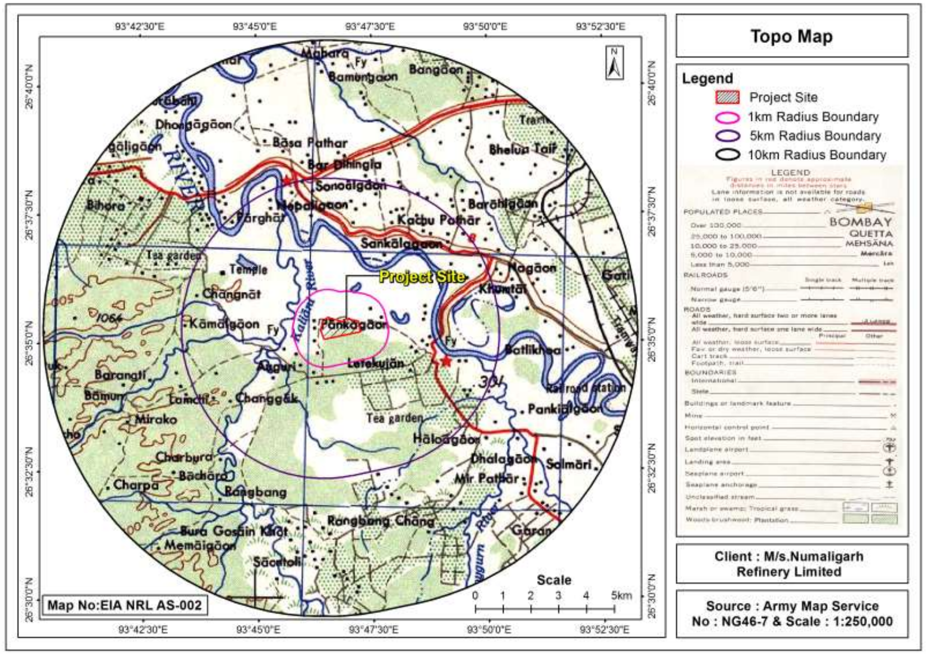
1. **Risk Assessment**: A detailed risk assessment has been conducted and the report is attached as **Annexure 6**
2. **Training**: Proper periodical trainings are given to the employees and management for various topics, as per the nature of work, in which they are involved.
1. **Record Keeping**: Proper Records will be kept, for any incidents, including near misses.
2. **Medical Checkup**: Periodical health heck up is being conducted for the employees
3. **PPEs:** Provision of proper PPEs to the employees and visitors.

The following recommendations are given in the report to improve the safety system.

		The following measures be considered for enhancing the safety standards at site: ➢ Quantitative Risk analysis needs to be carried out for the entire facility for overall risk assessment. ➢ To enable rapid detection of leak/ fire, flammable gas detector shall be located in strategic location in the PP Unit, mounded bullet, Loading gantry & Pump house. ➢ For positively pressurized building, both Hydrocarbon & Toxic detectors need to be placed at suction duct of HVAC. HVAC to be tripped automatically in event of the detection of any Hydrocarbon / toxic material by detector. ➢ Proper checking of contract people for Smoking or Inflammable materials to be ensured at entry gates to avoid presence of any unidentified source of ignition. ➢ It shall be ensured that all the vehicles entering the plant shall be provided with spark arrestors at the exhaust. ➢ Employees and Truck drivers must be well trained and must be aware of the hazards involved in the loading operation. ➢ The critical operating steps shall be displayed on the board near the location where applicable. ➢ It is suggested that any person within the affected zone of (4 kW/m2) without proper PPE should immediately leave the area and fire fighting shall be done with proper PPEs by fire and safety/authorized personnel only ➢ Installation of fire detectors in the dyke area for earliest response in the control room and field may be reviewed by M/s NRL considering status of liquid HC holdup in other tanks along with Surge Relief Tank. ➢ Automatic Shut down system shall be installed ➢ All the project premises shall be monitored by surveillance cameras. ➢ Loading operations shall be immediately suspended in the event of leak, a fire in the vicinity, lightning and thunder storm. ➢ Clearly marked escape routes shall be provided in the gantry for ease of escape. ➢ Chemicals should be stored in a well-ventilated room. ➢ Electrical fixtures in the storage areas should be vapour-proof. ➢ Manual call point, Gas detection system and smoke detection system to be provided. ➢ Smoking and carrying smoking accessories are to be strictly prohibited. ➢ Storage of propylene should be in a place where temperature does not exceed 52°C. ➢ Periodic training and refresher courses should be provided to employees addressing all the hazards prevailing in the process ➢ Training should be provided on firefighting. ➢ Work Permit System should be strictly enforced. ➢ Any incidents including near misses should be recorded and root cause analysis should be done. ➢ The hazards identified shall be communicated to the neighbouring facilities and the employees shall be well aware of the hazards related to their facilities. ➢ MSDS shall be made easily available and the safety instructions to be communicated to all employees periodically. ➢ Periodic thickness survey to be conducted for pipelines. ➢ Safety Procedures and Do’s and Don’ts should be prepared and displayed in handling and storage area. ➢ Mock Drills should be carried out regularly basis. ➢ Occupational health surveillance programmes are to be done six monthly & their documentation should be maintained

		➢ Periodic health check-up employees to be conducted and recorded. ➢ Provision and use of proper PPEs to be confirmed. Employees are being trained for First aider and made available in each shift.
	viii. Expansion/ modernization proposals (a) Copy of all Environmental Clearance(s) including amendments thereto obtaining for the project from MoEF&CC/SEIAA shall be attached as an Annexure. A certified copy of the latest monitoring report of the Regional office of the Ministry of Environment and Forests as per circular dated 30th May, 2012 on the status of compliance of conditions stipulated in all existing environmental clearances including Amendments shall be provided. In addition, status of compliance of Consent to Operate for the ongoing existing operation of the project from SPCB shall be attached with the EIA-EMP report (b) In case the existing project has not obtained environmental clearance, reasons for not taking EC under the provisions of the EIA notification 1994 and/or EIA notification 2006 shall be provided.	Not Applicable. It is new Project.

	Copies of Consent to Establish / No objection certificate and Consent to Operate (in case of units operating in prior to EIA notification 2006, CTE and CTO of FY 2005-2006) obtained from the SPCB shall be submitted. Further compliance report to the conditions of Consents from the SPCB shall be submitted.	
4	**Site Details**	
	i. Location of the project site covering village, Taluka/Tehsil, District and State, justification for selecting the site. Whether other sites were considered	The existing Numaligarh Refinery complex is located at Plot No. 93 &94, Patta No. 2, Pankagrant village,Golaghat District, Assam Pin-785699. The proposed PP unit will be set up at a Green field land at Plot No.11 located at North side of the Numaligarh Refinery. Alternate sites were not considered since the proposed projectwill be near to the existing Numaligarh Refinery in south direction to utilize the major utilities present in NREP. Adequate land is available with Numaligarh Refinery for the proposed petrochemical complex.

<table>
<tr>
<td></td>
<td>ii. A Topo sheet of the study area of radius of 10 km and site location on 1:50,000/ 1:25,000 scale on an A3/A2 sheet (including al eco-sensitive areas and environmentally sensitive places)</td>
<td>


No notified Eco-sensitive areas and environmentally sensitive places within 10km radius from the project boundary.

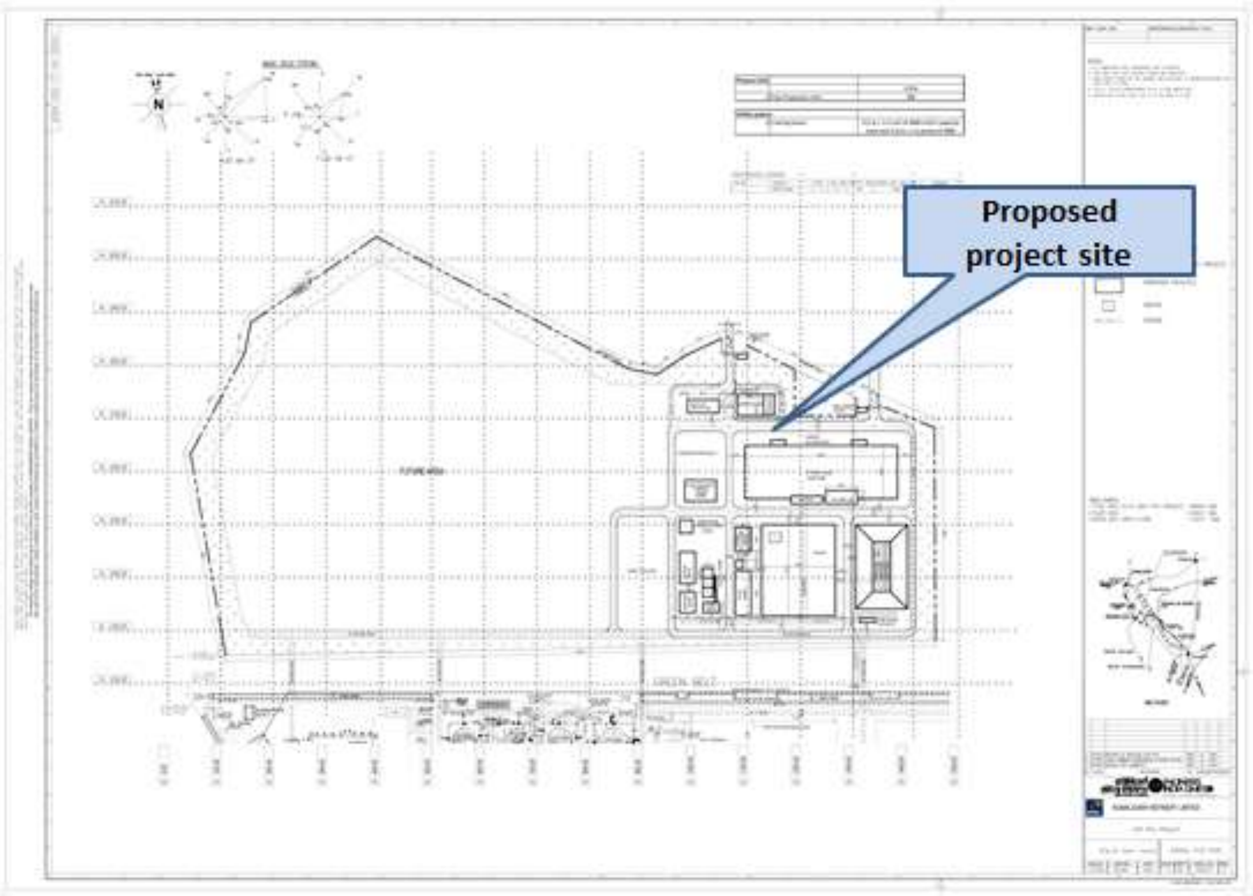
A Topo sheet of the study area of radius of 10km and site location on 1:250,000 scale on an A3 sheet (including al eco-sensitive areas and environmentally sensitive places) given in **Chapter 3, Section 3.3, Figure 3-2** of EIA Report.
</td>
</tr>
<tr>
<td></td>
<td>iii. Co-ordinates (lat-long) of all four corners of the site. Google map Earth downloaded of the project site. Layout maps including existing unit as well as proposed unit indicating storage area, plant area, greenbelt area, utilities etc. If located within an industrial area/Estate/Complex, layout of</td>
<td>
a.Co-ordinates (lat-long) of all four corners of the site
<table>
<tr><th>Ref</th><th>Latitude</th><th>Longitude</th></tr>
<tr><td>B</td><td>26°35'11.49"N</td><td>93°47'14.45"E</td></tr>
<tr><td>C</td><td>26°35'2.90"N</td><td>93°46'26.85"E</td></tr>
<tr><td>D</td><td>26°35'13.97"N</td><td>93°46'22.22"E</td></tr>
<tr><td>G</td><td>26°35'28.71"N</td><td>93°46'31.82"E</td></tr>
</table>
</td>
</tr>
</table>

<table>
<tr>
<td></td>
<td>Industrial indicating location of unit within the Industrial area/Estate</td>
<td>

b.Google map Earth downloaded of the project site

<table>
<tr><th>S.No</th><th>Latitude</th><th>Longitude</th></tr>
<tr><td>A</td><td>26°35'24.05"N</td><td>93°47'11.56"E</td></tr>
<tr><td>B</td><td>26°35'11.49"N</td><td>93°47'14.45"E</td></tr>
<tr><td>C</td><td>26°35'2.90"N</td><td>93°46'26.85"E</td></tr>
<tr><td>D</td><td>26°35'13.97"N</td><td>93°46'22.22"E</td></tr>
<tr><td>E</td><td>26°35'20.58"N</td><td>93°46'24.49"E</td></tr>
<tr><td>F</td><td>26°35'22.63"N</td><td>93°46'24.55"E</td></tr>
<tr><td>G</td><td>26°35'28.71"N</td><td>93°46'31.82"E</td></tr>
<tr><td>H</td><td>26°35'23.53"N</td><td>93°46'51.98"E</td></tr>
<tr><td>I</td><td>26°35'26.59"N</td><td>93°46'56.01"E</td></tr>
</table>

</td>
</tr>
</table>

		c. Site Layout
		 The layout indicating storage area, plant area, greenbelt area, utilities etc is appended in **Chapter 2, Section 2.8, Figure 2-12** of EIA Report and also in **Annexure 5.**

		The project site is situated outside industrial area/Estate/Complex
	iv. Photographs of the proposed and existing (if applicable) plant site, existing, show photographs of plantations/greenbelt, in particular.	**Photographs of the Proposed Project Site:**  

v. Land use break-up of total land of the project site (indicate and acquired), government/ private- agriculture, forest, wasteland, water bodies, settlements, etc shall be included (not required for industrial area)

The total Plot no. 11 area is 600 Bigha (8,02,681.92 sq.m) (80.27 Ha). Out of which Total plot area required for the PP Unit and its associated facility is 348093 SQM (34.8 Ha). The plant area is 232821 sq.m (23.28Ha) and Greenbelt area is 115272 sq.m (11.52 Ha) i.e, (33.1 % of total area) at Plot No.11 located at North side of the Numaligarh Refinery. The remaining 454588.92 sq.m (45.45 Ha) will be utilized for future project activities.

S. No	Description	Proposed Area in Ha	Proposed Area in m^2	%
1	Plant area (Process units + Utility + Offsite + Building + Road)	23.28	232821	66.9
2	Green Belt Area	11.52	115272	33.1
Total		**34.8**	**348093**	**100**

vi. A list of major industries with name and type within the study area (10 km radius) shallbe incorporated.

List of major industries within 10km radius

Industries	Dist(km)	Direc
Numaligarh Refinery	Adjacent to Site	S
Lattakoojan Tea Estate	2.13	ESE
Tanay Tea Factory	3.66	S
NR Tea Factory	3.97	S
Numaligarh Tea Factory	5.97	NW
Sirajuli Tea Factory	6.54	SE
Badulipar Ltd Khumtai Tea Estate Factory	6.87	ENE
Radhabari Tea Estate	8.58	N
Bukhial Tea Estate	8.65	S
Borchapori Tea Factory	9.77	WNW

vii. Details of drainage of the project upto 5km radius of the study area. If the site is within

Details of major river, peak and lean season river present within 1Km radius of the study area

<table>
<tr><td></td><td>1Km radius of any major river, peak and lean season river discharge as well as flood occurrence frequency based on peak rainfall data of the past 30 years. Details of Flood Level of the project site and maximum of Flood of the river shall also be provided (mega green field projects)</td><td>
<table>
<tr><th>Sl. No</th><th>Description</th><th>Distance (~Km)</th><th>Direction</th></tr>
<tr><td>1</td><td>Dhansiri River</td><td>0.80</td><td>N</td></tr>
<tr><td>2</td><td>Kaliani River</td><td>1.36</td><td>WNW</td></tr>
<tr><td>3</td><td>Doygurn River</td><td>4.61</td><td>ESE</td></tr>
<tr><td>4</td><td>Deuri Nadi</td><td>6.54</td><td>SSW</td></tr>
<tr><td>5</td><td>Disai Nadi</td><td>9.41</td><td>N</td></tr>
<tr><td>6</td><td>Dhala Jan</td><td>11.55</td><td>SSE</td></tr>
<tr><td>7</td><td>Brahmaputra River</td><td>12.62</td><td>NNW</td></tr>
<tr><td>8</td><td>Pora Jan</td><td>14.50</td><td>SSW</td></tr>
</table>
</td></tr>
<tr><td></td><td>viii. Status of acquisition of land. If acquisition is not complete, stage of the acquisition process and expected time of complete procession of the land.</td><td>For NREP, a total of 11 plots were identified requiring NDZ clearance, out of which Forest Department, Govt. of Assam had recommended 9 plots including Plot no.11 (Rajabari TE). However, out of the 9 plots, 8 plots of Land were shortlisted by NRL for NREP related activities.
Now, the proposed PP unit will be installed in Plot no.11 which comes under NDZ zone and the site has been under the 9 recommended plots by Forest Dept. of Assam and has been recommended for Project activities
Land Documents are enclosed as Annexure 1.</td></tr>
<tr><td></td><td>ix. R&R details in respect of land in line with state Government policy</td><td>Not applicable.
The project site is located in existing Numaligarh Refinery land area.</td></tr>
<tr><td>5</td><td colspan="2">Forest and wildlife related issues (if applicable):</td></tr>
<tr><td></td><td>i. Permission and approvals for the use of forest land (forestry clearance), if any, and recommendations of the State Forest Department (if applicable)</td><td>Not Applicable, since no forest land involved.</td></tr>
<tr><td></td><td>ii. Land use map based on High resolution satellite imagery (GPS) of the proposed site delineating the forest land (in case of projects involving forest land more than 40 Ha)</td><td>Not Applicable, since no forest land involved.</td></tr>
<tr><td></td><td>iii. Status of application submitted for obtaining the stage I Forestry Clearance along with latest</td><td>Not Applicable, since no forest land involved.</td></tr>
</table>

<table>
<tr><td></td><td>status shall be submitted</td><td></td></tr>
<tr><td></td><td>iv. The projects to be located within 10 Km of the National parks, Sanctuaries, Biosphere Reserves, Migratory Corridors of Wild Animals, the project proponent shall submit the map duly authenticated by Chief Wildlife Warden showing these features vis-à-vis the project location and the recommendations or comments of the Chief Wildlife Warden-thereon.</td><td>Not Applicable since no National parks, Sanctuaries, Biosphere Reserves, Migratory Corridors of Wild Animals in 10km radius from the project boundary.</td></tr>
<tr><td></td><td>v. Wildlife Conservation Plan duly authenticated by the Chief Wildlife Warden of the State Government for conservation of schedule I fauna, if any exists in the study area.</td><td>There are Schedule-I- Species in study area i.e.,
Mammal: Slow Loris (<i>Nycticebus bengalensis)</i>, Leopard (<i>Panthera pardus)</i>, Asiatic Elepha nt (<i>Elephas maximus)</i>
Details of utilization of funds (amount is in lakhs)
<table>
<tr><th>Sr. No.</th><th>Component</th><th>Provision in Lakhs</th></tr>
<tr><td>1.</td><td>Habitat improvement & mitigate (Food, water, shelter, movement, etc) and measure to reduce minimize the human –animal conflicts.
a. Maintenance of water ponds/water holes at the periphery of project area
b. Plantation at the periphery of project area</td><td>4,60,000</td></tr>
<tr><td>2.</td><td>Awareness & Extension (Forest staff will also be invited for various activities to ensure participation)</td><td>52,000</td></tr>
<tr><td>3.</td><td>Support to forest department for monitoring, rescue & Rehabitation of wildlife (veterinary care animal health, rescue, tools and equipment's, etc.)
a. Purchasing of rescue equipment's for rescue of strayed and injured wild animals and their Trans location.</td><td>52,000</td></tr>
<tr><td>4.</td><td>Contribution towards conservation of wildlife in PCCF (to be deposited in GPCCF)</td><td>52,000</td></tr>
<tr><td>5.</td><td>Administrative cost for processing inspection etc. (to be deposited in GPCCF)</td><td>52,000</td></tr>
<tr><td>6.</td><td>Miscellaneous including Eco-development
a. Plantation around the water body</td><td>1,52,000</td></tr>
</table>
</td></tr>
</table>

		Total **8,20,000**
	vi. Copy of application submitted for clearance under the Wildlife (Protection) Act, 1972 to the Standing Committee of the National Board for Wildlife.	No notified Sanctuaries/ National Parks/ Eco-sensitive zones within the 15km radius from the project boundary. Not Applicable
6	**Environmental Status**	
	i. Determination of atmospheric inversion level at the project site and site-specific micrometeorological data using temperature, relative humidity, hourly wind speed and direction and rainfall	The daily inversion level at the project site varies from 50 to 2162 m during 6 AM to 3 PM, the maximum recorded at 3 PM, February 2023. Further details are given in **Chapter 3, Section 3.5**of EIA report.

Meteorological Data for the Study Period (December 2022 to February 2023)		
S. No	**Parameter**	**Observation**
1.	Temperature	Max Temperature : 29^{0}C Min Temperature : 8^{0}C Avg Temperature : 20.95^{0}C
2.	Average Relative Humidity	74.24%
3.	Average Wind Speed	1.27 m/s
4.	Predominant Wind Direction during study period	East

	ii. AAQ data (except monsoon) at 8 locations for PM_{10}, $PM_{2.5}$, SO_2, NO_X, CO and other parameters relevant to the project shall be collected. The monitoring stations shall be based on CPCB guidelines and take into account the pre-dominant wind direction, population zone, sensitive receptors including reserved forests.	AAQ data (except monsoon) at 8 locations for PM_{10}, $PM_{2.5}$, SO_2, NO_X, CO and other parameters relevant to the project are collected. The monitoring stations are identified based on CPCB guidelines and the pre-dominant wind direction, population zone, sensitive receptors including reserved forests are considered for monitoring.The baseline air quality of the study area, Eight (08) monitoring locations have been identified as per Indian Meteorological data. Baseline monitoring was conducted during study period **December 2022 to February 2023.** The Average baseline concentration (minimum and maximum) baseline levels of PM10 (48.65 µg/m^3 to 86.25 µg/m^3), PM2.5 (22.09 µg/m^3 to 49.47 µg/m^3), SO2 (8.25 µg/m^3 to 23.03 µg/m^3), NO_2 (15.96 & 33.95µg/m^3). However, the average baseline levels of PM10 (58.34 to 72.58µg/m^3), PM2.5 (26.49 to 41.63µg/m^3), SO2 (9.90 to 19.38µg/m^3), NO2(19.14 to 28.57µg/m^3). AAQ locations detail is provided in the **Chapter 3, Section 3.6.1** and monitoring results are provided in the **Section 3.6.2**of EIA report.
	iii. Raw data of all AAQ measurement for 12 weeks of all stations as per frequency given in the NAAQM notification of Nov. 2009 along	Raw data of all AAQ measurement for 12 weeks of all stations as per frequency given in the NAAQM notification of Nov. 2009 along with- min-max, average and 98% values for each of the AAQ parameters from data of all AAQ stations are provided as **Annexure 7.**

with- min-max, average and 98% values for each of the AAQ parameters from data of all AAQ stations should be provided as an annexure to the EIA report

iv. Surface water quality of nearby River (100m upstream and downstream of discharge point) and other surface drains at eight locations as per CPCB/ MoEF&CC guidelines.

Surface water sampling locations

S. No	Water bodies	Location code	Distance from project boundary (~Km)	Direction from project boundary
1	Dhansiri River d/s	SW1	3.19	N
2	Disai Nadi	SW2	9.48	N
3	Sarkari Pond	SW3	5.92	E
4	Dhansiri River u/s	SW4	3.62	ESE
5	Doygurn River	SW5	5.75	ESE
6	Deuri Nadi	SW6	8.61	SW
7	Kaliani River u/s	SW7	3.16	WSW
8	Kaliani River d/s	SW8	1.77	NW

Surface water quality results of nearby River

Surface water samples were collected from the 8 location based on the availability of the water in water bodies. The results of surface water analysis were compared with the IS2296:1992. Based on the values, the best use of the water can be determined.

Parameter	Surface water sample	Standard Limit				
		Class A	Class B	Class C	Class D	Class E
pH	6.89 – 7.68	8.5	8.5	8.5	8.5	8.5
Total Dissolved Solids (TDS)	151 - 205	500	-	1500	-	2100
Hardness	77 - 126	300	-	-	-	-
BOD	BLQ (LOQ 1.0) - 3.0	2	3	3	-	-

<table>
<tr><td></td><td></td><td>
<table>
<tr><td>COD</td><td>8.0 - 24.0</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
</table>
<p>Class A- Drinking water without conventional treatment but after disinfection.
Class B-Water for outdoor bathing.
Class C- Drinking water with conventional treatment followed by disinfection.
Class D-Water for fish culture and wild life propagation.
Class E-Water for irrigation, industrial cooling and controlled waste disposal</p>
<p>Surface water quality of nearby River and other surface drains at eight locations as per CPCB/ MoEF&CC guidelines are collected & analyzed and the details are provided in the Chapter 3, Section 3.8 ofEIA report.</p>
</td></tr>
<tr><td></td><td>v. Whether the site falls near to polluted stretch of river identified by the CPCB/MoEF& CC, if yes give details</td><td>No Polluted stretch of river identified as per CPCB within 10km radius from the project site.</td></tr>
<tr><td></td><td>vi. Ground water monitoring at minimum 8 locations shall be included</td><td>
<p>Ground water monitoring results at 8 locations
8 samples were collected from different sources within the study area and some important parameters analysis carried out for depicting the baseline status of the study area are shown below.</p>
<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Range of Results</th><th colspan="2">Standard Limit</th></tr>
<tr><th>Acceptable Limit</th><th>Permissible Limit</th></tr>
<tr><td>pH</td><td>6.88 - 7.87</td><td>6.5-8.5</td><td>No Relaxation</td></tr>
<tr><td>Total Dissolved Solids (TDS)</td><td>166 - 220</td><td>500mg/l</td><td>2000 mg/l</td></tr>
<tr><td>Fluoride</td><td>0.21 - 0.28</td><td>1mg/l</td><td>1.5 mg/l</td></tr>
<tr><td>Hardness</td><td>81 - 105</td><td>200mg/l</td><td>600 mg/l</td></tr>
</table>
<p>Ground water monitoring at minimum 8 locations are collected & analyzed. Futher detailed Ground water monitoring results are provided in Chapter 3, Section 3.8 of EIA report.</p>
</td></tr>
<tr><td></td><td>vii. Noise levels monitoring at 8 locations within the study area.</td><td>
<p>Noise levels monitoring results at 8 locations within the study area
Noise level monitoring at all the proposed well locations in and around 10 km radius from the block boundary shows that at most of the locations the noise levels are well within the permissible limit as prescribed by CPCB.</p>
<table>
<tr><th rowspan="2">Site</th><th colspan="2">Day Time (dB(A))</th><th colspan="2">Night Time (dB(A))</th></tr>
<tr><th>Results</th><th>Standards</th><th>Results</th><th>Standards</th></tr>
<tr><td>Industrial areas (Project site)</td><td>52.2</td><td>75</td><td>45.2</td><td>70</td></tr>
<tr><td>Residential area</td><td>47.9 - 53.9</td><td>55</td><td>40.2 - 42.2</td><td>45</td></tr>
</table>
<p>Noise levels monitoring at 8 locations within the study area are collected &analysed. Further detailed Noise level monitoring results were provided in the Chapter 3, Section 3.9of EIA report.</p>
</td></tr>
<tr><td></td><td>viii. Soil characteristics as per</td><td>Soil characteristics as per CPCB guidelines</td></tr>
</table>

CPCB guidelines

- The pH of the soil samples ranged from 4.25 to 4.48
- Conductivity of the soil samples ranged from 542.0 to 873.0µmhos/cm.
- Nitrogen content in the collected soil samples ranged from 213.7 mg/kg to 252.4 mg/kg.
- Phosphorous content ranged from 8.9mg/kg to 10.5 mg/kg.
- Potassium content ranges from 106.9 mg/kg to 126.2 mg/kg.

Further detailed Soil characteristics are analysed as per CPCB guidelines are provided in **Chapter 3, Section 3.7** of EIA report.

ix. Traffic study of the area, type of vehicles, frequency of vehicles for transportation of materials, additional traffic due to proposed project, parking arrangement etc.

Existing & Proposed Vehicular movement per peak hour-NRL Assam SH 129-Dimapur-Numaligarh Highway

S. No	Type of Vehicle	Existing vehicles	Existing PCU	Proposed vehicles	Proposed PCU	Total vehicles after project implementation	PCU Factors IRC (SP 41)	Total PCU after project implementation
1	Motor Cycles or Scooters etc.	511	383	0	0	511	0.75	383
2	Three Wheelers/ Auto Rickshaw	24	29	0	0	24	1.2	29
3	Four Wheelers/ Cars	424	424	0	0	424	1.0	424
4	Truck/Bus	170	629	70	259	240	3.7	888
5	Agricultural Tractor	26	104	0	0	26	4.0	104
6	Light Commercial Vehicle	51	102	0	0	51	1.4	71
	Total	**1206**	**1671**	**70**	**259**	**1276**	**--**	**1899**

Traffic Volume after Implementation of the Project

For the Road	Volume of Traffic	Volume (V)	Road Capacity (C)	V/C Ratio	LOS Category*	Traffic Classification
Existing	1206	1671	15000	0.11	“A”	Free Flow Traffic

After implementation	1276	1899	15000	0.13	“A”	Free Flow Traffic

*LOS (Level of Service) categories are A-Free Flow, B- Reasonably Free Flow, C-Stable Flow, D-Approaching unstable flow, E- Unstable flow, F- Forced or breakdown flow.

LEVEL OF SERVICE	V/C	CLASSIFICATION
A	<0.35	Free Flow Traffic
B	0.35-0.55	Stable Traffic Flow
C	0.55-0.77	Restricted Flow
D	0.77-0.92	High Density Flow
E	0.92-1.0	Unstable Flow
F	>1.0	Forced Traffic Flow

Due to propose project there will be slight increment in the vehicle movement but the level of service (LOS) anticipated will be Free flow traffic.

x. Detailed description of flora and fauna (terrestrial and aquatic) existing in the study area shall be given with special reference to rare, endemic and endangered species. If Schedule-I fauna and found within the study area, a Wildlife Conservation plan shall be prepared and furnished

There are Schedule-I- Species in study area i.e.,

Mammal: Slow Loris (*Nycticebus bengalensis)*, Leopard (*Panthera pardus)*, Asiatic Elepha nt (*Elephas maximus)*

Details of utilization of funds (amount is in lakhs)

Sr. No.	Component	Provision in Lakhs
1.	Habitat improvement & mitigate (Food, water, shelter, movement, etc) and measure to reduce minimize the human –animal conflicts. a. Maintenance of water ponds/water holes at the periphery of project area b. Plantation at the periphery of project area	4,60,000
2.	Awareness & Extension (Forest staff will also be invited for various activities to ensure participation)	52,000
3.	Support to forest department for monitoring, rescue & Rehabitation of wildlife (veterinary care animal health, rescue, tools and equipment’s, etc.) a. Purchasing of rescue equipment’s for rescue of strayed and injured wild animals and their Trans location.	52,000
4.	Contribution towards conservation of wildlife in PCCF (to be deposited in GPCCF)	52,000

5.	Administrative cost for processing inspection etc. (to be deposited in GPCCF)	52,000
6.	Miscellaneous including Eco-development a. Plantation around the water body	1,52,000
	Total	**8,20,000**

Flora and Fauna study is carried out found within the 10km radius study area and the details are provided in **Chapter 3, Section 3.10**

xi. Socio-economic status of the study area

Summary of Socioeconomic indicators within the study area

S.No	Particulars	Study Area	Unit
0-5 Km			
1.	Number of villages and Town in the Study Area	42	Nos.
2.	Total Households	6163	Persons
3.	Total Population	29836	Persons
4.	Children Populati on (0-6 Years Old)	4252	Persons
5.	SC Population	1148	Persons
6.	ST Population	4406	Persons
7.	Total Working Population	12116	Persons
8.	Main Workers	9185	Persons
9.	Marginal Workers	2931	Persons
10.	Cultivators	3042	Persons
11.	Agricultural Labourers	1207	Persons
12.	Household Industries	249	Persons
13.	Other Workers	7264	Persons
14.	Literates population	17427	Persons
15.	Illiterates population	12409	Persons
5-10 km			
16.	Number of villages and Town in the Study Area	60	Nos.
17.	Total Households	9667	Persons
18.	Total Population	46560	Persons
19.	Children Population (0-6 Years Old)	6267	Persons
20.	SC Population	2870	Persons

21.	ST Population	6930	Persons
22.	Total Working Population	20217	Persons
23.	Main Workers	13874	Persons
24.	Marginal Workers	6343	Persons
25.	Cultivators	5960	Persons
26.	Agricultural Labourers	3232	Persons
27.	Household Industries	662	Persons
28.	Other Workers	10363	Persons
29.	Literates population	28942	Persons
30.	Illiterates population	17618	Persons

*(**Source:** Census 2011)*

Further detailed socio-economic status of the study area is provided in the **Chapter 3, Section 3.11** of EIA report.

7 **Impact and Environmental Management Plan**

i. Assessment of ground level concentration of pollutants from the stack emission based on site-specific meteorological features. In case the project is located on a hilly terrain, AQIP modeling shall be done using inputs of the specific terrain characteristics for determining the potential impacts of the project on the AAQ. Cumulative impact of all sources of emissions (including transportation) on the AAQ of the area shall be assessed. Details of the model used and the input data used for modelling shall also be provided. The air quality contours shall be plotted on a location map showing the location of project site,

The ground level concentration of pollutants (PM, SO2&NOx) using AERMOD software were assessed and presented in Chapter 4 of EIA report.

AERMOD Software Version 8.0.5 was used for air dispersion modeling and is applicable to a wide range of buoyant or neutrally buoyant emissions up to a range of 50 km. The air quality contours shall be plotted on a location map showing the location of the project site are shown in GLCs for proposed is given in Chapter 4 of EIA report

Point source emission:

Pollutant	**Max. Base line Conc. (µg/m^3)**	**Estimated Incremental Conc. (µg/m^3)**	**Total Conc. (µg/m^3)**	**NAAQ standard (µg/m^3)**
PM$_{10}$	86.25	0.079	86.329	100
SO2	23.03	0.074	23.104	80
NO$_x$	33.95	0.709	34.659	80

Line Source emission:

Pollutant	**Max. Base line Conc. (µg/m^3)**	**Estimated Incremental Conc. (µg/m^3)**	**Total Conc. (µg/m^3)**	**NAAQ standard (µg/m^3)**
PM$_{10}$	86.25	0.006	86.256	100

habitation nearby, sensitivereceptors, if any.

NOx	33.95	0.311	34.261	80

Cumulative emission:

Pollutant	Max. Base line Conc. (µg/m^3)	Estimated Incremental Conc. (µg/m^3)	Total Conc. (µg/m^3)	NAAQ standard (µg/m^3)
PM_{10}	86.25	0.079	86.329	100
SO2	23.03	0.074	23.104	80
NO_x	33.95	0.711	34.661	80

ii. Water Quality modelling - in case of discharge in water body.

No effluent from PP unit shall be discharged and shall be diverted to existing NREP ETP for further treatment .Hence quality modelling is not applicable.

iii. Impact of the transport of raw material and end products on the surrounding environment shall be assessed and provided. In this regard, options for transport of raw materials and finished products and wastes (large quantities) by rail or rail-cum road transport or conveyor-cum-rail transport shall be examined.

Material Handling Storage and Transportation

i. All transfers from drums / tanks are being done through pumps in closed pipelines.
ii. The loading of finished products to trucks and drums is done through automated filling systems with overflow protections.
iii. All key raw materials are charged to the reactors through closed pipeline systems including pneumatic systems for solid handling.
iv. Raw materials/ intermediates/ products are stored in closed tanks/drums provided with breather arrangements to avoid fugitive emissions.

Raw materials:

S.no.	Raw-Material	Unit	Proposed quantity	Mode of Transport	Source	Storage Facility (M3)
1	Polymer Grade Propylene	KTPA	368.6	Pipeline	Petro FCC Unit of NREP	3 nos (2W+1S) of Mounted Bullet with Dia 8m & Height 80m
2	Hydrogen Gas	KTPA	0.032	Pipeline	NREP Hydrogen network	Nil

Product evacuation and Mode of Transportation

- 90% of product shall be bagged in 25 kg bags and 10% in 1000 kg Flexible Intermediate Bulk Container (FIBC).Bagging operation should be considered during the period from 6AM to 10 PM i.e 16 hours per day bagging with 12hrs of effective bagging time is considered.

- Bagged product from bagging machine is stacked in the ware house with the help of fork lift. From the ware house stacked bags of final product is loaded in the truck at loading station and send to various consumers by road.
- Following assumptions are considered for truck loading and unloading facility:
    - Truck loading/ unloading will take place in only day time = 7 hrs/day
    - Truck Capacity = 16 Tons/truck
    - No. of trucks loading/unloading per station = 2 trucks/ station
    - Time for loading/unloading in 1 station = 1 hrs/ station
    - 8 no. of truck loading station & 10 trucks for loading per hour is envisaged for NRL PP Unit./ with 2 trucks loading in 1 station is envisaged for NRL PP Unit

iv. A note on treatment of waste water from different plant operations, extent recycled and reused for different purposes shall be included. Complete scheme of effluent treatment, characteristics of untreated and treated effluent to meet the prescribed standards of discharge under E(P) rules.

The wastewater generation from the proposed project will be mostly Intermittent liquid effluent streams containing White Oil/TEA/Atmer/IPA/other organic components. A continuous liquid effluent having various organic components like Acetone, Isopropanol, Tert-butanol will be generated from Phase Separator Process which will have very less flow. These waste water streams along with non-process effluents like floor wash, contaminated rain water will be sent to existing ETP of NREP and treated there. The concentrated organic components and PP powder will be thermally incinerated. 50 m3/hr of Cooling tower blown down already considered in RO design will be routed to existing RO-DM plant of adjacent NRL refinery for treatment and reuse. Condensate generated will also be recovered.

The process effluent generation from PPU unit (0.23 m3/hr) is very negligible and ETP of NREP (Design:450 m3/hr) is adequate to process the same. This will not have any impact on effluent and subsequent sludge generation of NREP ETP.”

v. Details of stack emission and action plan for control of emissions to meet standards.

Proposed Project Stack Emission details

S.No	Source	Fuel Type	Stack Details					Emission(g/s)		
			No.of stacks	Height(m)	Dia(m)	Temp(°C)	Exit velocity(m/s)	PM	SO2	NOX
1	EMDG 750 KW	HSD	1	14	0.05	220	9.8	0.0115	0.0107	0.1632
Total(g/s)								**0.0115**	**0.0107**	**0.1632**

Air Pollution Control Measures

- Provision of stack of sufficient height as required by per CPCB’s guidelines for the proposed DG sets.
- 01 no. CAAQMS will be proposed for PP unit. NRL already having 02 CAAQMS and one more will come as a part of NREP. NRL already having 3 manual monitoring station within 10 km range and 01 in Kaziranga National Park
- Monitoring of fugitive emissions from NRL with the help of VOC (Volatile Organic Carbon), LDAR (Leak Detection and Repair) program will be done annually with the help of an external agency. Thus observed leaks will beidentified and rectified

vi. Measures for fugitive emission control

Fugitive Emission Control Measures:

Details of action plan for control of emissions

- Minimum number of flanges, valves, etc.
- High grade gasket material for packing.
- Usage of state-of-the-art low leakage valves preferably with bellow seals.
- Usage of pumps with Double Mechanical seals for light hydrocarbon services.
- Provisions of double seal in some of storage tanks.
- Provision of covering the oil-water separation units in ETP.
- Provision of seals in the drains and manholes.

Monitoring of fugitive emissions from NRL with the help of VOC (Volatile Organic Carbon), LDAR (Leak Detection and Repair) program will be done annually with the help of an external agency. Thus observed leaks will beidentified and rectified.

vii. Details of hazardous waste generation and their storage, utilization and management, Copies of MOU regarding utilization of solid and hazardous waste in cement plant also be included. EMP shall include the concept of waste-minimization, recycle/ reuse/recover techniques, Energy conservation, and natural resource conservation.

The process effluent generation from PPU unit is very negligible and the same will not have any impact on NREP ETP effluent and subsequent sludge generation.In addition, spent oil/ Used oil which will be generated from the emergency DG will be minimal which will be disposed to authorized recyclers.

Other Hazardous waste generated

Source	Name	Mode of Operation	Frequency	Quantity approx.	Composition	Treatment (OSBL)
1P39-R-1171, Propylene Treater (Arsine, Phosphine, COS)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	18,600 kgs (2,120 kg) **(Note 1)**	Clariant Actisorb®401 or equal **(Note 1)**	Secured Landfill/Disposal to recyclers
1P39-R-1172A/B Propylene Treater (H2O, Oxygenates, MeOH)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	2 x 31,752 kgs (2 x 6,000 kgs) **(Note 1)**	Porocel Dynocel650 or equal **(Note 1)**	Secured Landfill/Disposal to recyclers

		1P39-R-1173A/B Propylene Treater (CO)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	2 x 5,040 kgs (2 x 1,420 kgs) **(Note 1)**	Clariant Actisorb®310 or equal **(Note 1)**	Secured Landfill/Disposal to recyclers
		1P39-R-1174 Propylene Treater (MAPD, Acetylene)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	3,312 kgs (1,060 kgs) **(Note 1)**	Clariant Polymax®303 or equal **(Note 1)**	Secured Landfill/Disposal to recyclers
		1P39-R-1571 Hydrogen Treater (CO, CO2)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	80 kgs (18 kgs) **(Note 1)**	Clariant Meth®150 or equal **(Note 1)**	Secured Landfill/Disposal to recyclers
		1P39-R-1572A/B Hydrogen Treater (H2O)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	2 x 120 kgs (2 x 26 kgs) **(Note 1)**	BASF – 4A Mol. Sieve or equal **(Note 1)**	Secured Landfill/Disposal to recyclers
		1P39-Z-1683 Nitrogen Treater (O2 Removal)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	630 kgs (76 kgs) **(Note 1)**	Clariant Polymax®301 or equal **(Note 1)**	Secured Landfill/Disposal to recyclers
		1P39-Z-1683 Nitrogen Treater (H2O Removal)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	2 x 500 kgs (2 x 200 kgs) **(Note 1)**	Porocel Dynocel 641S or equal **(Note 1)**	Secured Landfill/Disposal to recyclers

1P39-Z-6581 Purge Gas Dryer (H2O Removal)	Spent Adsorbents	Replacement	by Membrane unit vendor	by Membrane unit vendor	Drying agent (molecular sieve)	Secured Landfill/Disposal to recyclers
1P39-MGN-1175A/B Propylene Filter	Spent Filter Cartridge	Replacement of Filter Elements	once / 2 years	5 kg (each Filter)	Filter Elements (PP) & treater filling particles	Secured Landfill/Disposal to recyclers
1P39-MGN-1371A/B White Oil Filter	Spent Filter Cartridge	Replacement of Filter Elements	once / 2 years	2 kg (each Filter)	Filter Elements (PP)	Secured Landfill/Disposal to recyclers
1P39-MGN-1575A/B, Hydrogen Filter	Spent Filter Cartridge	Replacement of Filter Elements	once / 2 years	2 kg (each Filter)	Filter Elements (PP) & treater filling particles	Secured Landfill/Disposal to recyclers
1P39-MGN-1671A/B, LP Nitrogen Filter	Spent Filter Cartridge	Replacement of Filter Elements	once / 2 years	5 kg (each Filter)	Filter Elements (PP)	Secured Landfill/Disposal to recyclers
1P39-MGN-1672A/B, Regeneration Recycle N2 Filter	Spent Filter Cartridge	Replacement of Filter Elements	once / 2 years	5 kg (each Filter)	Filter Elements (PP) & treater filling particles	Secured Landfill/Disposal to recyclers
1P39-MGN-1971A/B, Silane Filter	Spent Filter Cartridge	Replacement of Filter Elements	once / 2 years	2 kg (each Filter)	Filter Elements (PP)	Secured Landfill/Disposal to recyclers
1P39-ZGN-2282, Additive Vent Filter	Spent Filter Bags	Replacement of Filter Elements	once / 2 years	5 kg (each Filter)	Filter Elements (PP)	Secured Landfill/Disposal to recyclers

		1P39-MGN-3175A/B, RG Filter	Spent Filter Bags	Replacement of Filter Elements	≤ 2 times/year	10 kg (each Filter) 2335 kg (by vendor)	Filter Elements (PP) & PP Solids	Secured Landfill/Disposal to recyclers
		1P 9-VV-3132, Powder Collector (via 1P39-CY-3173)	PP Powder	Upset Conditions	≤ 6 times/year	45 kg	PP Solids	Secured Landfill/Disposal to recyclers
		1P39-VV-3 34, Powder K.O. Drum	P Powder	Upset Conditions	once / year	60 kg	PP Solids	Secured Landfill/Disposal to recyclers
		1P39-VV-3432, Drop Out Pot (for special products only)	PP Powder	Special operation	once / month	50 kg	PP Solids	Secured Landfill/Disposal to recyclers
		1P39-MGN-3471, Carrier Gas Filter	Spent Filter Bags	Replacement of Filter Elements	once / year	150 kg each	PP Filter Bags & PP Solids	Secured Landfill/Disposal to recyclers
		1P39-MGN-3472A/B, Purge Silo Filter	Spent Filter Bags	Replacement of Filter Elements	once / year	60 kg each	PP Filter Bags & PP Solids	Secured Landfill/Disposal to recyclers

		1P39-ZEX-3682, Extruder / Pelletizer	Start-up Material	Discontinuous	Cold Start-up Warm Start-up	2,520 kg for 7 min. 1,080 kg for 3 min.	PP (Melt)	Secured Landfill/Disposal to recyclers
		1P39-ZGN-3684, Extruder Feed Vent Filter	Spent Filter Bags	Replacement of Filter Elements	once / year	40 kg (by vendor)	PP Filter Bags & PP Solids	Secured Landfill/Disposal to recyclers
		1P39-ZVV-3783, Pellet Water Tank	PP Dust	Discontinuous	once / month	36 kg	PP (Fines)	Secured Landfill/Disposal to recyclers **(Note 2)**
		1P39-ZSR-3784, Pellet Water Start-Up Screen	PP Pellets	Discontinuous Start-Up of Extruder	-	600 kg per event	PP	Secured Landfill/Disposal to recyclers **(Note 2)**
		1P39-ZSR-3784, Pre-Separation Sieve	PP Pellets & Agglomerates	Discontinuous, Extruder start-up	once / week	11 kg each	PP (agglomerates)	Secured Landfill/Disposal to recyclers **(Note 2)**
		1P39-ZCL-3787, Pellet Classifier	PP Pellets & Agglomerates	Discontinuous, Under-/Oversized Pellets	once / week	5 kg each 37 kg each	PP Pellets undersized PP Pellets oversized	Secured Landfill/Disposal to recyclers **(Note 2)**

			Conveying Air Compress. Suction / Discharge Filter 1P39-ZGN-7086A/B 1P39-ZGN-7088A/B 1P39-ZGN-7087A/B 1P39-ZGN-7089A/B 1P39-ZGN-7094A/B 1P39-ZGN-7095A/B 1P39-ZGN-7096A/B 1P39-ZGN-7097A/B	Spent Filter Bags	Replacement of Filter Elements	every 6 months years **(Note 1)**	25 kg each **(Note 1)**	PP Filter Bags & PP Solids	Secured Landfill/Disposal to recyclers	
			1P39-ZGN-7185A/B, Silo Exhaust Filter	Spent Filter Bags	Replacement of Filter Elements	every 6 months years **(Note 1)**	25 kg each **(Note 1)**	PP Filter Bags & PP Solids	Secured Landfill/Disposal to recyclers	

		1P39-ZGN-7584A/B, Elutriator Blower Filter	Spent Filter Bags	Replacement of Filter Elements	once / year	(Note 1)	PP Filter Bags	Secured Landfill/Disposal to recyclers
		1P39-ZCY-7583, Elutriator Cyclone	PP Fines	Continuous	8,000 h / year	0.5 kg/h (by vendor)	PP (Fines)	Secured Landfill/Disposal to recyclers
		Wastes from Sampling (e.g., 1P39-VV-3133 Powder Sampling Pot)	PP Powder & Pellets	Discontinuous	once / day	60 kg (Note 3)	PP (Pellets and Powder)	Secured Landfill/Disposal to recyclers **(Note 2)**
		Packaging Material of Additives	Bags	Discontinuous	once / day	approx. 20 kg	Paper, PP/PE	Disposal to recyclers
		Packaging Material of Bagging section	Bags	Discontinuous	once / day	approx. 20 kg	Paper, PP/PE	Disposal to recyclers
		1P39-VV-1733, Waste White Oil Tank	Waste White Oil	Discontinuous emptying of tank	1 time per year	approx. 660 kg	White Oil, Isopropanol, Alcoholate	Disposal to Recycler
		1P39-VV-2231, Additive Feed Hopper Vent Pot	Waste White Oil	Discontinuous	1 time per year	60 l	White Oil	Disposal to Recycler

1P39-VV-3033, Catalyst Vent Pot	Waste White Oil	Discontinuous	1 time per year	80 l	White Oil	Disposal to Recycler
1P39-VV-6631, Phase Separator	Oily Waste	Discontinuous	30 times per year	max. 80 kg	Mixed Organic Components. Heating Value approx. 41000 kJ / kg	Bioremediation/ Disposal to Recycler
Gear Boxes of Machinery	Waste Lube Oil	Discontinuous	1 time per year	approx. 5 t	Lubrication Oils (100%)	Disposal to recyclers

viii. Proper utilization of fly ash shall be ensured as per Fly Ash notification, 2009. A detailed plan of action shall be provided.

There is no furnace envisaged in proposed PP Plant, hence there is no fly ash generation.

ix. Action plan for the green belt development plan in 33% area i.e., land with not less than 1500 trees per Ha. Giving details of Species, width of plantation, planning schedule etc. shall be included. The green belt shall be around the project boundary and a scheme for greening of the roads used for the project shall also be incorporated.

<u>Green belt development:</u>

Land Area Breakup:

The total Plot no. 11 area is 600 Bigha (8,02,681.92 sq.m) (80.27 Ha). Out of which Total plot area required for the PP Unit and its associated facility is 348093 SQM (34.8 Ha). The plant area is 232821 sq.m (23.28Ha) and Greenbelt area is 115272 sq.m (11.52 Ha) i.e, (33.1 % of total area) at Plot No.11 located at North side of the Numaligarh Refinery. The remaining 454588.92 sq.m (45.45 Ha) will be utilized for future project activities.

S. No	Description	Proposed Area in Ha	Proposed Area in m^2	%
1	Plant area (Process units + Utility + Offsite + Building + Road)	23.28	232821	66.9
2	**Green Belt Area**	11.52	115272	33.1
Total		**34.8**	**348093**	**100**

Greenbelt Plan:

S.No.	Description	Proposed
1	Area proposed incremental for green belt (in	115272m^2 (11.52 Ha)

	Ac)	
2	Width of green belt (in m) along the boundary of the project or activity	15m
3	Percentage of the total area covered under green belt (%)	33%
4	No. of tree saplings to be planted	34560
5	Funds allocated for plantation in Lakhs.	207.36

Recommended Species for Proposed Green Belt Development is given in **Chapter 2, Table 2-16** of the EIA report.

	x. Action plan for rain water harvesting measures at plant site shall be submitted to harvest rainwater from the roof tops and storm water drains to recharge the ground water and also to use for the various activities at the project site to conserve fresh water and reduce the water requirement from other sources.	Capital cost of INR50 lakhs and recurring cost of INR 3 lakhs t has been considered in EMP for Rainwater Harvesting. Rainwater harvesting measures will be planned during Detailed engineering stage.
8	**Occupational Health**	
	i. Plan and fund allocation to ensure the occupational health & safety of all contract and casual workers	All the occupational health related expenditure of casual & contract workers incorporated in the scope of contractor and compliance to the statutory rules in this regard is ensured. Approximate cost for OHC checkup is Rs.4815 per person. Occupational Health checkup profile is attached as **Annexure-12.** NRL has fully functional VK- NRL hospital operating in Township for their OHC. NRL, Safety, Health and Environment Policy (SHE) is provided in Chapter 10 of EIA report.
	ii. Details of exposure specific health status evaluation of worker. If the worker's health is being evaluated by pre-designed format, chest x-rays, Audiometry, Spirometry, Vision testing (Far and near vision, color vision and any other	Not Applicable. New Project.

		ocular defect), ECG, during pre-placement and periodical examinations give the details of the same. Details regarding last month analyzed data of above mentioned parameters as per age, sex, duration of exposure and department wise.	
	iii.	Details of existing Occupational& Safety Hazards. What are the exposure levels of hazards and whether they are Permissible Exposure level (PEL) if these are not within PEL, what measures the company has adopted to keep them within PEL. So that health of the workers can be preserved.	Not Applicable. New Project.
	iv.	Annual report of health status of workers with special reference to Occupational Health and Safety	Not Applicable. New Project.
9	**Corporate Environment Policy**		
	i.	Does the company have a well laid down Environmental Policy approved by its Board of Directors? If so, it may be detailed in the EIA report	Yes, the company have a well laid down Environmental Policy approved by its Board of Directors. NRL- Environment, Health & Safety Policy (EHS) provided in **Chapter 10** of EIA report
	ii.	Does the Environment Policy prescribe for standard operating process/procedures to bring into focus any infringement/ deviation/ violation of the environemnt or forest norms/ conditions? If so, it may be detailed in the EIA	Yes A dedicated Environmental Management Cell (EMC) will be in force to bring into focus of any infringement/ deviation/ violation of the environemnt. A Plant Safety & Environment Department under its technical services department, which consists of well-qualified and experienced technical personnel from the relevant fields shouldbe in place to look after Environment cell. The Environment Cell will look after thecompliance of statutory Environmental standards applicable for the proposed project. Details provided in **Chapter 10** of EIA report.
	iii.	What is the hierarchical system	Hierarchical system or Administrative order of the company to deal with the environmental issues and for ensuring compliance

	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.	is provided in **Chapter 10, Section 10.3** of EIA report.
	iv. Does the company have system of reporting of non-compliances/ violations of environemntal norms to the Board of Directors of the company and/or Stakeholders or stakeholders at large? This reporting mechanism shall be detailed in the EIA report	System of reporting of non-compliances/ violations of environemntal norms & the Board Hierarchical system or Administrative order of the company to deal with the environmental issues and for ensuring compliance is provided in Reporting mechanism detailed in **Chapter 10, Section 10.3** of EIA report.
10	Details regarding infrastructure facilities such as sanitation, fuel, restroom etc. to be provided to the labour force during construction as well as to the casual workers including truck drivers during operation phase.	The site layout indicating all the facilities is enclosed as **Annexure 5.** Infrastructure facilities such as sanitation, restroom etc. shall be provided to the labour force during construction as well as to the casual workers including truck drivers during operation phase.
11	**Enterprise Social Commitment (ESC)**	
	i. Adequate funds (at least 2.5% of the project cost) shall be earmarked towards the Enterprise Social Commitment based on public Hearing issues and item-wise details along with the bound action plan shall be included. Socio-Economic development activities need to be elaborated upon.	The company is aware of the obligations towards the Environment and to fulfill the social obligations. As per OM **F. No: 22-65/2017-IA.III** dated 1st May 2018 M/s. NRL will Allocate 0.5% of the project cost (7231 Crores) towards CER i.e. 0.5% of 7231 Crores = 36.155 Crores ***Note:****In Form-1 the project cost is mentioned as 4735Cr and it has been revised as 7231Cr.* After completion of public hearing, CER budget allocation will be made in the Action Plan to address the issues raising during public hearings
12	ii. Any litigation pending against the project and/ or any direction/ order passed by any Court of Law against the	No litigation pending against the project and/ or any direction/ order passed by any Court of Law against the land in which the PP project is proposed to be set up .

<table>
<tr><td></td><td>project, if so, details thereof shall also be included. Has the unit received any notice under the section 5 of Environment (Protection) Act, 1986 or relevant Sections of Air and Water Acts? If so, details thereof and compliance /ATR to the notice(s) and present status of the case.</td><td></td></tr>
<tr><td>13</td><td>A tabular chart with index for point wise compliance of above TOR</td><td>Point wise ToR compliance is provided in provided in Chapter 1 of EIA Report.</td></tr>
<tr><td colspan="3">SPECIFIC CONDITIONS</td></tr>
<tr><td>1</td><td>Details on requirement of raw material (naphtha /gas feedstock), its source of supply and storage at the plant.</td><td>Raw materials:
<table>
<tr><th>S.no.</th><th>Raw-Material</th><th>Unit</th><th>Proposed quantity</th><th>Mode of Transport</th><th>Source</th><th>Storage Facility (M3)</th></tr>
<tr><td>1</td><td>Polymer Grade Propylene</td><td>KTPA</td><td>368.6</td><td>Pipeline</td><td>Petro FCC Unit of NREP</td><td>3 nos (2W+1S) of Mounted Bullet with Dia 8m & Height 80m</td></tr>
<tr><td>2</td><td>Hydrogen Gas</td><td>KTPA</td><td>0.032</td><td>Pipeline</td><td>NREP Hydrogen network</td><td>Nil</td></tr>
</table>
</td></tr>
<tr><td>2</td><td>Complete process flow diagram for all products with material balance.</td><td>Process Flow Diagram:</td></tr>
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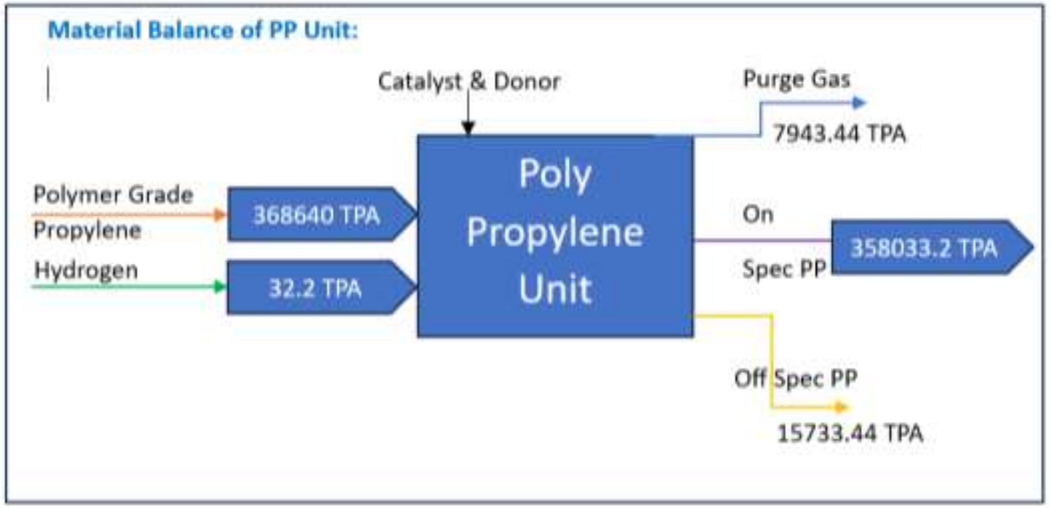
<tr><td></td><td></td><td>
</td></tr>
<tr><td>3</td><td>Brief description of equipments for various process (cracker, separation, polymerization etc)</td><td>
<table>
<tr><th>Sl. no.</th><th>Description</th></tr>
<tr><td colspan="2">Treaters</td></tr>
<tr><td>1</td><td>Propylene Treater</td></tr>
<tr><td>2</td><td>Propylene Treater</td></tr>
<tr><td>3</td><td>Hydrogen Treater</td></tr>
<tr><td>4</td><td>Hydrogen Dryer</td></tr>
<tr><td>5</td><td>Propylene Treater</td></tr>
<tr><td colspan="2">Vessels,Tanks,Drums</td></tr>
<tr><td>1</td><td>HP Nitrogen Buffer Vessel</td></tr>
<tr><td>2</td><td>Regeneration Recycle N2 KO Drum</td></tr>
<tr><td>3</td><td>Tea Holding Tank</td></tr>
<tr><td>4</td><td>Tea Vent Pot</td></tr>
<tr><td>5</td><td>Waste White Oil Tank</td></tr>
<tr><td>6</td><td>Silane Holding Tank</td></tr>
<tr><td>7</td><td>Additive Feed Hopper Vent Pot</td></tr>
<tr><td>8</td><td>Catalyst Preparation Vessel</td></tr>
<tr><td>9</td><td>Catalyst Metering Vessel</td></tr>
<tr><td>10</td><td>Catalyst Vent Pot</td></tr>
<tr><td>11</td><td>RG Compressor Suction Drum</td></tr>
</table>
</td></tr>
</table>

		12	Powder Collector
		13	Flare K.O Drum
		14	Degassing Vessel
		15	Chase Gas Buffer Vessel
		16	Phase Separator
		17	Condensate Drum
		18	Dry Flare K.O.Drum
		Silo	
		1	Purge Silo
		2	Pellet Blending Silos
		3	Bagging Silo
		Cyclone	
		1	RG Cyclone
		2	Shutdown Cyclone
		3	Carrier Gas Cyclone
		Reactor	
		1	Polymerisation Reactor
		Exchanger	
		1	Hydrogen Pre-heater
		2	Hydrogen Cooler
		3	Regeneration Recycle N2 Heater
		4	Regeneration Recycle N2 Cooler 1
		5	Regeneration Recycle N2 Cooler 2
		6	RG Condenser
		7	Carrier Gas Cooler
		8	Extruder Off Gas Condenser
		9	Vent Condenser
		10	Hydrogen Preheater
		11	Hydrogen Cooler
		12	Regeneration Recycle N2 Heater
		13	Regeneration Recycle N2 Cooler 1
		14	Regeneration Recycle N2 Cooler 2
		15	RG Condenser
		16	Carrier Gas Cooler
		17	Extruder Off Gas Condenser
		Pump	

1	Tea Metering Pump
2	White Oil Drum Pump
3	Isopropanol Drum Pump
4	Silane Metering Pump
5	Silane Drum Pump
6	Peroxide Metering Pump
7	Catalyst Suspension Metering Pump
8	White Oil Drum Pump
9	Recycle Pump
10	Condensate Pump
11	Waste Water Pump
Compressor/Blower	
1	Regeneration Recycle N2 Blower
2	RG Compressor
3	Hydrogen Compressor
4	Nitrogen Compressor
5	Carrier Gas Compressor
Agitator	
1	Waste Oil Oil Tank Agitator
2	Catalyst Preparation Vessel Agitaor
3	Catalyst Metering Vessel Agitaor
4	Polymerisation Reactor Agitator
Packages	
1	Solid Additive Package
2	Bag Additive Discharge and Feeding System
3	Talcum/Silica Additive Discharge and Feeding System
4	GMS Additive Discharge & Feeding system
5	Extrusion Package/ Extruder
6	Purge gas Recovery Unit
7	Extruder Vacuum Unit
8	Pellet Pneumatic Conveying System
9	Bagging Line
10	Peroxide Dosing skid

4	Details of proposed source-specific pollution control schemes and equipments to meet the national	**Air Management** **Point source:** Only EMDG 750 KW will be provided for which adequate stack height of 14m will be provided.

<table>
<tr>
<td></td>
<td>standards</td>
<td>
Line source:
Since BS VI grade of vehicles is considered, SO2 emission is negligible.

• Auto Fuel / Air ratio
• Adequate stack height
• Online Continuous emission monitoring system is provided to monitor emission parameter and is connected to PCB/CPCB.
In addition to the above, the additional emission from the proposed project are given in **Chapter 4, Section 4.1.2** of the EIA report.

Air pollution contrl schemes:

For this PP unit, only Emergency DG will be proposed and operated only during power failure.

• Provision of stack of sufficient height as required by per CPCB’s guidelines for the proposed DG sets.
• 01 no. CAAQMS will be proposed for PP unit. NRL already having 02 CAAQMS and one more will come as a part of NREP. NRL already having 3 manual monitoring station within 10 km range and 01 in Kaziranga National Park
• Monitoring of fugitive emissions from NRL with the help of VOC (Volatile Organic Carbon), LDAR (Leak Detection and Repair) program will be done annually with the help of an external agency. Thus observed leaks will beidentified and rectified
Waste water management
Only effluent generation of 50.23 m3/hr and sewage of 0.212 m3/hr will be generated due to this proposed project and treated in the existing NREP ETP.
<table>
<tr><th>Description</th><th>Proposed(m^3/hr)</th><th>Disposal Method & Facility Details (m^3/hr)</th></tr>
<tr><td colspan="3">**Effluent generation**</td></tr>
<tr><td>Cooling tower blowdown</td><td>50</td><td>Cooling tower blowdown from PP unit will be diverted to RO plant (Design: 600 m3/hr) under existing NREP ETP Package.</td></tr>
<tr><td>Process effluent</td><td>0.23</td><td>PP process effluent to be treated in existing NREP ETP (Design: 450 m3/hr and cnormal flow is 360 m3/hr</td></tr>
<tr><td>**Sub-Total**</td><td>**50.23**</td><td></td></tr>
<tr><td>Sewage</td><td>0.212</td><td>Diverted to existing NREP ETP for treatment</td></tr>
<tr><td>**Total waste water generation**</td><td>**50.442**</td><td></td></tr>
</table>
</td>
</tr>
</table>

The sewage generated will be routed to the existing NREP ETP for further treatment.. The processeffluent from PP unit will be routed to NREP ETP for treatment.The treated effluent from NREP ETP is planned to be reused in cooling tower, fire water and Horticulture (greenbelt).

Details of Liquid Effluent from the proposed project are given **Chapter 2, Table 2-14** in the EIA report.

Solid waste management

During construction phase:

S. No	Description	Proposed Quantity (Kg/day)	Method of Disposal
1	Organic	472.5	Municipal Bins
2	Inorganic	315	Disposed to PCB authorized recyclers
Total		**787.5**	

During operation phase:

S. No	Description	Proposed (Kg/day)	Method of Disposal
1	Organic	14.31	Municipal Bins
2	Inorganic	9.54	Disposed to PCB authorized recyclers
Total		**23.85**	

Hazardous waste management

The process effluent generation from PPU unit is very negligible and the same will not have any impact on NREP ETP effluent and subsequent sludge generation. However, note that estimated sludge generation from NREP ETP will be 30 m3/hr-oily and (chemical)and 20 m3/hr (bio sludge).In addition, spent oil/ Used oil which will be generated from the emergency DG will be minimal which will be disposed to authorized recyclers.

The details of other hazardous waste generated are given in **Chapter 2, Table 2-19** of EIA report.

5	Details on VOC emission control system from vents, stacks, fugitive emissions and flare management, etc.	**To control VOC emission from the Storage Tanks:** • Heavier products have fixed roof tanks, whose Vapor pressure lower than the atmospheric pressure, results in no emissions to atmosphere from the tanks. • All Floating roof tanks have provision of primary and secondary seals to prevent emissions from the tanks. Monitoring of fugitive emissions with the help of VOC (Volatile Organic Carbon) program is being done monthly with the help of an external agency.
6	Details on proposed LDAR protocol	Preventive maintenance schedule is prepared and being followed.

		Online continuous sensor for monitoring VOC (benzene) in atmospheric air is provided and monitoring data has been connected to Assam PCB/CPCB. LDAR will be conducted once in a year and will be implemented.
7	Ambient air quality should include hydrocarbon (methane and non-methane), VOC and VCM (if applicable).	AAQ Monitoring results include hydrocarbon (methane and non-methane), VOC are provided in the **Chapter 3-Table 3-10** of EIA report.

Parameters	**Conc.**	**NAAQ Standards**	**Locations**							
			Project site	**Borgoria**	**Khumtai**	**Letekujan**	**Purabangla**	**Telgaram**	**No 1 Rongbong Pathar**	**NRL Township**
			A1	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**A8**
PM_{10} Conc. (µg/m³)	**Min.**	**100 (24 Hours)**	60.52	50.98	52.57	48.65	59.29	57.46	53.09	49.43
	Max		86.25	72.65	74.92	69.33	84.49	81.90	75.66	70.45
	Avg.		**72.58**	**61.13**	**63.04**	**58.34**	**71.09**	**68.91**	**63.66**	**59.28**
	98th 'tile		85.75	72.23	74.49	68.93	84.00	81.42	75.22	70.04
$PM_{2.5}$ Conc. (µg/m^3)	**Min.**	**60 (24 Hours)**	34.71	26.13	22.09	22.77	26.88	27.86	29.88	24.56
	Max		49.47	37.24	31.48	32.45	38.31	39.70	42.58	35.00
	Avg.		**41.63**	**31.33**	**26.49**	**27.31**	**32.24**	**33.41**	**35.83**	**29.45**
	98th 'tile		49.18	37.02	31.29	32.26	38.08	39.47	42.33	34.79
SO_2 Conc. (µg/m^3)	**Min.**	**80 (24 Hours)**	16.16	9.93	10.08	8.25	10.74	10.91	10.14	10.10
	Max		23.03	14.15	14.36	11.76	15.30	15.54	14.45	14.40
	Avg.		**19.38**	**11.91**	**12.09**	**9.90**	**12.88**	**13.08**	**12.16**	**12.12**
	98th 'tile		22.89	14.07	14.28	11.69	15.21	15.45	14.36	14.32
NO_2Conc.(µg/m^3)	**Min.**	**80 (24 Hours)**	23.82	15.96	18.29	16.43	19.87	18.89	18.60	17.66
	Max		33.95	22.74	26.06	23.42	28.32	26.92	26.50	25.17
	Avg.		**28.57**	**19.14**	**21.93**	**19.71**	**23.84**	**22.65**	**22.30**	**21.18**
	98th 'tile		33.75	22.61	25.91	23.28	28.16	26.76	26.35	25.02
Pb (µg/m^3)	**Av .**	**1 (2 hour)**	BLQ(LOQ 0.05)	B Q(LOQ 0.05)	BLQ(LOQ 0.05)	B Q(LOQ 0 05)	BL (LOQ 0 5)	BLQ(L Q 0 05)	LQ(L Q 0.05)	BLQ(LOQ 0. 5)

<table>
<tr><td></td><td></td><td>
<table>
<tr><td>CO (mg/m^3)</td><td>Avg.</td><td>4
(1hour</td><td>.09</td><td>0.51</td><td>0.88</td><td>0.60</td><td>0.84</td><td>0 79</td><td>0.72</td><td>.54</td></tr>
<tr><td>Benzene (µg/m^3)</td><td>Avg.</td><td>5
(Annual)</td><td>BLQ(LOQ 1)</td><td>BLQ LOQ 1)</td><td>BLQ(LO 1)</td><td>BL (LOQ 1)</td><td>BLQ(LOQ 1)</td><td>BLQ LOQ 1)</td><td>BLQ(LOQ 1)</td><td>BLQ(LOQ 1</td></tr>
<tr><td>Hydro arbon</td><td>vg.</td><td>-</td><td>Q</td><td>BL</td><td>BLQ</td><td>BL</td><td>BLQ</td><td>BLQ</td><td>LQ</td><td>BLQ</td></tr>
<tr><td>TVOC</td><td>Avg.</td><td></td><td>B Q</td><td>BL</td><td>BLQ</td><td>BL</td><td>BLQ</td><td>BLQ</td><td>BLQ</td><td>L</td></tr>
</table>

AAQ locations detail is provided in the Chapter 3 of the EIA report.</td></tr>
<tr><td>8</td><td>Action plan to meet the standard prescribed under EPA for petro chemical complex</td><td>APC Measures

Point source:
Only EMDG 750 KW will be provided for which adequate stack height of 14m will be provided.
Line source:
Since BS VI grade of vehicles is considered, SO2 emission is negligible.

Water Pollution Control Measures

All process effluent to be diverted to existing NREP ETP to meet treated effluent standards

Solid and Hazardous Waste Disposal.
• Municipal Solid waste will be collected through bins .
• Inorganic waste will be disposed through authorized vendors.</td></tr>
<tr><td>9</td><td>Risk Assessment & Disaster Management Plan
i. Identification of hazards
ii. Consequence Analysis
iii. Measures for mitigation of risk</td><td>Risk Assessment Study and Disaster Management Plan have been conducted for the facility and attached in Annexure 6. respectively.Consequence analysis for propylene was done and arrived the below conclusions:
• For propylene, LFL Fraction received at maximum distance due to Vapour Cloud Dispersion in catastrophic rupture scenario is 2294.11 m at 1.5m/s wind speed and stability classes F.
• For propylene treater, Radiation profile (4 kW/m2) received at maximum distance due to Jet Fire in Large leak scenario is 171.634 m at 1.5m/s wind speed and stability classes D. The major receptors are employees within the facility.
• For propylene storage, Radiation profile (4 kW/m^2) received at maximum distance due to Late Pool Fire in Catastrophic rupture scenario is 1255m at 1.5m/s wind speed and stability classes F.
• For propylene storage, LFL Fraction received at maximum distance due to Flash Fire in catastrophic rupture scenario is 2294.11 m at 1.5m/s wind speed and stability classes f. The major receptors are employees within the facility.
The below mitigation measures will be adopted to control the hazards in the site</td></tr>
</table>

		• Quantitative Risk analysis needs to be carried out for the entire facility for overall risk assessment. • To enable rapid detection of leak/ fire, flammable gas detector shall be located in strategic location in the PP Unit, mounded bullet, Loading gantry & Pump house. • For positively pressurized building, both Hydrocarbon & Toxic detectors need to be placed at suction duct of HVAC. HVAC to be tripped automatically in event of the detection of any Hydrocarbon / toxic material by detector. • Proper checking of contract people for Smoking or Inflammable materials to be ensured at entry gates to avoid presence of any unidentified source of ignition. • It shall be ensured that all the vehicles entering the plant shall be provided with spark arrestors at the exhaust. • Employees and Truck drivers must be well trained and must be aware of the hazards involved in the loading operation. • The critical operating steps shall be displayed on the board near the location where applicable. • It is suggested that any person within the affected zone of (4 kW/m2) without proper PPE should immediately leave the area and firefighting shall be done with proper PPEs by fire and safety/authorized personnel only • Installation of fire detectors in the dyke area for earliest response in the control room and field may be reviewed by M/s NRL considering status of liquid HC holdup in other tanks along with Surge Relief Tank. • Automatic Shutdown system shall be installed • All the project premises shall be monitored by surveillance cameras. • Loading operations shall be immediately suspended in the event of leak, a fire in the vicinity, lightning and thunder storm. • Clearly marked escape routes shall be provided in the gantry for ease of escape. • Chemicals should be stored in a well-ventilated room. • Electrical fixtures in the storage areas should be vapour-proof. • Manual call point, Gas detection system and smoke detection system to be provided. • Smoking and carrying smoking accessories are to be strictly prohibited. • Storage of propylene should be in a place where temperature does not exceed 52°C.

		• Periodic training and refresher courses should be provided to employees addressing all the hazards prevailing in the process • Training should be provided on firefighting. • Work Permit System should be strictly enforced. • Any incidents including near misses should be recorded and root cause analysis should be done. • The hazards identified shall be communicated to the neighbouring facilities and the employees shall be well aware of the hazards related to their facilities. • MSDS shall be made easily available and the safety instructions to be communicated to all employees periodically. • Periodic thickness survey to be conducted for pipelines. • Safety Procedures and Do's and Don'ts should be prepared and displayed in handling and storage area. • Mock Drills should be carried out regularly basis. • Occupational health surveillance programmes are to be done six monthly & their documentation should be maintained • Periodic health check-up employees to be conducted and recorded. • Provision and use of proper PPEs to be confirmed. Employees are being trained for First aider and made available in each shift.

CHAPTER 2

PROJECT DESCRIPTION

2 PROJECT DESCRIPTION

2.1 Condensed Description of the Project

Under this NREP project a high severity PFCCU unit with a capacity of 1.955 MMTPA is being implemented. The LPG that will be generated in the high severity mode will contain asignificant potential of propylene which can be recovered for value addition.

NRL intends to explore the feasibility of putting up a PP unit in the refinery complex from Polymer grade propylene feed from PFCC unit along with associated utilities and offsite facilities.

The Polypropylene Unit is to be designed as a single train with a capacity of 360,000 TPA of Homo-polymer grades of Polypropylene (PP) product with a target annualized product split discussed elsewhere in the report. The capacity stated is inclusive of off spec (low value) products produced during transition from one grade to another.

2.2 Type of Project

M/s Numaligarh Refinery Limited proposes Environmental Clearance for "**Proposed Poly Propylene Unit (PPU) Of Capacity 360KTPA"** Schedule 5(c) Category 'A' – "Petro-chemical complexes (industries based on processing of petroleum fractions & natural gas and/or reforming to aromatics)" as per EIA Notification 2006 and its Amendments

2.3 Location of the project site

The total Plot no. 11 area is 600 Bigha (8,02,681.92 sq.m) (80.27 Ha). Out of which Total plot area required for the PP Unit and its associated facility is 348093 SQM (34.8 Ha). The plant area is 232821 sq.m (23.28Ha) and Greenbelt area is 115272 sq.m (11.52 Ha) i.e, (33.1 % of total area) at Plot No.11 located at North side of the Numaligarh Refinery. The remaining 454588.92 sq.m (45.45 Ha) will be utilized for future project activities.

The Index map of project Location and Google Imagery of the Project site are shown in Figure 2-1**.** The Google imageries of 10 km radius of the project site is shown in **Figure 2-2 .** The google image showing project boundary of the project site is shown in **Figure 2-3**. The proposed plant layout is shown in **Figure 2-4**.Geographical coordinates of the project site given below in **Table 2-1.**

Table 2-1Geographical coordinates of the project site

S.No	Latitude	Longitude
A	26°35'24.05"N	93°47'11.56"E
B	26°35'11.49"N	93°47'14.45"E
C	26°35'2.90"N	93°46'26.85"E
D	26°35'13.97"N	93°46'22.22"E
E	26°35'20.58"N	93°46'24.49"E
F	26°35'22.63"N	93°46'24.55"E
G	26°35'28.71"N	93°46'31.82"E
H	26°35'23.53"N	93°46'51.98"E
I	26°35'26.59"N	93°46'56.01"E

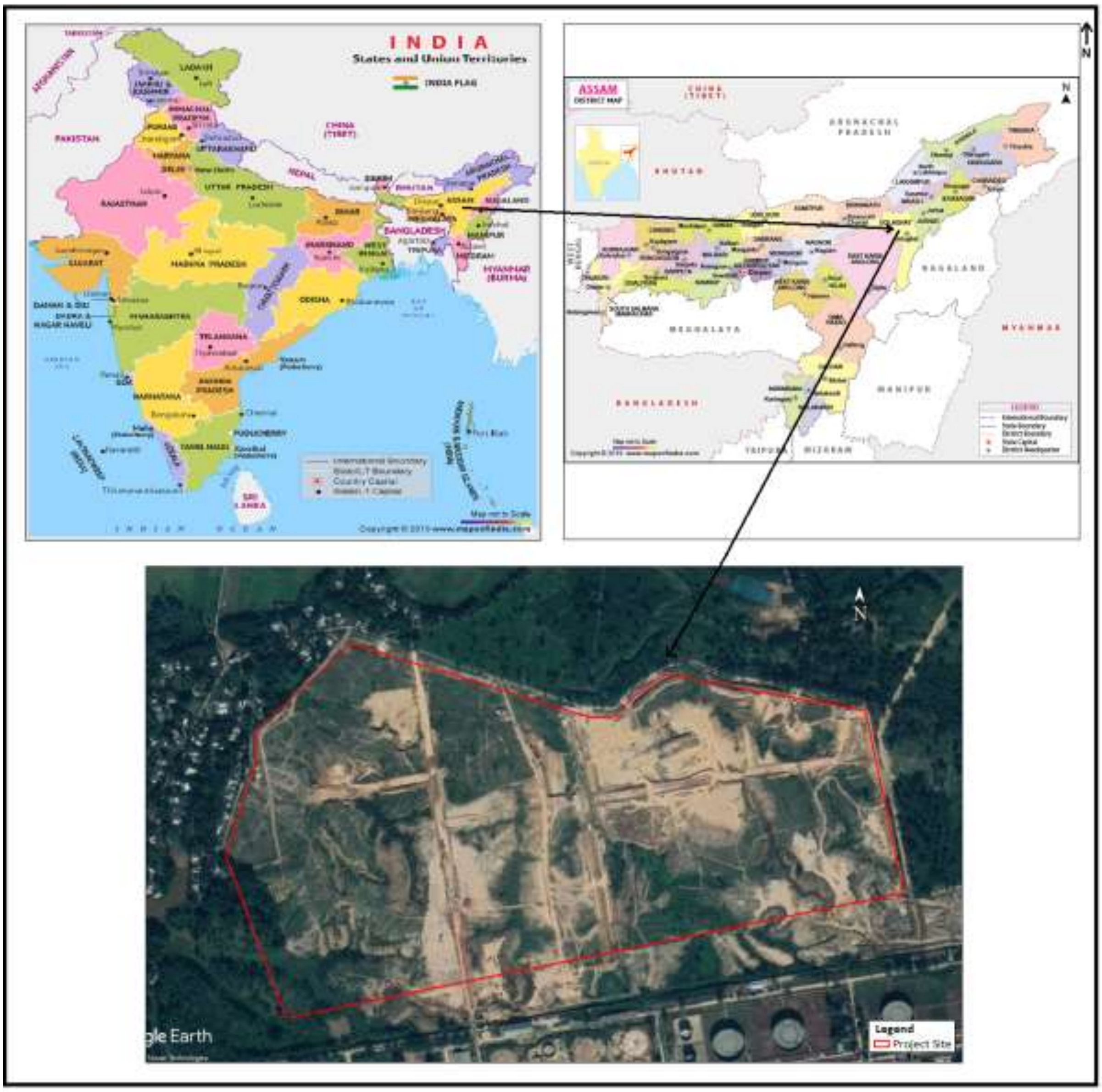


Figure 2-1 Index map showing general location of the project site

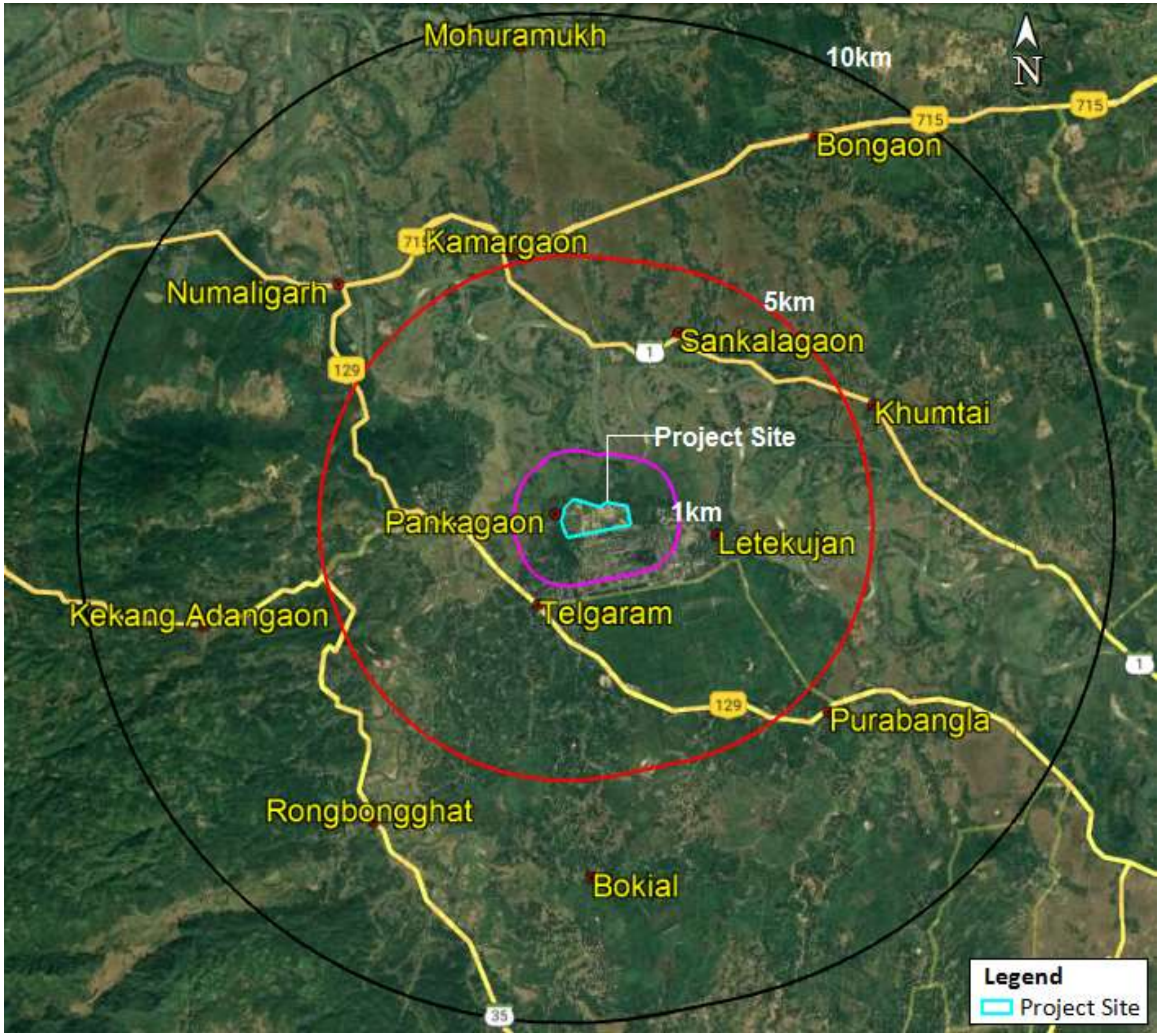


Figure 2-2 Google image showing salient features within 0- 10 km radius

S.No	Latitude	Longitude
A	26°35'24.05"N	93°47'11.56"E
B	26°35'11.49"N	93°47'14.45"E
C	26°35'2.90"N	93°46'26.85"E
D	26°35'13.97"N	93°46'22.22"E
E	26°35'20.58"N	93°46'24.49"E
F	26°35'22.63"N	93°46'24.55"E
G	26°35'28.71"N	93°46'31.82"E
H	26°35'23.53"N	93°46'51.98"E
I	26°35'26.59"N	93°46'56.01"E

Figure 2-3Google image showing project boundary of the project site

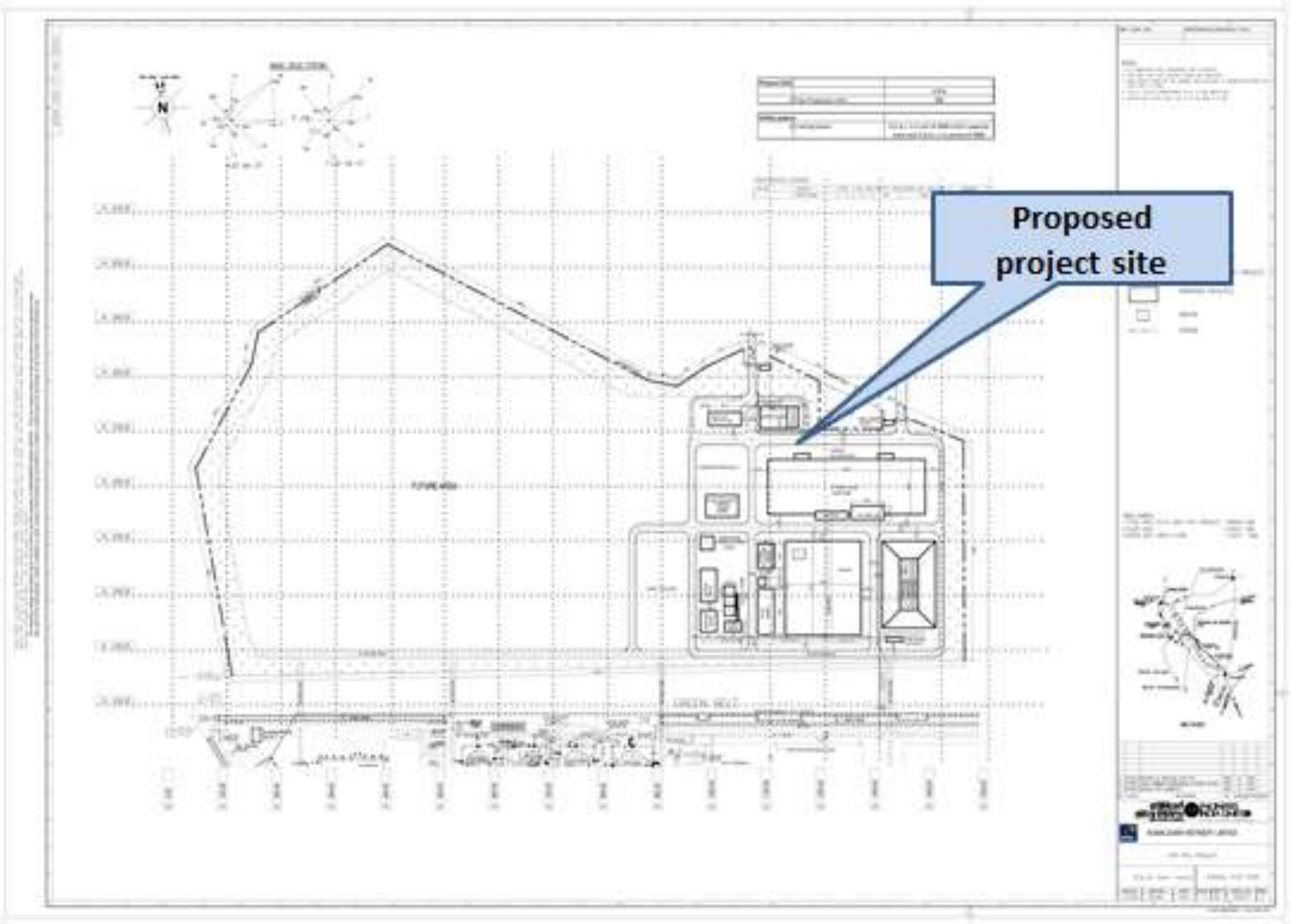


Figure 2-4 Proposed Site Layout

2.4 Need of the project

The needs of the proposed Poly propylene unit of Numaligarh Refinery Expansion Project are as follows:

- PP unit Capacity: 360KTPA of homo polymer polypropylene production
- Maximization of on-spec poly propylene product and minimize the transition time in shifting between different grades of production.
- Minimize hydrogen consumption
- Minimise Capex through Integration of Streams
- Maximise Return on Investment

2.5 Size or magnitude of operation

The Polymer Grade Propylene produced in the PRU section of the PFCC Unit of NREP is further processed in the downstream unit i.e. PP unit to produce Homo-polymer grade Polypropylene product. The proposed unit of the project is given in the **Table 2-2**.

Table 2-2 Proposed Facility

S.No.	Name of the Unit	Unit Configuration
1	Poly propylene unit	360 KTPA

Polypropylene Unit produce the homo-polymer PP with an annual product slate as per the **Table 2-3.**The list of major equipment are given in **Table 2-4.**

Table 2-3 Proposed Products

Name of the Product	Proposed Quantity (KTPA)	Mode of storage	Storage capacity
Raffia Grade	190	Bags in Ware house	Inpellet form & is stored in warehouse before dispatch. The warehouse will be sized corresponding to twentyone(21)days of storage requirement corresponding to 100% throughput of the unit
Non–Woven Spun Bond Grade	90	Bags in Ware house	
Non-Woven Melt Blown Grade	25	Bags in Ware house	
Injection Moulding Homo-polymer Grade	55	Bags in Ware house	

Table 2-4 List of Major Equipment Proposed

Sl.no.	Description
Treaters	
1	Propylene Treater
2	Propylene Treater
3	Hydrogen Treater
4	Hydrogen Dryer
5	Propylene Treater
Vessels,Tanks,Drums	
1	HP Nitrogen Buffer Vessel
2	Regeneration Recycle N2 KO Drum
3	Tea Holding Tank
4	Tea Vent Pot
5	Waste White Oil Tank
6	Silane Holding Tank
7	Additive Feed Hopper Vent Pot
8	Catalyst Preparation Vessel
9	Catalyst Metering Vessel
10	Catalyst Vent Pot
11	RG Compressor Suction Drum
12	Powder Collector
13	Flare K.O Drum
14	Degassing Vessel
15	Chase Gas Buffer Vessel
16	Phase Separator
17	Condensate Drum
18	Dry Flare K.O.Drum
Silo	
1	Purge Silo
2	Pellet Blending Silos
3	Bagging Silo
Cyclone	
1	RG Cyclone
2	Shutdown Cyclone
3	Carrier Gas Cyclone
Reactor	
1	Polymerisation Reactor
Exchanger	
1	Hydrogen Pre-heater
2	Hydrogen Cooler
3	Regeneration Recycle N2 Heater
4	Regeneration Recycle N2 Cooler 1
5	Regeneration Recycle N2 Cooler 2
6	RG Condenser
7	Carrier Gas Cooler
8	Extruder Off Gas Condenser
9	Vent Condenser
10	Hydrogen Preheater
11	Hydrogen Cooler
12	Regeneration Recycle N2 Heater
13	Regeneration Recycle N2 Cooler 1
14	Regeneration Recycle N2 Cooler 2

Sl.no.	Description
15	RG Condenser
16	Carrier Gas Cooler
17	Extruder Off Gas Condenser
Pump	
1	Tea Metering Pump
2	White Oil Drum Pump
3	Isopropanol Drum Pump
4	Silane Metering Pump
5	Silane Drum Pump
6	Peroxide Metering Pump
7	Catalyst Suspension Metering Pump
8	White Oil Drum Pump
9	Recycle Pump
10	Condensate Pump
11	Waste Water Pump
Compressor/Blower	
1	Regeneration Recycle N2 Blower
2	RG Compressor
3	Hydrogen Compressor
4	Nitrogen Compressor
5	Carrier Gas Compressor
Agitator	
1	Waste Oil Oil Tank Agitator
2	Catalyst Preparation Vessel Agitaor
3	Catalyst Metering Vessel Agitaor
4	Polymerisation Reactor Agitator
Packages	
1	Solid Additive Package
2	Bag Additive Discharge and Feeding System
3	Talcum/Silica Additive Discharge and Feeding System
4	GMS Additive Discharge & Feeding system
5	Extrusion Package/ Extruder
6	Purge gas Recovery Unit
7	Extruder Vacuum Unit
8	Pellet Pneumatic Conveying System
9	Bagging Line
10	Peroxide Dosing skid

Table 2-5 Proposed Utilities

S. No	Description	Specification	Remarks
Additional Proposed for PP Unit			
1	Cooling Tower	Capacity : 4000 m3/hr each - Number : 2w+ 1 s	***Additionally proposed within the Project site***
2	Re-circulating Cooling Water Pumps	Capacity : 4000 m3/hr each - Number : 2 w+1 s	***Additionally proposed within the Project site***

S. No	Description	Specification	Remarks
3	Propylene Transfer Pump- Centrifugal (Vertical Can)	Capacity : 115 m3/hr each Number : 1 w+1 s	***Additionally proposed within the Project site***
From NREP			
4	Re-Circulating cooling water	6780 m3/hr	Demand to be met from the NREP RWTP.
5	Cooling water Blow-down	50 m3/hr	To be routed to NREP ETP
6	Treated Raw Water	Normal: 210 m3/hr & Peak :250 m3 /hr	Demand to be met from the NREP RWTP.
7	DM Water	Normal: 2 m3/hr & Peak : 95 m3/hr	Demand to be met from the NREP RODM
8	Nitrogen	Normal : 990 Nm3/hr & Peak :3740 Nm3/hr	Demand to be met from the NREP Nitrogen Plant
9	Plant Air	Normal : 340 Nm3/hr & Peak : 1050Nm3/hr	Demand to be met from the NREP Compressed Air system
10	Instrument Air	Normal: 1300 Nm3/hr	Demand to be met from the NREP
11	Power	Normal: 26 MW	Demand to be met from Grid
12	LP Steam	Normal: 12.53 TPH & Peak:16.5 TPH	Demand to be met from NREP utility Boiler
13	MP steam	Normal: Nil & Peak: 9 TPH	Demand to be met from NREP utility Boiler
14	HP steam	Normal : 1.05 TPH & Peak: 1.7 TPH	Demand to be met from NREP utility Boiler
15	MP BFW	Normal: 0.5 TPH&Peak: 1 TPH	
16	Flare	Peak: 135TPH	To be connected to NREP flare header
17	Effluent	0.23 m3/hr	To be routed to NREP ETP
18	Suspect condensate	Normal: 12.5 TPH Design: 13.9 TPH	To be routed to NREP CPU
19	Pure condensate	Normal: 1.05 TPH Peak : 4 TPH	To be routed to NREP CPP

2.6 Proposed Schedule for Approval and Implementation

The construction activities will be started immediately after getting EC and CTE. The expansion project Time schedule for completion of the proposed project is given in **Table 2-5.**

Table 2-6 Time Schedule for proposed project

S. No.	Particulars	Time Schedule
1	EC	May 2024
2	Consent to Establish from PCB	August 2024
3	Erection & Installation of Machinery	2024-27
4	Consent to Operate from PCB	2025-26
5	Commissioning	2026-27

2.7 Project Details

2.7.1 Proposed Facility

The Polymer Grade Propylene produced in the PRU section of the PFCC Unit of NREP is further processed in the downstream unit i.e. PP unit to produce Homo-polymer grade Polypropylene product.

S.No.	Name of the Unit	Unit Configuration
1	Poly propylene unit	360 KTPA

2.7.1.1 Technology & Process Description

Base Case: Base case corresponds to 6 MMTPA Refinery with PFCCU operating in low severity mode and propylene produced from PRU is absorbed in the LPG product streamand no propylene sale is envisaged. No Polypropylene unit.

Max Propylene + PP Case: Expansion case corresponds to 6 MMTPA Refinery withPFCCU operating in propylene maximization mode or high severity mode and with Polypropylene (PP) unit in operation. PP Unit taking feed propylene from upstream PFCC unit and producing poly propylene which will be sold as final product.

Under NREP a high severity PFCC unit with a capacity of 1.955MMTPA is being implemented. The LPG that will be generated in the high severity mode will contain a significant potential of propylene which can be recovered for value addition. The Polymer Grade Propylene produced in the PRU section of the PFCC Unit is further processed in the downstream unit i.e. PP unit to produce Homo-polymer grade Polypropylene product

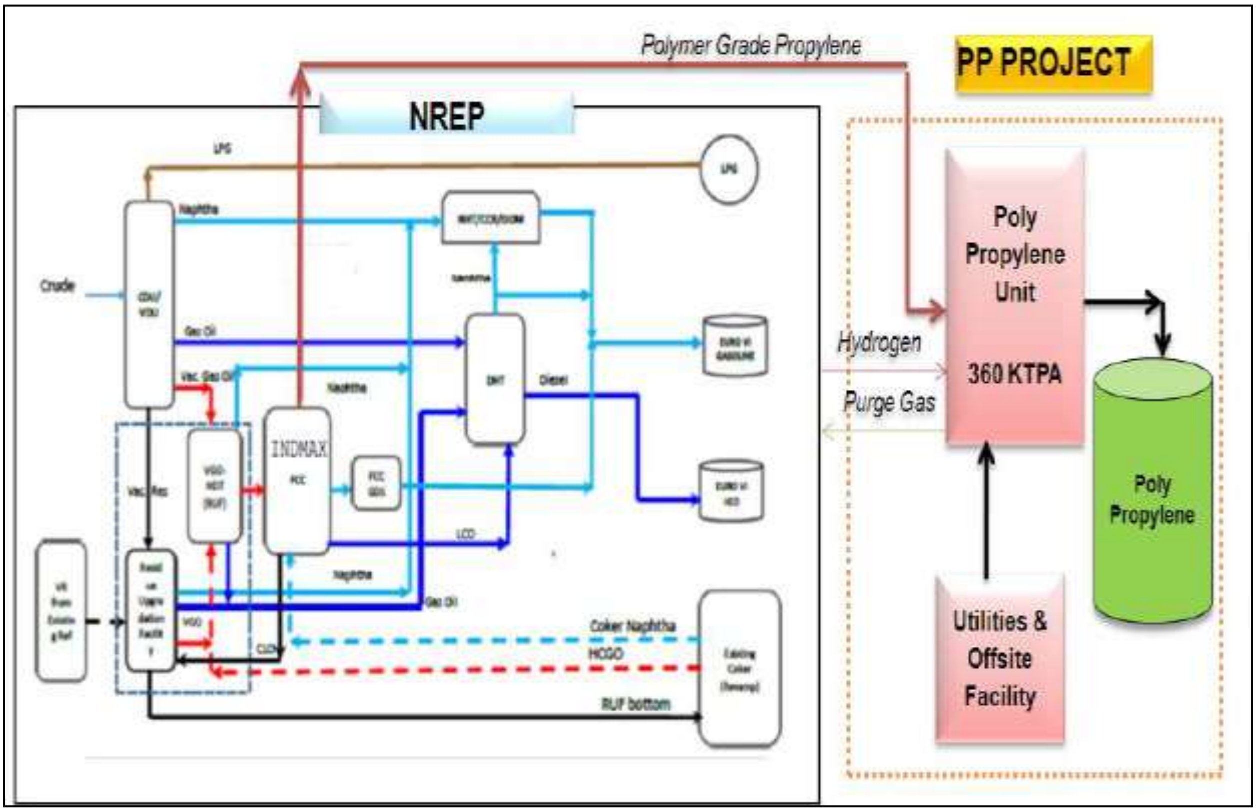


Figure 2-5 Schematic diagram of Proposed PP Facility

Poly Propylene Unit

Polymer grade propylene having 99.6 wt% of propylene and 0.4 wt% of propane is provided from OSBL at 39 kg/cm2(g) and 40 deg C.

Polypropylene unit is divided in 8 sections i.e :

a) Propylene Purification Section
b) Hydrogen purification Section
c) Nitrogen Purification Section
d) Reaction section
e) Resin Degassing Section
f) Vent Recovery Section
g) Extruder and pelleting section
h) Pellet Conveying and homogenization section

A) Propylene Purification Section:

Facilities are provided to purify and pump propylene to reaction section. Traces amount of components such as water; arsine, oxygen, CO2, CO, ammonia, alcohols and ketones are reduced to acceptable concentrations in the propylene purification system to avoid polymerization catalyst poisons. Purification section comprises of:

I. Propylene Arsine removal Vessel

II. Propylene Dryer: To remove water

III. Propylene CO Treater: To remove CO IV. MAP Removal: To remove acetylene V. Propylene filter

B)Hydrogen Purification Section:

Hydrogen is added to control the size of the polymer molecule and sets the MFR of the final product. Low pressure Hydrogen is supplied from OSBL with a battery limit pressure of 18 kg/cm²(g) and 45 deg C.Facilities are provided to purify and compress hydrogen to reaction section. Traces amount of CO, CO2 and water compounds poisons the polymerization catalyst. In the purification system CO, CO2 and water is reduced to acceptable concentrations in the purification system.

C)Nitrogen Purification section:

Nitrogen is supplied from OSBL with a battery limit pressure of 4.0 kg/cm2(g) and at amb. temperature. Facilities are provided to compress nitrogen and to fed reaction section which is to be used during reactor shutdown and for designated high pressure consumer.

Low pressure Nitrogen provided at Battery limit is used for regenerable bed treatersi.e Hydrogen dryer, Propylene Dryer and CO removal bed. Following major equipments are provided in the nitrogen purification section:

I. Nitrogen compressor

II. Nitrogen Heater : To heat Nitrogen during regeneration of dryer beds

III. Nitrogen Filter

D)Reaction section:

Fresh propylene is fed to the reactor along with the required catalyst, co-catalyst, hydrogen and stereo-modifier (donar) for production of four different grades of homopolymeri.e

I. Raffia Grade : Annual production 190KTPA (*)

II. Non-woven spun Bond grade : Annual Production 90 KTPA (*)

III. Non-woven melt blown grade : Annual Production 25 KTPA (*)

IV. Injection Moulding homopolymergrade : Annual Production 55KTPA (*)

(*)Quantity specified above including off-spec (transition) material generated.

The reaction take place in a gas phase reactor, the heat of polymerization is removed by evaporative cooling supplied by liquid propylene feed. Reaction gas is continuously removed from the top of the reactor. Reactor overhead vapour (“Recycle Gas”) is partially condensed and recycled backed to the reactor. The products are discharged from the reactor to the resin degassing section.

E)Resin Degassing Section:

A mixture of entrained hydrocarbons and nitrogen separates from the resin in the resin degassing section. The un-reacted monomer and nitrogen from degassing vessel top is sent to the vent recovery section for separation of un-reacted monomer and nitrogen.

F)Vent Recovery Section

Un-reacted monomer from the degassing section is further compressed and Nitrogen is separated from un-reacted monomer by using propylene as a refrigerant. Recovered nitrogen rich stream is further used as a conveying gas. Un-reacted monomer recycled back to the reactor and a part of un-reacted stream which is rich in propylene content is send to PFCC for propylene recovery.

G)Extruder and pelleting section

The main flow of granular resin, solid additives and liquid additive from the resin additive handling system are fed to the extruder. In the extruder the polymer powder together with solid additives is melted and homogenized through the shear induced by the co-rotating intermeshing screws.

Gases, nitrogen and devolatilized hydrocarbons are vented from the extruder. The melt then enters the underwater pelletizer through a die plate where rotating knife blade cut the melt into pellets. The pellet water slurry is pumped into an agglomerate remover and pellet dryer. The water returns to the pellet water system consisting of a pelleting water tank, a pelleting water pump and a pelleting water cooler.

Losses from the pellet water loop are compensated with demineralized water. The dry pellets are screened (removal of possible oversize pellet agglomerates or undersize pellets) and pneumatically conveyed to the pellet blending silos for homogenization.

H) Pellet Conveying and homogenization section

Within the pellet pneumatic conveying system, pellets are conveyed by air in a conveying system that is suitable to minimize dust and angel hair formation during the conveying process. The air compressors supply the air for:

- pneumatic conveying of pellets from extrusion to blending silos
- pneumatic conveying of pellets from blending silos to bagging units
- blending air and purge air for homogenization silos

Conveying air is filtered before compression. Downstream of the compressors the air is cooled. Condensed water is separated, and the air is again filtered.

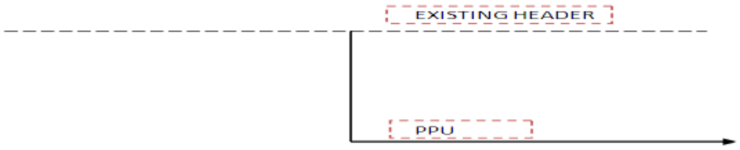
Within the pellet homogenization process, polymer pellets are homogenized by re- circulating the pellets around the pellet blending silos. In addition, the silos are designed with internals that permit pellets to flow at different rates within the body of the silo. This ensures a homogeneous blend of pellets at the silo discharge point.

Pellets from the blending silos are conveyed to the bagging system. Pellets from the blending silos are fed by conveying air to the elutriator. Air for elutriators is supplied by elutriator blower which is equipped with elutriator blower filter. Pellets flow by gravity via elutriator rotary feeders to the pellets bagging lines and storage.

2.7.2 Proposed Utility

2.7.2.1 Treated Raw Water System

Treated Raw water for the PP complex will be provided from existing NREP treated raw water header.



The estimated treated water requirement for various purposes in the complex is summarized in the following table

Table 2-7 Treated Raw Water Consumption

S.No	Unit	Normal -m3/hr	Maximum-m3/hr
1.	CoolingwaterMake up	205	244 (Note-1)
2	PP Unit	5	6
Total Treated Raw Water Demand; m^3/hr		210	250 (Note-2)

Note:

1. Maximum cooling water makeup corresponds to the installed capacity of the cooling tower.

2. Maximum raw water demand is considering 20% Design margin on normal raw water requirement. This will also take care of the maximum requirement of any of the above stream at a time along with the normal requirements of other streams.

2.7.2.2 Recirculating Cooling Water System

Cooling water, an essential utility in process units is required to remove heat from process fluids for cooling.A typical scheme of re-circulating cooling water system is shown in figure below

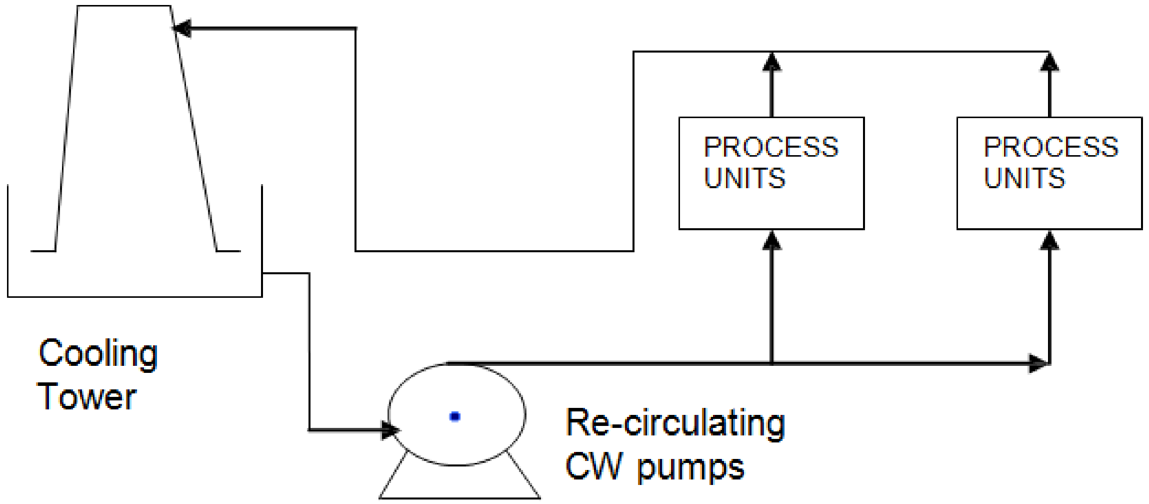


Figure 2-6 Typical Scheme of Recirculating Cooling Water System

The cooling water requirements of the PP Unit and associated facilities will be met through separate re-circulating cooling water systems operating with treated raw water as makeup. Cooling water requirement for all the facilities in the PP complex will be entirely met through one new cooling water systems as mentioned below:-

Cooling water system (Cooling tower): This cooling water system will meet total cooling water demand of PP unit and its associated facilities such as Lab, PP Substation, and PP SRR. The cooling water system includes cooling towers, cooling water circulating pumps, cooling water treatment facilities viz. chemical dosing for quality control, Sulphuric acid for pH control etc. and other auxiliary items.

The make-up water for the cooling water system shall be taken from the NREP existing treated raw water system header.

2.7.2.3 Power demand for the PP complex

Power is used in the PPU Unit and its associated facility mainly for the following main purposes:

a) For driving motors to run various rotating machinery (pumps, compressors, blowers, etc.) in the complex

b) For meeting the power demand of instruments in the entire complex

c) For operating electric heaters (like instrument air dryer heater, electric tracing of lines if specified, etc.)

d) For plant lighting and other miscellaneous purposes, etc

2.7.2.4 Compressed Air And Nitrogen System

Compressed air is required in the complex for the following main requirements:

- As Instrument Air to operate the various instruments in the facility and also for the purging of some control panels
- As PlantAir is used for scouring air for side stream filters of cooling water systems, etc.
- Compressed air required for all of the above uses is generated at a centralised location in the plant and distributed to the various users through headers. Two qualities of compressed air are produced and distributed:
- Plant Air comprising compressed air cooled to ambient temperature. This air,though not containing any entrained water droplets,is saturated with water vapour at the supply conditions.
- Instrument Air comprises compressed air cooled to ambient temperature and dried toremove water vapour to meet stringent atmospheric dew point requirements.

This systemwill be designed to supply compressed air to the various users at the required conditions, quality and quantity.

There will be a common plant air header & common Instrument air header fromNREP CompressedAirSystem to various processand utilityareas.

During a power failure,to enable the safe shutdown of PPUnit,facilities will be provided to supply emergency instrument air for upto 30minutes

2.7.2.5 Nitrogen system

High purity Nitrogen is required in the PP Unit and associated facility for the following purposes:

(A) Continuous requirement

- Blanketing of surge drums and storage tanks
- Purging of compressor seals,flareheader purgingetc.

(B) Intermittent requirement

- Purging of systems during start-upsand shut-downs
- Absorbant/AdsorbantRegeneration

2.7.2.6 Fuel System

No additonal fuel requirement for the NRL PP Project.The fuel requirement of 125 kg/hr for the Emergency DG will be utilised from the existing NREP fuel requirement.

2.7.2.7 Flare system

The flare system will be provided for safe disposal of combustible, toxic gases which are relieved from process plants and offsites during start-up,shutdown,normal operation or in case of an emergency such as:

- Coolingwater failure
- General Power failure
- External firecase
- Anyotheroperationalfailure
    - Blocked outlet
    - Reflux failure
    - Local power failure
    - Tuberupture

The refinery complex shall have single flare systems, for Hydrocarbon flare for process units &off-sites handling hydrocarbon and the other for the sulphur block handling sour flare.

The HC flare from the PP Unit has one independent flare header and shall be connected to existing flareheader of NREP.

2.7.2.8 Brief specification of Electric Equipments

Emergency Power requirement for PP complex

Emergency powers are considered for the compressor Lube oil package, MOVs, Firewaterpump, Lighting, communication system, Hazard detection and signalling etc.The emergency power required for the PP complex is750KW.This emergency power requirement shall be met from the new emergencygenerator set in the Substationof NRL PP complex. The emergency generator set will start automatically on power failure and feed the selected loads.It shallbe capable of taking care of the load variations (e.g.the starting of the largest rated motor with specified base load).

2.7.2.9 Project requirements

2.7.2.10 Material Balance

The material balance of the proposed project is given in **Figure 2-7**.

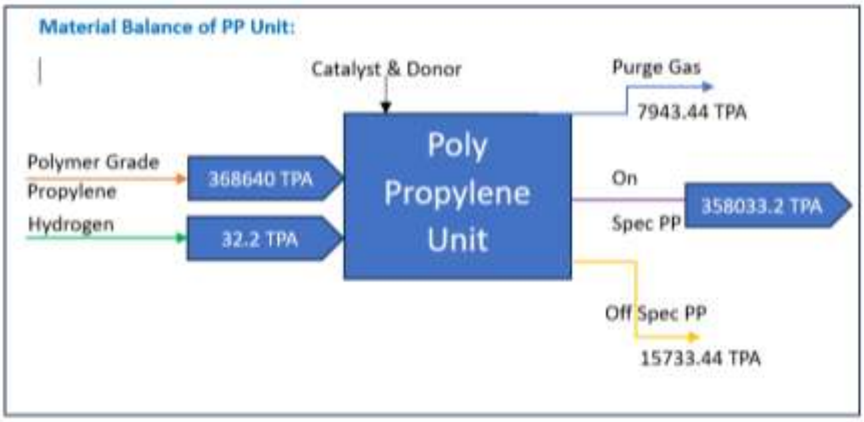


Figure 2-7 Schematic diagram of Material Balance of Proposed PP Facility

2.7.2.11 Raw Materials and Mode of Transportation

PPU receives polymer grade propylene as feed from the upstream PFCC unit. Normally, PPU will receive 100% of feed directly from the PFCC unit. However, in case ofemergency shutdown of the PP Unit, provision has been kept to store polymer grade propylene in the offsite storage. Three (3) no. of mounded bullets (MB) each with a pumpable capacity of 1620MT have been considered for storing propylene. Three (3) daysof storage requirement have been considered while working out the bullet capacity.

Table 2-8 Proposed Raw material

S.no.	Raw-Material	Unit	Proposed quantity	Mode of Transport	Source	Storage Facility (M3)
1	Polymer Grade Propylene	KTPA	368.6	Pipeline	Petro FCC Unit of NREP	3 nos (2W+1S) of Mounted Bullet with Dia 8m & Height 80m
2	Hydrogen Gas	KTPA	0.032	Pipeline	NREP Hydrogen network	Nil

Table 2-9 Proposed Chemicals and Catalyst

S.no.	Raw-Material	Unit	Proposed quantity	Mode of Transport	Source	Storage Facility (M3)
1	Polymerization catalyst	TPA	21.8	Truck via road	Licensor-proprietary item	Catalyst and chemical warehouse-OSBL: 25 m X 25m Catalyst and chemical warehouse-ISBL: 20 m X 20 m Peroxide storage-ISBL: 10m X 15m
2	Co-catalyst: TEA	TPA	97.2	Truck via road	Open market	
3	Donor: Silane	TPA	5.26	Truck via road	Open market	
4	Peroxide	TPA	151.7	Truck via road	Open market	
5	Solid additives	TPA	652.3	Truck via road	Open market	

2.7.2.12 Product evacuation and Mode of Transportation

90% of product shall be bagged in 25 kg bags and 10% in 1000 kg Flexible IntermediateBulk Container (FIBC).Bagging operation should be considered during the period from6AM to 10 PM i.e 16 hours per day bagging with 12hrs of effective bagging time is considered.

Bagged product from bagging machine is stacked in the ware house with the help of fork lift. From the ware house stacked bags of final product is loaded in the truck at loading station and send to various consumers by road.

Following assumptions are considered for truck loading and unloading facility:

Truck loading/ unloading will take place in only day time = 7 hrs/day

Truck Capacity = 16 Tons/truck

No. of trucks loading/unloading per station = 2 trucks/ station

Time for loading/unloading in 1 station = 1 hrs/ station

8 no. of truck loading station & 10 trucks for loading per hour is envisaged for NRL PP Unit./with 2 trucks loading in 1 station is envisaged for NRL PPUnit

2.7.2.13 Plot area

The proposed PP unit will be set up at a Green field land located at North side of theNumaligarh Refinery. The proposed site is well connected by road network and rail network. The proposed PP plant will be integrated with NREP complex.

The total Plot no. 11 area is 600 Bigha (8,02,681.92 sq.m) (80.27 Ha). Out of which Total plot area required for the PP Unit and its associated facility is 348093 SQM (34.8 Ha). The plant area is 232821 sq.m (23.28Ha) and Greenbelt area is 115272 sq.m (11.52 Ha) i.e, (33.1 % of total area) at Plot No.11 located at North side of the Numaligarh Refinery. The remaining 454588.92 sq.m (45.45 Ha) will be utilized for future project activities.

Table 2-10 Land use breakup of the Project Site

S. No	Description	Proposed Area in Ha	Proposed Area in m^2	%
1	Plant area (Process units + Utility + Offsite + Building + Road)	23.28	232821	66.9
2	Green Belt Area	11.52	115272	33.1
Total		**34.8**	**348093**	**100**

2.7.2.14 Site Photographs

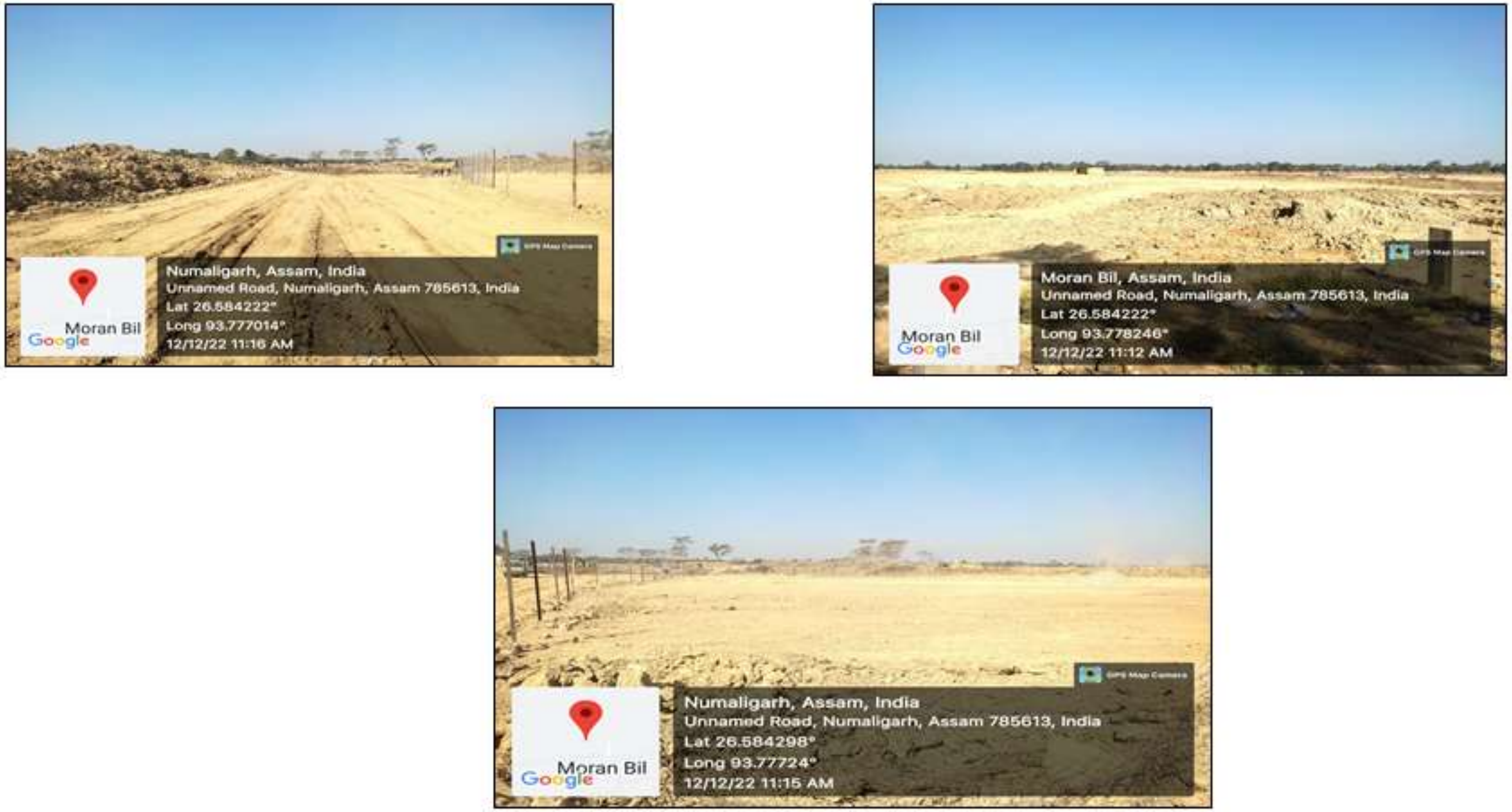


Figure 2-8 Proposed site Photograph

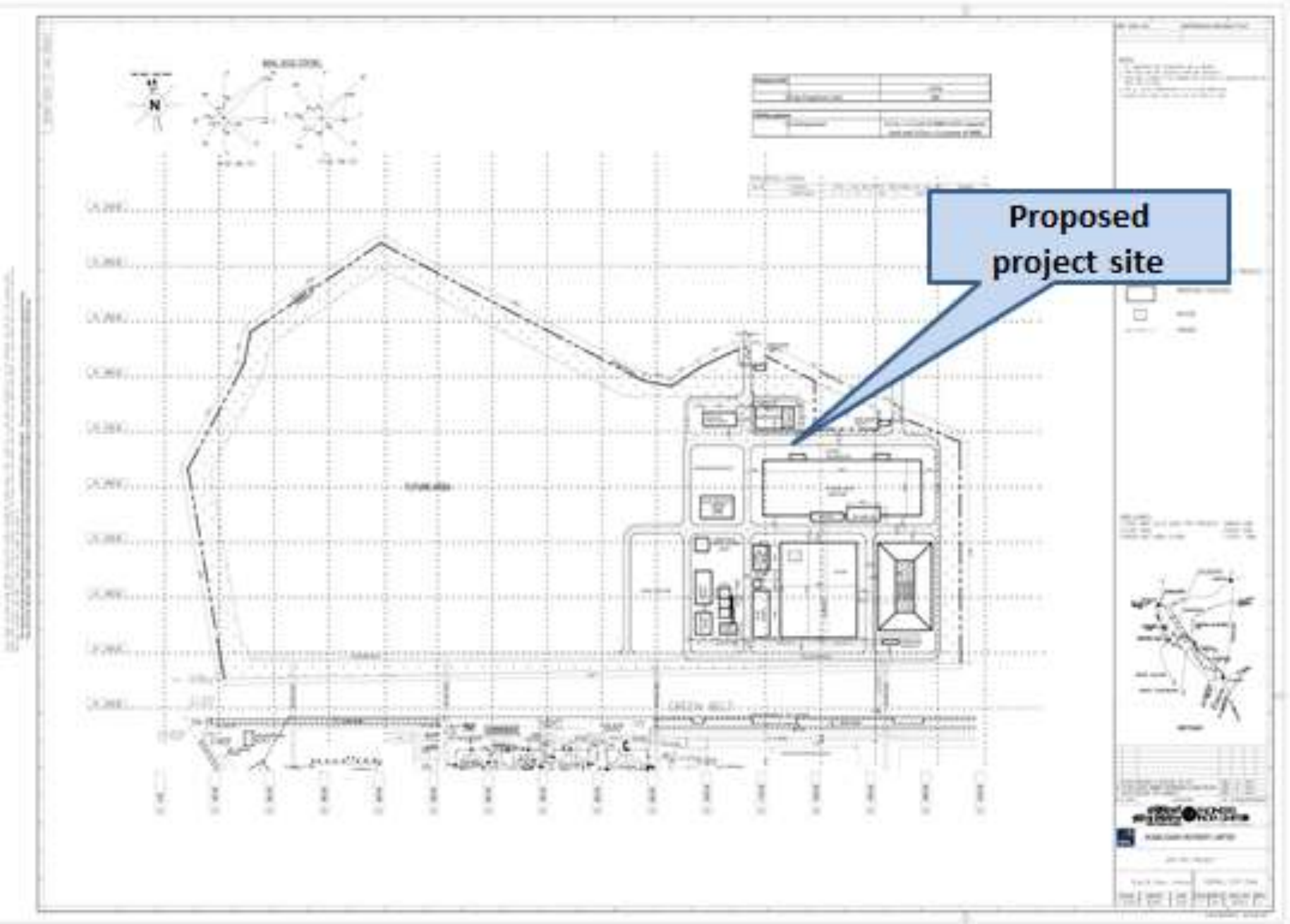


Figure 2-9 Proposed Site Layout

2.7.2.15 Manpower

Table 2-11 Manpower requirements

Description		Construction Phase	Operation Phase
Proposed	**Permanent**	0	17
	Contract	1750	36
Total (A)		1750	53
Period of employment in days (B)		1080	365
Total Man-days(A*B)		1080*1750=18,90,000	19,345

2.7.2.16 Power and Fuel Requirements

The power requirement for the project is sourced from Grid. The details of power requirement are given in **Table 2-12.**

Table 2-12 Power and fuel Requirement

Description	Unit	Proposed	Source
Power requirement	MW	26	Grid
Emergency DG	KW	750	-
No Fuel Requirement for the NRL PP project*			
Diesel for DG	Kg/hr	-	Existing NREP fuel

Note:**The fuel requirement of 125 kg/hr for the Emergency DG will be utilised from the existing NREP fuel requirement.*

2.7.2.17 Water requirements

Total raw water requirement of the proposed facility will be 210 m3/hr. Treated Raw water of 210 m3/hr for the PP complex will be provided from existing NREP treated rawwater header.The water approval obtained is attached as **Annexure-9**.

Break up of Treated Raw Water required for the PP complex is as follows:

S.No	Unit	Normal m3/hr	Maximum m3/hr
1.	Cooling water Make up	205	244 (Note-1)
2	PP Unit	5	6
Total Treated Raw Water Demand; m^3/hr		210	250 (Note-2)

Notes:

1. Maximum cooling water makeup corresponds to the installed capacity of the cooling tower.

2. Maximum raw water demand is considering 20% Design margin on normal raw water requirement. This will also take care of the maximum requirement of any of the above stream at a time along with the normal requirements of other streams.

2.7.2.18 Waste water Quality, Quantity and Treatment Method

Only effluent generation of 50.23 m^3/hr and sewage of 0.212 m^3/hr will be generated due to this proposed project and treated in the existing NREP ETP.

Description	**Proposed(m^3/hr)**	**Disposal Method & Facility Details (m^3/hr)**
Effluent generation		
Cooling tower blowdown	50	Cooling tower blowdown from PP unit will be diverted to RO plant (Design: 600 m3/hr) under existing NREP ETP Package.
Process effluent	0.23	PP process effluent to be treated in existing NREP ETP (Design: 450 m3/hr and cnormal flow is 360 m3/hr
Sub-Total	**50.23**	
Sewage	0.212	Diverted to existing NREP ETP for treatment
Total waste water generation	**50.442**	

The sewage generated will be routed to the existing NREP ETP for further treatment.. The processeffluent from PP unit will be routed to NREP ETP for treatment.The treated effluent from NREP ETP is planned to be reused in cooling tower, fire water and Horticulture (greenbelt).The other wastewater generation has been given in the **Table 2-14.**

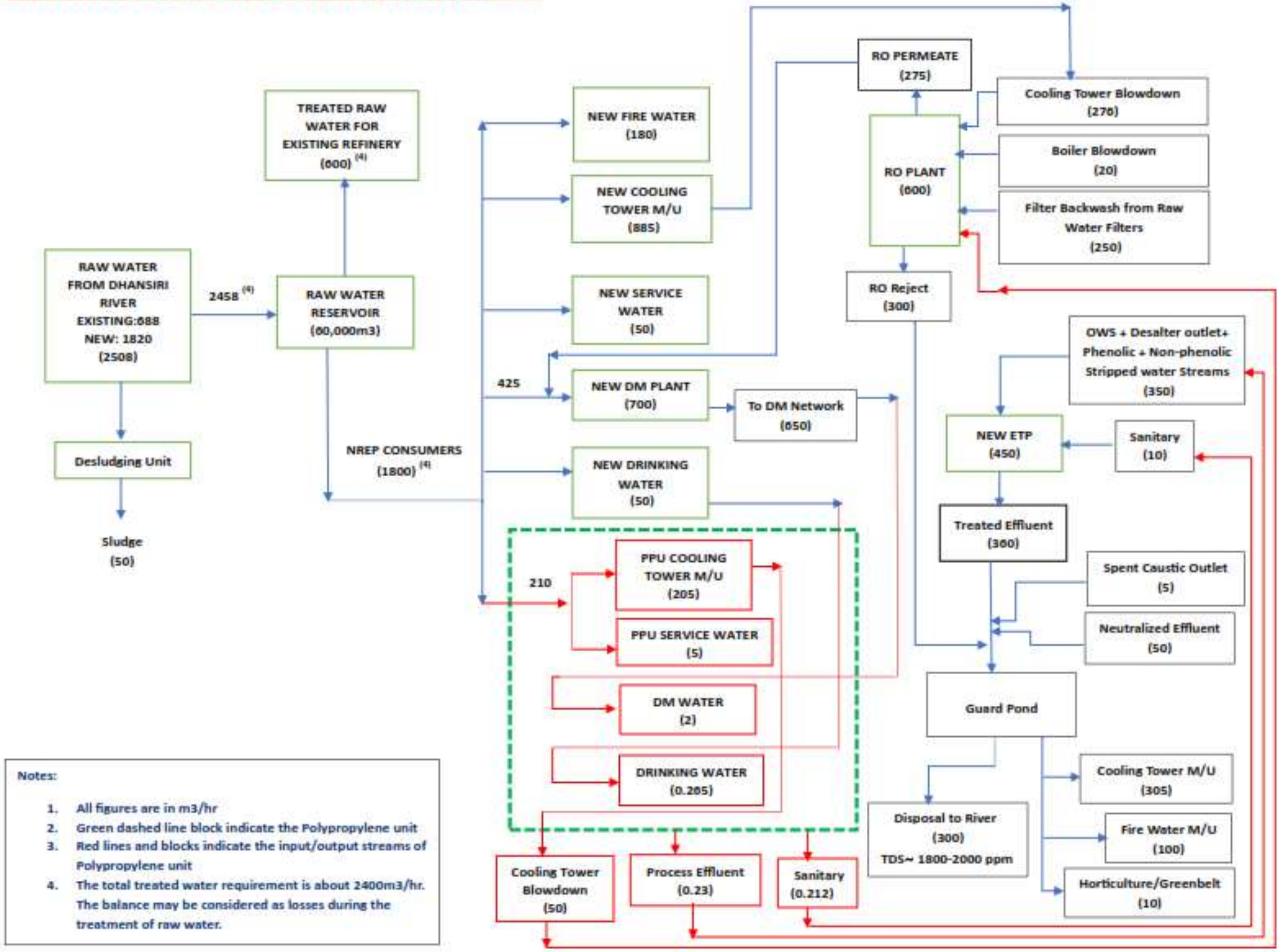
Process description and flow diagram of ETP is attached as **Annexure 10** and **Annexure 11.**

Table 2-13 Details of Liquid Effluent from the proposed project

Source of Emission	Name	Mode of Operation	Frequency	Quantity	Composition	Treatment (OSBL)
1P39-VV1632, Nitrogen Regeneration Recycle K.O. Vessel	Waste Water	discontinuous	1 time per year	Approx. 0.6 m^3 **(Note 1)**	Condensed moisture during regeneration	Sewer
1P39-Z-3681, Extruder Pelletizer	Waste Water	Discontinuous	during start-up during emptying	max. 1 m^3 / Start-up max. 40 m^3 for 1 min. (by Extrusion package vendor)	Clean water with polypropylene pellets and powder (fines)	Separation of solids in waste water basin (designed with separator)
1P39-ZVV-3783, Pellet Water Tank	Wastewater	Discontinuous	during start-up during emptying of tank (maintenance)	max. 1 m^3 / Start-up max. 25 m^3 during emptying of tank (by Extrusion package vendor)	Demin. Water with PP Solids	Separation of Solids

Source of Emission	Name	Mode of Operation	Frequency	Quantity	Composition	Treatment (OSBL)
1P39-VV-6631, Phase Separator	Wastewater	Continuous	8,000 h / year	max 0.23 m^3/h	Water; pH = 6-9 Typical average values COD (chemical oxygen demand) < 500 mg/l BOD (5 day) < 350 mg/l TOC < 600 mg/l Typical organic contaminants - Acetone (~10%) - Isopropanol (~20%) - Terbutanol (~70%)	Separation of insoluble Organic Compounds
Waste Water Collection Pit	Waste Water / Rain Water	discontinuous / continuous			Water; pH = 6-9	Separation of insoluble Organic Compounds

Water Balance of Refinery post NREP-Polypropylene unit



Notes:

1. All figures are in m3/hr
2. Green dashed line block indicate the Polypropylene unit
3. Red lines and blocks indicate the input/output streams of Polypropylene unit
4. The total treated water requirement is about 2400m3/hr. The balance may be considered as losses during the treatment of raw water.

Figure 2-10 Proposed Water Balance Diagram

2.7.2.19 Green Belt

As per the rules and regulations laid by Ministry of Environment Forest and Climate Change, Central Pollution Control Board (CPCB) and State Pollution Control Board (SPCB), it is legally mandatory to earmark 33% of the project area for greenbelt development to promote integration of environmental issues with industrial development projects.

Table 2-14 Proposed Green belt details

S.No.	Description	Proposed
1	Area proposed incremental for green belt (in sq.m)	115272sq.m (11.52 Ha)
2	Width of green belt (in m) along the boundary of the project or activity	15m
3	Percentage of the total area covered under green belt (%)	33.1%
4	No. of tree saplings to be planted	34560
5	Funds allocated for plantation in Lakhs.	207.36

The following are the list of species which will be planted for the proposed project.

Table 2-15 Recommended Species for Proposed Green Belt Development

S. No.	Species Name	Family	Type	Areas to be Planted
1	Abutilon indicum L.	Malvaceae	Shrub	Avenue
2	Acacia catechu Willd.	Mimosaceae	Tree	Greenbelt
3	Acacia farnesiana (L.) Willd.	Mimosaceae	Tree	Avenue
4	Acacia leucophloea (Roxb.) Willd.	Mimosaceae	Tree	Greenbelt
5	*Acacia mearnsii* de Willd.	Mimosaceae	Tree	Avenue
6	Acacia nilotica (L.) Willd.	Mimosaceae	Tree	Avenue
7	Acacia pennata Willd.	Mimosaceae	Tree	Avenue
8	Acacia polycantha Willd.	Mimosaceae	Tree	Greenbelt
9	Acacia Senegal Willd.	Mimosaceae	Tree	Greenbelt
10	Acacia sinuate (Lour) Merill	Mimosaceae	Tree	Avenue
11	Acer campbellii Hook F. and Thomas.	Aceraceae	Tree	Greenbelt
12	Acer negundo L.	Aceraceae	Tree	Greenbelt
13	Achras sapota L.	Sapotaceae	Tree	Residential
14	Actinodaphne angustifolia Nees.	Lauraceae	Tree	Avenue
15	Adenanthera pavonia L.	Mimosaceae	Tree	Avenue
16	Adina cordifolia Roxb.	Rubiaceae	Tree	Greenbelt
17	Aegle marmelos (L.) Correa ex Roxb.	Rutaceae	Tree	Residential
18	Aesculus indica Hook	Sapindaceae	Tree	Greenbelt
19	Ailanthus altissima (Mill)Swingle	Simarubaceae	Tree	Greenbelt

S. No.	Species Name	Family	Type	Areas to be Planted
20	Ailanthus excelsa	Simarubaceae	Tree	Greenbelt
21	Alangium chinense (Lour) Harms	Alanginaceae	Tree	Greenbelt
22	Albizia chinensis (Osbeck) Merill	Mimosaceae	Tree	Greenbelt
23	Albizia lebbeck	Mimosaceae	Tree	Greenbelt
24	Albizia odoratissima Benth.	Mimosaceae	Tree	Greenbelt
25	Albizia procera Benth	Mimosaceae	Tree	Greenbelt
26	Aleurites fordii Hemsl	Euphorbiaceae	Tree	Greenbelt
27	Alnus nepalensis D.Don	Betulaceae	Tree	Greenbelt
28	Alnus nitida Endl	Betulaceae	Tree	Greenbelt
29	Alstonia scholaris (L.) R.Br.	Apocynaceae	Tree	Avenue
30	Annona reticulata L.	Annonaceae	Tree	Residential
31	Annona squamosa L.	Annonaceae	Tree	Residential
32	Anogeissus latifolia Wall.	Combretaceae	Tree	Greenbelt
33	Anthocephalus chinensis Lamk.	Rubiaceae	Tree	Avenue
34	Aphanamixis polystachya (Wall) Parker	Meliaceae	Tree	Avenue
35	Artocarpus heterophyllus Lamk.	Urticaceae	Tree	Residential
36	Artocarpus lacucha Bucb.	Urticaceae	Tree	Residential
37	Azadirachta indica A. Juss.	Meliaceae	Tree	Avenue
38	Balanites roxburghii Planch.	Zygophyllaceae	Tree	Avenue
39	Bambusa arundinacea (Retz.) Roxb.	Poaceae	Shrub	Park/Office
40	Bambusa vulgaris Schrad.	Poaceae	Shrub	Park/Office
41	Barringtonia acutangula (L.) Gaertn.	Barringtoniaceae	Tree	Greenbelt
42	Bauhinia acuminata L.	Caesalpiniaceae	Tree	Avenue
43	Bauhinia purpurea L.	Caesalpiniaceae	Tree	Avenue
44	Bauhinia racemosa Lam.	Caesalpiniaceae	Tree	Avenue
45	Bauhinia semla Wanderlin	Caesalpiniaceae	Tree	Avenue
46	Bauhinia variegata L.	Caesalpiniaceae	Tree	Avenue
47	Betula alnoides Buch- Ham.	Betulaceae	Tree	Greenbelt
48	Bischofia javanica Blume	Euphorbiaceae	Tree	Greenbelt
49	Bougainvillea spetabilis Willd.	Nyctaginaceae	Shrub	Park/Office
50	Bridelia squamosa Lamk.	Euphorbiaceae	Tree	Greenbelt
51	Broussonetia papyrifera L. Nerit	Moraceae	Tree	Greenbelt
52	Buchnania lanzan Spreng	Anacardiaceae	Tree	Greenbelt
53	Butea monosperma (Lam.) Taub.	Papilionaceae	Tree	Greenbelt
54	Caesalpinia pulcherrima (L.) Swartz	Caesalpiniaceae	Shrub	Avenue
55	Callistemon citrinus (Curtis) Stapf	Myrtaceae	Shrub	Park/Office
56	Calophyllum inophyllum L.	Clusiaceae	Tree	Greenbelt
57	Carissa spinarum L.	Apocynaceae	Shrub	Park/Office

S. No.	Species Name	Family	Type	Areas to be Planted
58	Cassia fistula L.	Caesalpiniaceae	Tree	Avenue
59	Cassia javanica L.	Caesalpiniaceae	Tree	Avenue
60	Cassia pumila Lamk.	Caesalpiniaceae	Tree	Avenue
61	Cassia siamea Lamk.	Caesalpiniaceae	Tree	Avenue
62	Ceiba pentandra (L.) Gaertn.	Bombacaceae	Tree	Greenbelt
63	Celtis australis L.	Ulmaceae	Tree	Greenbelt
64	Citrus aurantium L.	Rutaceae	Tree	Park/Residen tial
65	Cordia dichotoma Forst	Cordiaceae	Tree	Greenbelt
66	Dalbergia latifolia Roxb.	Caesalpiniaceae	Tree	Greenbelt
67	Dalbergia sisoo Roxb.	Papilionaceae	Tree	Greenbelt/Avenue
68	Delonix regia (Bojer) Rafin.	Caesalpiniaceae	Tree	Avenue
69	Dendrocalamus strictus Nees	Poaceae	Shrub	Park/Residen tial
70	Pongamia pinnata (L.) Pierre	Papilionaceae	Tree	Greenbelt
71	Diospyros melanoxylon Roxb.	Ebenaceae	Tree	Avenue
72	Drypetes roxburghii (Wall.) Hurusawa	Euphorbiaceae	Tree	Avenue
73	Duranta repens L.	Verbenaceae	Shrub	Park
74	Emblica officinalis Gaertn.	Euphorbiaceae	Tree	Residential
75	Embryopteris peregrine Gaertn.	Ebenaceae	Tree	Greenbelt
76	Erythrina variegata L.		Tree	Avenue
77	Eucalyptus citriodora Hook.	Myrtaceae	Tree	Greenbelt
78	Eucalyptus citriodora Hook.	Myrtaceae	Tree	Greenbelt
79	Exbucklandia populnea (R.Br) R.W.Br.	Hamamelidaceae	Tree	Greenbelt
80	Ficsu benghalensis L.	Moraceae	Tree	Greenbelt
81	Ficus benjamina L.	Moraceae	Tree	Avenue
82	Ficus elastica Roxb.exHornme	Moraceae	Tree	Park/Office
83	Ficus gibbosa Blume	Moraceae	Tree	Greenbelt
84	Ficus glomerata Roxb.	Moraceae	Tree	Greenbelt
85	Ficus hispida (L.) L.f.	Moraceae	Tree	Greenbelt
86	Ficus religiosa L.	Moraceae	Tree	Park/Residen tial
87	Ficus semicordata Buch. Ham.	Moraceae	Tree	Greenbelt
88	Gardenia jasminoides Ellis	Rubiaceae	Shrub	Park/Residential
89	Gardenia resinifera Roth	Rubiaceae	Shrub	Park/Residential
90	Grevillea robusta A. cunn.	Proteaceae	Tree	Greenbelt
91	Grewia elastica Royle	Tiliaceae	Tree	Greenbelt
92	Grewia subinequalis DC.	Tiliaceae	Tree	Greenbelt
93	Heterophragma roxburghii DC.	Bignonaceae	Tree	Greenbelt
94	Hibiscus rosa-sinensis L.	Malvaceae	Shrub	Park/Office
95	Hippophae rhamnoides L.	Elaeganaceae	Tree	Avenue
96	Ixora arborea Roxb.	Rubiaceae	Shrub	Greenbelt
97	Ixora chinensis			
98	Ixora coccinea L.	Rubiaceae	Herb	Park
99	Ixora rosea Wall.	Rubiaceae	Herb	Park
100	Jacaranda mimosaefolia D.Don.	Caesalpiniaceae	Tree	Office
101	Juniperus communis	Pinaceae	Shrub	Office

S. No.	Species Name	Family	Type	Areas to be Planted
102	Kigelia africana Lamk	Bignoniaceae	Tree	Greenbelt
103	Lagerstroemia parviflora Roxb	Lythraceae	Tree	Avenue
104	Lagerstroemia speciosa L.	Lythraceae	Tree	Avenue
105	Lantana camara L. var. aculeata (L.) Mold.	Verbenaceae	Herb	Park/Office
106	Lawsonia intermis L.	Lythraceae	Shrub	Office
107	Madhuca butyraceae Macb.	Sapotaceae	Tree	Greenbelt
108	Madhuca longifolia (Koenig) J. F. Macb.	Sapotaceae	Tree	Avenue
109	Mallotus philippensis(Lour) Muell	Euphorbiaceae	Tree	Greenbelt
110	Mangifera indica L.	Anacardiaceae	Tree	Greenbelt
111	Milletia peguensis Ali	Papilionaceae	Tree	Avenue
112	Millingtonia hortensis L.f.	Bignoniaceae	Tree	Avenue
113	Moringa oleifera Lamk.	Moringaceae	Tree	Residential
114	Morus alba L.	Moraceae	Tree	Residential
115	Murraya paniculata (L.) Jack	Rutaceae	Shrub	Residential
116	Nerium indicum Mill.	Apocynaceae	Shrub	Park/Residential
117	Nyctanthus arbor-tristis L.	Oleaceae	Shrub	Park/Residen tial
118	Ougeinia oojeinensis (Roxb.) Hochr	Papilionaceae	Tree	Greenbelt
119	Phoenix sylvestris (L.)Roxb.	Arecaceae	Shrub	Park/office
120	Pinus khasiana Hook.f.	Pinaceae	Tree	Greenbelt
121	Pinus roxburghii Sarg.	Pinaceae	Tree	Greenbelt
122	Pinus wallichiana A.B.Jackson	Pinaceae	Tree	Greenbelt
123	Pithecellobium dulce (Roxb.) Benth	Mimosaceae	Tree	Residential
124	Poincia pulcherrima L.	Caesalpiniaceae	Shrub	Avenue
125	Populus alba L.	Salicaceae	Tree	Greenbelt
126	Populus ciliate Wall.	Salicaceae	Tree	Greenbelt
127	Populus deltoids Bartr.	Salicaceae	Tree	Greenbelt
128	Populus euphratica Olivier	Salicaceae	Tree	Greenbelt
129	Populus nigra L.	Salicaceae	Tree	Greenbelt
130	Polyalthia longifolia(Sonn.) Thw	Annonaceae	Tree	Residential/Office
131	Pterygota alata var. irregularis	Sterculiaceae	Tree	Greenbelt
132	Psidium guajava L.	Myrtaceae	Tree	Residential
133	Quercus petraea(Mattuschka) Lieblein	Fagaceae	Tree	Greenbelt
134	Quercus rubra	Fagaceae	Tree	Greenbelt
135	Quercus palustris	Fagaceae	Tree	Greenbelt
136	Salix alba L.	Salicaceae	Tree	Greenbelt
137	Salix babylonica L.	Salicaceae	Tree	Greenbelt
138	Salix caprea L.	Salicaceae	Shrub	Avenue
139	Salix fragalis L.	Salicaceae	Tree	Greenbelt
140	Salix tetrasperma Roxb.	Salicaceae	Tree	Greenbelt
141	Sapindus emarginatusVahl.	Sapindaceae	Tree	Greenbelt

S. No.	Species Name	Family	Type	Areas to be Planted
142	Sapindus sebiferum Roxb.	Sapindaceae	Tree	Greenbelt
143	Saraca asoka Roxb. DeWilde.	Caesalpiniaceae	Tree	Avenue
144	Sesbania grandiflora (L.)Poir.	Caesalpiniaceae	Shrub	Residential
145	Spondias pinnata L.f.	Anacardiaceae	Tree	Avenue
146	Syzigium cumini L.	Myrtaceae	Tree	Residential
147	Taberneamontana divaricata (L.) Burkill	Apocynaceae	Shrub	Residential/Park
148	Tamarindus indica L.	Caesalpiniaceae	Tree	Residential
149	Tecoma stans (L.) Kunth	Bignoniaceae	Shrub	Residential/Park
150	Tectona gandis L.	Verbenaceae	Tree	Greenbelt
151	Terminalia alata Heyne ex Roth.	Combretaceaae	Tree	Greenbelt
152	Terminalia arjuna(Roxb.ex DC.) Wight&Arn.	Combretaceae	Tree	Greenbelt/Avenue
153	Terminalia bellerica(Gaertn) Roxb.	Combretaceae	Tree	Greenbelt
154	Terminalia catappa L.	Combretaceae	Tree	Avenue
155	Terminalia chebula Retz.	Combretaceae	Tree	Greenbelt
156	Thuja occidentalis L.	Cupressaceae	Tree	Avenue
157	Trema orientalis Blume	Ulmaceae	Tree	Greenbelt
158	Ulmus wallichiana Planch.	Ulmaceae	Tree	Greenbelt
159	Ziziphus mauritiana Lam.	Rhamnaceae	Tree	Greenbelt

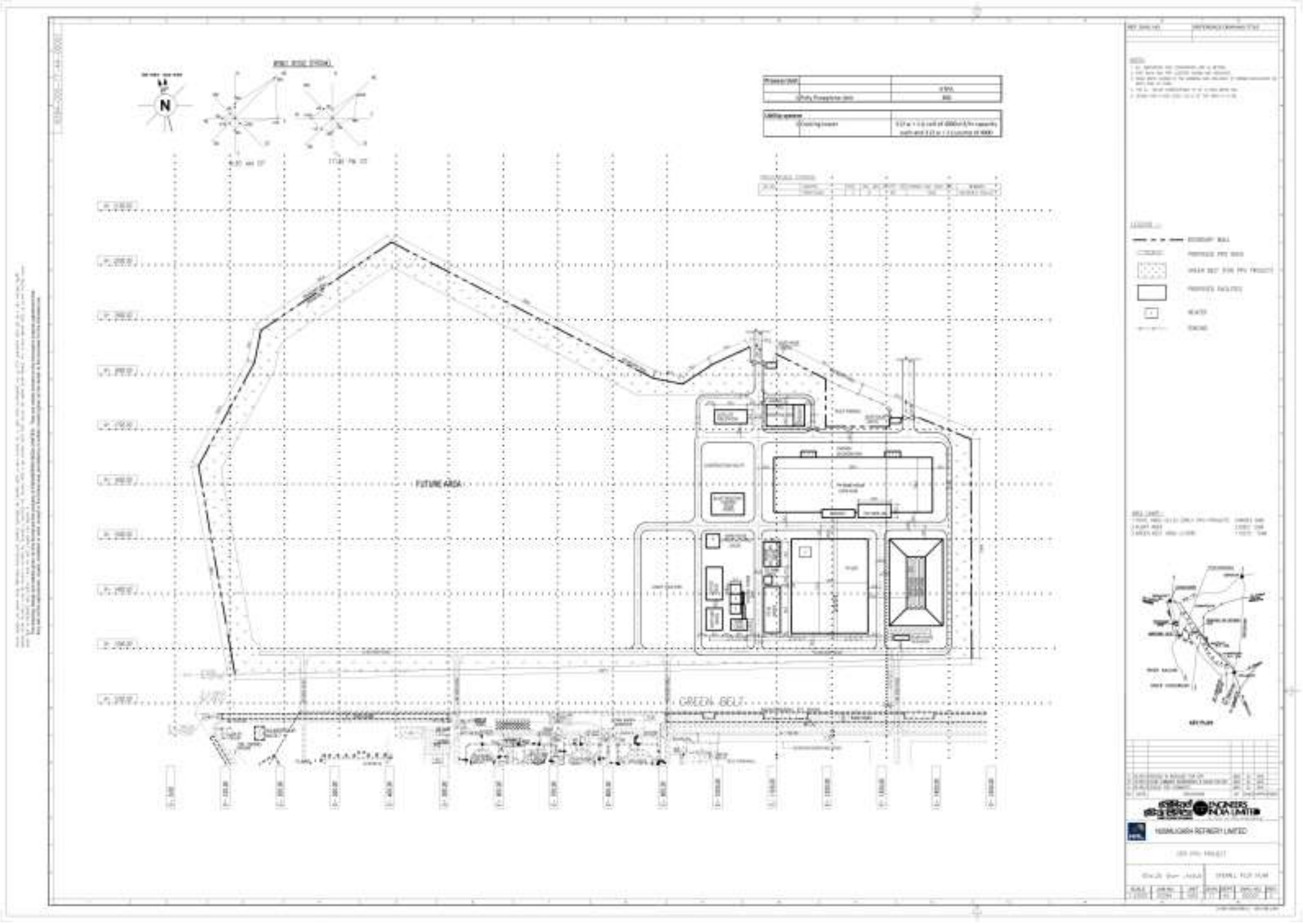


Figure 2-11 Proposed Greenbelt development Layout

2.7.2.20 Solid Waste Management.

The Municipal Solid Waste generation during construction and operation Phase is given in the **Table 2-16** and **Table 2-17** respectively.

Table 2-16 Solid waste generation in construction phase

S. No	Description	Proposed Quantity (Kg/day)	Method of Disposal
1	Organic	472.5	Municipal Bins
2	Inorganic	315	Disposed to PCB authorized recyclers
Total		**787.5**	

Table 2-17 Solid waste generation in construction phase

S. No	Description	Proposed (Kg/day)	Method of Disposal
1	Organic	14.31	Municipal Bins
2	Inorganic	9.54	Disposed to PCB authorized recyclers
Total		**23.85**	

2.7.2.21 Hazardous Waste Management

Hazardous waste materials will be properly disposed as per the Hazardous Wastes (Management, Handling and Transboundary Movement) Rules 2016; Hazardous waste authorization will be obtained**.**

The process effluent generation from PPU unit is very negligible and the same will not have any impact on NREP ETP effluent and subsequent sludge generation. However, note that estimated sludge generation from NREP ETP will be 30 m3/hr-oily and (chemical)and 20 m3/hr (bio sludge).In addition, spent oil/ Used oil which will be generated from the emergency DG will be minimal which will be disposed to authorized recyclers.The other Hazardous waste generated in the project has been given in **Table 2-18.**

Table 2-18 Other Hazardous waste generated

Source	Name	Mode of Operation	Frequency	Quantity approx.	Composition	Treatment (OSBL)
1P39-R-1171, Propylene Treater (Arsine, Phosphine, COS)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	18,600 kgs (2,120 kg) **(Note 1)**	Clariant Actisorb®401 or equal **(Note 1)**	Secured Landfill/Disposal to recyclers
1P39-R-1172A/B Propylene Treater (H2O, Oxygenates, MeOH)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	2 x 31,752 kgs (2 x 6,000 kgs) **(Note 1)**	Porocel Dynocel650 or equal **(Note 1)**	Secured Landfill/Disposal to recyclers
1P39-R-1173A/B Propylene Treater (CO)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	2 x 5,040 kgs (2 x 1,420 kgs) **(Note 1)**	Clariant Actisorb®310 or equal **(Note 1)**	Secured Landfill/Disposal to recyclers
1P39-R-1174 Propylene Treater (MAPD, Acetylene)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	3,312 kgs (1,060 kgs) **(Note 1)**	Clariant Polymax®303 or equal **(Note 1)**	Secured Landfill/Disposal to recyclers
1P39-R-1571 Hydrogen Treater (CO, CO2)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	80 kgs (18 kgs) **(Note 1)**	Clariant Meth®150 or equal **(Note 1)**	Secured Landfill/Disposal to recyclers
1P39-R-1572A/B Hydrogen Treater (H2O)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	2 x 120 kgs (2 x 26 kgs) **(Note 1)**	BASF – 4A Mol. Sieve or equal **(Note 1)**	Secured Landfill/Disposal to recyclers
1P39-Z-1683 Nitrogen Treater (O2 Removal)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	630 kgs (76 kgs) **(Note 1)**	Clariant Polymax®301 or equal **(Note 1)**	Secured Landfill/Disposal to recyclers
1P39-Z-1683 Nitrogen Treater (H2O Removal)	Spent Adsorbents (Ceramic balls)	Replacement	once / 3-5 years **(Note 1)**	2 x 500 kgs (2 x 200 kgs) **(Note 1)**	Porocel Dynocel 641S or equal **(Note 1)**	Secured Landfill/Disposal to recyclers
1P39-Z-6581 Purge Gas Dryer (H2O Removal)	Spent Adsorbents	Replacement	by Membrane unit vendor	by Membrane unit vendor	Drying agent (molecular sieve)	Secured Landfill/Disposal to recyclers
1P39-MGN-1175A/B Propylene Filter	Spent Filter Cartridge	Replacement of Filter Elements	once / 2 years	5 kg (each Filter)	Filter Elements (PP) & treater filling particles	Secured Landfill/Disposal to recyclers
1P39-MGN-1371A/B White Oil Filter	Spent Filter Cartridge	Replacement of Filter Elements	once / 2 years	2 kg (each Filter)	Filter Elements (PP)	Secured Landfill/Disposal to recyclers
1P39-MGN-1575A/B, Hydrogen Filter	Spent Filter Cartridge	Replacement of Filter Elements	once / 2 years	2 kg (each Filter)	Filter Elements (PP) & treater filling particles	Secured Landfill/Disposal to recyclers
1P39-MGN-1671A/B, LP Nitrogen Filter	Spent Filter Cartridge	Replacement of Filter Elements	once / 2 years	5 kg (each Filter)	Filter Elements (PP)	Secured Landfill/Disposal to recyclers

Source	Name	Mode of Operation	Frequency	Quantity approx.	Composition	Treatment (OSBL)
1P39-MGN-1672A/B, Regeneration Recycle N2 Filter	Spent Filter Cartridge	Replacement of Filter Elements	once / 2 years	5 kg (each Filter)	Filter Elements (PP) & treater filling particles	Secured Landfill/Disposal to recyclers
1P39-MGN-1971A/B, Silane Filter	Spent Filter Cartridge	Replacement of Filter Elements	once / 2 years	2 kg (each Filter)	Filter Elements (PP)	Secured Landfill/Disposal to recyclers
1P39-ZGN-2282, Additive Vent Filter	Spent Filter Bags	Replacement of Filter Elements	once / 2 years	5 kg (each Filter)	Filter Elements (PP)	Secured Landfill/Disposal to recyclers
1P39-MGN-3175A/B, RG Filter	Spent Filter Bags	Replacement of Filter Elements	≤ 2 times/year	10 kg (each Filter) 2335 kg (by vendor)	Filter Elements (PP) & PP Solids	Secured Landfill/Disposal to recyclers
1P 9-VV-3132, Powder Collector (via 1P39-CY-3173)	PP Powder	Upset Conditions	≤ 6 times/year	45 kg	PP Solids	Secured Landfill/Disposal to recyclers
1P39-VV-3 34, Powder K.O. Drum	PP Powder	Upset Conditions	once / year	60 kg	PP Solids	Secured Landfill/Disposal to recyclers
1P39-VV-3432, Drop Out Pot (for special products only)	PP Powder	Special operation	once / month	50 kg	PP Solids	Secured Landfill/Disposal to recyclers
1P39-MGN-3471, Carrier Gas Filter	Spent Filter Bags	Replacement of Filter Elements	once / year	150 kg each	PP Filter Bags & PP Solids	Secured Landfill/Disposal to recyclers
1P39-MGN-3472A/B, Purge Silo Filter	Spent Filter Bags	Replacement of Filter Elements	once / year	60 kg each	PP Filter Bags & PP Solids	Secured Landfill/Disposal to recyclers
1P39-ZEX-3682, Extruder / Pelletizer	Start-up Material	Discontinuous	Cold Start-up Warm Start-up	2,520 kg for 7 min. 1,080 kg for 3 min.	PP (Melt)	Secured Landfill/Disposal to recyclers
1P39-ZGN-3684, Extruder Feed Vent Filter	Spent Filter Bags	Replacement of Filter Elements	once / year	40 kg (by vendor)	PP Filter Bags & PP Solids	Secured Landfill/Disposal to recyclers
1P39-ZVV-3783, Pellet Water Tank	PP Dust	Discontinuous	once / month	36 kg	PP (Fines)	Secured Landfill/Disposal to recyclers **(Note 2)**
1P39-ZSR-3784, Pellet Water Start-Up Screen	PP Pellets	Discontinuous Start-Up of Extruder	-	600 kg per event	PP	Secured Landfill/Disposal to recyclers **(Note 2)**
1P39-ZSR-3784, Pre-Separation Sieve	PP Pellets & Agglomerates	Discontinuous, Extruder start-up	once / week	11 kg each	PP (agglomerates)	Secured Landfill/Disposal to recyclers **(Note 2)**

Source	**Name**	**Mode of Operation**	**Frequency**	**Quantity approx.**	**Composition**	**Treatment (OSBL)**
1P39-ZCL-3787, Pellet Classifier	PP Pellets & Agglomerates	Discontinuous, Under-/Oversized Pellets	once / week	5 kg each 37 kg each	PP Pellets undersized PP Pellets oversized	Secured Landfill/Disposal to recyclers **(Note 2)**
Conveying Air Compress. Suction / Discharge Filter 1P39-ZGN-7086A/B 1P39-ZGN-7088A/B 1P39-ZGN-7087A/B 1P39-ZGN-7089A/B 1P39-ZGN-7094A/B 1P39-ZGN-7095A/B 1P39-ZGN-7096A/B 1P39-ZGN-7097A/B	Spent Filter Bags	Replacement of Filter Elements	every 6 months years **(Note 1)**	25 kg each **(Note 1)**	PP Filter Bags & PP Solids	Secured Landfill/Disposal to recyclers
1P39-ZGN-7185A/B, Silo Exhaust Filter	Spent Filter Bags	Replacement of Filter Elements	every 6 months years **(Note 1)**	25 kg each **(Note 1)**	PP Filter Bags & PP Solids	Secured Landfill/Disposal to recyclers
1P39-ZGN-7584A/B, Elutriator Blower Filter	Spent Filter Bags	Replacement of Filter Elements	once / year	(Note 1)	PP Filter Bags	Secured Landfill/Disposal to recyclers
1P39-ZCY-7583, Elutriator Cyclone	PP Fines	Continuous	8,000 h / year	0.5 kg/h (by vendor)	PP (Fines)	Secured Landfill/Disposal to recyclers
Wastes from Sampling (e.g., 1P39-VV-3133 Powder Sampling Pot)	PP Powder & Pellets	Discontinuous	once / day	60 kg (Note 3)	PP (Pellets and Powder)	Secured Landfill/Disposal to recyclers **(Note 2)**
Packaging Material of Additives	Bags	Discontinuous	once / day	approx. 20 kg	Paper, PP/PE	Disposal to recyclers
Packaging Material of Bagging section	Bags	Discontinuous	once / day	approx. 20 kg	Paper, PP/PE	Disposal to recyclers
1P39-VV-1733, Waste White Oil Tank	Waste White Oil	Discontinuous emptying of tank	1 time per year	approx. 660 kg	White Oil, Isopropanol, Alcoholate	Disposal to Recycler
1P39-VV-2231, Additive Feed Hopper Vent Pot	Waste White Oil	Discontinuous	1 time per year	60 l	White Oil	Disposal to Recycler
1P39-VV-3033, Catalyst Vent Pot	Waste White Oil	Discontinuous	1 time per year	80 l	White Oil	Disposal to Recycler

Source	Name	Mode of Operation	Frequency	Quantity approx.	Composition	Treatment (OSBL)
1P39-VV-6631, Phase Separator	Oily Waste	Discontinuous	30 times per year	max. 80 kg	Mixed Organic Components. Heating Value approx. 41000 kJ / kg	Bioremediation/ Disposal to Recycler
Gear Boxes of Machinery	Waste Lube Oil	Discontinuous	1 time per year	approx. 5 t	Lubrication Oils (100%)	Disposal to recyclers

Notes:

(1) Dependent on requirements.

(2) PP pellets & PP blocks from extruder start-up can be sold to special converters.

(3) Dependent on Sampling frequency.

(*) The values and data in this table are estimates only; actual values and data may differ during detailed engineering, depending on the equipment used and the operation methods.

2.7.2.22 Description of Mitigation Measures.

It is envisaged that with strict adherence to the pollution prevention and control measures during the design stage, the environmental impacts could be moderated to the minimum possible level during the operation phase.

Air pollution control measure

In-plant Control Measures

Some of the important operational measures, which can reduce the impact on air environment, are as follows:

- All the emission standards will be met for gaseous emissions.
- Blow down (CBD) system for all the process units to minimize VOC emission from the operations.
- Leak Detection and Repair (LDAR) programme for fugitive hydrocarbon emission control will be followed.
- Ensuring preventive maintenance of equipment.
- Developing green belt in the proposed plant premises.
- Ensuring the operations of various process units as per specified operating guidelines/operating manuals.
- Strict adherence to maintenance schedule for various machinery/equipment.
- Good housekeeping practices

Stack and Ambient Air Monitoring

In order to keep a check on the emissions of SO2, NOx, SPM and CO from DG set shall be monitored as per statutory regulations. Ambient Air Monitoring Stations shall continuously monitor quality of the air in the vicinity of the plant complex. Laser based instruments for measuring Sulfur Dioxide, NOx, Particulate matters, Ozone, Lead, Ammonia, Benzene, Benzo(a)Pyrene, Arsenic, Nickel, Carbon Monoxide, Hydrocarbons shall be used in these Monitoring Stations.

No furnace in PP unit; hence no stack emissions

Water Pollution Control Measures

In-plant Control Measures

Some of the measures, which can be taken up during operational phase of the complex are:

- Reducing the actual process water consumption by way of improvement in operation of processing units.

- Closed blow down system will be incorporated for hydrocarbon liquid discharges in the process units, which will reduce the wastewater load to ETP both in terms of quantum load and quality. This is another of the in-plant control measures.
- Appropriate segregation and collection philosophy (separate sewers for process waste, contaminated rainwater,cooling tower blow down etc.) will be incorporated for various effluents depending on individual stream characteristics.
- A comprehensive wastewater management system to comply with treated effluent quality as specified by CPCB shall be established.
- Process area will be paved to avoid contamination of soil/sub-soil/ground water in case of accidental spill/leakage of hydrocarbon liquids.
- Looking into more options of reusing the treated effluent besides fire water make up or for horticulture development.
- Ensuring proper monitoring and maintenance schedule for the existing NREP Effluent treatment plant.
- Providing reuse and recycle of the treated effluent and water.

Water Quality Monitoring

For regular monitoring of the operation of various pollution control facilities, a laboratory with sophisticated instruments and well- trained manpower is already in existing NRL refinery plant. Environmental Cell with qualified Chemical Engineers/Scientists also form part of the facility, which will ensure that all pollution control measures are effectively operating and to carry out day-to-day checks, trouble shooting and further improvements wherever necessary.

Noise

As the plant is going to be operational on a 24-hour basis, noise considerations are very important. All equipments will be specified to meet 85 dB (A) at 1 m distance. Theexposure of employees working in the noisy area shall be monitored regularly to ensure compliance with the OSHA requirements.

A green belt of appropriate width around the plant complex will be developed.

This green belt will help to reduce the noise and visual impact upon the surrounding population as much as possible.

Land

To improve the environmental quality following measures are recommended.

In-plant Control Measures

- The solid waste generated in the form of packaging material etc. shall be sold off for making it suitable for reuse by reprocessing.

- The solids wastes identified to be sent to nearby authorized landfill agency for further disposal.
- In order to improve the aesthetics in the plant surrounding, further plantation shall be carried out the around the plant boundary.

Socio-Economic

Since the project is big in nature it will affect the socio-economic status of the region due to high intensive investment, development of infrastructure such as road, railways communication, education and other common facilities. There will be cascading effects on economic status and avenues in the area as well as in the buffer zone where in there will be growth in employment scenario. However there will be adverse impact in terms of usage of common resources as well as rise in the price of commodities and environmental pollution However, NRL shall take part actively in the overall development of the area.

2.7.3 Assessment of new & untested Technology

Under NREP a high severity PFCC unit with a capacity of 1.955MMTPA is being implemented. The LPG that will be generated in the high severity mode will contain a significant potential of propylene which can be recovered for value addition. The Polymer Grade Propylene produced in the PRU section of the PFCC Unit is further processed in the downstream unit i.e. PP unit to produce Homo-polymer grade Polypropylene product.

CHAPTER 3

DESCRIPTION OF ENVIRONMENT

3 DESCRIPTION OF ENVIRONMENT

3.1 Preamble

This chapter depicts the establishment of baseline for valued environmental components, as identified in and around the proposes area over an extent of 600 Bigha (8,02,681.92 sq.m) (80.27 Ha) at Pankagrant Village, Bokakhat Tehsil, Golaghat District, Assam State by M/s. Numalighar Refiniery Limited .The primary baseline data monitoring covered Three month i.e., December 2022 to February 2023 and secondary data was collected from government and semi-government organization's published data. The primary baseline data has been generated by M/s. Hubert Enviro Care Systems (P) Ltd, Chennai, a MoEF&CC approved and National Accreditation Board for Testing and Calibration Laboratories (NABL) accredited environmental testing laboratory for the following terrestrial environmental components.

3.2 Study Area and Period

A 10 Km radial distance from the proposed project site boundary has been identified as the General study area for assessing the baseline environmental status. The core study area is the project area and its immediate surroundings to the tune of 1.0 Km radius from the boundary. Further the Project Impact/Influence Area (PIA) is 10Km from the boundary of the project site which covers parts of Golaghat District, Assam State .

3.3 Description of Study Area and components

As described in Chapter 1, M/s. Numalighar Refinery Limited proposes area over an extent of 600 Bigha (8,02,681.92 sq.m) (80.27 Ha) in at Pankagrant Village, Bokakhat Tehsil and Golaghat District, Assam State. An overall idea of the study area with reference to the physical conditions are presented for better understanding in the following sections before proceeding into the section on the prevailing environmental conditions of the study area. The map showing the satellite image of the study area is given in **Figure 3-1** and Topo Map of the study area is given in **Figure 3-2.**

- **Meteorology:** Temperature, Relative Humidity, Rainfall, Wind Speed & Direction- **Refer Section - 3.6**
- **Ambient Air Quality:** Particulate matter <10 micron size (PM10),Particulate matter <2.5 micron size (PM2.5), Sulphur Dioxide (SO2), Nitrogen Dioxide (NO2),Carbon Monoxide (CO), Lead (Pb),TVOC ,Total Hydrocarbon, Methane HC, Non-Methane HC - **Refer Section - 3.7**
- **Ambient Noise Levels:** Day equivalent noise levels, Night equivalent noise levels - **Refer Section - 3.8**
- **Water Quality:** Groundwater Quality, Surface Water Quality - **Refer Section - 3.9**
- **Soil Quality - Refer Section - 3.10**
- **Ecology - Refer Section - 3.11**
- **Social Economic Status - Refer Section - 3.13**

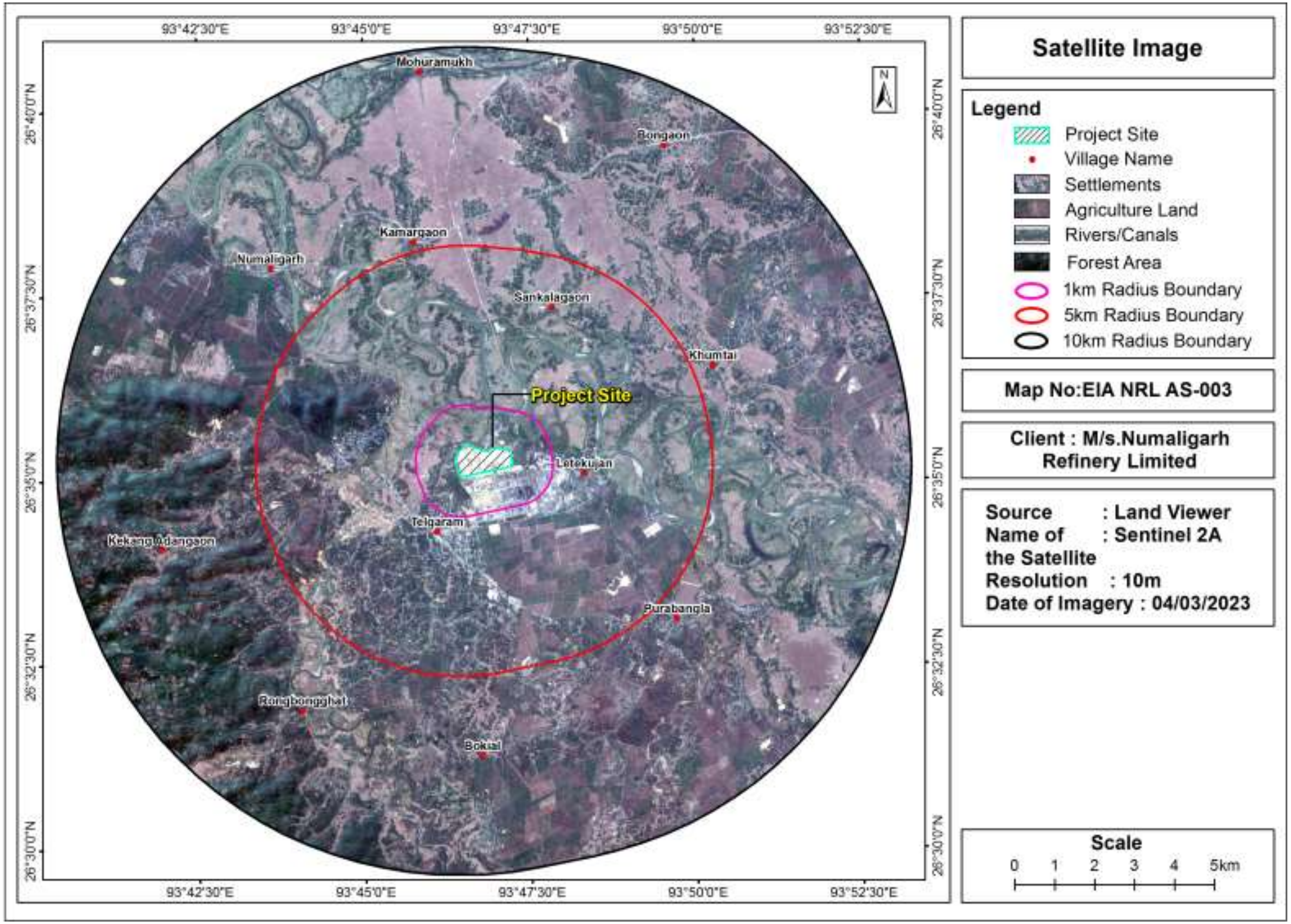


Figure 3-1Map showing the Satellite Image of the study area of Project

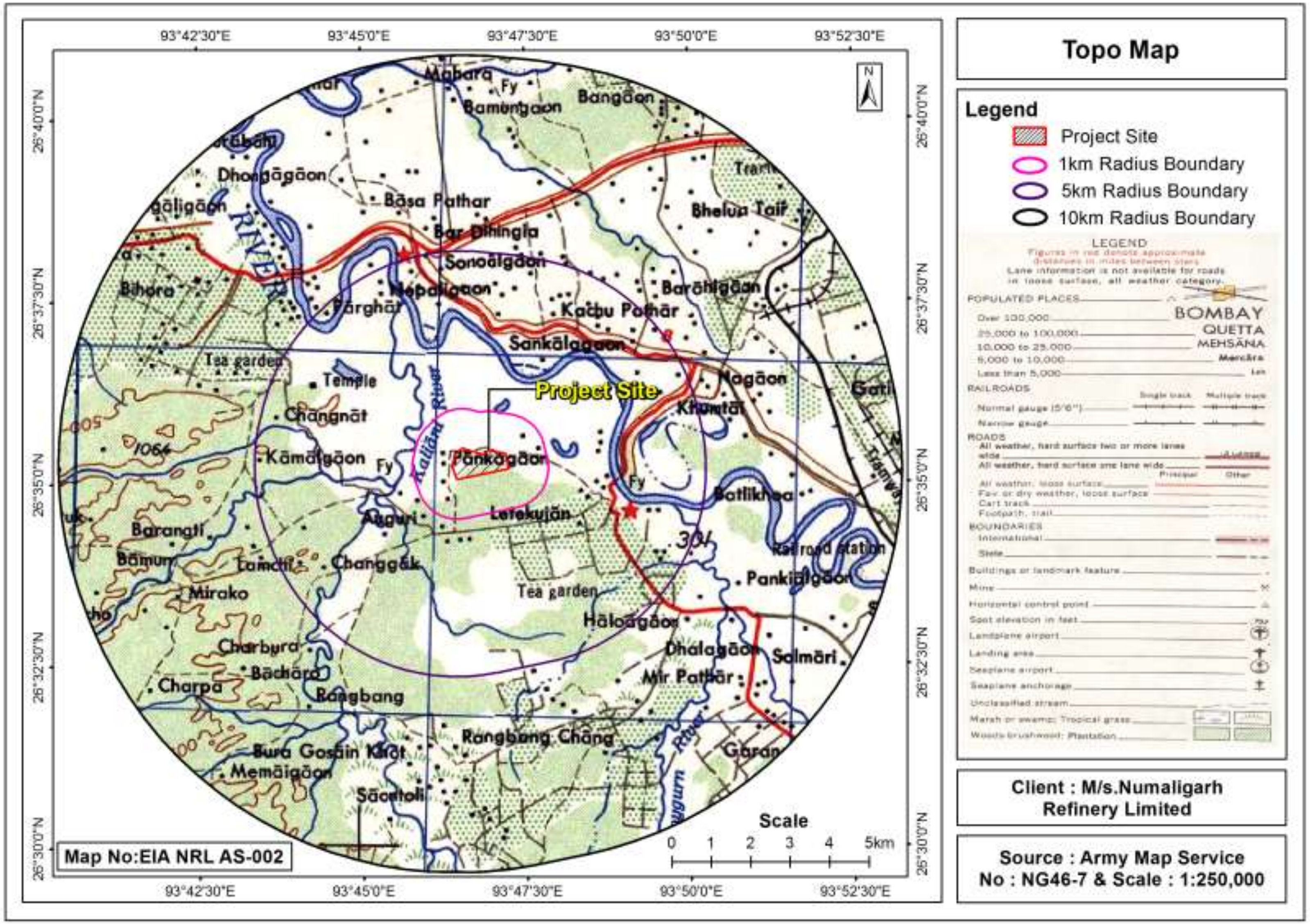


Figure 3-2Topo Map of the Study area

3.4 Environmentally/Ecologically Sensitive areas

This section details with the environmentally sensitive areas present within the project site and surrounding environs. It included national parks, state forest, essential habitats etc. The environmental sensitive areas covering an aerial distance of 15 km from the project boundary is given in **Table 3-1**.

Table 3-1Environmentally Sensitive Areas within 15 km from Project Boundary

<table>
<tr><th>S.No</th><th>Areas</th><th>Distance & Direction from project boundary</th></tr>
<tr><td>1</td><td>Monuments</td><td>Nil</td></tr>
<tr><td>2</td><td>Waterbodies</td><td>
<table>
<tr><th>S.No</th><th>Water Bodies</th><th>Distance (~km)</th><th>Direction</th></tr>
<tr><td>1.</td><td>Dhansiri River</td><td>0.80</td><td>N</td></tr>
<tr><td>2.</td><td>Kaliani River</td><td>1.36</td><td>WNW</td></tr>
<tr><td>3.</td><td>Doygurn River</td><td>4.68</td><td>ESE</td></tr>
<tr><td>4.</td><td>Deuri Nadi</td><td>6.62</td><td>SSW</td></tr>
<tr><td>5.</td><td>Disai Nadi</td><td>9.41</td><td>N</td></tr>
<tr><td>6.</td><td>Dhala Jan</td><td>11.68</td><td>SSE</td></tr>
<tr><td>7.</td><td>Brahmaputra River</td><td>12.62</td><td>NNW</td></tr>
<tr><td>8.</td><td>Pora Jan</td><td>14.58</td><td>SSW</td></tr>
<tr><td>9.</td><td>Kaliyani RF</td><td>14.59</td><td>SSW</td></tr>
</table>
</td></tr>
<tr><td>3</td><td>State, National boundaries</td><td>Nil</td></tr>
<tr><td>4</td><td>Nearest Highway</td><td>➢ NH-129(Dimapur-Numaligarh) at a distance of ~1.39km towards SW
➢ SH-1(Kamargaon-Joypur) at a distance of ~3.12 km towards N</td></tr>
<tr><td>5</td><td>Nearest Railway station</td><td>➢ Khumtai Railway Station, ~7.38km , ENE</td></tr>
<tr><td>6</td><td>Defence installations</td><td>Nil</td></tr>
<tr><td>7</td><td>Nearest Town</td><td>Golaghat, ~16.50km towards ESE</td></tr>
<tr><td>8</td><td>Nearest City</td><td>Jorhat, ~39km, ENE</td></tr>
<tr><td>9</td><td>Nearest Airport</td><td>Jorhat Airport,~39.57 km, ENE</td></tr>
<tr><td>10</td><td>Nearest Villages</td><td>
<table>
<tr><th>S.No</th><th>Villages</th><th>Distance</th><th>Directions</th><th>Populations</th></tr>
<tr><td>1.</td><td>Pankagaon</td><td>0.02km</td><td>W</td><td>250</td></tr>
<tr><td>2.</td><td>Telgaram</td><td>0.44km</td><td>SSW</td><td>2,500</td></tr>
<tr><td>3.</td><td>Rajabari</td><td>0.37km</td><td>N</td><td>557</td></tr>
<tr><td>4.</td><td>Letekujan</td><td>0.38km</td><td>E</td><td>3,000</td></tr>
<tr><td>5.</td><td>Numaligarh Township</td><td>1.80km</td><td>WNW</td><td>1,000</td></tr>
</table>
</td></tr>
</table>

11	Manmade

S.No	School	Dist(km)	Direc
11.	Ponka Senior Basic School	0.32	W
12.	Borgoria LP School	0.74	N
13.	Ouguri L P School	0.76	E
14.	Delhi Public School Numaligarh	2.57	W
15.	Deithor Govt Hr Sec School	5.76	W
16.	Bokial High School	6.85	S
17.	Bholaguri Kamalamiri Higher Secondary School	8.99	NE
18.	Rongagorah Govt LP School	9.13	S
19.	Balijan Sankarjyoti High School	12.45	SSE
20.	Jawahar Navodaya Vidyalaya School	12.53	ESE

S.No	Colleges	Dist(km)	Direc
1.	Deithor Govt Model Degree College	3.84	W
2.	Harlongbi Velongbi College	4.49	W
3.	Marangi Mahavidyalaya Junior College	5.61	SE
4.	Joya Gogoi College	5.62	ENE
5.	Kamargaon College	6.10	NNW

S.No	Hospitals	Dist(km)	Direc
1.	Numaligarh PHC	1.27	SW
2.	Numaligarh Veterinary Dispensary	1.30	SW
3.	Vivekanand Kendra-NRL Hospital	2.33	W
4.	Khumtai Model Hospital	5.65	ENE
5.	Numaligarh T.E Hospital	5.83	NE
6.	Deihori Karabi Model Hospital	7.09	SW
7.	Dholaguri Hospital	8.11	SE
8.	Behora Hospital	8.41	NW
9.	Mahuramukh MPHC	9.33	N
10.	Naharchalla MPHC	10.87	S
11.	Borfollong Hospital	12.63	E

S.No	Government Buildings	Dist(km)	Direc
1.	CISF Unit NRL Numaligarh	1.33	ESE
2.	Kachupather Gaon Post Office	4.69	NNE
3.	Kamargaon Police Station	5.19	N
4.	Khumtai Police Station	5.37	ENE
5.	Khumtai PWD Office	6.26	E
6.	Bokial Branch Post Office	6.44	S
7.	Numaligarh Gram Panchayat office	6.48	NW
8.	Office of the Superintendent Customs Preventive Force Numaligarh	6.62	NW
9.	Rajabari Gram Panchayat office	11.13	WNW

S.No	Religious Places	Dist(km)	Direc
1.	CSI Church	0.38	SSW
2.	Borgoria Jame Masjid	0.77	N
3.	Kanaighat Jama Masjid	1.70	W
4.	Hanuman Mandir	1.70	W
5.	Baba Than Lord Shiva Temple	4.45	WNW
6.	Believers Eastern Church	6.32	W
7.	Kaliani Baptist Church	6.76	SW
8.	Khumtai Shiv Temple	6.85	NE
9.	Mowkhowa Masjid Mosque	10.67	E
10.	Buddhist Monastery Of Bhitar Kalioni	11.81	S
11.	Shiva Temple	12.08	WNW

S.No	Industries	Dist(km)	Direc
1.	Numaligarh Refinery	Adjacent to Site	S
2.	Lattakoojan Tea Estate	2.13	ESE
3.	Tanay Tea Factory	3.66	S
4.	NR Tea Factory	3.97	S
5.	Numaligarh Tea Factory	5.97	NW
6.	Sirajuli Tea Factory	6.54	SE
7.	Badulipar Ltd Khumtai Tea Estate Factory	6.87	ENE
8.	Radhabari Tea Estate	8.58	N
9.	Bukhial Tea Estate	8.65	S
10.	Borchapori Tea Factory	9.77	WNW
11.	Bijulee Tea Estate	11.48	S
12.	Shyamraipore Tea Factory	12.42	SSE
13.	Sanjiv Tea Industry Pvt Ltd	12.85	SE
14.	Aegle Tea Factory	13.65	SE

12	Monuments	Deopahar Archaeological Site, ~4.35km, WNW

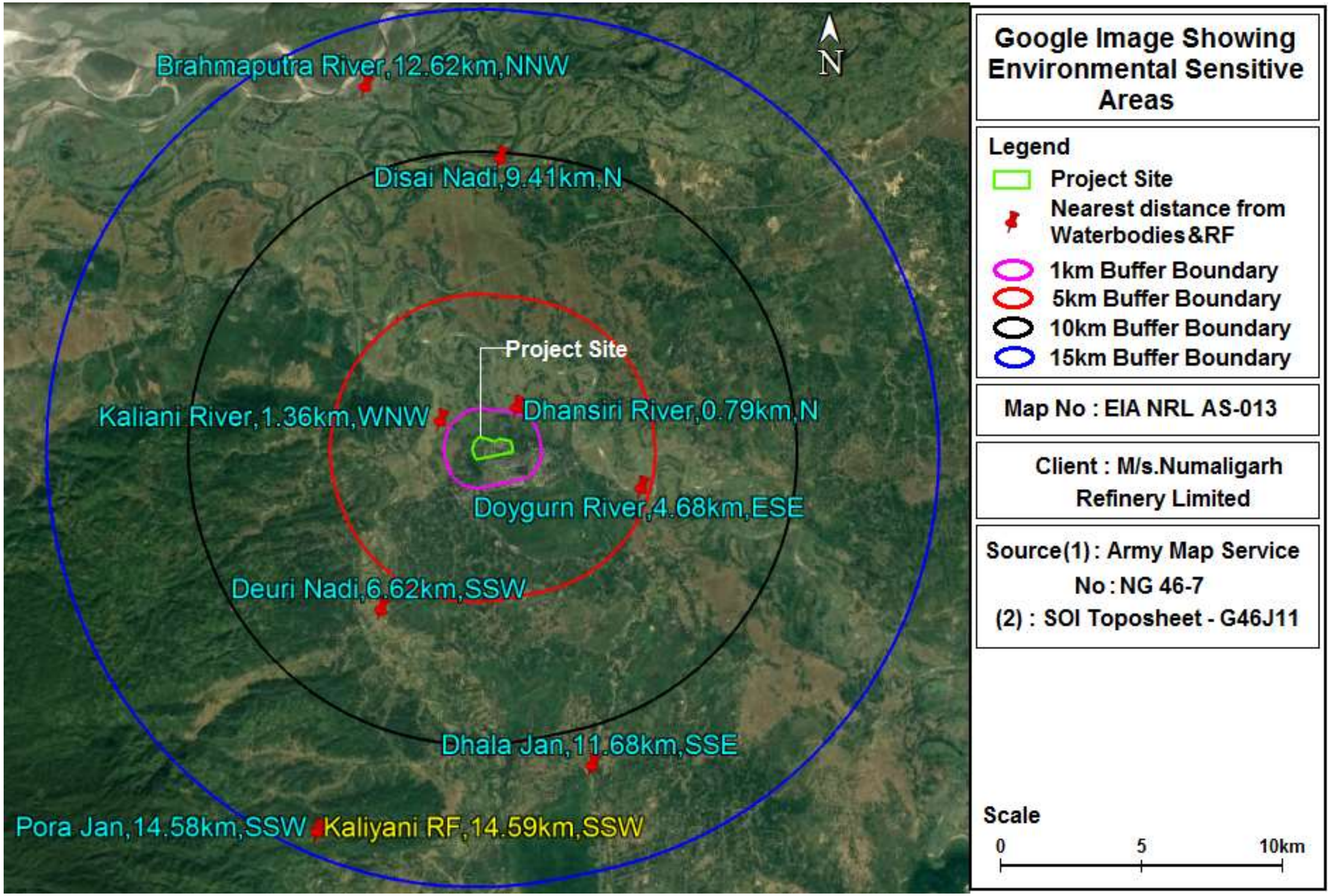


Figure 3-3Environmental sensitive areas covering within 15 km from project boundary

3.5 Physical Conditions of PIA district

In this section, the physical conditions of PIA district are discussed in general and wherever possible references to the conditions prevailing in the study area in particular are also provided. The physical conditions are discussed as under:

- District profile
- Drainage, land use, geology, Physiographic profile
- Natural resources
- Climatic conditions, seismic zone characteristics and natural hazard.

3.5.1 PIA District Profile

Golaghat :

Golaghat district lies between 26041″ and 27017″ N latitudes and 930 18″ and 95026″E longitudes. On the north it is bounded by the river Brahmaputra and on the south by Nagaland and Karbi Anglong district, on the east by Jorhat and on the west by Karbi Anglong and Nagaon district. The district is surrounded by the river Brahmaputra to the north, the state of Nagaland to the south, Jorhat district to the east and Karbi Anglong and Nagaon district to the west. Dhansiri is the principal river, which originates from Laisang peak of Nagaland. It streams through a distance of 352 km from south to north before joining the Brahmaputra. Its catchment area is 1220 km^2. Doyang, Nambor, Doigrung and Kalioni are the four rivulets of the Dhansiri. The river Kakodonga marks the border between Golaghat and Jorhat districts. The district covers an area of 1125 square kms and has a population of 1066888 .In terms of total area covered, the district occupies 7th rank among the districts of the state. The district of Golaghat is constituted by 6 Revenue Circles.

Source:https://censusindia.gov.in/nada/index.php/catalog/216/download/514/DH_2011_1814_PART_A_DCHB_GOLAGHAT.pdf

(Ref Directorate of Census Operations –Assam , “District Census Handbook-2011, Golaghat District”, Series-19 Part XII A)

3.5.2 Climatic Conditions

Golaghat:

Just like climate of Assam, this district has a climate, which is characterized by a highly humid atmosphere, abundant rains and general coolness. The cold season from December to February is followed by the season of severe thunderstorms from April to June. The southwest monsoon season is from June to about the beginning of October. October and November constitute the post monsoon season.

Source:https://censusindia.gov.in/nada/index.php/catalog/216/download/514/DH_2011_1814_PART_A_DCHB_GOLAGHAT.pdf

(Ref Directorate of Census Operations –Assam, "District Census Handbook-2011, Golaghat District", Series-19 Part XII A)

3.5.2 Natural Resources of PIA District

3.5.2.1 Flora & Fauna

Golaghat:

Botanically the forest of Golaghat can roughly be divided into two divisions - the tropical and evergreen forests. The first category includes climatic climax vegetation such as Hollong, Nahor, Sam, Amri, Aunseroi, Makoi, Sopa etc. These are the best stocked stand of the district. In the second category such species are included whose top canopies are deciduous and the middle and lower canopies are evergreen in nature. The evergreen forests are most picturesque to the eyes. The evergreen forests as the name suggests, are evergreen in character and are generally found in all reserve forests. The species of Kaziranga reserve represent Savannah type which contains various kinds of grass such as Ekara, Nal, Khagari (reed) etc. Patches of Koroi also occur here and there. Simalu grows profusely in these areas. A belt of mixed evergreen forest also occur along the bank of Kaziranga. The belt generally harbours the wild elephants and rhinos of the sanctuary. In Golaghat quite a large number of the denizens of the silvan world is conglomerated in the Kaziranga wild Life Sanctuary. The exhibit par excellence of the Sanctuary is the great Indian onehorned Rhinoceros to be found generally wallowing in the mud of the swamps. Another magnificent species, getting rare in the rest of India, which can be seen, is the wild buffalo's. Another important species is the swamp deer. Countless numbers of the hog deers are also there in the sanctuary and the number of wild pigs is ever greater. Tigers and leopards have been seen in the Sanctuary. The barking deer and sumbhur deer can also been seen. The bear, jungle cats and crab-eating mongoose are some other fauna of the sanctuary. Water birds such as the whistling teel, snipe, adjutant, cormorants, black-billed storks, and white-billed stork are found abundantly. It would be wrong to conclude that species found in Kaziranga are absent in other parts of the district. Various kinds of colorful land and water birds are available in this district. Birds like fowls, Crow, Parakeets or Bhatau, Horn bills or Dhanesh, Maina Charai, Gray mynas, Pigeons, Doves or Kapon charai, Bulbuls, Wood-peckers, Salika etc are some of the various kinds of other jungle birds and hill birds. The birds who live in the neighbourhood or human habitation are Crows, Sparrow, Ghanchirika, Salika, Balimahi, Owls etc. There are Vultures or Sagun, Chalani, Kuruha in the district. Water birds or both indigenous and migratory nature are seen in the beels, swamps and rivers. Storks or Bartokola, Bagali, PaniKauri, Kam Charai, Ganga Chilani, Manihari (snake bird) are some of the water and marsh birds seen in the district. Ducks are generally found in the beels as winter visitors. Chakai chakua, Saralihanh, and Pintail ducks are some of the winter visitor birds which come to the district in winter season. Tortoises, crocodiles, lizards and sakes are grouped as reptilian. Tortoises of various kinds are found in the beels and Rivers of the district. Crocodiles are rarely seen in the Brahmaputra. The green lizards are found almost in every part of the district. Among the snakes the most common are king cobras, adders and water snakes of the district. Pythons are normally found in the forest areas of the district. Among the amphibians frogs and toads are found in all part of the district. Fishes of various kinds are found in the beels and rivers. The bigger fishers are Rau, Barali, Chital, Bahu, Kalijara , Ari, Gagal, Bhakuwa, etc

Source:

https://censusindia.gov.in/nada/index.php/catalog/216/download/514/DH_2011_1814_PART_A_DCHB_GOLAGHAT.pdf

(Ref Directorate of Census Operations –Assam , “District Census Handbook-2011, Golaghat District”, Series-19 Part XII A)

3.5.3.2 Forest Resources

Golaghat:

Out of 354,070 hectares areas in the district, about 152,294 hectares is under forests, which come to about 43.0% of the total areas. There are two types of forests in the district, tropical evergreen forests and miscellaneous forests. Forestry plays an important role in the economy of the district. A vast majority of the people of the district depends upon forest for firewood for cooking. Timber, bamboo, ekra (reed), thatch, jengu, tokopat, cane etc. for house building purposes. A number of forest-based industries have been opened in the district.

Source:

https://censusindia.gov.in/nada/index.php/catalog/216/download/514/DH_2011_1814_PART_A_DCHB_GOLAGHAT.pdf

(Ref Directorate of Census Operations –Assam , "District Census Handbook-2011, Golaghat District", Series-19 Part XII A)

3.5.2.2 Irrigation

Golaghat:

Golaghat receives heavy rainfall during the months May to July of the year. This is the wettest period of the year and these months account for more than 60% of the total annual rainfall. The cultivators of the district depend largely on rainwater for their agricultural fields. Agriculture suffers loss on year of extensive rains due to floods and fails in year of drought. In times of drought people are compelled to irrigate their fields by digging canals from various streams. Indigenous way of irrigation is still prevailing in the district. The channels and ponds are constructed to water the paddy as well as for other crops. Some minor irrigation projects are installed in the district by constructing bunds across the streams and rivulets, drainage channels and silt channels to obtain silt deposit in low lying areas. Lift irrigation with electric pump has also been used in some parts of the district. To meet the demands of the agriculturists for a regular supply of water irrigation schemes are initiated by the government of Assam. The following table shows the data on irrigation potential utilized during different seasons, additional potential created and targets and achievements, additional irrigation potential etc.

Source:

https://censusindia.gov.in/nada/index.php/catalog/216/download/514/DH_2011_1814_PART_A_DCHB_GOLAGHAT.pdf

(Ref Directorate of Census Operations –Assam , "District Census Handbook-2011, Golaghat District", Series-19 Part XII A)

3.5.2.3 Agricultural Resources

Golaghat:

Economy of Golaghat district is agriculturebased. Tea, rice and sugar cane are the main agricultural crops grown in the district, with tea being is the largest agricultural industry. There are 63 large tea gardens producing about 20,000 tones of tea per year. Moreover, the emergence of small tea growers has proclaimed a new improvement in the district. Smallscale tea growers have gotten considerable fame here because of large incomes compared to other high-land crops. It has caught the desire of unemployed people to take owning tea-gardens as their profession The rearing and reeling of muga and endi, the making of Japi (headgear) and earthen potential and the extraction of agaru oil are the cottage industries prevalent in Golaghat district. Quality muga silk and agaru oil in Golaghat district are well known in the state. Long-neck earthen potl made in Dhekial, especially for storing molasses, is unique in the world. 'Japi' of Naharani, Dergaon finds a market in the entire Brahmaputra valley.

Source:*https://censusindia.gov.in/nada/index.php/catalog/216/download/514/DH_2011_1814_PART_A_DCHB_GOLAGHAT.pdf*

(**Ref**: Directorate of Census Operations –Assam, "District Census Handbook-2011, Golaghat District", Series-19 Part XII A)

3.5.3.5 Mineral Resources

Golaghat:

Oil is another mineral of considerable economic importance which has been discovered in Golaghat also. The oil and natural gas commission undertook exploration in Golaghat. The Numalighar Oil Refinery is now functioning in the district. So far clay is concerned, ordinary clay for pottery and brick making is found almost everywhere in the district. Fire clays have been found the district. Fine white clay also reported in the district.

Source:

https://censusindia.gov.in/nada/index.php/catalog/216/download/514/DH_2011_1814_PART_A_DCHB_GOLAGHAT.pdf

(Ref Directorate of Census Operations –Assam , "District Census Handbook-2011, Golaghat District", Series-19 Part XII A)

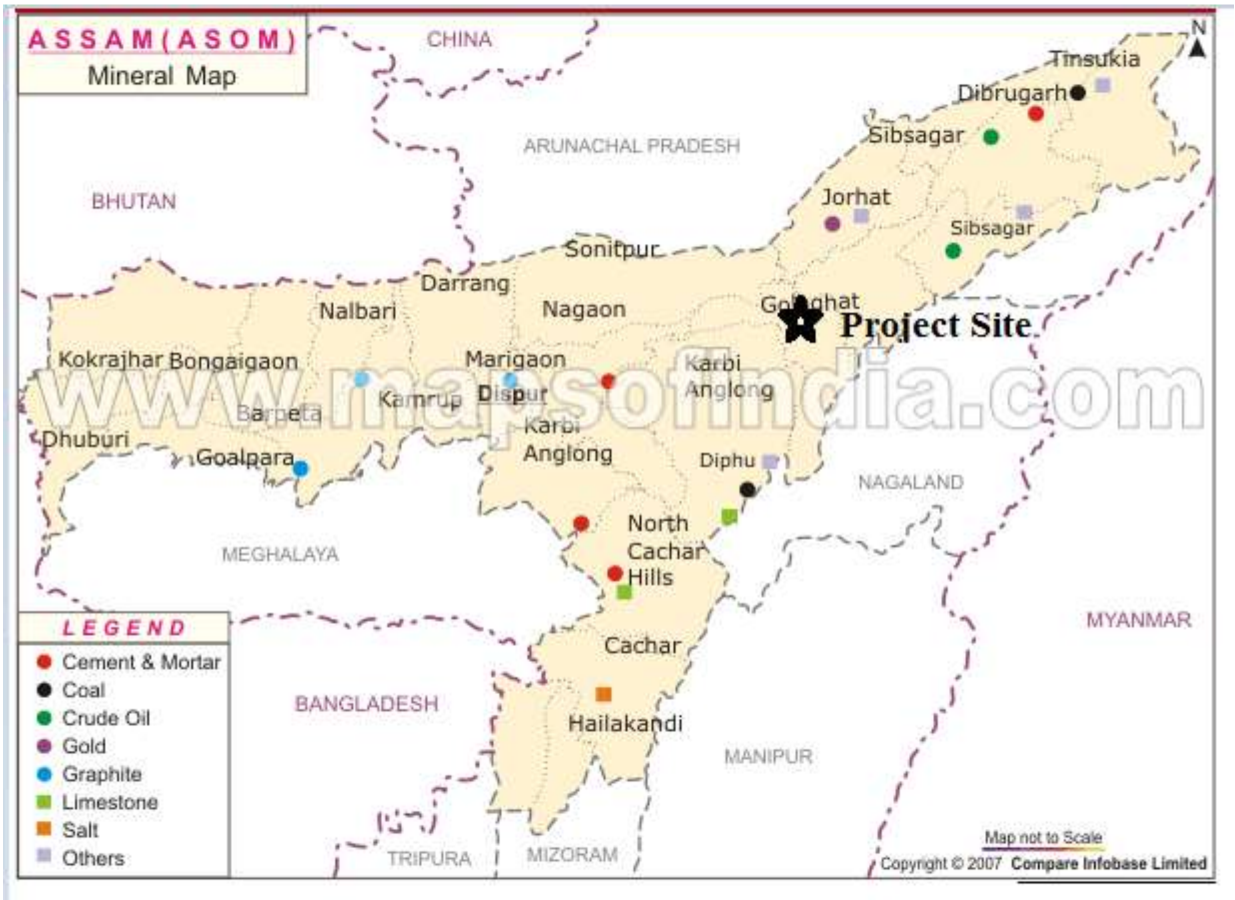


Figure 3-4 Mineral Map of Assam

From **Figure 3-4** it is evident that there is no trace of mineral resources in the Project Site.

Land Use & Land Cover

Total geographic area of Golaghat district is 3502 Sq. Km. Urban Built up area is 41.51Sq.km and Rural Built up area is 37.02 Sq.km. Details of land use/land cover statistics (2015-2016) for Golaghat District were given in **Table 3-2**.

Table 3-2 District land use/land cover statistics (2015-16) for Golaghat district

S.No	Division of Land Use/Land Cover	Area in Sq.Km	Area in Acres	Area in Ha	Total Area %
1.	Built-up, Urban	**41.51**	10257.33	4151	1.19
2.	Built-up ,Rural	**37.02**	9147.83	3702	1.06
3.	Built-up, Mining	**5.5**	1359.08	550	0.16
4.	Agriculture, Crop land	**1332.46**	329257.53	133246	38.05

5.	Agriculture, Plantation	**329.44**	81406.27	32944	9.41
6.	Agriculture, Fallow	**6.64**	1640.78	664	0.19
7.	Forest, Evergreen/ Semi evergreen	**52.65**	13010.08	5265	1.50
8.	Forest, Deciduous	**862.9**	213226.90	86290	24.64
9.	Forest, Forest Plantation	**5.93**	1465.33	593	0.17
10	Forest, Scrub Forest	**29.55**	7301.95	2955	0.84
11.	Grass / Grazing	**289.65**	71573.96	28965	8.27
12.	Barren/ unculturable/ Wastelands, Scrub land	**15.04**	3716.46	1504	0.43
13.	Barren/ unculturable/ Wastelands, Sandy area	**0.01**	2.47	1	0.00
14.	Wetlands/Water Bodies, Inland Wetland	**78.17**	19316.20	7817	2.23
15.	Wetlands/Water Bodies, River/Stream/canals	**413.3**	102128.50	41330	11.80
16.	Wetlands/Water Bodies, Resorvoir/Lakes/Ponds	**2.23**	551.04	223	0.06
Total		**3502.0**	**865361.71**	**350200**	**100.00**

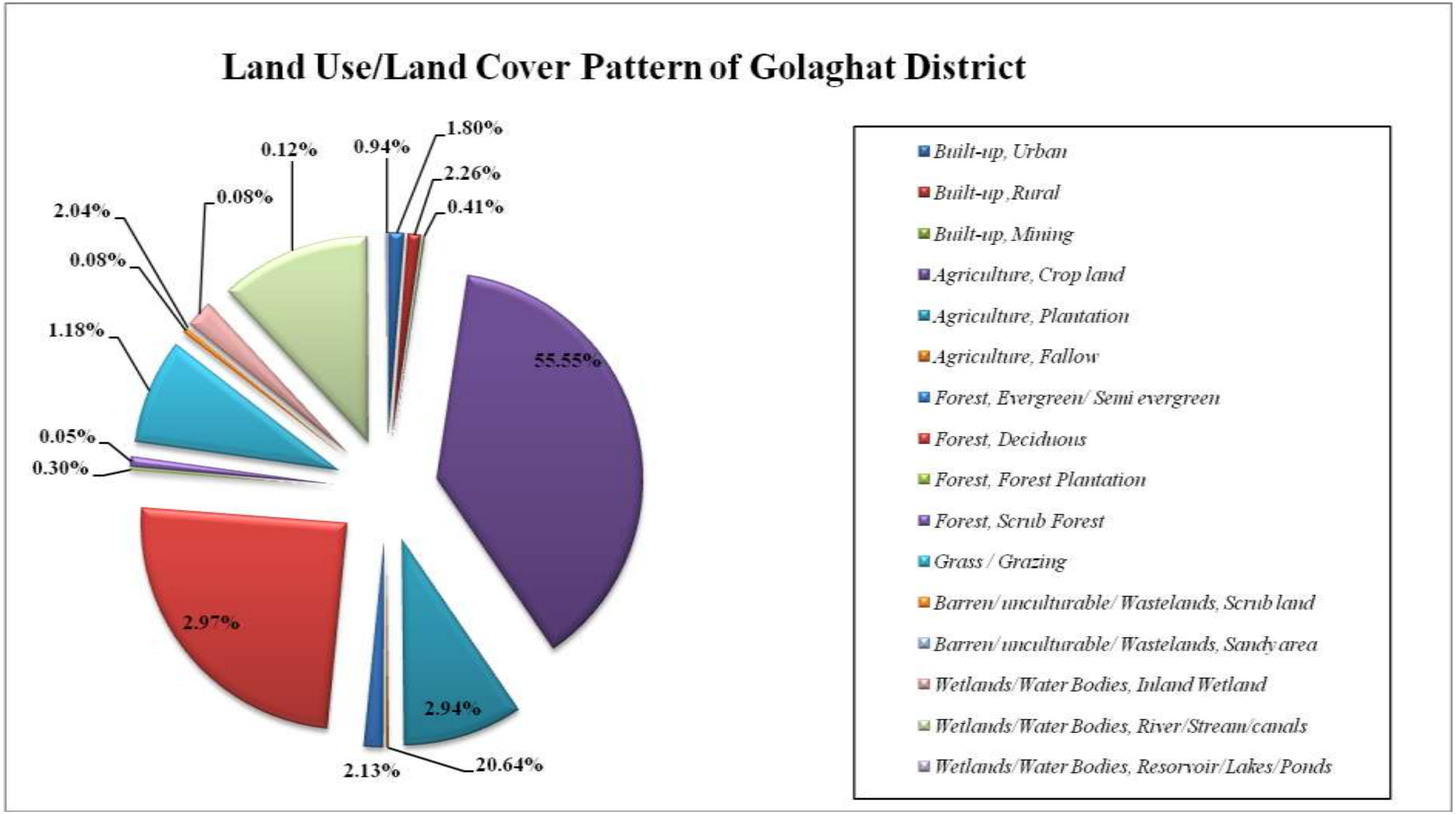
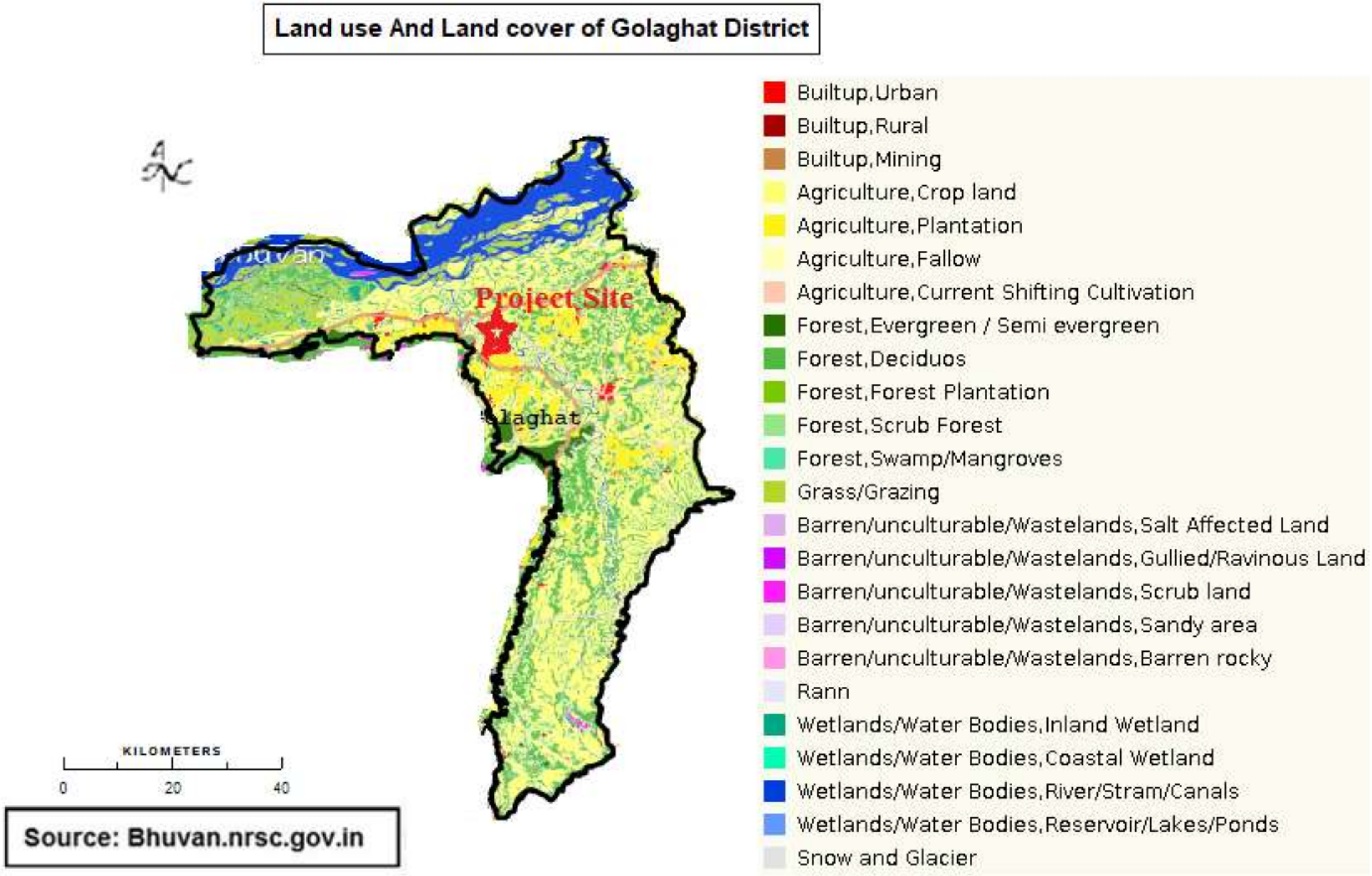


Figure 3-5 Land use/Land cover pattern of the Golaghat District


Land use And Land cover of Golaghat District

Source: Bhuvan.nrsc.gov.in

Figure 3-6 Land use and Land cover of Golaghat District

3.5.2.4 Land Use and Land Cover of the Study Area

Total Project Study area is 356.14 Sq.km. The Land Use Pattern of the study area is given in **Table 3-3.** The Land Use Pattern and Land Use Map of the Study area are given in **Figure 3-7 & Figure 3-8** respectively.

Table 3-3 Land Use Pattern of the Study Area

S.No	Description	Area (%)	Area (sq.Km)	Area (Acres)	Area (Ha)
1	Cropland	29.78	105.19	25992.97	10519
2	Deciduous	27.67	97.75	24154.51	9775
3	Plantation	24.18	85.42	21107.71	8542
4	Scrub Land	5.96	21.06	5204.03	2106
5	Rivers/ Streams/ Canals	3.80	13.43	3318.62	1343
6	Urban	3.54	12.52	3093.75	1252
7	Inland Wetland	2.01	7.09	1751.97	709
8	Rural	1.81	6.41	1583.94	641
9	Grass/Grazing Land	0.74	2.62	647.42	262
10	Fallow	0.31	1.08	266.87	108
11	Mining	0.11	0.39	96.37	39
12	Current Shifting Cultivation	0.05	0.17	42.01	17
13	Scrub Forest	0.02	0.08	19.77	8
Total		**100.00**	**353.21**	**88003.97**	**87279.96**

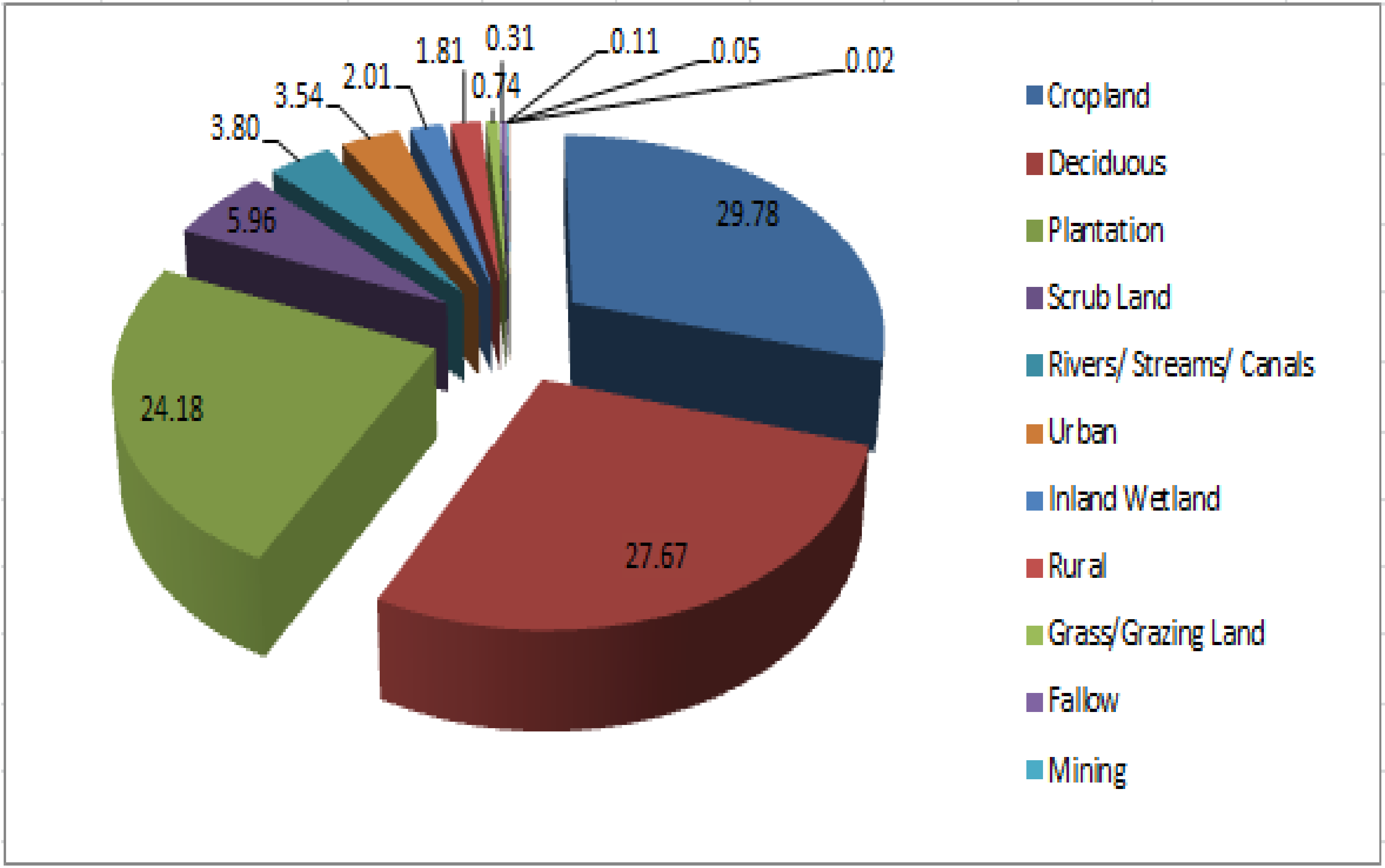


Figure 3-7 Land Use Pattern of the Study Area

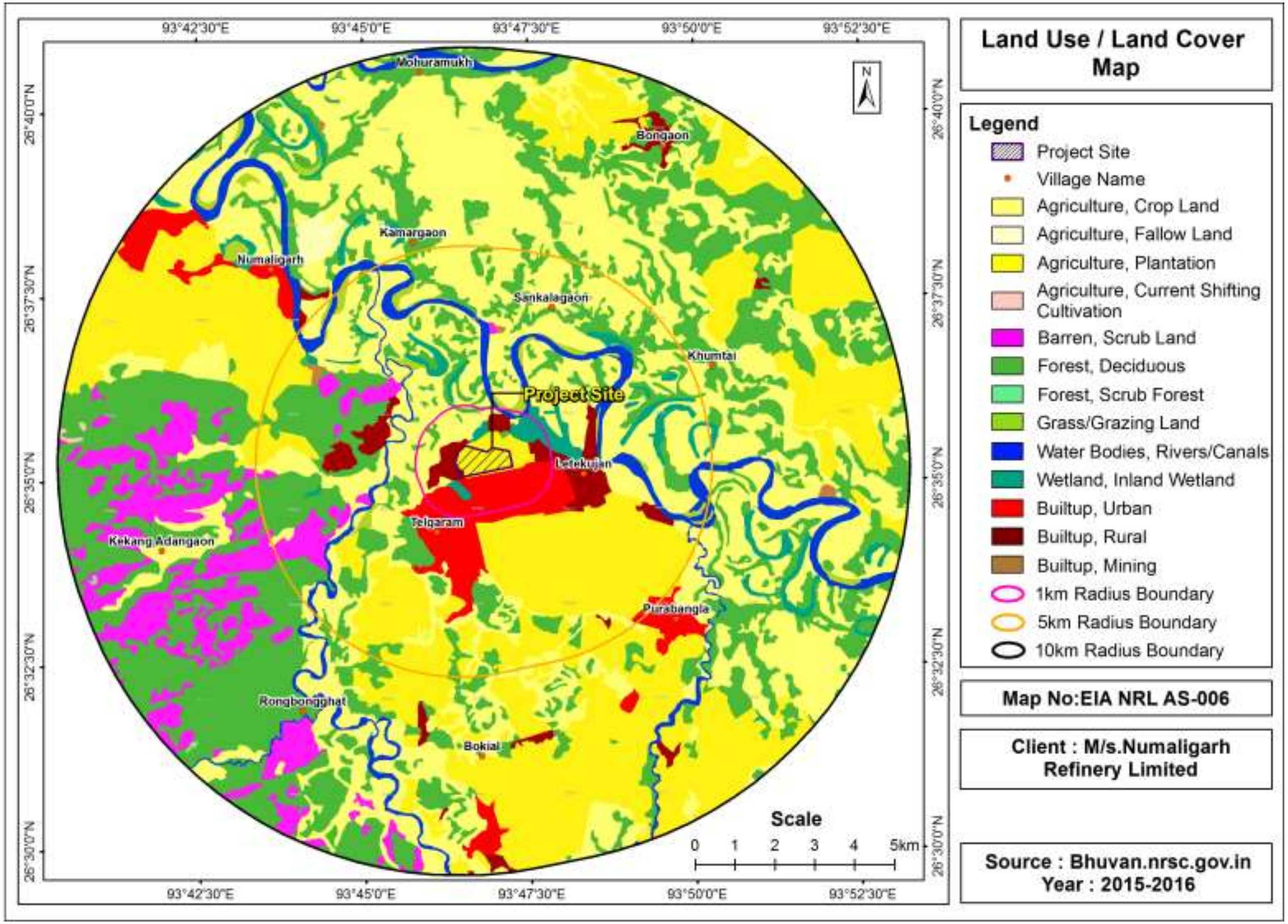


Figure 3-8 Land Use/Land cover Map of the Study Area

3.5.3 Topography

Golaghat:

The natural topography of the district Golaghat is a belt of flooded land situated in the north of Dergaon sub-division which is a wide and homogenous plain and low lying area along the Brahmaputra. It is the populous and important portion where cultivation brings in considerable prosperity and progress. On the lower land, the staple crop is rice, and the higher levels have been planted out with tea. The entire landscape of the district is one of rural plenty and the district is very rich in tea. The tea gardens themselves have enough to appeal to the lover of the picturesque. The rows of the bushes are premed down to one uniform level and the monotony of this expanse of green is only relieved by the labourer's lines, the factory and the manager's bungalows. The Upper Valley of the Dhansiri and Kajiranga are covered with dense forest. A wonderful view of forest can be obtained from one of the outer ranges of the Naga. The Diyong forest area is also covered with dense tree-forest, which makes the place beautiful and abode for many hinds of animals. The whole of the district is a level plain. One small hillock calls for special mention, but only on account of the associations with which it is connected and not from any intrinsic importance of its own. The Neghereting hill is a small imminence near the Brahmaputra on which stands a temple sacred to Mahadeva/Siva.

Source:
https://censusindia.gov.in/nada/index.php/catalog/216/download/514/DH_2011_1814_PART_A_DCHB_GOLAGHAT.pdf

(Ref Directorate of Census Operations –West Bengal , "District Census Handbook-2011, Golaghat District", Series-19 Part XII A)

Figure 3-9 Physical Map of Assam

From **Figure 3-9** it can be observed that the project site is located at an Altitude of range of about 600 m to 150m

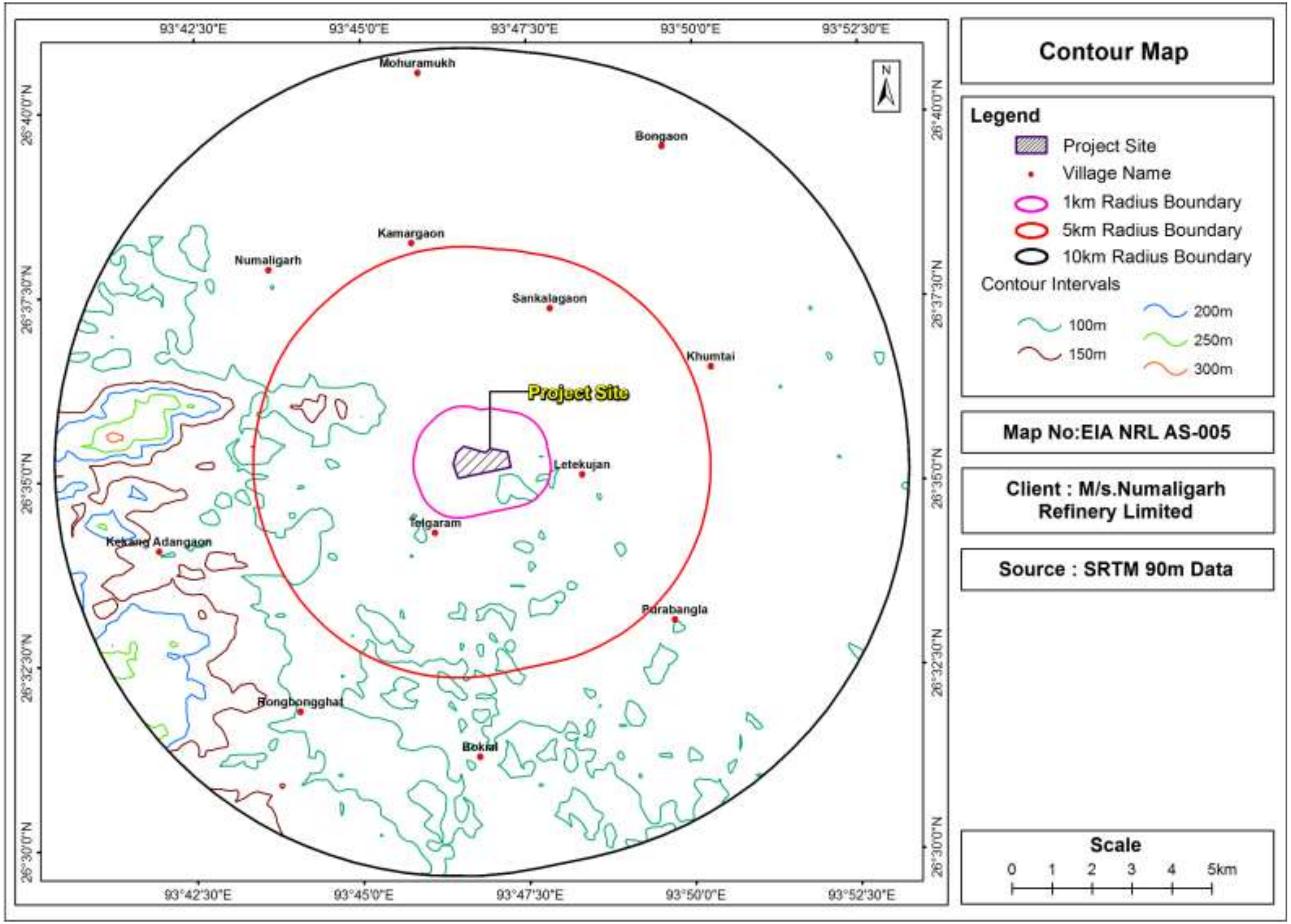


Figure 3-10 Contour Map of Study Area

3.5.4 Geomorphology of PIA district

Golaghat:

Physiographically, the district shows a monotonous plain topography towards north and southeast, while the southwestern part of the area represents an undulating topography. The general elevation of the elevated area is around 100 meters above Mean Sea Level(MSL) and low lying areas show altitude about 80 m above MSL. Maximum height of about 128 m above MSL is observed in the southern parts of the district, where it merges with the hills of the Nagaland as well as Karbi-Anglong district of Assam. The slope of the district is towards north east from south..The Geomorphology Map of the Golaghat District is shown as **Figure 3-12.**

Source: https://cgwb.gov.in/District_Profile/Assam/Golaghat.pdf

(Ref: Government of India Ministry of Water Resources Central Ground water Board, District Ground Water Brochure Golaghat District,Assam")

3.5.5 Geomorphology of the Study Area

The total Geographical area of the study area is 356.14 Sq.Km. The Geomorphology of the study area is given in **Table 3-4** and Geomorphology pattern and Geomorphology Pattern of the study area is given in

Figure 3-11 and **Figure 3-13** respectively.

Table 3-4Geomorphology of the Study Area

S.No.	Description	Area (Sq.Km)	Area (Acres)	Area (Hectares)	Area (%)
1	Fluvial Origin-Younger Alluvial Plain	58.35	206.11	50930.81	20611
2	Structural Origin-Moderately Dissected Hills and Valleys	15.08	53.27	13163.28	5327
3	Fluvial Origin-Older Flood Plain	12.77	45.11	11146.91	4511
4	Fluvial Origin-Active Flood Plain	7.17	25.31	6254.23	2531
5	Waterbodies	3.84	13.58	3355.69	1358
6	Denudational Origin-Pediment PediPlain Complex	2.10	7.41	1831.05	741
7	Denudational Origin-Moderately Dissected Hills and Valleys	0.69	2.42	597.99	242
	Total	**100.00**	**353.21**	**87279.96**	**35321**

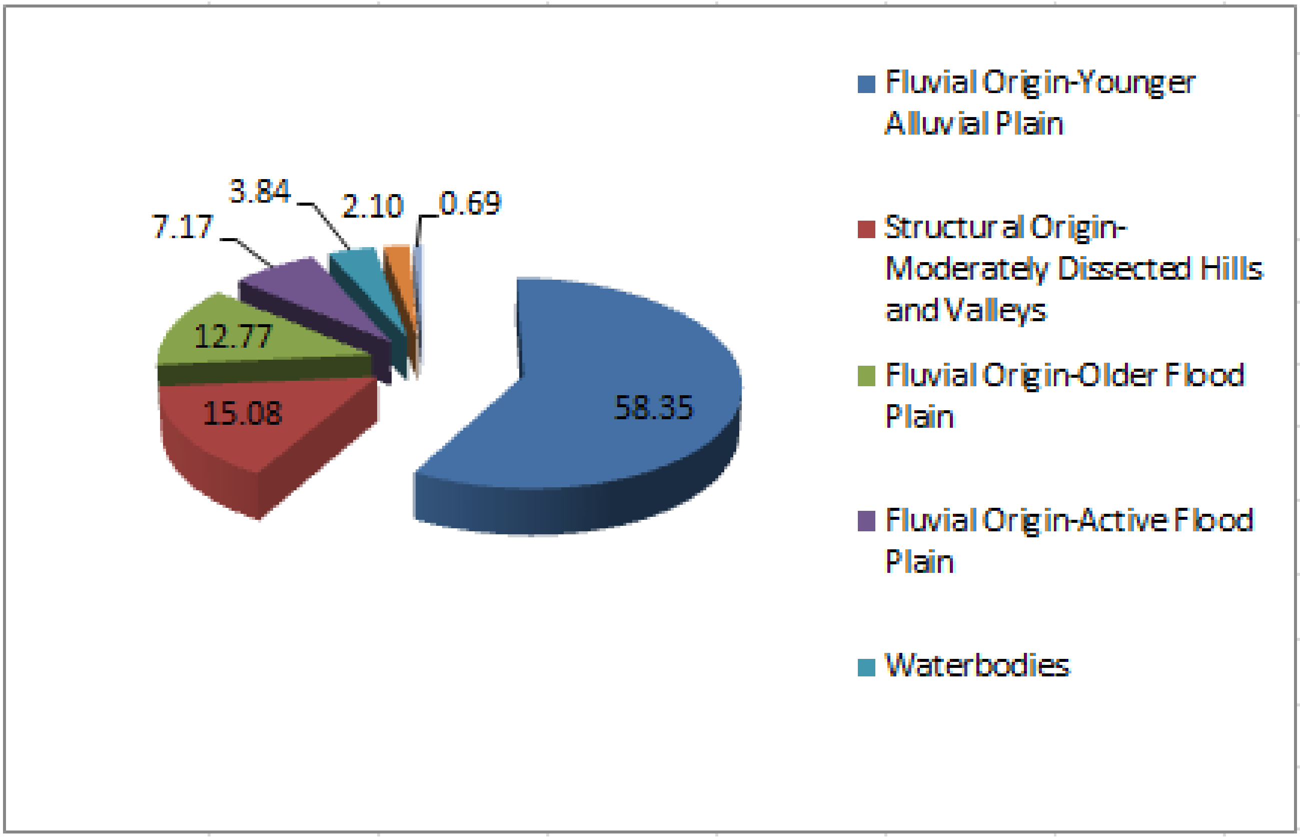


Figure 3-11Geomorphology Pattern of the Study Area

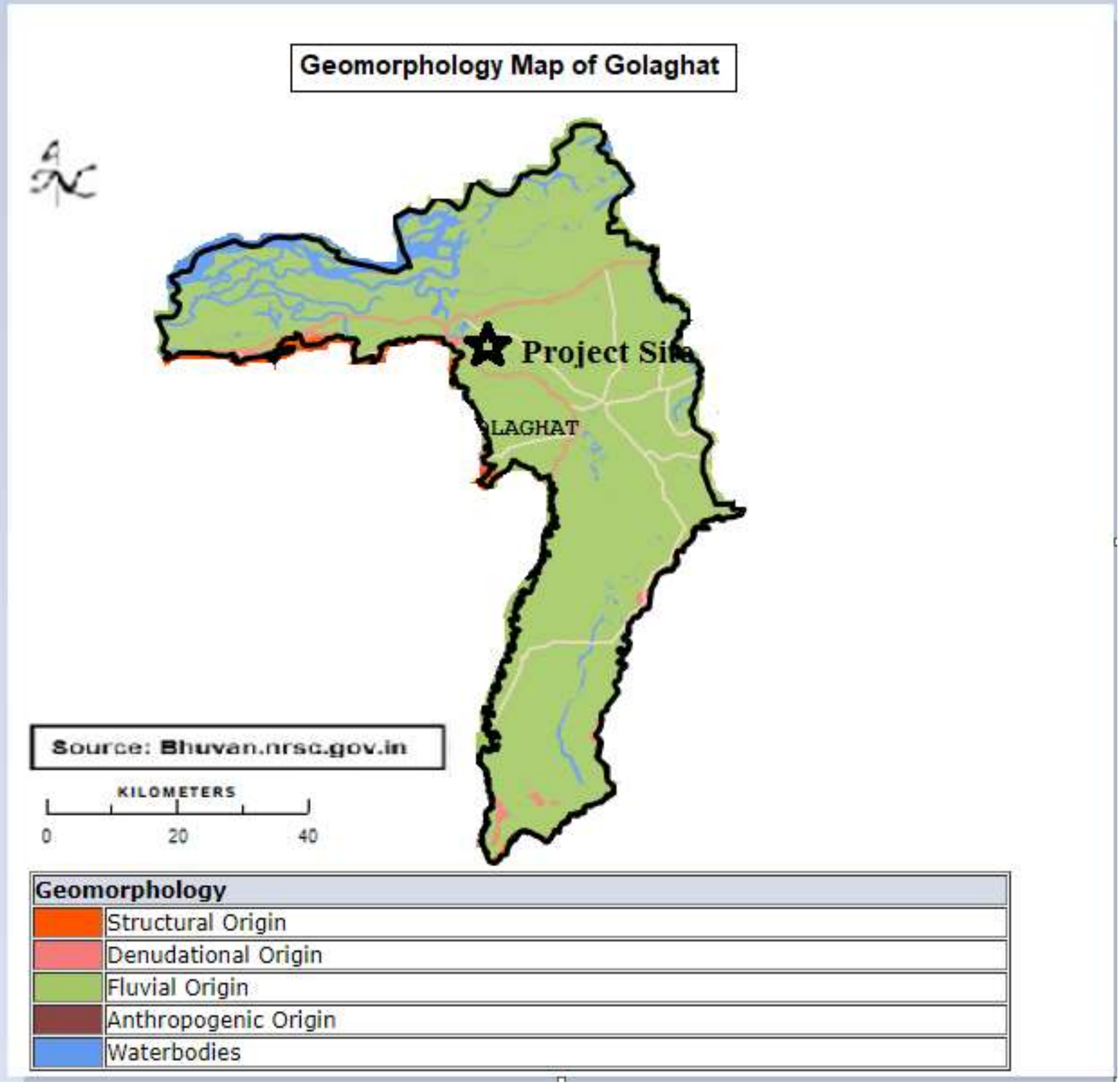


Figure 3-12Geomorphology Map of Golaghat

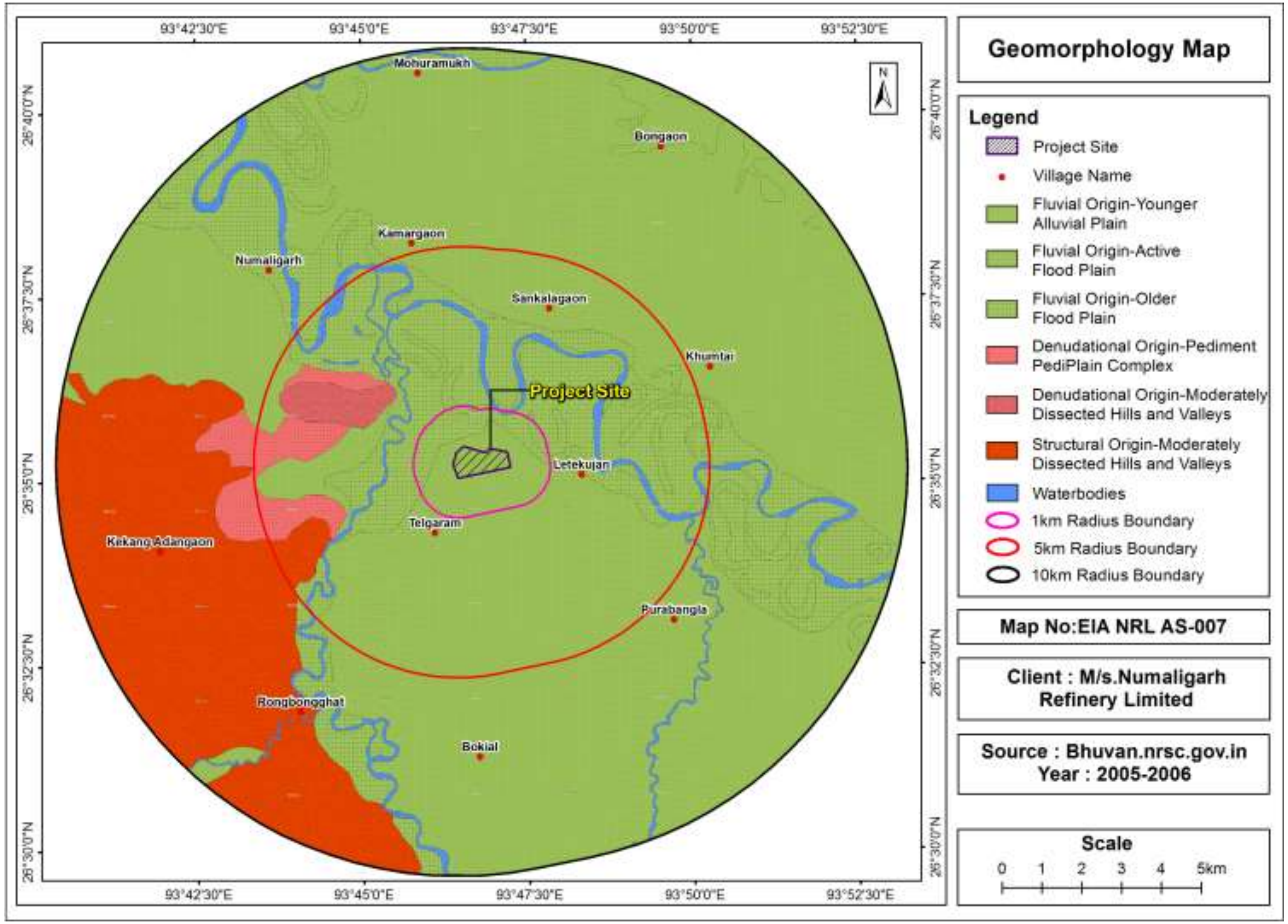


Figure 3-13Geomorphology Map of the Study Area

3.5.6 Hydrogeology of PIA district

Geologically the district is underlain by Quaternary formation followed by Archaean group of rocks. Quaternary formation comprises younger and older alluvial deposits consisting of different grades of sand, pebbles, cobbles, gravel and clay in the area. Major parts in the north of NH-37 passing in the east-west direction in the district show younger alluvial deposits. The older alluvial deposits occur mainly towards southern parts of the NH37. The hard crystalline of Archaean age covers extreme southern boundary of the district merging with Karbi-Anglong district. The rock types are granite, granite gneiss and quartzite. Sub-surface geology as evidenced from available data infers that the potential aquifer pertaining to Quaternary formation exist down to the explored depth of 300 m. The cumulative thickness of aquifer zones has the tendency to increase towards the north and in the southeastern parts, the thickness reverses considerably. Hydrogeologically, the district is proved to be very potential. Ground water occurs under water table to confined conditions. Depth to water level in major parts of the district varies from 2 to 5 m. In the extreme southern and southwestern parts close to hills, the water level is found to be deeper and generally rests within 5 to 7 m. The movement of ground water is from south to north. The water level trend shows that there is gradual rising of water level in the district. Central Ground Water Board has so far constructed fourteen exploratory tube wells in the district. The details of the deep tube wells are presented in Table 1. Hydrogeological information collected from these wells indicates that three to nine prolific aquifer system exist in the district. Deep tube wells constructed down to maximum depth of 250 m give variable discharge from 26 to 216 m3 /hr for draw down within 13 m. Transmissivity and permeability value varies from 415 to 500 m2 /d and 7 to 82 m/day respectively.The hydrogeology map of Golaghat District is given in **Figure 3-14**

Source:https://cgwb.gov.in/District_Profile/Assam/Golaghat.pdf

(**Ref:** Government of India Ministry of Water Resources Central Ground water Board, District Ground Water Brochure Golaghat District,Assam")

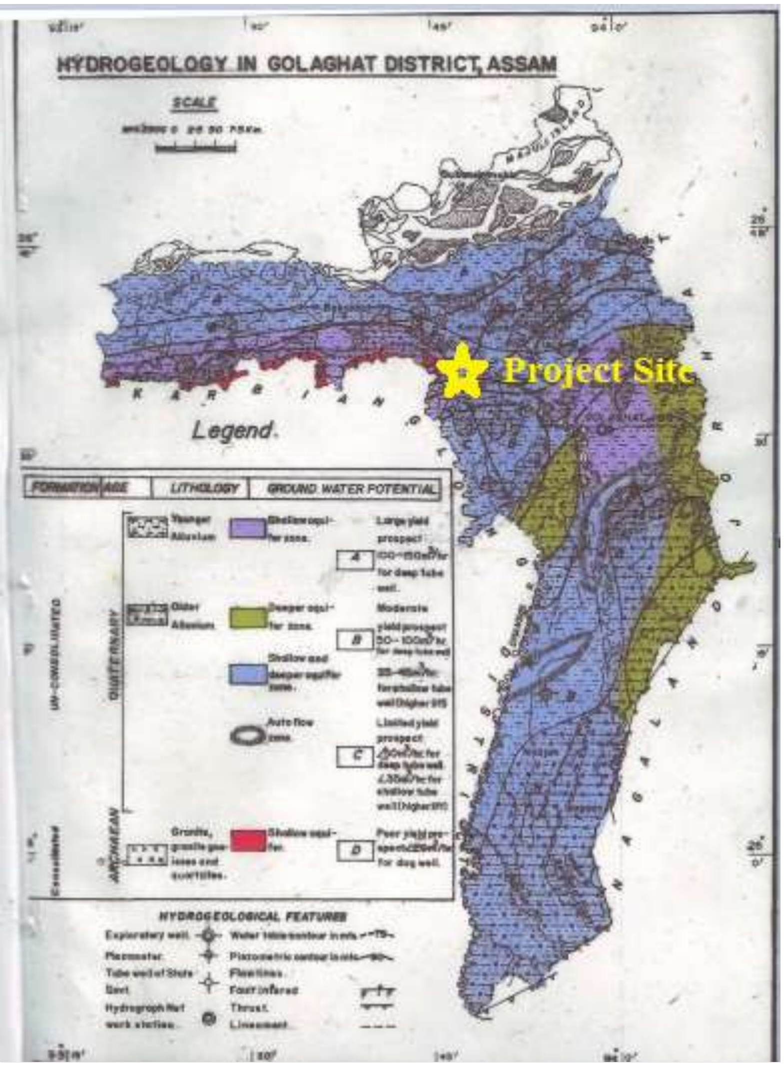


Figure 3-14 Hydrogeology Map of Golaghat District

From the hydrogeological map of Golaghat district given in **Figure 3-14** the Project site comes under Shallow Aquifer Zone.

3.5.7 Drainage Pattern in PIA district

The River Brahmaputra flowing in east-west direction in the extreme northern parts of the district and its tributaries flowing in northerly direction, control the entire drainage system of the district and plays an important role in the ground water occurrence and control of the district. Important Rivers of the district are Dhansiri and Dayang. These rivers have meandering courses with abandoned channels in the form of bils and ox-bow lakes along their courses.

Source:https://cgwb.gov.in/District_Profile/Assam/Golaghat.pdf

(**Ref:** Government of India Ministry of Water Resources Central Ground water Board, District Ground Water Brochure Golaghat District,Assam")

3.5.8 Geology

The geology of almost the entire district is concealed by alluvial deposits. Geological surveys, aided by drilling for oil have shown that under the recent deposits there are many thousands of feet Tertiary sediments which lie over on Nagaland basement complex. **Figure 3 -15** Depicts that the Geology of the Project site is located in Alluvium plain

Source:

https://censusindia.gov.in/nada/index.php/catalog/216/download/514/DH_2011_1814_PART_A_DCHB_GOLAGHAT.pdf

(Ref Directorate of Census Operations –Assam , "District Census Handbook-2011, Golaghat District", Series-19 Part XII A)

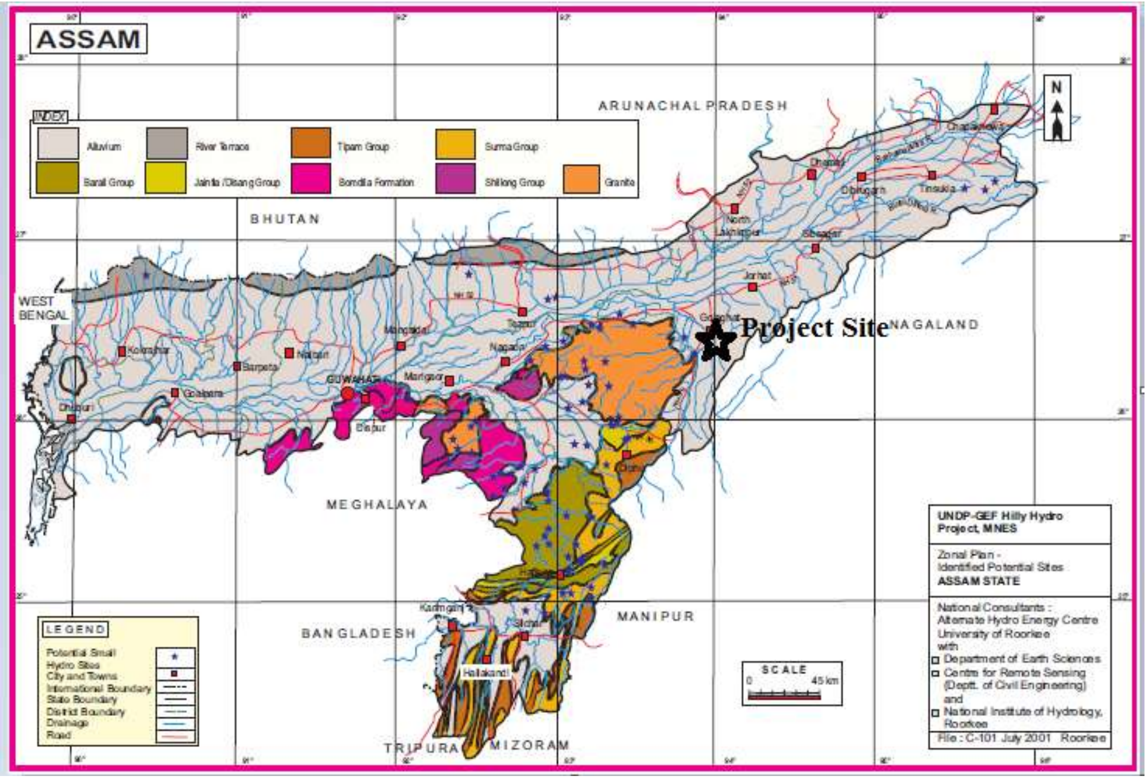


Figure 3-15 Geology Map of Assam

3.5.9 Seismicity

As per Vulnerability Atlas of India- 2nd Edition, The project location/study area falls in Zone V, which is categorized as a Highest Active zone. The seismicity map of India is shown in **Figure 3-16**.

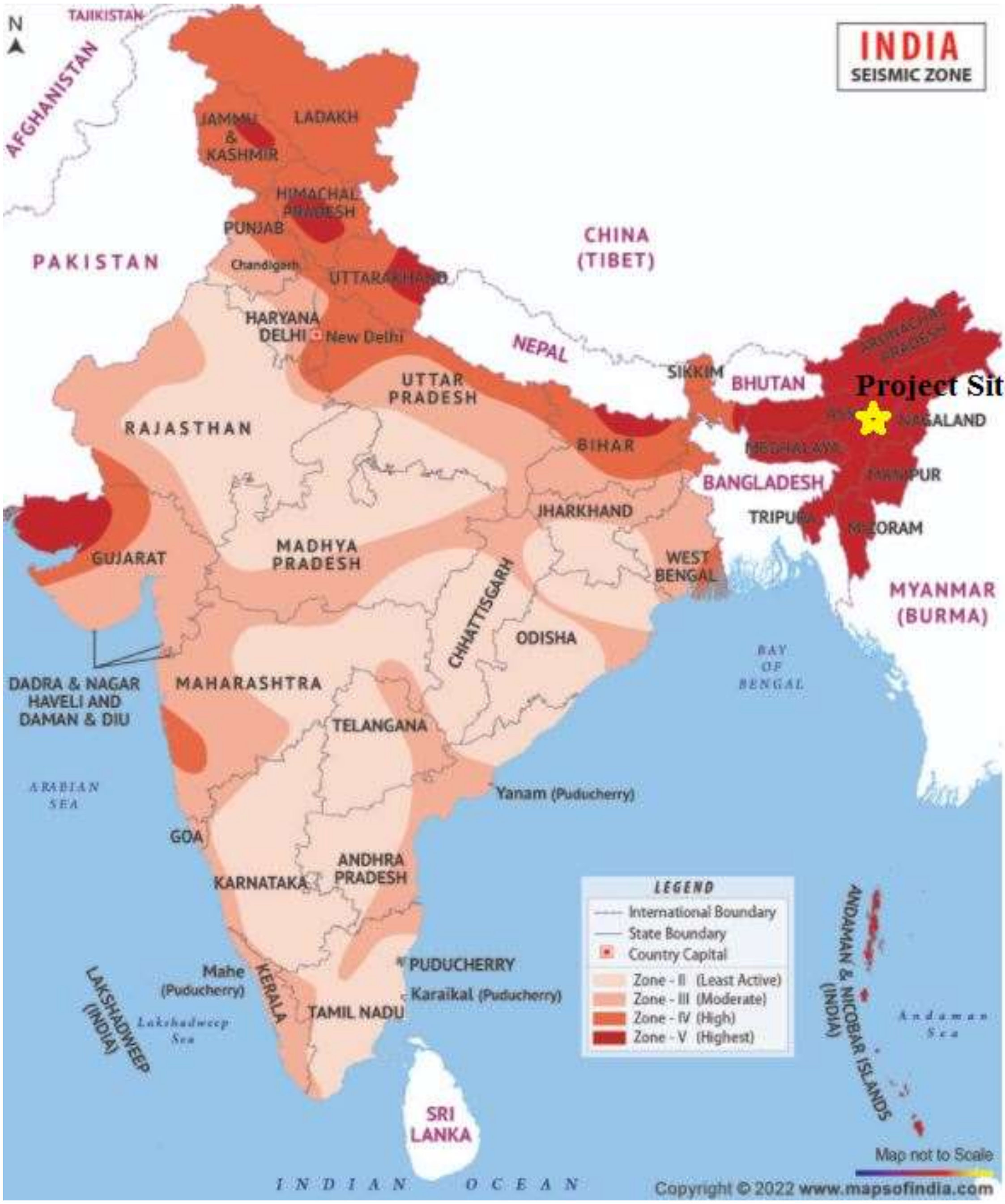


Figure 3-16 Seismicity Zone Map of India

3.5.10 Soils in PIA District

The arable soils of Golaghat district may broadly be grouped into—- 1. Old alluvial soils. 2. New alluvial soils of riparian tracts and 3. Hilly soils. The major portions of the arable soils of the district are however, alluvial soils. The textures of the soils of the district vary from sandy loams to sands. There are also some clayed loams or clayed soils. Both old alluvial soils and hills soil are acid in reaction and deficient in 'available' phosphate and potash also. As regards to total nitrogen, it varies from high to low in case of old alluvial soils, it is medium in most of new alluvial soils, while hill soils are usually comparatively rich in nitrogen apparently due to the virgin nature of the soils..Soil map of India is given in **Figure 3-17.**

Source:
https://censusindia.gov.in/nada/index.php/catalog/216/download/514/DH_2011_1814_PART_A_DCHB_GOLAGHAT.pdf

(Ref Directorate of Census Operations –Assam , "District Census Handbook-2011, Golaghat District", Series-19 Part XII A)

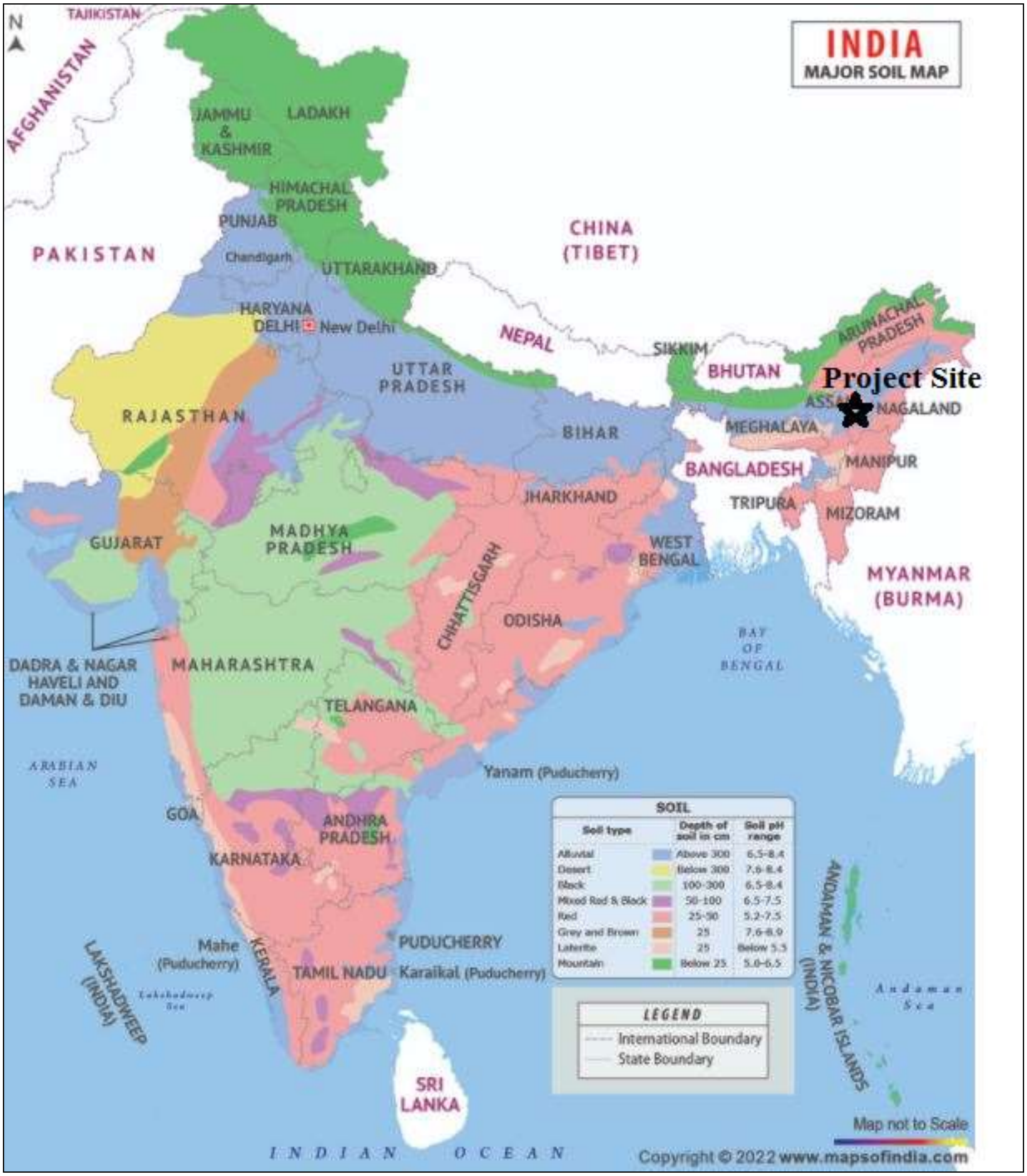


Figure 3-17 Soil map of India

3.5.11 Natural Hazards in PIA District

Flood is a common phenomenon of Assam. Like most of the districts Golaghat district also experiences heavy flood during the rainy seasons. The plains of Golaghat district lying in the basin areas of river Brahmaputra and Dhansiri suffer annually from the floods. The magnitudes of the devastation and havoc caused frequently by floods have increased after the great earthquake that occured in 1950. There is a great loss of life and property in the district every year due to recurring flood. The causes of the increased flood hazard to which the plains have been subjected are complex. It is well known that the great earthquake of 1950 has changed the topography of the basins. The large-scale landslides caused by earthquake have denuded hills of forests and hill slopes have cracked and become unstable. The riverbed elevated and the water carrying capacitates of the river have been reduced. In search of required waterways the rivers overflow their already dwarfed banks and spread all over the plains. The causes of the flood havoc lie mostly in the conditions of river course and the rapid silting of riverbeds and sometimes due to heavy intensity of monsoon rainfall. In spite of remedial measures under taken by the government, the district still reels under flood menaces and continue to suffer loss of life and property due to flood havocs .The Wind Hazard Map of India is given in **Figure 3-18.**

Source:

https://censusindia.gov.in/nada/index.php/catalog/216/download/514/DH_2011_1814_PART_A_DCHB_GOLAGHAT.pdf

(Ref Directorate of Census Operations –Assam , “District Census Handbook-2011, Golaghat District”, Series-19 Part XII A)

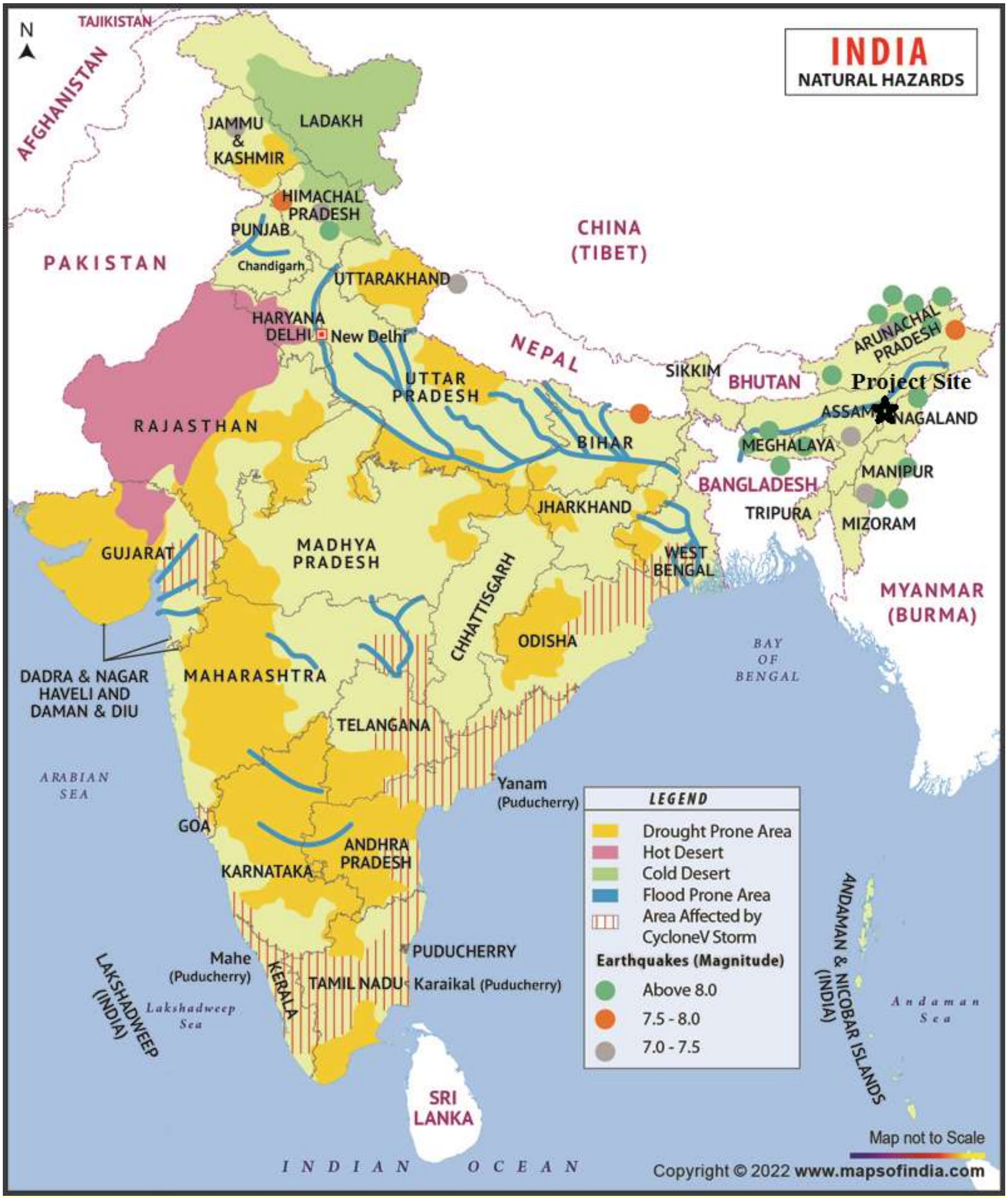


Figure 3-18 Natural hazard Map of India

3.6 Establishment of Baseline for valued environmental components

3.6.1 Air Environment

Baseline ambient air quality assessment gives the status in the vicinity of site and is an indispensable part of environmental impact assessment studies. Significant changes, in predominant winds and weather conditions are observed in winter, summer and post-monsoon seasons apart from the local topographic influences by using secondary data and also the baseline status of air environment in the study area is assessed for one season through a systematic air quality surveillance programme as a primary data generation.

3.6.2 Meteorological Conditions

The regional air quality is influenced by the meteorology of that region. The principal weather parameters that influence the concentration of the air pollutants in the surroundings are wind speed, wind direction and temperature. The meteorological data is useful for proper interpretation of the baseline data. It is used as input for air quality dispersion models for predicting the post project environmental scenario.

3.6.3 Meteorological Data Collection

Available secondary data pertaining to the meteorological parameters was obtained from the IMD Climatological tables. In addition, baseline meteorological data (primary data) was generated during the study period (December 2022 to February 2023). The methodology adopted for monitoring surface observations is as per the standard norms laid down by Bureau of Indian Standards (BIS) i.e. IS:8829 and India Meteorological Department (IMD).

3.6.4 General Meteorological Scenario based on IMD Data

The nearest India Meteorological Department (IMD) station located near to the project site is Tezpur in Assam. The Climatological data of Tezpur, published by the IMD, based on daily observations at 08:30 and 17:30 hour IST for period 1991 – 2020, is presented in the following sections, representing the meteorological conditions of the region. The monthly variations of the relevant meteorological parameters are reproduced in **Table 3-5.**

Table 3-5 Climatological Summary – Tezpur (1991-2020)

Month	Temp (°C)		Rainfall		Relative Humidity (%)		Vapour Pressure hPa		Mean Wind Speed (Kmph)	Predominant Wind Directions (From)*	
	Daily Max.	Daily Min.	Total (mm)	No. of days	08:30	17:30	08:30	17:30		08:30	17:30
Jan	23.7	11.3	12.0	1.1	82	73	14.6	15.9	0.9	NE	NE
Feb	26.3	13.9	22.3	2.0	76	64	16.2	17.1	1.5	NE	NE
Mar	29.3	17.2	49.7	4.2	68	58	18.4	19.0	2.2	NE	NE
Apr	29.7	20.0	167.2	11.4	76	68	22.8	23.5	2.4	NE	NE
May	30.7	22.4	268.2	14.3	81	74	27.8	28.4	1.8	NE	NE
Jun	31.6	24.7	315.5	15.3	86	79	32.3	32.9	1.1	N,NE, SW	NE,E, SW
Jul	31.9	25.3	289.3	15.4	87	80	33.4	33.8	0.8	NE,SW	N,NE,E,S,SW
Aug	32.3	25.5	281.8	13.3	87	80	33.8	34.4	0.7	S	NE,SW
Sep	32.0	24.7	210.2	11.8	87	82	32.4	33.1	0.8	N,NE	N,NE
Oct	31.0	21.8	104.2	5.3	81	81	27.6	29.2	0.8	NE	N,NE,E
Nov	28.3	16.8	21.7	1.4	77	78	20.5	22.0	0.9	N,NE	NE
Dec	25.0	12.7	7.1	0.6	81	77	16.4	17.8	0.8	NE	NE
Max.	**32.3**	**25.5**	**315.5**	**15.4**	**87**	**82**	**33.8**	**34.4**	**2.4**	**Annual Predominant wind direction is North East**	
Min.	**23.7**	**11.3**	**7.1**	**0.6**	**68**	**58**	**14.6**	**15.9**	**0.7**		
Annual Avg/Total.	**29.3**	**19.7**	**1749.0**	**96.1**	**80**	**74**	**24.4**	**25.5**	**1.2**		

As per the above IMD climatological Data given in Table 3-5**,** the observations drawn are as follows

- Highest Daily maximum temperature is 32.3°C and the Lowest daily minimum temperature is 23.7°C were recorded in the months of August and January respectively.
- Maximum and minimum relative humidity of 87 % and 58 % were recorded in the months of July, August, September and March respectively.
- Maximum and minimum rainfall of 315.5 mm and 7.1 mm was recorded in the months of June and December respectively.
- Maximum and minimum Mean wind speed is 2.4 km/hr and 0.7 km/hr was recorded in the months of April and August respectively. Annual Wind predominant pattern is **North East.**

3.6.5 Meteorological Scenario during Study Period

The meteorological scenario in and around the project site is an essential requirement during study period for proper interpretation of baseline air quality status. Meteorological data was collected during the study period **(December 2022 to February 2023)** and is presented in **Table 3-6**. The wind rose for the study period is given as **Figure 3-19.**

Table 3-6 Meteorological Data for the Study Period (December 2022 to February 2023)

S. No	Parameter	Observation
1.	Temperature	Max Temperature : 29^{0}C Min Temperature : 8^{0}C Avg Temperature : 20.95^{0}C
2.	Average Relative Humidity	74.24%
3.	Average Wind Speed	1.27 m/s
4.	Predominant Wind Direction during study period	East

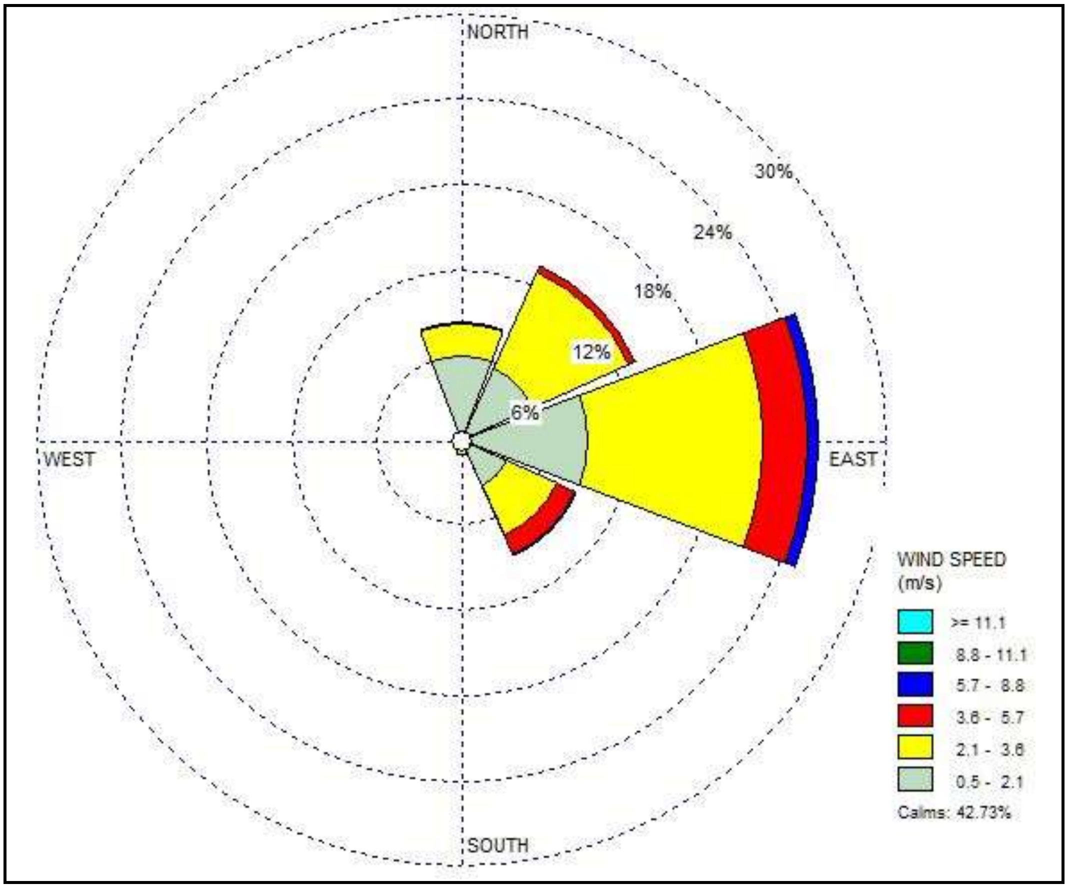


Figure 3-19 Wind rose during study period (December 2022 to February 2023)

3.6.6 Atmospheric Inversion

Atmospheric inversion level at the project site was monitored; the results observed at the site during the study period are as follows

- Average atmospheric temperature:20.95 °C
- Average Relative humidity: 74.24%
- Average Wind speed: 1.27m/s

The daily inversion level calculated based on the average temperature and average wind speed at the project site and the maximum inversion height is derived by the graph plotted based on the average temperature and average wind speed. The daily inversion level at the project site varies from 50 to 2162 m during 6 AM to 3 PM, the maximum recorded at 3 PM, February 2023. This is shown in **Figure 3-20.**

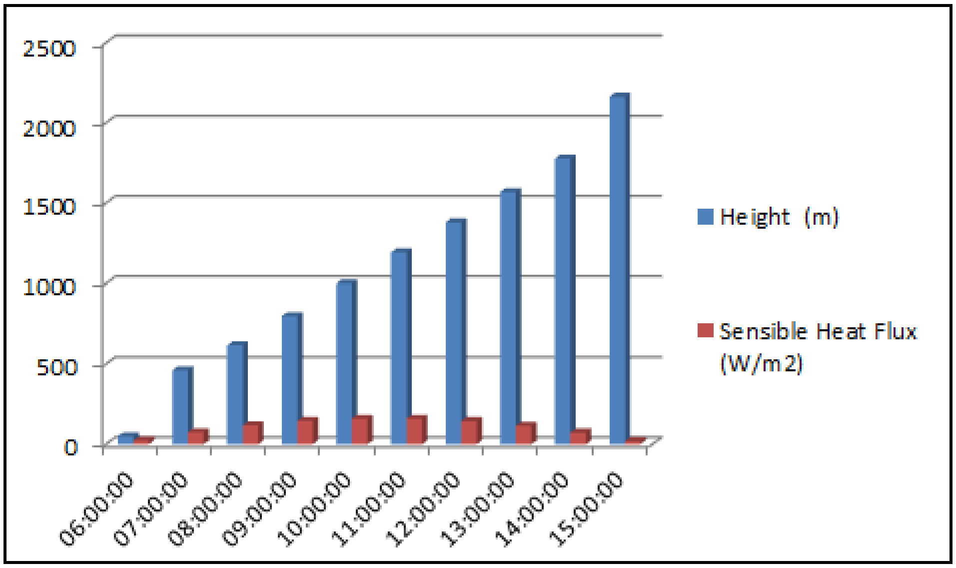


Figure 3-20Atmospheric inversion level at the project site

3.7 Ambient Air Quality

The selection criteria for monitoring locations are based on the following:

- Topography/Terrain

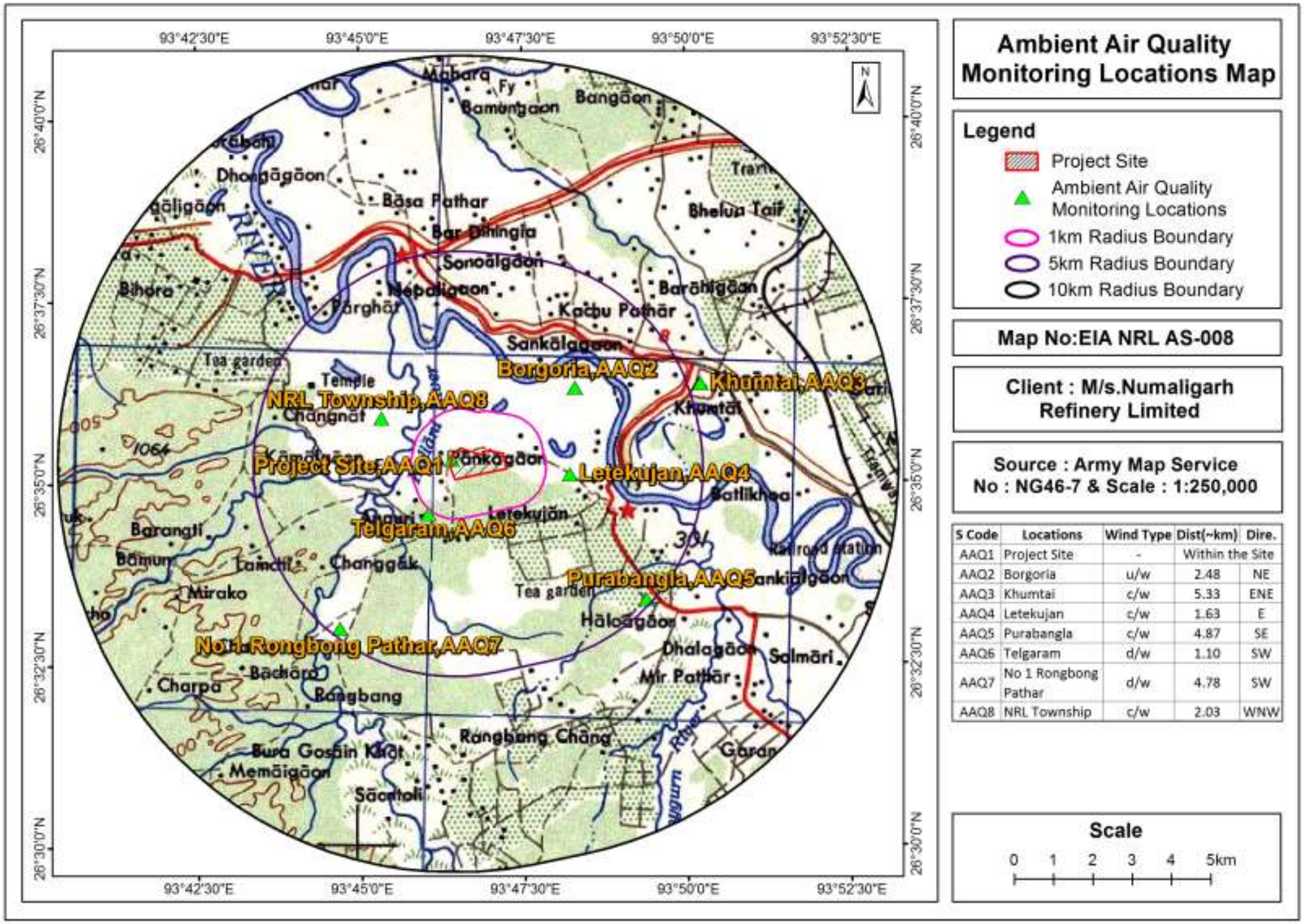
- Meteorological conditions – Upwind and Downwind locations
- Residential and sensitive areas within the study area
- Representatives of regional background air quality/pollution levels and
- Representation of likely impacted areas

3.7.1 Ambient Air Quality Monitoring Stations

To evaluate the baseline air quality of the study area, Eight (08) monitoring locations have been identified as per Meteorological data during the study period (**December 2022 to February 2023**). The Annual wind predominance is from North East to South West. AAQ monitoring locations are selected based on Annual wind predominance, map showing the air monitoring locations is given in **Figure 3-21** and the details of Ambient Air Quality Monitoring locations are given in **Table 3-7.**

Table 3-7 Details of Ambient Air Quality Monitoring Locations

Station Code	Location	Type of Wind	Distance (~km) from Project boundary	Azimuth Directions
A1	Project site	-	Within Project site	
A2	Borgoria	u/w	2.48	NE
A3	Khumtai	c/w	5.33	ENE
A4	Letekujan	c/w	1.63	E
A5	Purabangla	c/w	4.87	SE
A6	Telgaram	d/w	1.10	SW
A7	No 1 Rongbong Pathar	d/w	4.78	SW
A8	NRL Township	c/w	2.03	WNW



S Code	Locations	Wind Type	Dist(~km)	Dire.
AAQ1	Project Site	-	Within the Site	
AAQ2	Borgoria	u/w	2.48	NE
AAQ3	Khumtai	c/w	5.33	ENE
AAQ4	Letekujan	c/w	1.63	E
AAQ5	Purabangla	c/w	4.87	SE
AAQ6	Telgaram	d/w	1.10	SW
AAQ7	No 1 Rongbong Pathar	d/w	4.78	SW
AAQ8	NRL Township	c/w	2.03	WNW

Figure 3-21Map showing the Air monitoring locations Map

3.7.2 Ambient Air Quality Monitoring Techniques, Frequency and Methodology

Ambient air quality was monitored twice in a week for three (3) months, i.e. (December 2022 to February 2023). Particulate matter <10 micron size (PM10),Particulate matter <2.5 micron size (PM2.5), Sulphur Dioxide (SO2), Nitrogen Dioxide (NO2),Carbon Monoxide (CO), Benzene (C6H6), Lead (Pb),TVOC ,Total Hydrocarbon, Methane HC, Non-Methane HC were monitored. Sampling was carried out as per Central Pollution Control Board (CPCB) monitoring guidelines at each location.Analytical methods used for analysis of Ambient Air Quality parameters are given in **Table 3-8.**

Table 3-8 Analytical Methods for Analysis of Ambient Air Quality Parameters

S.No	Parameters	Analytical method	NAAQ standards: 2009		Sampling Time
1	Sulphur Dioxide (SO_2), $\mu g/m^3$	IS:5182(Part-2):2001	50 (Annual)	80(24 Hours)	24 Hours
2	Nitrogen Dioxide (NO_2), $\mu g/m^3$	IS: 5182 (Part - 6): 2006	40 (Annual)	80 (24 Hours)	24 Hours
3	Particulate Matter ($PM_{2.5}$), $\mu g/m^3$	IS 5182 Part 24: 2019	40 (Annual)	60 (24 hours)	24 Hours
4	Particulate Matter (PM_{10}), $\mu g/m^3$	IS:5182 (Part– 23): 2006	60 (Annual)	100 (24 hours)	24 Hours
5	CO mg/m^3	IS:5182(Part–10):1999	2 (8 hours)	4 (1hour)	8 Hours
6	Benzene, $\mu g/m^3$	IS 5182 Part 11: 2006	5 (Annual)	5 (Annual)	24 Hours
7	O_3, $\mu g/m^3$	IS: 5182 (Part – 9): 1974	100(8hours)	180 (1hour)	8 Hours
8	Pb $\mu g/m^3$	IS:5182(Part–22):2004	0.5(Annual)	1(24 hours)	24 Hours
9	TVOC	HECS/INS/SOP/073	-	-	-
10	Hydrocarbon	IS 5182 Part 17: 1979	-	-	-
11	Methane Hydrocarbon	IS 5182(Part 17)	-	-	-
12	Non-Methane Hydrocarbon	IS 5182(Part 17)	-	-	-

3.7.3 Results and Discussions

The variations of the pollutant concentrations of PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO, Pb, NH_3, C_6H_6, $C_{20}H_{12}$, HC, TVOC are compared with National Ambient Air Quality Standards (NAAQS), MoEF&CC Notification, November, 2009. The Summary of the average baseline concentrations of pollutants is given in **Table 3-9** and trends of measured ambient concentration in the study area were graphically represented in **Figure 3-22**.

Table 3-9 Summary of the average baseline concentrations of pollutants

Parameters	Conc.	NAAQ Standards	Locations							
			Project site	Borgoria	Khumtai	Letekujan	Purabangla	Telgaram	No 1 Rongbong Pathar	NRL Township
			A1	A2	A3	A4	A5	A6	A7	A8
PM$_{10}$ Conc. (µg/m^3)	Min.	100 (24 Hours)	60.52	50.98	52.57	48.65	59.29	57.46	53.09	49.43
	Max		86.25	72.65	74.92	69.33	84.49	81.90	75.66	70.45
	Avg.		**72.58**	**61.13**	**63.04**	**58.34**	**71.09**	**68.91**	**63.66**	**59.28**
	98th ‘tile		85.75	72.23	74.49	68.93	84.00	81.42	75.22	70.04
PM$_{2.5}$ Conc. (µg/m^3)	Min.	60 (24 Hours)	34.71	26.13	22.09	22.77	26.88	27.86	29.88	24.56
	Max		49.47	37.24	31.48	32.45	38.31	39.70	42.58	35.00
	Avg.		**41.63**	**31.33**	**26.49**	**27.31**	**32.24**	**33.41**	**35.83**	**29.45**
	98th ‘tile		49.18	37.02	31.29	32.26	38.08	39.47	42.33	34.79
SO$_2$ Conc. (µg/m^3)	Min.	80 (24 Hours)	16.16	9.93	10.08	8.25	10.74	10.91	10.14	10.10
	Max		23.03	14.15	14.36	11.76	15.30	15.54	14.45	14.40
	Avg.		**19.38**	**11.91**	**12.09**	**9.90**	**12.88**	**13.08**	**12.16**	**12.12**
	98th ‘tile		22.89	14.07	14.28	11.69	15.21	15.45	14.36	14.32
NO$_2$Conc.(µg/m^3)	Min.	80 (24 Hours)	23.82	15.96	18.29	16.43	19.87	18.89	18.60	17.66
	Max		33.95	22.74	26.06	23.42	28.32	26.92	26.50	25.17
	Avg.		**28.57**	**19.14**	**21.93**	**19.71**	**23.84**	**22.65**	**22.30**	**21.18**
	98th ‘tile		33.75	22.61	25.91	23.28	28.16	26.76	26.35	25.02
Pb (µg/m^3)	Avg.	1	BLQ(LO	BLQ(LOQ	BLQ(LOQ	BLQ(LOQ	BLQ(LOQ	BLQ(LOQ	BLQ(LOQ	BLQ(LOQ

Parameters	Conc.	NAAQ Standards	Locations							
			Project site	Borgoria	Khumtai	Letekujan	Purabangla	Telgaram	No 1 Rongbong Pathar	NRL Township
			A1	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**A8**
		(24 hour)	Q 0.05)	0.05)	0.05)	0.05)	0.05)	0.05)	0.05)	0.05)
CO (mg/m^3)	**Avg.**	**4 (1hour)**	**1.09**	**0.51**	**0.88**	**0.60**	**0.84**	**0.79**	**0.72**	**0.54**
O$_3$ (µg/m^3)	**Avg.**	**180 (1hour)**	**28.69**	**20.10**	**23.48**	**20.89**	**23.06**	**22.56**	**21.50**	**20.34**
Benzene (µg/m^3)	**Avg.**	**5 (Annual)**	BLQ(LOQ 1)	BLQ(LOQ 1)	BLQ(LOQ 1)	BLQ(LOQ 1)	BLQ(LOQ 1)	BLQ(LOQ 1)	BLQ(LOQ 1)	BLQ(LOQ 1)
Hydrocarbon(µg/m^3)	**Avg.**	**-**	BLQ(0.1)	BLQ(0.1)	BLQ(0.1)	BLQ(0.1)	BLQ(0.1)	BLQ(0.1)	BLQ(0.1)	BLQ(0.1)
Methane HC(µg/m^3)	**Avg.**	**-**	BLQ(0.1)	BLQ(0.1)	BLQ(0.1)	BLQ(0.1)	BLQ(0.1)	BLQ(0.1)	BLQ(0.1)	BLQ(0.1)
Non-Methane HC(µg/m^3)	**Avg.**	**-**	BLQ(0.1)	BLQ(0.1)	BLQ(0.1)	BLQ(0.1)	BLQ(0.1)	BLQ(0.1)	BLQ(0.1)	BLQ(0.1)
TVOC(µg/m^3)	**Avg.**	**-**	BLQ(0.1)	BLQ(0.1)	BLQ(0.1)	BLQ(0.1)	BLQ(0.1)	BLQ(0.1)	BLQ(0.1)	BLQ(0.1)

Note: *BLQ (Below Limit Of Quantification), LOQ (Limit Of Quantification)*

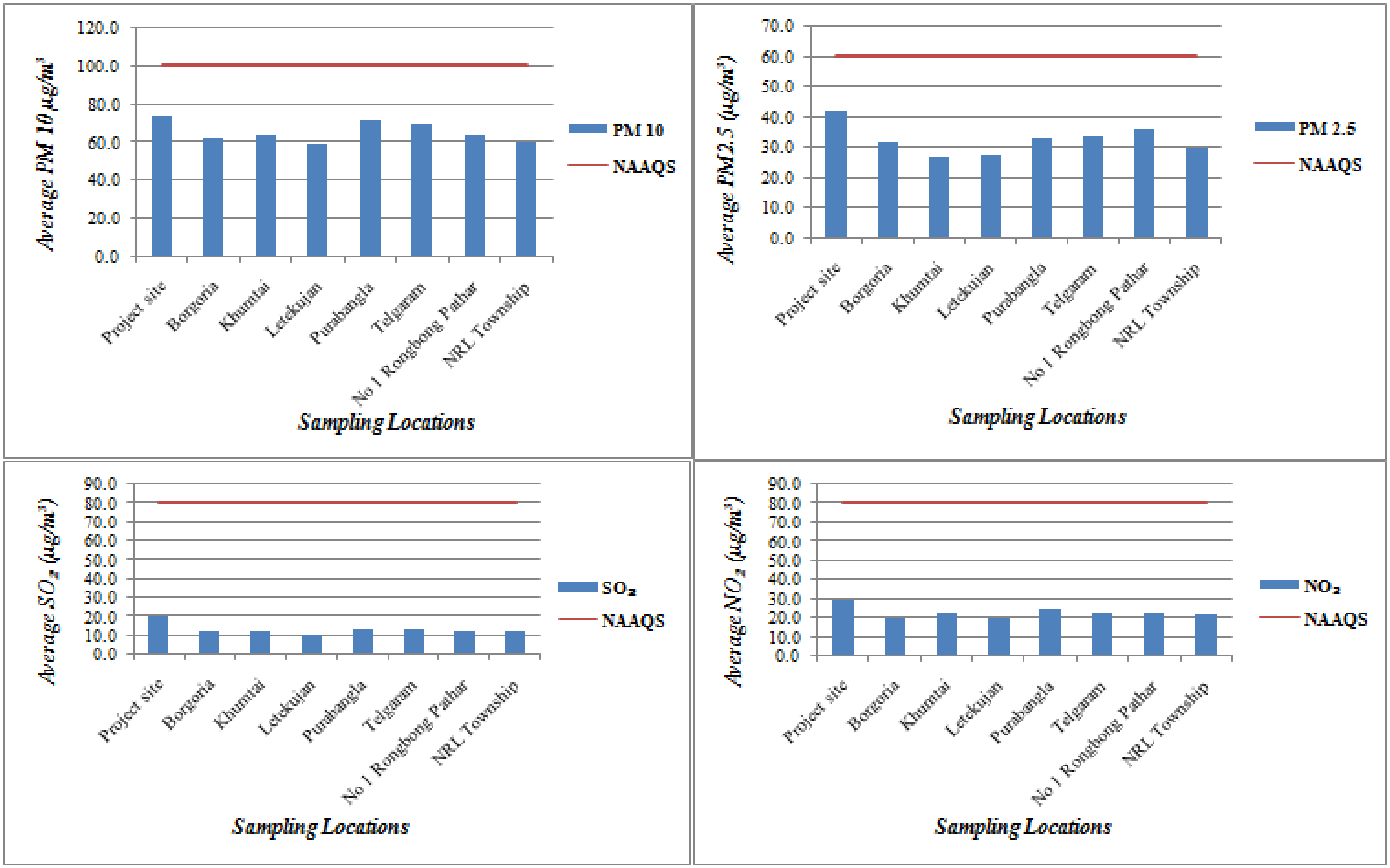


Figure 3-22 Trends of Measured Ambient Concentrations in the Study Area

3.7.3.1 Observations

The ambient air quality has been monitored at 8 locations for 12 parameters as per CPCB guidelines within the study area. The minimum and maximum baseline levels of PM_{10} is 48.65 µg/m³ to 86.25 µg/m³, $PM_{2.5}$ is 22.09 µg/m³ to 49.47 µg/m³, SO_2 is 8.25 µg/m³ to 23.03 µg/m³, NO_2 is 15.96 µg/m³ to 33.95 µg/m³, all the parameters are well within the National Ambient Air Quality at all monitoring locations during the study period December 2022 to February 2023.

3.8 Noise Environment -components and methodology

The prevailing ambient noise level at a particular location is nothing but the resultant (total) of all kinds of noise sources existing at various distances around that location. The ambient noise level at a location varies continuously depending on the type of surrounding activities. Ambient noise levels have been established by monitoring noise levels at Eight(08) locations in and around 10Km distance from project area during the study period using precision noise level meter. The noise monitoring locations in the study area were selected after giving due consideration to the various land use categories. The land use categories include commercial, residential, rural and sensitive areas. Noise levels were recorded on an hourly basis for one complete day at each location using pre- calibrated noise levels. A map noise showing the noise monitoring locations is given in **Figure 3-23.**

3.8.1 Results and Discussions

Based on the recorded hourly noise levels at each monitoring location, the day equivalent (Ld) and night equivalent (Ln) were calculated;

- Ld: Average noise levels between 6:00 hours to 22.00 hours.
- Ln: Average noise levels between 22:00 hours to 6.00 hours.

The day and night equivalent noise levels are shown in the **Table 3-10** and their graphical representation is given in **Figure 3-24** with the respective CPCB stipulated noise standards for various land use categories.

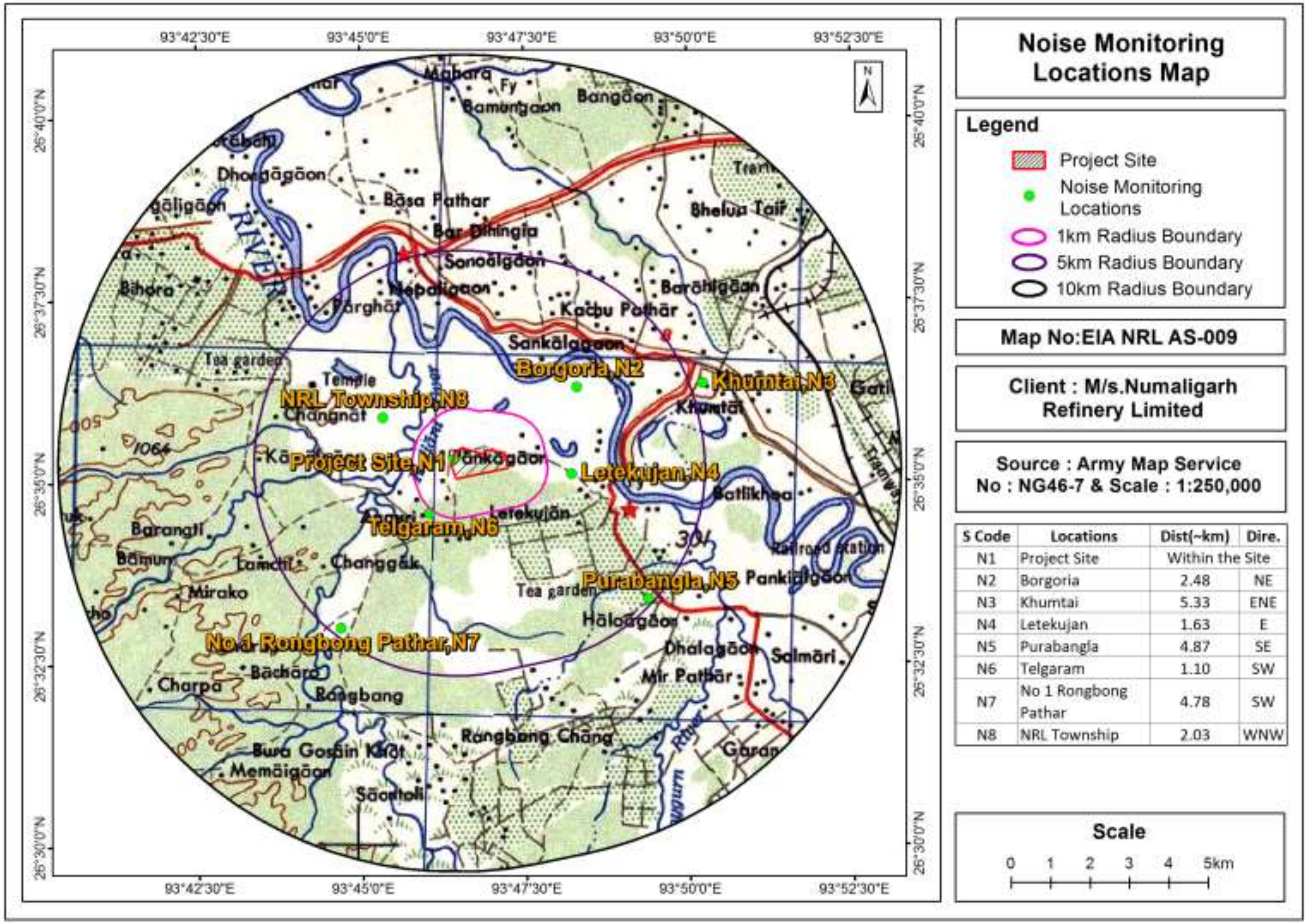
Table 3-10 Day and Night Equivalent Noise Levels

S. No	Location	Location Code	Distance (km) from Project boundary	Azimuth Direction	Noise level in dB(A) Leq		CPCB Standard		Environmental Setting
					Day	Night	Lday (Ld)	LNight (Ln)	
1	Project site	N1	Within site		52.2	45.2	75	70	Industrial
2	Borgoria	N2	2.48	NE	52.9	41.2	55	45	Residential
3	Khumtai	N3	5.33	ENE	53.9	41.4	55	45	Residential
4	Letekujan	N4	1.63	E	48.1	40.8	55	45	Residential
5	Purabangla	N5	4.87	SE	51.3	40.9	55	45	Residential
6	Telgaram	N6	1.10	SW	47.9	42.2	55	45	Residential
7	No 1 Rongbong Pathar	N7	4.78	SW	48.4	41.1	55	45	Residential
8	NRL Township	N8	2.03	WNW	51.3	40.2	55	45	Residential

3.8.2 Observations

The observations of day equivalent and night equivalent noise levels at all locations are given below

- In Industrial area at day time noise levels was about 52.2 dB(A) During day time and 45.2 dB(A) during night time, which is within prescribed limit by CPCB (75 dB(A) Day time & 70 dB(A) Night time).
- In residential areas day time noise levels varied from 47.9 dB(A) to 53.9 dB(A) and night time noise levels varied from 40.2 dB(A) to 42.2 dB(A) across the sampling stations. The field observations during the study period indicate that the ambient noise levels is within the prescribed limit by CPCB (55 dB(A) Day time & 45 dB(A) Night time).



S Code	Locations	Dist(~km)	Dire.
N1	Project Site	Within the Site	
N2	Borgoria	2.48	NE
N3	Khumtai	5.33	ENE
N4	Letekujan	1.63	E
N5	Purabangla	4.87	SE
N6	Telgaram	1.10	SW
N7	No 1 Rongbong Pathar	4.78	SW
N8	NRL Township	2.03	WNW

Figure 3-23 Map showing the Noise Monitoring locations

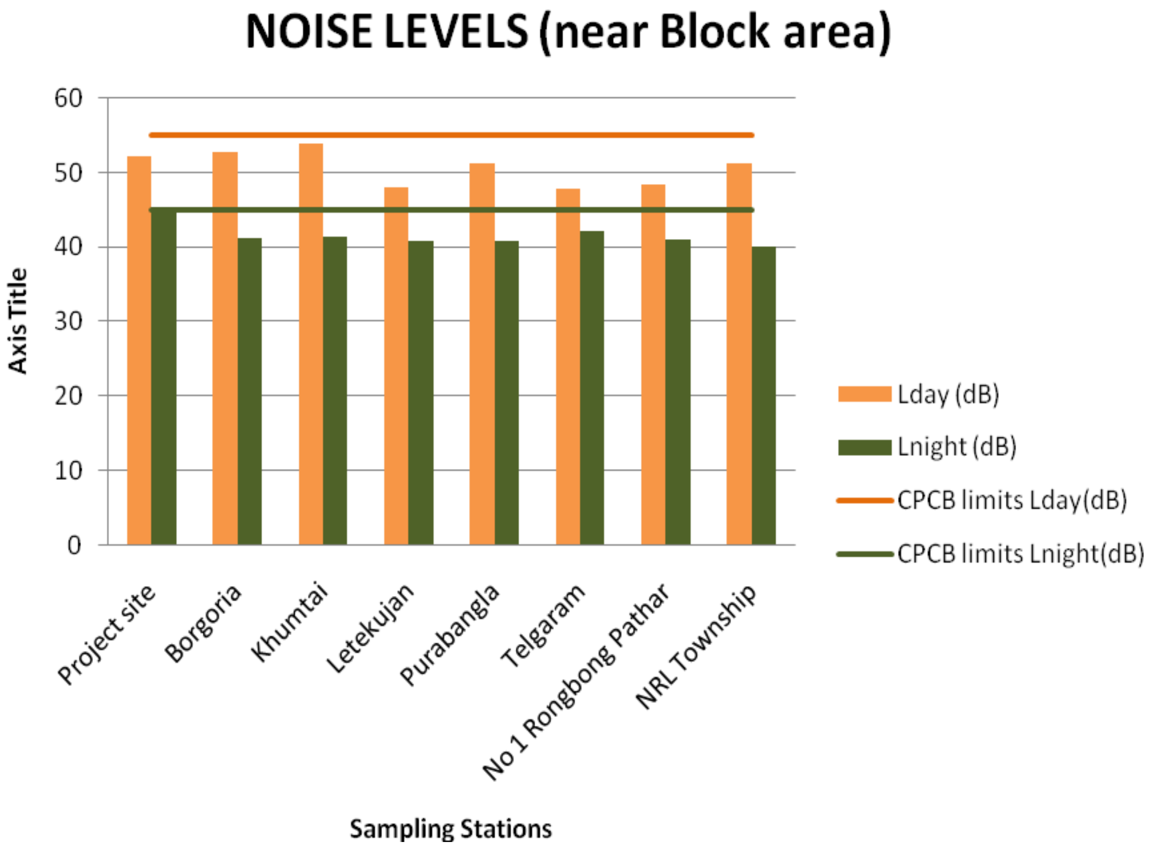


Figure 3-24 Trends of Measured Noise Level in the Study Area

3.9 Water Environmentcomponents and methodology

3.9.1 Surface Water Resources

The River Brahmaputra flowing in east-west direction in the extreme northern parts of the district and its tributaries flowing in northerly direction, control the entire drainage system of the district and plays an important role in the ground water occurrence and control of the district. Important Rivers of the district are Dhansiri and Dayang. These rivers have meandering courses with abandoned channels in the form of bils and ox-bow lakes along their courses.

Source: *https://cgwb.gov.in/District_Profile/Assam/Golaghat.pdf*

_(**Ref**: Government of India Ministry of Water Resources Central Ground water Board, District Ground Water Brochure Golaghat District, Assam")

3.9.2 Surface Water Quality Assessment

To establish the baseline status of water environment, the representative sampling locations for surface water within a radial distance of 10 Km from project site have been selected as per CPCB guidelines of Water Quality Monitoring through an adequate survey of the project area. Test methods used for the analysis of water quality parameters is given in **Table 3-11.**

Table 3-11 Test methods used for the analysis of water quality parameters

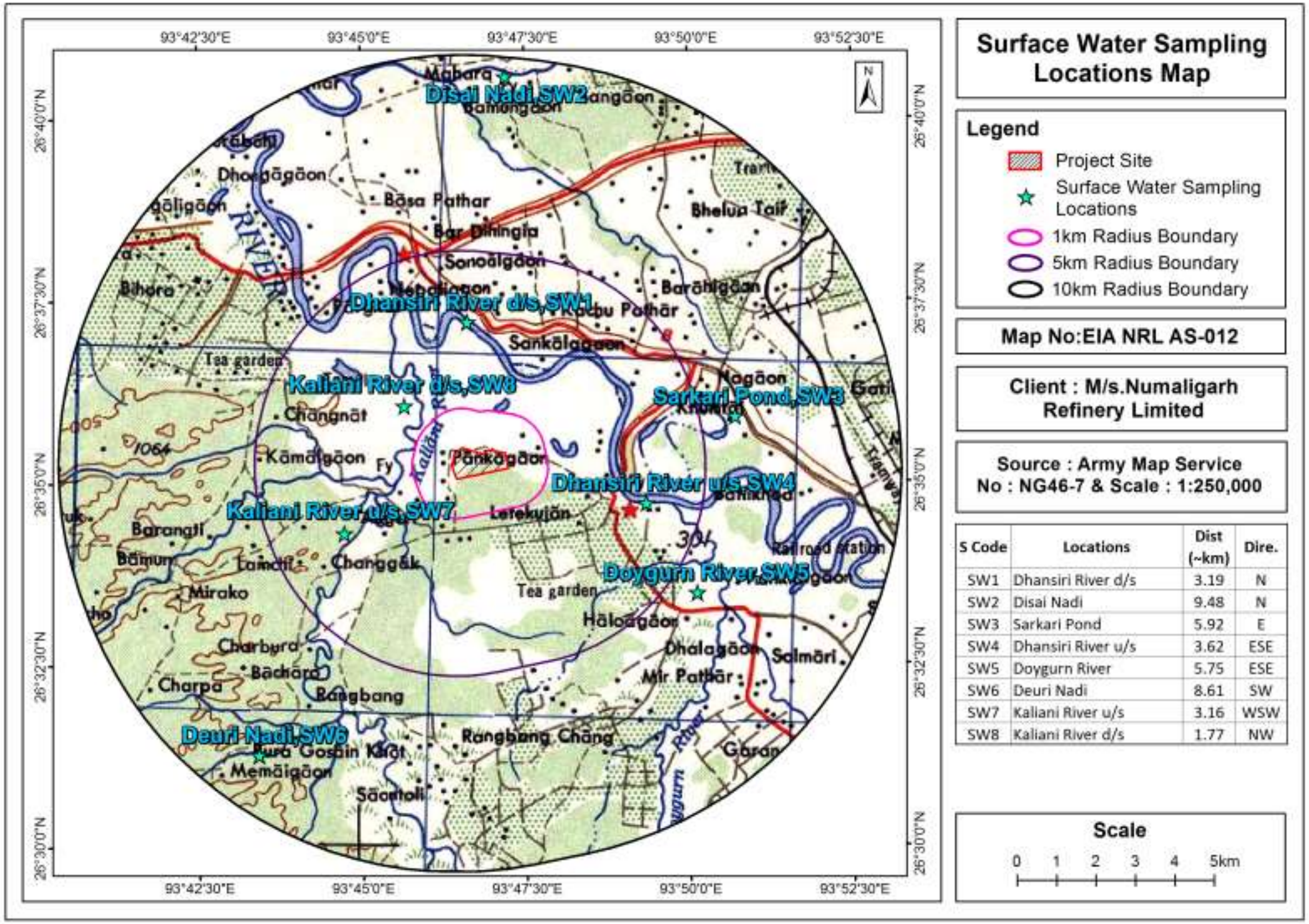
S. No	Parameter Measured	Test Method
1.	Turbidity	IS 3025(Part - 10):1984
2.	pH	IS:3025 (Part - 11): 1983
3.	Conductivity	IS:3025 (Part - 14): 1983
4.	Total Dissolve Solids	IS:3025:1(Part - 16) 1984
5.	Total Suspended Solids	IS 3025 (Part - 17) 1984
6.	Alkalinity as CaCO3	IS:3025,1 (Part - 23) 1986
7.	Total Hardness as CaCo3	IS:3025 (Part - 21) 1983
8.	Sodium	IS:3025,5(Part - 45) 1993
9.	Potassium	IS:3025,5(Part - 45) 1993
10.	Calcium as Ca	IS 3025 (Part - 40):1991
11.	Magnesium as Mg	IS 3025 (Part - 46) 1994
12.	Chloride	IS 3025 (Part - 32):1988
13.	Sulphate SO4	IS 3025(Part - 24):1986
14.	Nitrate as NO3	ASTM(Part - 31)1978
15.	Fluorides as F	IS 3025 (Part - 60):2008
16.	Arsenic	IS 3025:(Part-37):1988
17.	Cyanide	IS : 3025 (Part 27) - 1986

18.	Boron	IS:3025 (Part - 57):2003
19.	Cadmium	IS 3025 (Part - 41)1991
20.	Chromium, Total	IS:3025 (Part - 52) 2003
21.	Copper	IS:3025 (Part - 42)1992
22.	Lead	IS:3025 (Part - 47) 1994
23.	Manganese	IS 3025:(Part - 59):2006
24.	Mercury	IS 3025 (Part48):1994
25.	Nickel	IS 3025:(Part-54):2003
26.	Selenium	IS 3025 Part (56)2003
27.	Dissolved Oxygen	IS:3025 (Part - 38)1989
28.	BOD	5210B APHA22nd Edn 2012
29.	COD	IS:3025 (Part-58)-2006

The prevailing status of surface water quality has been assessed during the study period. Surface water Sampling locations and results are provided in **Table 3-12 and Table 3-13**. Surface Water sampling locations Map is given in **Figure 3-25**.and Trends of Surface Water Quality Parameters in the Study Area is given in **Figure 3 -25**

Table 3-12 Details of Surface water sampling locations

S. No	Water bodies	Location code	Distance from project boundary (~Km)	Direction from project boundary
1	Dhansiri River d/s	SW1	3.19	N
2	Disai Nadi	SW2	9.48	N
3	Sarkari Pond	SW3	5.92	E
4	Dhansiri River u/s	SW4	3.62	ESE
5	Doygurn River	SW5	5.65	ESE
6	Deuri Nadi	SW6	8.61	SW
7	Kaliani River u/s	SW7	3.16	WSW
8	Kaliani River d/s	SW8	1.77	NW



Surface Water Sampling Locations Map

Map No:EIA NRL AS-012

Client : M/s.Numaligarh Refinery Limited

Source : Army Map Service No : NG46-7 & Scale : 1:250,000

S Code	Locations	Dist (~km)	Dire.
SW1	Dhansiri River d/s	3.19	N
SW2	Disai Nadi	9.48	N
SW3	Sarkari Pond	5.92	E
SW4	Dhansiri River u/s	3.62	ESE
SW5	Doygurn River	5.75	ESE
SW6	Deuri Nadi	8.61	SW
SW7	Kaliani River u/s	3.16	WSW
SW8	Kaliani River d/s	1.77	NW

Figure 3-25 Surface Water Sampling Locations Map

Table 3-13 Surface water Monitoring Results

S. No	**Parameter**	**Unit**	**Surface water standards (IS 2296 Class-A)**	**Dhansiri River d/s**	**Disai Nadi**	**Sarkari Pond**	**Dhansiri River u/s**	**Doygurn River**	**Deuri Nadi**	**Kaliani River u/s**	**Kaliani River d/s**
				SW1	**SW2**	**SW3**	**SW4**	**SW5**	**SW6**	**SW7**	**SW8**
1	Turbidity	NTU	**1**	7.1	7.2	1.8	5.2	4	4.9	4.7	5.3
2	pH (at 25°C)	--	**6.5-8.5**	7.68	6.91	6.89	7.13	7.02	7.47	7.35	7.23
3	Electrical Conductivity	µS/cm	**-**	354	341	371	311	338	322	283	290
4	Total Dissolved Solids	mg/l	**500**	193	191	205	169	185	174	151	161
5	Total Suspended Solids	mg/l	**-**	15	15	5	12	9	11	10	12
6	Total Alkalinity as $CaCO_3$	mg/l	**-**	85	90	85	80	84	95	75	80
7	Total Hardness as $CaCO_3$	mg/l	**300**	84	96	126	77	92	116	82	92
8	Sodium as Na	mg/l	**-**	27	25	20	23	22	16	14	18
9	Potassium as K	mg/l	**-**	3	2	1	2	2	1	1	1
10	Calcium as Ca	mg/l	**-**	19.53	22.32	31.62	17.99	21.39	26.69	19.06	21.39

S. No	Parameter	Unit	Surface water standards (IS 2296 Class-A)	Dhansiri River d/s	Disai Nadi	Sarkari Pond	Dhansiri River u/s	Doygurn River	Deuri Nadi	Kaliani River u/s	Kaliani River d/s
				SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
11	Magnesium as Mg	mg/l	**-**	8.5	9.8	11.4	7.7	9.3	12.0	8.3	9.3
12	Chloride as Cl	mg/l	**250**	35.10	32.40	42.10	28.50	33.80	28.10	22.30	27.30
13	Sulphate as SO_4	mg/l	**400**	15.20	13.60	17.70	12.00	13.50	13.30	9.60	11.10
14	Nitrate as NO_3	mg/l	**20**	2.9	3.2	3.1	2.7	2.8	2.1	2.3	2.4
16	Fluorides as F	mg/l	**1.5**	0.43	0.35	0.39	0.41	0.20	0.35	0.42	0.45
17	Cyanide	mg/l	**0.05**	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)
18	Arsenic	mg/l	**0.05**	BLQ (LOQ 0.005)	BLQ (LOQ 0.005)	BLQ (LOQ 0.005)	BLQ (LOQ 0.005)	BLQ (LOQ 0.005)	BLQ (LOQ 0.005)	BLQ (LOQ 0.005)	BLQ (LOQ 0.005)
19	Boron as B	mg/l	**-**	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)
20	Cadmium as Cd	mg/l	**0.01**	BLQ(LOQ 0.001)	BLQ(LOQ	BLQ(LOQ	BLQ(LOQ 0.001)	BLQ(LOQ 0.001)	BLQ(LOQ	BLQ(LOQ 0.001)	BLQ(LOQ 0.001)

S. No	Parameter	Unit	Surface water standards (IS 2296 Class-A)	Dhansiri River d/s	Disai Nadi	Sarkari Pond	Dhansiri River u/s	Doygurn River	Deuri Nadi	Kaliani River u/s	Kaliani River d/s
				SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
					0.001)	0.001)			0.001)		
21	Chromium, Total	mg/l	**0.05**	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)
22	Copper as Cu	mg/l	**1.5**	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)
23	Lead as Pb	mg/l	**0.1**	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)
24	Manganese as Mn	mg/l	**0.5**	BLQ(LOQ 0.05)	BLQ(LOQ 0.05)	BLQ(LOQ 0.05)	BLQ(LOQ 0.05)	BLQ(LOQ 0.05)	BLQ(LOQ 0.05)	BLQ(LOQ 0.05)	BLQ(LOQ 0.05)
25	Mercury	mg/l	**0.001**	BLQ(LOQ 0.0005)	BLQ(LOQ 0.0005)	BLQ(LOQ 0.0005)	BLQ(LOQ 0.0005)	BLQ(LOQ 0.0005)	BLQ(LOQ 0.0005)	BLQ(LOQ 0.0005)	BLQ(LOQ 0.0005)
26	Nickel as Ni	mg/l	**-**	BLQ(LO	BLQ(LOQ	BLQ(LOQ	BLQ(LOQ	BLQ(LO	BLQ(LOQ	BLQ(LOQ	BLQ(LO

S. No	Parameter	Unit	Surface water standards (IS 2296 Class-A)	Dhansiri River d/s	Disai Nadi	Sarkari Pond	Dhansiri River u/s	Doygurn River	Deuri Nadi	Kaliani River u/s	Kaliani River d/s
				SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
				Q 0.01)	0.01)	0.01)	0.01)	Q 0.01)	0.01)	0.01)	Q 0.01)
27	Selenium as Se	mg/l	**0.01**	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)
29	Dissolved Oxygen	mg/l	**6**	6.1	6.0	6.1	6.4	6.1	5.8	6.0	5.7
30	Chemical Oxygen Demand as O_2	mg/l	**-**	12.0	20.0	12.0	8.0	12.0	24.0	8.0	12.0
31	BOD, 3 days @ 27°C as O_2	mg/l	**2**	2.0	3.0	2.0	BLQ (LOQ 1.0)	2.0	3.0	BLQ (LOQ 1.0)	2.0

*(**Note:** BLQ – Below Limit of Quantification; LOQ – Limit Of Quantification)*

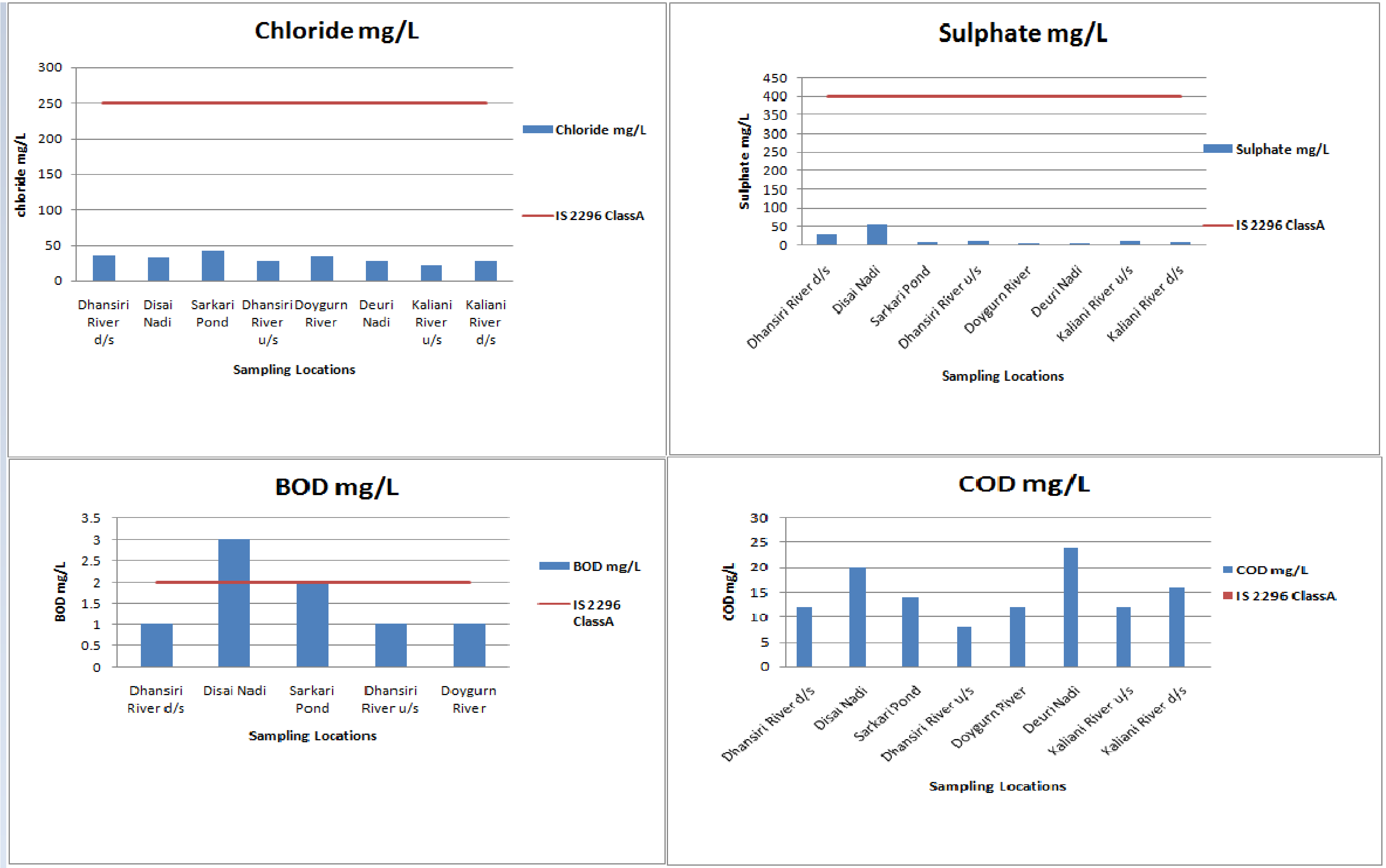


Figure 3-26 Trends of Measured Ambient Concentrations in the Study Area

3.9.2.1 Results and Discussions

Surface water sample results are discussed below:

- pH in the collected surface water samples varies between 6.89 to 7.68.
- The Total Dissolved Solids (TDS) value of collected surface water sample ranges from 151 mg/l to 205 mg/l.
- The Total hardness value of the collected surface water sample ranges between 77 mg/l to 126 mg/l.
- BOD value of the collected surface water sample ranges from BLQ (LOQ 1.0) to 3 mg/l.It is slightly higher than the limit in SW2 and SW6 which may indicate the presence of organic pollution.
- COD value of collected surface water varies from 8 mg/l to 24 mg/l.
- The concentration of heavy metals like As,Cn,B,Cd, Cr, Pb, Mn, Hg, Ni and Se are within the limits of IS 2296:1992 is given in **Table 3 -14**.

Table 3-14 Water Quality Standards in India (Source IS 2296:1992)

S.No	Parameters	Unit	A	B	C	D	E
1	Turbidity	NTU	---	---	---	---	---
2	pH	--	8.5	8.5	8.5	8.5	8.5
3	Conductivity	µS/cm	---	---	---	1000	2250
4	Total Dissolved Solids	mg/l	500	---	1500	---	2100
5	Alkalinity as CaCO3	mg/l	---	---	---	---	---
6	Total Hardness as CaCo3	mg/l	300	---	---	---	---
7	Calcium as Ca	mg/l	---	---	---	---	---
8	Magnesium as Mg.	mg/l	---	---	---	---	---
9	Sodium Na	mg/l	---	---	---	---	---
10	Potassium	mg/l	---	---	---	---	---
11	Chloride as Cl	mg/l	250	---	600	---	600
12	Sulphate as SO4	mg/l	400	---	400	---	1000
13	Phosphate	mg/l	---	---	---	---	---
14	Nitrate as NO3	mg/l	20	---	50	---	---
15	Fluorides as F	mg/l	1.5	1.5	1.5	---	---
16	Cyanide	mg/l	0.05	0.05	0.05	---	---
17	Arsenic	mg/l	0.05	0.2	0.2	---	---
18	Cadmium	mg/l	0.01	---	0.01	---	---

S.No	Parameters	Unit	A	B	C	D	E
19	Chromium, Total	mg/l	0.05	0.05	0.05	---	---
20	Copper	mg/l	1.5	---	1.5	---	---
21	Iron	mg/l	0.3	---	50	---	---
22	Boron	mg/l	---	---	---	---	2
23	Lead	mg/l	0.1	---	0.1	---	---
24	Zinc	mg/l	15	---	15	---	---
25	Manganese	mg/l	0.5	---	---	---	---
26	Selenium	mg/l	0.01	---	0.05	---	---
27	Mercury	mg/l	0.001	---	---	---	---
28	Dissolved Oxygen	mg/l	6	5	4	4	---
29	COD	mg/l	---	---	---	---	---
30	BOD	mg/l	2	3	3	---	---

Class A – Drinking water without conventional treatment but after disinfection.

Class B –Water for outdoor bathing.

Class C – Drinking water with conventional treatment followed by disinfection.

Class D – Water for fish culture and wild life propagation.

Class E – Water for irrigation, industrial cooling and controlled waste disposal

3.9.3 Ground Water Resources

Geologically the district is underlain by Quaternary formation followed by Archaean group of rocks. Quaternary formation comprises younger and older alluvial deposits consisting of different grades of sand, pebbles, cobbles, gravel and clay in the area. Major parts in the north of NH-37 passing in the east-west direction in the district show younger alluvial deposits. The older alluvial deposits occur mainly towards southern parts of the NH37. The hard crystalline of Archaean age covers extreme southern boundary of the district merging with Karbi-Anglong district. The rock types are granite, granite gneiss and quartzite. Sub-surface geology as evidenced from available data infers that the potential aquifer pertaining to Quaternary formation exist down to the explored depth of 300 m. The cumulative thickness of aquifer zones has the tendency to increase towards the north and in the southeastern parts, the thickness reverses considerably. Hydrogeologically, the district is proved to be very potential. Ground water occurs under water table to confined conditions. Depth to water level in major parts of the district varies from 2 to 5 m. In the extreme southern and southwestern parts close to hills, the water level is found to be deeper and generally rests within 5 to 7 m.

The movement of ground water is from south to north. The water level trend shows that there is gradual rising of water level in the district. Central Ground Water Board has so far constructed fourteen exploratory tube wells in the district.Hydrogeological information collected from these wells indicates that three to nine prolific aquifer system exist in the district. Deep tube wells constructed down to maximum depth of 250 m give variable discharge from 26 to 216 m3 /hr for draw down within 13 m. Transmissivity and permeability value varies from 415 to 500 m2 /d and 7 to 82 m/day respectively.

Source: https://cgwb.gov.in/District_Profile/Assam/Golaghat.pdf

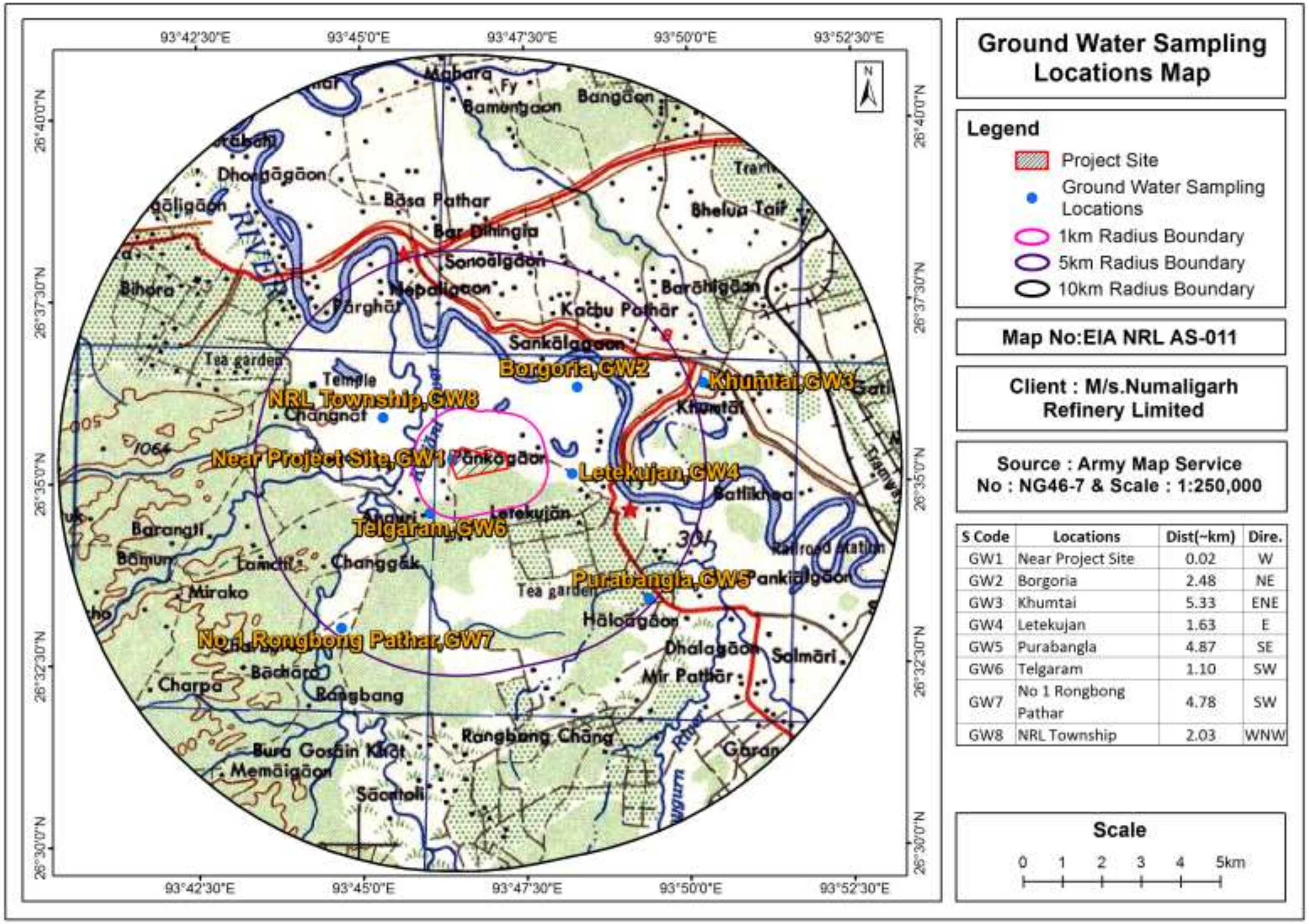
(Ref: Government of India Ministry of Water Resources Central Ground water Board, District Ground Water Brochure Golaghat District,Assam")

3.9.3.1 Ground Water Quality

Total Eight (08) ground water monitoring locations were identified for assessment in different villages around the project site based on the usage of sub surface water by the settlements/ villages in the study area. The groundwater results are compared with the acceptable and permissible water quality standards as per IS: 10500 (2012) for drinking water. Details of Groundwater quality monitoring locations and Ground Water sampling Results are given in **Table 3-15** and **Table 3-16**. A map map showing the groundwater sampling locations Map is given in **Figure 3-27** and the Trends of Measured Ground Water Quality Parameters in the Study Area is given in and the Trends of Measured Ground Water Quality Parameters in the Study Area is given in **Figure 3-28**.

Table 3-15 Details of Groundwater Quality Monitoring Locations

Station Code	Location	Distance (km) from Project boundary	Azimuth Directions
GW1	Project site	0.02	W
GW2	Borgoria	2.48	NE
GW3	Khumtai	5.33	ENE
GW4	Letekujan	1.59	E
GW5	Purabangla	4.76	SE
GW6	Telgaram	0.96	SW
GW7	No 1 Rongbong Pathar	4.70	SW
GW8	NRL Township	2.03	WNW



S Code	Locations	Dist(~km)	Dire.
GW1	Near Project Site	0.02	W
GW2	Borgoria	2.48	NE
GW3	Khumtai	5.33	ENE
GW4	Letekujan	1.63	E
GW5	Purabangla	4.87	SE
GW6	Telgaram	1.10	SW
GW7	No 1 Rongbong Pathar	4.78	SW
GW8	NRL Township	2.03	WNW

Figure 3-27 Groundwater monitoring locations Map

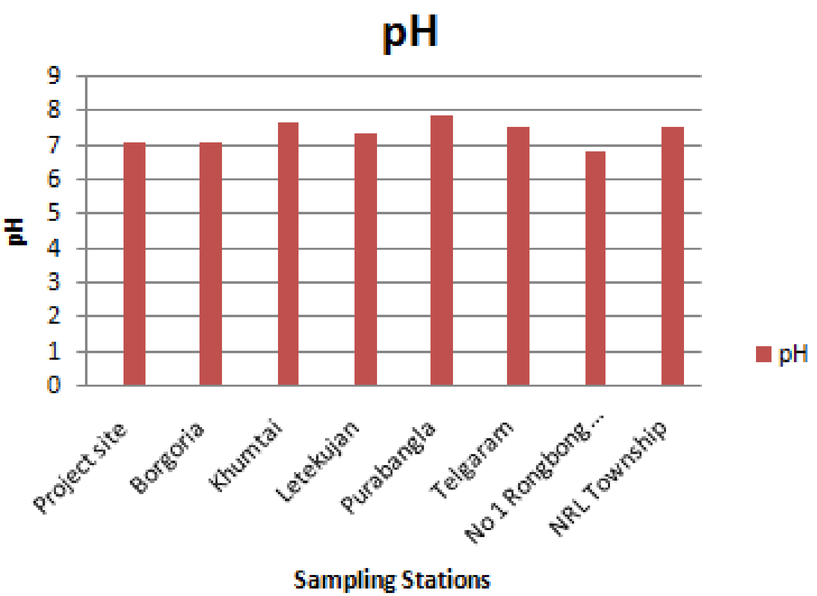
Table 3-16 Ground Water Monitoring Results

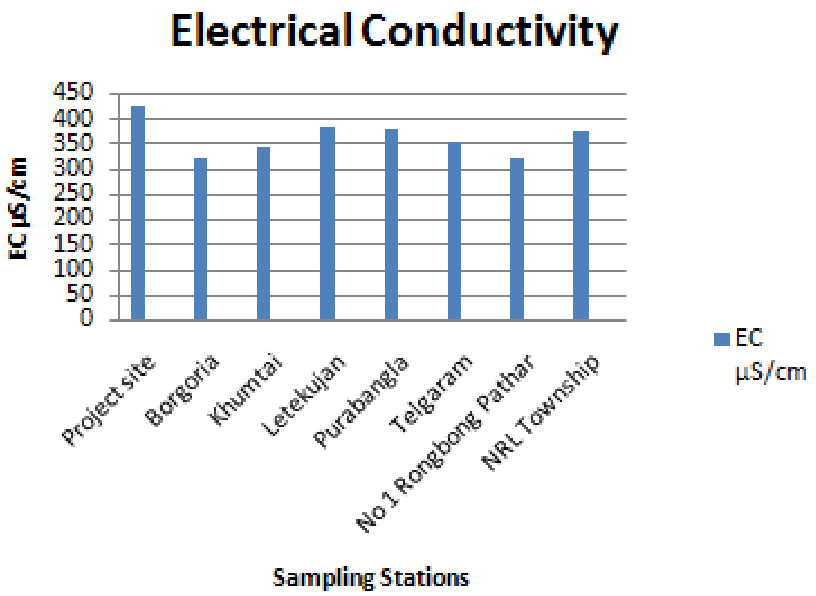
S. No	Parameters	Unit	Drinking water Standard (IS 10500: 2012)		Project site	Borgoria	Khumtai	Letekujan	Purabangla	Telgaram	No 1 Rongbong Pathar	NRL Township
			Permissible Limit	**Acceptable Limit**	**GW1**	**GW2**	**GW3**	**GW4**	**GW5**	**GW6**	**GW7**	**GW8**
1	Colour	Hazen	**15**	**5**	BLQ(LOQ 1)	BLQ(LOQ 1)	BLQ(LOQ 1)	BLQ(LOQ 1)	BLQ(LOQ 1)	BLQ(LOQ 1)	BLQ(LOQ 1)	BLQ(LOQ 1)
2	Turbidity	NTU	**5**	**1**	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)
3	pH	--	**NR**	**6.5-8.5**	7.14	7.12	7.72	7.36	7.87	7.57	6.88	7.59
4	Conductivity	µS/cm	**-**	**-**	423	320	345	384	380	350	319	374
5	Total Dissolved Solids	mg/l	**2000**	**500**	220	168	180	200	198	195	166	195
6	Total Suspended Solids		**-**	**-**	BLQ(LOQ 1)	BLQ(LOQ 1)	BLQ(LOQ 1)	BLQ(LOQ 1)	BLQ(LOQ 1)	BLQ(LOQ 1)	BLQ(LOQ 1)	BLQ(LOQ 1)
7	Alkalinity as $CaCO_3$	mg/l	**600**	**200**	68	62	61	80	86	87	70	75
8	Total Hardness as $CaCO_3$	mg/l	**600**	**200**	85	81	90	96	105	96	81	95
9	Sodium as Na	mg/l	**-**	**-**	38	24	26	27	25	27	20	27
10	Potassium as K	mg/l	**-**	**-**	3	2	2	3	2	3	2	3
11	Calcium as Ca	mg/l	**200**	**75**	20.04	19.67	21.97	23.99	26.74	24.06	19.97	22.04
12	Magnesium as Mg	mg/l	**100**	**30**	8.5	7.8	8.5	8.8	9.3	8.8	7.5	9.72

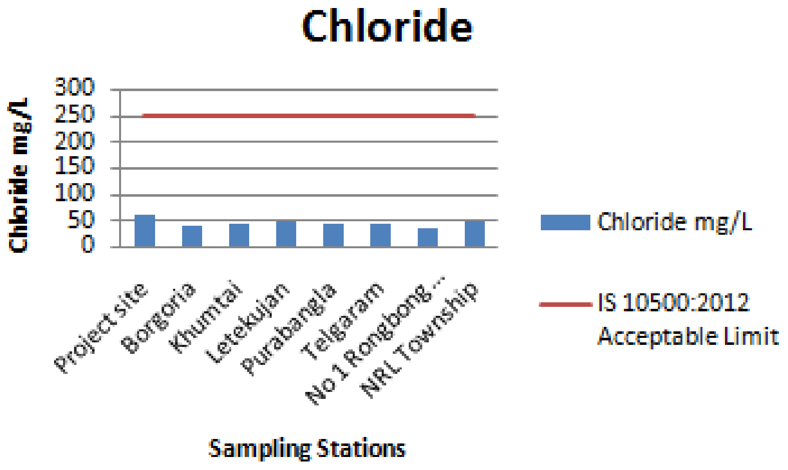
S. No	Parameters	Unit	Drinking water Standard (IS 10500: 2012)		Project site	Borgoria	Khumtai	Letekujan	Purabangla	Telgaram	No 1 Rongbong Pathar	NRL Township
			Permissible Limit	Acceptable Limit	GW1	GW2	GW3	GW4	GW5	GW6	GW7	GW8
13	Chloride as Cl	mg/l	**1000**	**250**	58.31	38.16	43.24	48.52	41.64	42.12	33.23	47.71
14	Sulphate SO_4	mg/l	**400**	**200**	24.91	17.74	20.41	20.48	19.72	17.45	13.26	19.41
15	Nitrate as NO_3	mg/l	**NR**	**45**	1.3	1.03	1.07	1.1	1.08	1.1	1.1	1.1
16	Fluorides as F		**1.5**	**1**	0.24	0.28	0.26	0.21	0.23	0.27	0.25	0.24
17	Cyanide	mg/l	**NR**	**0.05**	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)
18	Arsenic as As	mg/l	**0.05**	**0.01**	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)
19	Boron as B	mg/l	**1.0**	**0.5**	BQL(LOQ 0.1)	BQL(LOQ 0.1)	BQL(LOQ 0.1)	BQL(LOQ 0.1)	BQL(LOQ 0.1)	BQL(LOQ 0.1)	BQL(LOQ 0.1)	BQL(LOQ 0.1)
20	Cadmium as Cd	mg/l	**NR**	**0.003**	BQL(LOQ 0.001)	BQL(LOQ 0.001)	BQL(LOQ 0.001)	BQL(LOQ 0.001)	BQL(LOQ 0.001)	BQL(LOQ 0.001)	BQL(LOQ 0.001)	BQL(LOQ 0.001)
21	Chromium as Cr	mg/l	**NR**	**0.05**	BQL(LOQ 0.01)	BQL(LOQ 0.01)	BQL(LOQ 0.01)	BQL(LOQ 0.01)	BQL(LOQ 0.01)	BQL(LOQ 0.01)	BQL(LOQ 0.01)	BQL(LOQ 0.01)
22	Iron as Fe	mg/l	**NR**	**0.3**	BLQ(LOQ 0.02)	BLQ(LOQ 0.02)	BLQ(LOQ 0.02)	BLQ(LOQ 0.02)	BLQ(LOQ 0.02)	BLQ(LOQ 0.02)	BLQ(LOQ 0.02)	BLQ(LOQ 0.02)
22	Copper as Cu	mg/l	**1.5**	**0.05**	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)
23	Lead as Pb	mg/l	**NR**	**0.01**	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)
24	Manganese as Mn	mg/l	**0.3**	**0.1**	BLQ(LOQ 0.05)	BLQ(LOQ 0.05)	BLQ(LOQ 0.05)	BLQ(LOQ 0.05)	BLQ(LOQ 0.05)	BLQ(LOQ 0.05)	BLQ(LOQ 0.05)	BLQ(LOQ 0.05)
25	Mercury	mg/	**NR**	**0.001**	BLQ(LO	BLQ(LO	BLQ(LO	BLQ(LOQ	BLQ(LO	BLQ(LOQ	BLQ(LO	BLQ(LOQ

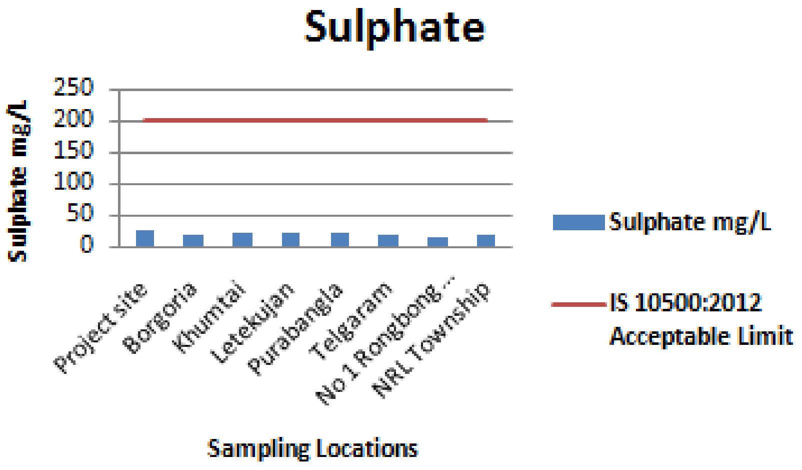
S. No	**Parameters**	**Unit**	**Drinking water Standard (IS 10500: 2012)**		**Project site**	**Borgoria**	**Khumtai**	**Letekujan**	**Purabangla**	**Telgaram**	**No 1 Rongbong Pathar**	**NRL Township**
			Permissible Limit	**Acceptable Limit**	**GW1**	**GW2**	**GW3**	**GW4**	**GW5**	**GW6**	**GW7**	**GW8**
		l			Q 0.0005)	Q 0.0005)	Q 0.0005)	0.0005)	Q 0.0005)	0.0005)	Q 0.0005)	0.0005)
26	Nickel as Ni	mg/l	**NR**	**0.02**	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)
27	Selenium as Se	mg/l	**NR**	**0.01**	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)
28	Zinc as Zn	mg/l	**15**	**5**	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)
29	Dissolved Oxygen	mg/l	**6-8**		6.2	6.4	6.2	6.4	6.3	6.4	6.2	6.4
30	Chemical Oxygen Demand as O_2	mg/l	**-**	**-**	BLQ(LOQ 4.0)	BLQ(LOQ 4.0)	BLQ(LOQ 4.0)	BLQ(LOQ 4.0)	BLQ(LOQ 4.0)	BLQ(LOQ 4.0)	BLQ(LOQ 4.0)	BLQ(LOQ 4.0)
31	BOD, 3 days @ 27°C as O_2	mg/l	**-**	**-**	BLQ(LOQ 1.0)	BLQ(LOQ 1.0)	BLQ(LOQ 1.0)	BLQ(LOQ 1.0)	BLQ(LOQ 1.0)	BLQ(LOQ 1.0)	BLQ(LOQ 1.0)	BLQ(LOQ 1.0)

*(**Note:** BLQ – Below Limit of Quantification; LOQ – Limit Of Quantification; NR – No Relaxation)*


pH
pH
9
8
7
6
5
4
3
2
1
0
Project site
Borgoria
Khumtai
Letekujan
Purabangla
Telgaram
No 1 Rongbong ...
NRL Township
Sampling Stations
pH


Electrical Conductivity
EC µS/cm
450
400
350
300
250
200
150
100
50
0
Project site
Borgoria
Khumtai
Letekujan
Purabangla
Telgaram
No 1 Rongbong Pathar
NRL Township
Sampling Stations
EC µS/cm


Chloride
Chloride mg/L
300
250
200
150
100
50
0
Project site
Borgoria
Khumtai
Letekujan
Purabangla
Telgaram
No 1 Rongbong ...
NRL Township
Sampling Stations
Chloride mg/L
IS 10500:2012 Acceptable Limit


Sulphate
Sulphate mg/L
250
200
150
100
50
0
Project site
Borgoria
Khumtai
Letekujan
Purabangla
Telgaram
No 1 Rongbong ...
NRL Township
Sampling Locations
Sulphate mg/L
IS 10500:2012 Acceptable Limit

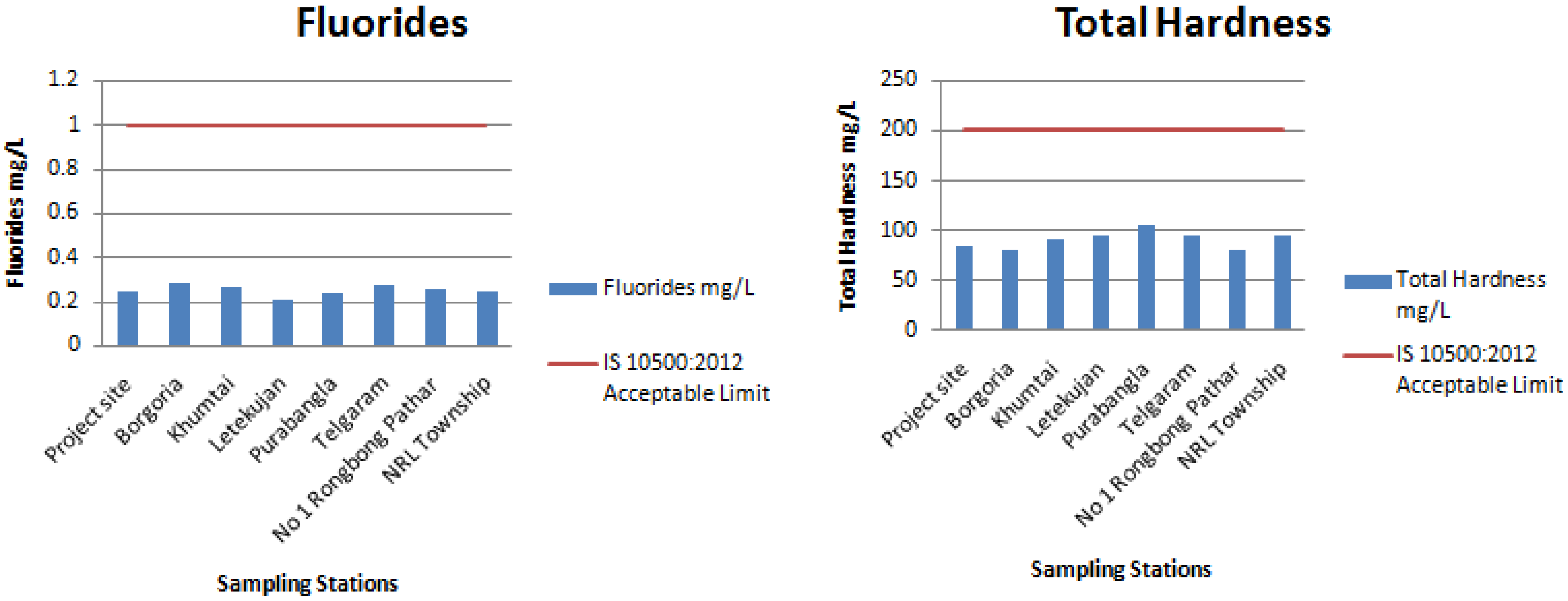


Figure 3-28 Trends of Measured Ground Water Quality Parameters in the Study Area

3.9.3.2 Results and Discussions

A summary of analytical results are presented below:

- The ground water results of the study area indicate that the pH range varies between 6.88 and 7.87. It is observed that the pH range is within the permissible limit of IS 10500:2012.
- The Total Dissolved Solids range of the collected ground water sample is varied between 166 mg/l – 220 mg/l. All the samples are within the permissible limit of IS 10500: 2012.
- The acceptable limit of the chloride content is 250mg/l and permissible limit is 1000 mg/l. The chloride content in the collected ground water samples in the study area ranges between 33.23 mg/l – 58.31 mg/l. It is observed that all the samples are within the permissible limit of IS 10500:2012.
- The acceptable limit of the sulphate content is 200mg/l and permissible limit is 400mg/l. the sulphate content in the collected ground water samples in the study area is varied between 13.26 mg/l – 24.91 mg/l. It is observed that all the samples are meeting the acceptable limit of the IS 10500: 2012.
- The Total hardness ranges is between 81 mg/l – 105 mg/l for ground water samples. It is observed that all the samples are within the permissible limit of the IS 10500: 2012.
- BOD value of the collected Ground water sample range is BLQ(LOQ 1.0)
- COD value of collected Ground water range is BLQ(LOQ 4.0)
- It is observed that all ground water sample collected within the study area are meeting the drinking water standards IS 10500:2012

3.10 Soil as a resource and its quality

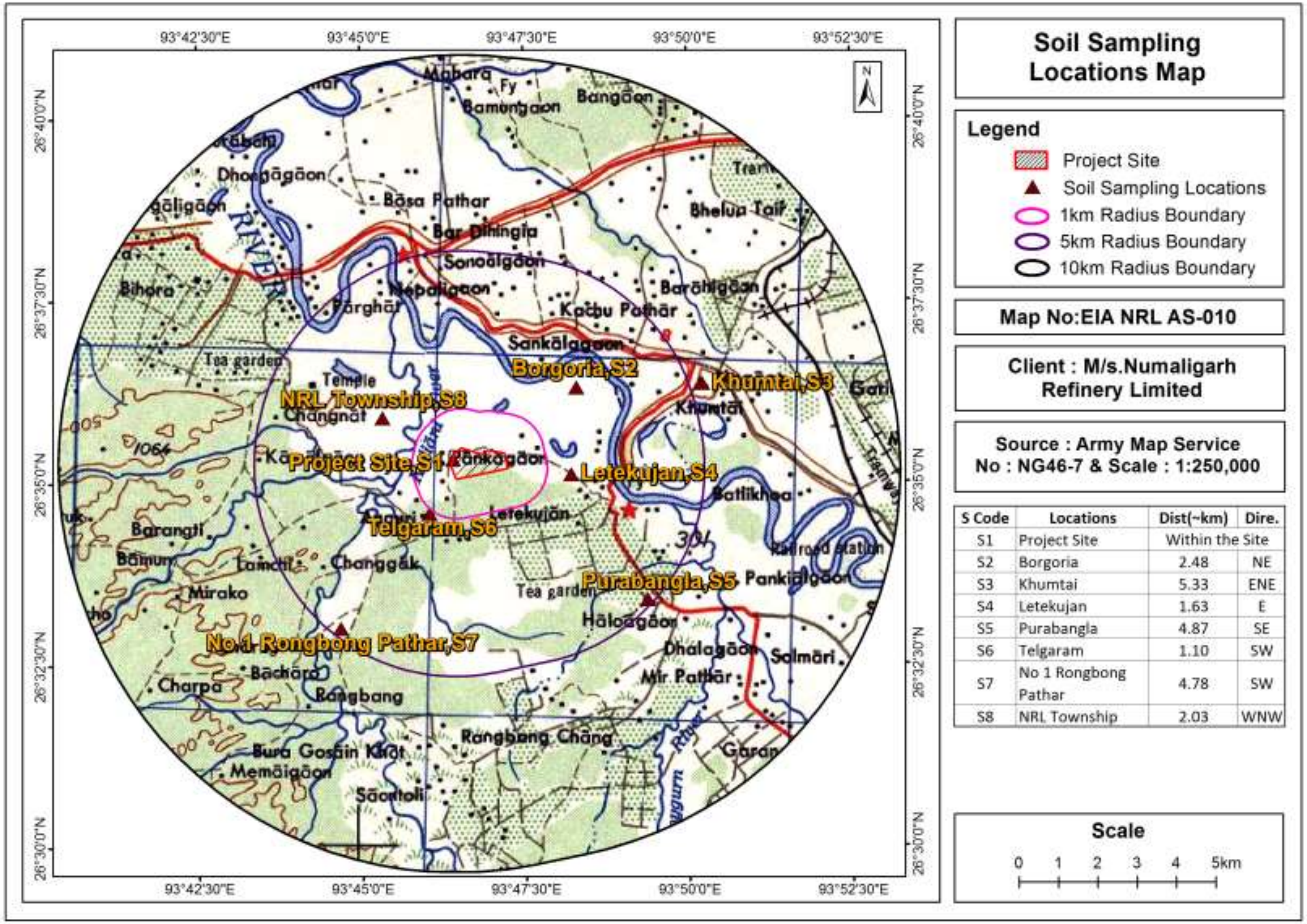
Two important soil groups are seen in the district. These are (i) deep reddish coloured soil developed over older geological formation and (ii) light grey to dark grey coloured soil covering the major parts of the district. Low nitrogen, low phosphate, medium to high potash, acidic characters of the soil are representative of the soil cover found in the hills. In the plain areas, the other type of the soil covers is found to be feebly alkaline. Soil sampling locations & results are given in **Table 3-17** & **Table 3-18** . Soil sampling locations Map is given in **Figure 3-29** and Trends of Soil Quality parameters in sampling locations is given in **Figure 3-30**Soil quality monitoring locations & results are given in **Table 3-17.** Map showing the soil monitoring locations is given in **Figure 3-29**.

Source: **https://cgwb.gov.in/District_Profile/Assam/Golaghat.pdf**

(Ref: Government of India Ministry of Water Resources Central Ground water Board, District Ground Water Brochure Golaghat District,Assam")

Table 3-17 Soil & Sediment Quality Monitoring Locations

Location Code	Location	Distance (Km) w.r.t project site	Direction w.r.t. project site
S1	Project site	Within site	
S2	Borgoria	2.48	NE
S3	Khumtai	5.33	ENE
S4	Letekujan	1.63	E
S5	Purabangla	4.87	SE
S6	Telgaram	1.10	SW
S7	No 1 Rongbong Pathar	4.78	SW
S8	NRL Township	2.03	WNW



S Code	Locations	Dist(~km)	Dire.
S1	Project Site	Within the Site	
S2	Borgoria	2.48	NE
S3	Khumtai	5.33	ENE
S4	Letekujan	1.63	E
S5	Purabangla	4.87	SE
S6	Telgaram	1.10	SW
S7	No 1 Rongbong Pathar	4.78	SW
S8	NRL Township	2.03	WNW

Figure 3-29 Soil sampling locations Map

Table 3-18 Soil Quality Monitoring Results

S.No	Parameters	Units	Project site	Borgoria	Khumtai	Letekujan	Purabangla	Telgaram	No 1 Rongbong Pathar	NRL Township
			S1	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**
1.	Soil Texture	-	Sandy Clay	Sandy Clay	Sandy Clay loam	Sandy Clay	Sandy Clay	Sandy Clay loam	Sandy Clay	Sandy Clay
2.	Sand	%	53.5	51.1	49.2	52.7	51.4	52.4	51.2	50.4
3.	Silt	%	9.0	13.6	17.4	11.1	13.2	14.2	12.6	13.8
4.	Clay	%	37.5	35.3	33.4	36.2	35.4	33.4	36.2	35.8
5.	pH	-	4.48	4.43	4.47	4.25	4.32	4.47	4.42	4.39
6.	Electrical conductivity	µS/cm	873.0	749.0	791.0	633.0	682.0	542.0	584.0	643.0
7.	Nitrogen as N	mg/kg	227.3	213.7	252.4	240.8	218.7	218.2	240.5	219.5
8.	Phosphorus	mg/kg	9.5	8.9	10.5	10.0	9.1	9.1	10.0	9.1
9.	Potassium	mg/kg	113.7	106.9	126.2	120.4	109.4	109.1	120.3	109.8
10.	Carbon (TOC)	%	0.86	0.81	0.96	0.91	0.83	0.83	0.91	0.83
11.	Calcium	mg/kg	50.12	46.23	41.78	39.67	57.12	49.12	50.36	45.26
12.	Boron	mg/kg	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)
13.	Cadmium	mg/kg	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)
14.	Chromium	mg/kg	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)
15.	Water Holding Capacity	%	15.2	15.4	16.0	15.6	15.2	15.8	15.6	15.4
16.	Porosity	-	0.42	0.43	0.42	0.43	0.42	0.42	0.43	0.43

Note: *BLQ: Below Limit of Quantification; LOQ: Limit Of Quantification*

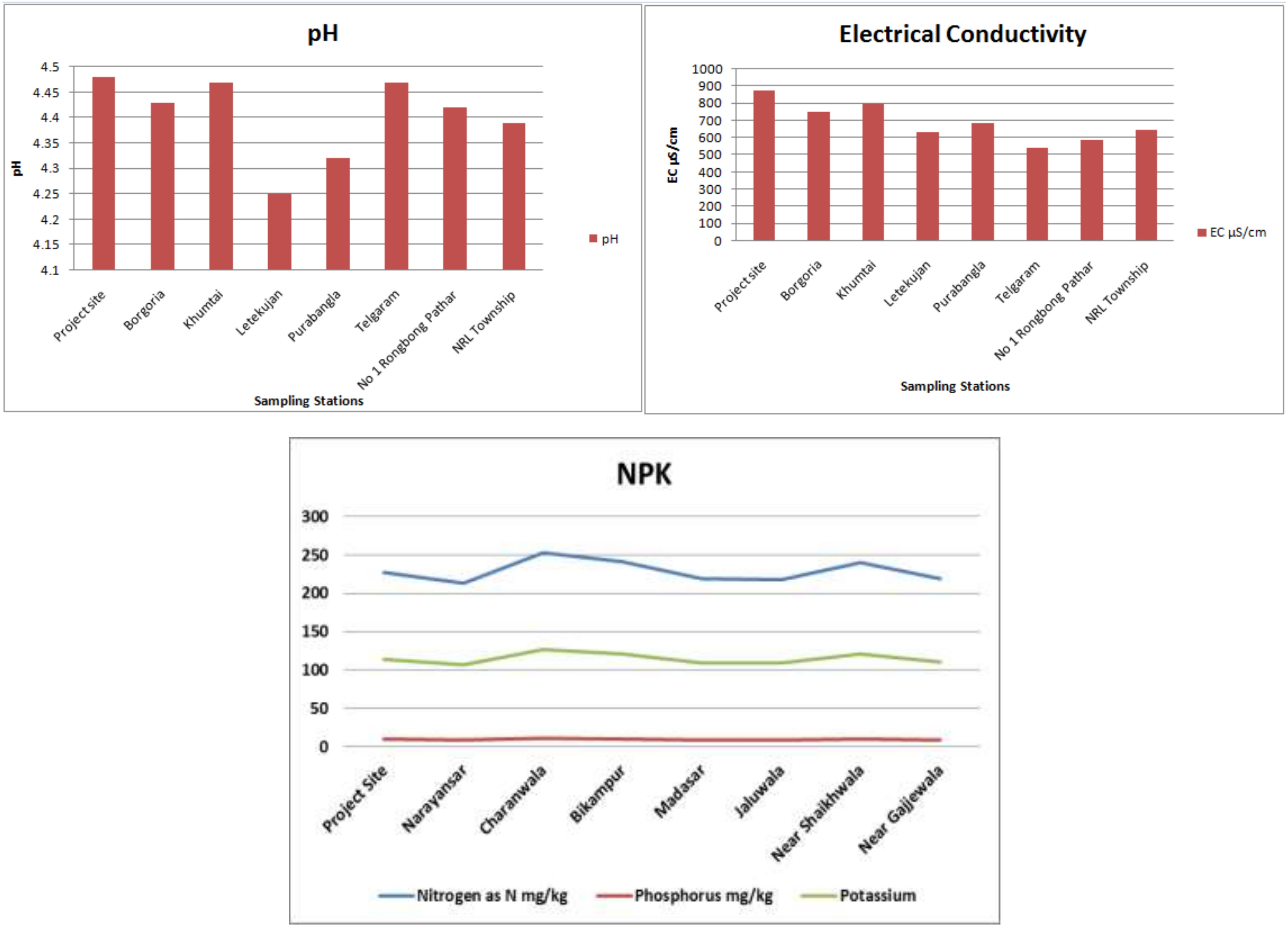


Figure 3-30 Trends of Soil Quality parameters in sampling locations

3.10.1 Results and Discussions

Summary of analytical results

- The pH of the soil samples ranged from 4.25 to 4.48.
- Conductivity of the soil samples ranged from 542 to 873 µS/cm.
- Nitrogen content in the collected soil samples ranged from 213.7 mg/kg to 252.4 mg/kg.
- Phosphorous content ranged from 8.9 mg/kg to 10.5 mg/kg.
- Potassium content ranges from 106.9 mg/kg to 126.2 mg/kg.

3.11 BIOLOGICAL ENVIRONMENT

3.11.1 Objectives of Ecological Studies

The objective of the present study was undertaken with a view to understand the present ecosystem on the following lines:

- To assess the distribution of vegetation in and around the project site;
- To assess the distribution of animal life in the project areas as well as surrounding areas;
- To assess the biodiversity and to understand the resource potential; and
- To understand the nature of pollution and the impact of pollution on the ecosystem.

3.11.2 Methodology Adopted for the Survey

To achieve above objectives a detailed study of the area was undertaken in 10-km radius area with the proposed project site as its centre. The different methods adopted were as follows:

- Compilation of secondary data with respect to the study area from published literature and Government agencies;
- Generation of first-hand data by undertaking systematic ecological studies in the area;
- Interrogating local people so as to elicit information for local plants, animals and their uses.

3.11.3 Forests

The forest type prevailing in the region is categorized predominantly as IB/C1AssamValley tropical Wet Evergreen Forest or more commonly Upper Assam *Dipterocarpus –Mesua* formation, characterized by multistoried canopy with scatteredpatches of Tropical semi evergreen forests and bamboo brakes (Champion and Seth,1968).

3.11.3.1 Assam Valley tropicalwet evergreen forest:

The most prominent tree species is Dipterocarpus retusus (Hollong). This giant tree along with Shorea assamica (Mekai),and Mesua ferrea (Nahor) forms the dominant layer. D. retusus occurs gregariously onthe well-drained high level alluvial plains in the foothills while at higher elevations and on the ridges; it is replaced by Shorea assamica which occurs in more or less purepatches on comparatively dried and gravelly soils. Other species occurring in the top storey are Terminaliamyriocarpa, Cinnamomumglaucescens, Artocarpuschama, Magnoliaspp, Toonaciliata, Ailanthus integrifolia,etc.

Trees are heavily plastered with lichens and festooned with climbers, epiphytesand lianas like Pericampylus glaucus, Stephania elegans, Parabaena sagittata, Mimosaspp etc.Species of Bauhinia, Derris, Entada, Gnetum, Hodgsonia, Piper, Raphidophora, etc. are also found. The second storey mainly consists of medium to small trees and shrubs, viz.Canarium strictum ,Duabangagrandi flora, Dysoxylumhamiltonii, Magnoliagriffithii, Terminaliabellirica, T.citrine, Manglietiainsignis, Magnoliamontana, Magnoliaoblonga, Endospermumchinense, Vaticalanceifolia, Castanopsis indica, Dysoxylum binectariferum, Magnolia hodgsonii, Dillenia indica,Garciniaspp., Altingiaexcelsa, Crypteroniapaniculata, Gynocordiaodorata,etc.Salacca secunda and Wallichia oblongifolia are found to grow scattered on the drier hillslopes; whereas Angiopteris evecta, Cyathea sp., Pandanus nepalensis, etc. are found along the shady gorges. Calamuserectus, Calamusleptospadix and various other species of similar plants occur along the swamp area and form extensive thickets. Arenga pinnata, Caryota urens, Livistona jenkinsiana, etc. are few of the palms that occur in these forests.The epiphytic flora is very rich and some of the common epiphytic orchids are the species of Aerides, Cymbidium, Eria, Pholidota, Dendrobiumetc.Along the hills slopes wild species of Musa comprising Musaacuminata,M.balbisiana and M. rosacea form thickets which are prominent feature of the vegetation.Because of the existence of quite close canopy over head and the resultant accumulation of thick humus on the forest floor, different species of herbs,ferns and grasses constitute a thick ground cover. The ground flora is mainly represented by herbaceous elements such as Phrynium sp, Begonia roxburghii, Floscopa scandens, Rhyncoglossumsp., Abacopterislakhimpurensis etc

3.11.3.2 Assam Valley Tropical Semi-evergreen Forest:

These forests occur along foot hill sand river bank. The emergent in this type of forests are mainly deciduous, whereas the evergreen vegetation predominate the lower canopy. The shrubs, climbers and liana constitute the rest. The upper canopy is dominated by tall trees like Altingia excelsa,Bombaxceiba,Canariumstrictum,Elaeocarpusrugosus,Phoebesp.,Terminaliamyriocarpa, Legerstroemia speciosa etc. Middle canopies are held by the species like Artocarpus chaplasa, Castanopsis indica, Dillenia indica, Magnolia spp., Mesua ferrea, etc. The undergrowth and climbers is similer to the Assam Valley Tropical Evergreen Forest. Ground flora is dominated by species of Colocacia, Costus, Pharynium, etc.

3.11.4 Wildlife

Historically, the wildlife of the study area must have been rich both in diversity and number, as it is part of the larger Dihing Patkai Landscape, but currently not as rich as it once used to be. Among the fauna elements reported in the past some of the species are of Chinese sub-region of the Oriental Zoo-Geographical region and alsoinclude the elements of the Indian Sub-region (Kakati, 2009). However, substantial number of wildlife is still there though their numbers have dwindled considerably.

Materials and Methods

3.11.5 Floral studies

The source of materials for this floristic survey was the extensive and intensive field collections of specimens made from the NRL project at Assam during the period from Febuary and March, 2023.

Ecological Field methods

A probability proportionate random sampling was done following quadrat methods. The sizes for tree, shrub and herb quadrat are 10 m X 10 m, 5 m X 5 m and 1 m X 1 m, respectively. Within each grid, a quadrate of (10m×10m) strip was used and all standing trees ≥30cm girth at breast height (GBH) was enumerated. Breast height is defined as 1.3m above the ground. Tree regeneration was investigated in quadrats of 5x5 m size and seedlings/saplings of trees were also enumerated.

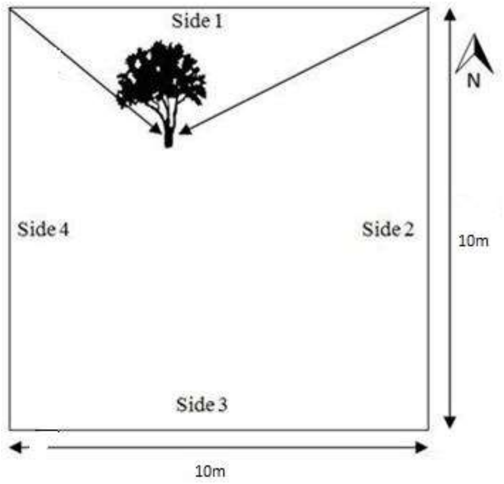


Figure 3-31 Triangulation method

How to measure tree location - Triangulation method

Data analysis: For the calculation of species richness, data analysis was carried out in Microsoft excel. Collected field data was coded and tabulated into excel sheet. At first, data collected in the field targeting different site of the study area.

Dominance analysis: In order to assess the relative share of each species in plant community, Importance Value Index (IVI) for a total score of 300 has been calculated using the frequency, density, abundance, relative frequency, relative density and relative abundance. (Sharma, 2005)

Frequency (F) and Relative Frequency (RF): Frequency (%)**:** The frequency refers to the degree of dispersion of individual species in an area and usually expressed in terms of percentage occurrence (Sharma, 2005). It is calculated using the equation:

$$\text{Frequency (\%)} = \frac{\text{No. of quadrats in which the species occurred}}{\text{Total number of quadrats studied}} \times 100$$

Frequency does not give the correct idea of the distribution of any species, unless it is correlated with other character (Sharma, 2005).

$$\text{Relative Frequency (\%)} = \frac{\text{Frequency of the species}}{\text{Total frequency of all the species}} \times 100$$

Density (D) and Relative Density (RD): Density is an expression of the numerical strength of a species where the total number of individuals of each species in all the nested quadrat divided by the total number of nested quadrat studied (Sharma, 2005). Density is calculated by the equation:

$$\text{Density} = \frac{\text{Total number of individuals of a species in all quadrats}}{\text{Total no of quadrats studied}}$$

$$\text{Relative Density} = \frac{\text{Density of the species}}{\text{Total density of all the species}} \times 100$$

Relative Dominance (%): Dominance is the parameter which is determined by the value of basal area For the comparative analysis Relative dominance is determined. It is the coverage value of a species with respect to the sum of coverage of the rest of the species in the area.

$$\text{Basal area} = \frac{(\text{Circumference at breast height})^2}{12.56}$$

$$\text{Relative dominance} = \frac{\text{Basal area of the species}}{\text{Basal area of all the species}}$$

Circumference at Breast Height*:* The second most important parameter of field data is circumference at breast height/diameter at breast height of the tree, this parameter used to calculate the volume or weight of the tree, which can converted to biomass per unit area (tonnes/hectare). The diameter and height can be used for estimating the volume by simple equations.

Height of trees: Next to DBH/CBH, height is the most important indicator of the volume or weight of a tree and used in many allometric functions along with DBH. To measuring the height of tall trees, 4 – 5 tall individuals were measured using the Range Finder and then for other tree species. Eye or ocular estimation was also practiced especially those with overlapping canopies.

Basal area: the basal area of individual tree is also calculated in Microsoft-excel using the

CBH with the formula:

Basal area = πr^2

Important Value Index (IVI): The concept of 'Important Value Index (IVI)' has been developed for expressing the dominance and ecological success of any species, with a single value (Mishra, 1968, Sharma, 2005). This index utilizes three characteristics, they are (i) Relative requency,(ii) Relative density and (iii) Relative abundance. The three characteristics computed using frequency, density and abundance for all the species falling in all the quadrat by using the following formula.

The relative frequency, relative density and relative abundance has been calculated to calculate the IVI value

IVI = Relative frequency + Relative abundance + Relative density [RF + RA + RD]

The IVI of all species, Genus, and Family has been calculated.

3.11.6 Fauna studies

Birds

Methods of study

The methodology followed in the study consists of stages as stated below:

a) The pre-field stage- it includes review of literature to develop necessary conceptual framework for the study and collection of secondary data.

b) The field stage- it comprises collection of primary data systematically in the field.

Secondary data collection

Relevant data have been collected from different secondary sources, especially from, Bombay Natural History Society (BNHS), Ministry of Environment and Forest, DFO, Wildlife Division, Revenue Circles and Block Development offices of the concerned areas.

Primary Data collection

Systemic study had been carried out one week of March 2023, to evaluate the diversity, distribution and density of core and buffer zone. Field surveys were carried out from 06:00 hrs. to 11:00 hrs. in the morning and 15:00 hrs. to 16:00 hrs. in the afternoon. Two sampling methodologies were applied for data collection, that were such as line transect and point transects (Bibby et al., 2000). Total of 9 random points of 100m radius were also established randomly to survey and data collections in around project site. Additional (opportunistic observations) data were also added to the list whenever any birds were sighted outside the regular transects, so that no such birds species data were missed in any occasions during the entire survey periods.

Species identification

All the birds seen within the limit of transect were recorded in the data sheet after accurate identification of species. On the bird data sheet the details of the recorded birds in terms of species; number, sex, distance, location, behavior and overall height of the vegetation used by the birds were noted. Identification of bird species on the basis of bird-call was generally avoided, if and when the calls were confusing. Surveys were conducted using a pair of binoculars (Zeiss Terra ED 8x32, Solognac 10x42), Digital Camera (Canon SX60, Nikon Coolpix, P510), Garmin GPS (etrax 30). Each species sighted were photographed for easy reference anddocumentation. Photographs and videos were obtained to justify the species type for those were difficult to identify in the field. Birds were identified as per the taxonomic keys of Ali and Ripley and Grimmett *et al*. The IUCN threatened species of birds were categorized in the checklist as per the IUCN Red List of Threatened Species, Version 3.1. Resident and Migratory status of birds were categorized as per the information given by Grimmett *et al*., Choudhury and Saikia and Saikia (2010) and Saikia and Bhattacharjee, (1993).

Data analysis

Data were arranged to obtain the following parameters:

I) The relative abundance of bird species per habitat/district was determined using:

Relative abundance=n/N

where n is the total number of birds of a particular species and N is the total number of birds of all species.

II) Bird species diversity:

Species richness is the number of different species present in an area (Deitmers, Buehler, Bartlett, & Klaus, 1999). Species richness was estimated for each habitat.

- Shannon-Weiner Index (H′) was calculated in order to know the species diversity (Hutcheson, 1970) based on species abundance using the Shannon and Weaver (1949) formula:

$H' = -[\Sigma Pi * LN(Pi)]$

where H′ is the Diversity Index, Pi is the proportion of each species in the sample, and LN (Pi) is the natural logarithm of this proportion.

Butterfly

An extensive field study was done in the morning hours from 9.00 to 11.00 and in afternoon hours from 15.00 to 17.00 trices a month, using Pollard Walk Method (Pollard and Yates, 1993). Species identification was done either by direct observation, collection by nets or photography with the help of guidance from Kunte (2000), Kehimkar (2008) and Smetacek (2017).

Mammal

The species were identified using the books of Chaudhury (1997). The individual study days were divided into three parts such as (1) morning- (sunrise to 1100 hours) (2) after-noon (1430 to 1800 hours) and (3) evening (1830 to 2100 hours). Occasionally, these time samplings were not followed, in case when long distances needed to be covered on foot in a day (e.g., 20- 30 km/day). The evening surveys were made only for corpuscular and nocturnal mammals. The information of various mammals' species was recorded either from direct sighting records, indirect evidences of animals, such as foot print, pug marks, fresh kills, live dens, nest holes and records from local people and forest department.

Figure 3-32 Floral in and around project site

Detailed list of tree diversity in core zone

3.11.7 Taxonomical status, species richness and diversity - Flora

Core Zone: Core zone extent of 5 km radius of the flora observed 19 tree species of plants. The IVI value is highest for *Terminalia bellirica* and followed by *Ailanthus integrifolia, Mallotus phillipensis, Cassia siamea* and the lowest value was observed *Litsea monopetala.*

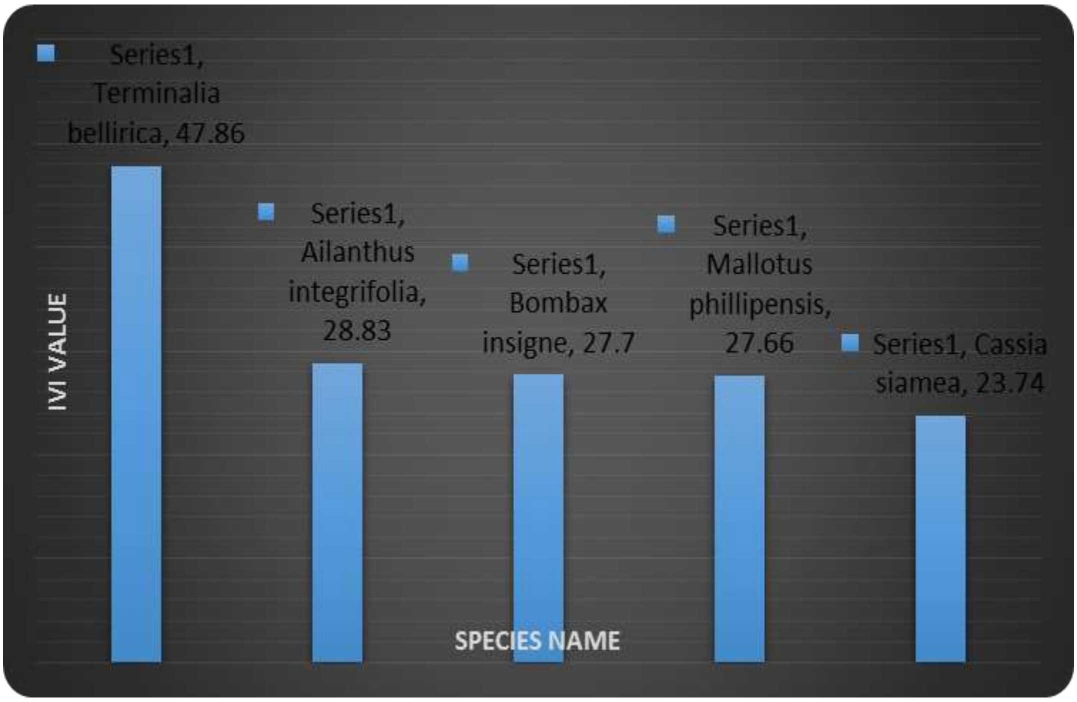


Figure 3-33 Top five tree species in core zone

Table 3-19 List of tree diversity in core zone

S.No.	Buffer zone	Family Name	RF	RD	Rdo	IVI
1.	*Acacia auriculiformis*	Leguminosae	3.17	9.16	2.14	14.48
2.	Ailanthus integrifolia	Simaroubaceae	3.17	4.58	21.08	28.83
3.	Alstonia scholaris	Apocynaceae	7.94	6.87	1.74	16.54
4.	*Bombax insigne*	Bombacaceae	17.46	9.16	1.08	27.70
5.	*Callistemon citrinus*	Myrtaceae	7.94	1.53	8.57	18.03
6.	*Canarium resiniferum*	Bursaraceae	3.17	0.76	7.81	11.75
7.	*Canarium strictum*	Burseraceae	1.59	0.76	0.64	2.99
8.	*Mallotus phillipensis*	Euphorbiaceae	7.94	19.08	0.64	27.66
9.	*Cassia siamea*	Leguminosae	3.17	16.03	4.53	23.74
10.	*Castanopsis hystix*	Fagaceae	3.17	1.53	0.64	5.34
11.	*Castanopsis indica*	Fagaceae	6.35	5.34	7.01	18.71
12.	*Chukrasia tabularis*	Meliaceae	1.59	3.05	0.64	5.28
13.	*Dysoxylum procerum*	Meliaceae	3.17	3.82	0.39	7.38
14.	*Erythrina stricta*	Leguminosae	6.35	1.53	2.77	10.64
15.	*Ficus hispida*	Moraceae	4.76	0.76	0.48	6.00
16.	*Litsea monopetala*	Lauraceae	1.59	0.76	0.36	2.71
17.	*Syzygium cuminii*	Myrtaceae	6.35	5.34	0.44	12.14
18.	Terminalia bellirica	Combretaceae	7.94	6.87	33.05	47.86
19.	Trema orientalis	Cannabaceae	3.17	3.05	6.00	12.22

Detailed list of tree diversity in buffer zone

Buffer Zone: Buffer zone extent of 10 km radius of the flora observed 51 tree species of plants. The IVI value is highest for *Albizia odoratissima* and followed by *Bombax insigne* and the lowest value was observed *Callistemon citrinus*.

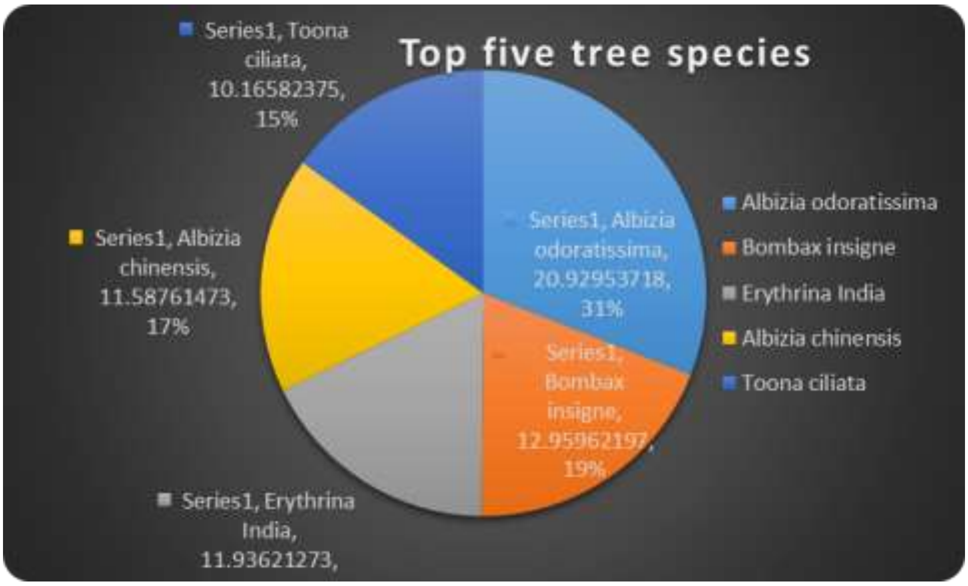


Figure 3-34 Top five tree species in buffer zone

Table 3-20 List of tree diversity in buffer zone

S.No.	Core Zone	Family Name	RF	RD	Rdo	IVI
1.	Ailanthus integrifolia	Simaroubaceae	0.84	2.07	1.69	4.60
2.	Albizia chinensis	Fabaceae	1.27	8.88	1.45	11.59
3.	Acacia myrtifolia	Fabaceae	1.69	0.30	2.89	4.87
4.	Acacia auriculiformis	Fabaceae	2.11	0.59	1.16	3.86
5.	Albizia schimperiana	Fabaceae	2.53	0.59	2.89	6.01
6.	Acacia lenticularis	Fabaceae	2.95	1.18	1.83	5.97
7.	Toona ciliata	Meliaceae	3.38	5.03	1.76	10.17
8.	Lagerstroemia speciosa	Lythraceae	3.80	0.30	3.43	7.52
9.	Azadirachta indica	Meliaceae	4.22	2.07	1.83	8.13
10.	Albizia procera	Fabaceae	4.64	1.78	1.45	7.86
11.	Adenanthera pavonina	Fabaceae	5.06	0.89	0.96	6.91
12.	*Albizia odoratissima*	Fabaceae	5.49	13.61	1.83	20.93
13.	*Alstonia scholaris*	Apocynaceae	0.42	1.78	1.38	3.58

14.	*Altingia excelsa*	Altingiaceae	2.53	1.78	4.47	8.78
15.	*Ammora wallichi*	Meliaceae	2.11	1.48	1.16	4.75
16.	*Artocarpus chama*	Moraceae	1.69	1.18	2.89	5.76
17.	*Artocarpus heterophyllus*	Moraceae	0.42	0.89	1.83	3.14
18.	*Bombax insigne*	Bombacaceae	0.84	10.36	1.76	12.96
19.	*Bischofia javanica*	Euphorbiaceae	0.84	0.89	3.43	5.16
20.	*Bursera serrata*	Bursaraceae	1.27	0.59	1.83	3.69
21.	*Cassia siamea*	Fabaceae	2.95	5.33	1.45	9.73
22.	*Callistemon citrinus*	Myrtaceae	0.42	0.59	0.96	1.98
23.	*Canarium resiniferum*	Bursaraceae	2.95	0.30	1.83	5.08
24.	*Canarium strictum*	Burseraceae	0.42	0.30	1.38	2.10
25.	*Castanopsis hystix*	Fagaceae	0.84	0.59	4.47	5.91
26.	*Castanopsis indica*	Fagaceae	2.11	2.07	1.16	5.34
27.	*Chukrasia tabularis*	Meliaceae	2.53	1.18	2.89	6.61
28.	*Dalbergia assamica*	Fabaceae	5.06	0.30	1.72	7.08
29.	*Dipterocarpus retusus*	Dipterocarpaceae	4.22	1.18	4.36	9.76
30.	*Duabanga grandifolia*	Lythraceae	1.69	0.30	1.83	3.82
31.	*Ficus hispida*	Moraceae	1.27	0.30	0.67	2.23
32.	*Dysoxylum procerum*	Meliaceae	0.84	1.48	1.80	4.12
33.	*Erythrina India*	Fabaceae	4.64	3.55	3.74	11.94
34.	*Litsea monopetala*	Lauraceae	0.42	0.30	1.80	2.52
35.	*Macaranga denticulata*	Euphorbiaceae	4.64	1.48	1.16	7.28
36.	*Magnolia hodgsonii*	Magnoliaceae	0.84	0.59	1.16	2.60
37.	*Magnolia pterocarpa*	Magnoliaceae	0.42	0.89	0.76	2.07
38.	*Mallotus albus*	Euphorbiaceae	0.42	0.59	1.83	2.85
39.	*Mallotus phillipensis*	Euphorbiaceae	0.84	0.89	1.95	3.68
40.	*Mesua ferrea*	Clusiaceae	1.69	1.18	3.53	6.40
41.	*Morus laevigata*	Moraceae	0.84	2.37	1.69	4.90
42.	*Osteodes paniculata*	Euphorbiaceae	0.42	2.07	2.11	4.60
43.	*Shorea assamica*	Dipterocarpaceae	1.69	1.48	2.23	5.40
44.	*Spondias axillaris*	Anacardiaceae	0.42	1.78	1.32	3.51

45.	*Sterculia villosa*	Sterculiaceae	0.42	2.66	2.07	5.15
46.	*Sterospermum celenoides*	Bignoniaceae	1.69	2.37	1.10	5.16
47.	*Syzygium cuminii*	Myrtaceae	0.42	2.07	1.83	4.33
48.	*Tectonia grandis*	Verbenaceae	3.38	1.18	1.80	6.36
49.	*Terminalia bellirica*	Combretaceae	1.69	1.48	1.35	4.52
50.	*Terminalia myriocarpa*	Combretaceae	0.84	1.48	1.07	3.40
51.	*Trema orientalis*	Cannabaceae	0.84	1.48	1.02	3.34

Detailed list of shrub and climber diversity

Core and Buffer Zone: The shrub and climber species observed 28 species of plants.

Table 3-21 List of shrub plants in core and buffer zone

S. No.	Species Name	Family Name	Core Zone	Buffer zone
1.	*Abroma augusta*	Malvaceae	+	+
2.	*Chromolaena odorata*	Asteraceae	+	+
3.	*Cissus repens*	Vitaceae		+
4.	*Clerodendrum cephalanthum*	Lamiaceae		+
5.	*Clerodendrum glandulosum*	Lamiaceae		+
6.	*Clerodendrum infortunatum*	Lamiaceae	+	+
7.	*Cheilocostus speciosus*	Costaceae		+
8.	*Croton caudatus*	Euphorbiaceae		
9.	*Cyathea spinulosa*	Cyathaceae		+
10.	*Dracaena angustifolia*	Asparagaceae		+
11.	*Elaeagnus caudata*	Elaegnaceae		+
12.	*Entada pursaetha*	Mimosaceae		
13.	*Hedychium spicatum*	Zingiberaceae		+
14.	*Hovenia dulcis*	Rhamnaceae		+
15.	*Ichnocarpus frutescens*	Apocynaceae		+
16.	*Knoxia mollis*	Rubiaceae		+
17.	*Lantana camara*	Verbenaceae	+	+

18.	*Dendrocnide sinuate*	Urticaceae		+
19.	*Saccharum spontaneum*	Poaceae	+	+
20.	*Schefflera venulosa*	Araliaceae		+
21.	*Solanum torvum*	Solanaceae		+
22.	*Tabernaemontana divaricata*	Apocynaceae		+
23.	*Tetracera sarmentosa*	Vitaceae		+
24.	*Tetrastigma thomsonianum*	Vitaceae		+
25.	*Thunbergia grandiflora*	Acanthaceae		+
26.	*Thysanolaena assamensis*	Poaceae		+
27.	*Urena lobata*	Malvaceae	+	+
28.	*Vitex glabrata*	Lamiaceae		+

Detailed list of herbaceous plants

Core and Buffer Zone: The herb species observed 39 species of plants.

Table 3-22 List of Herbaceous plants in core and buffer zone

S. No.	Species Name	Family Name	Core Zone	Buffer zone
1.	*Ageratum conyzoides*	Asteraceae		+
2.	*Ageratum houstonianum*	Asteraceae		
3.	*Alocasia macrorrhizos*	Araceae		+
4.	*Axonopus compressus*	Poaceae	+	+
5.	*Blumea fistulosa*	Asteraceae	+	+
6.	*Blumea lacera*	Asteraceae	+	+
7.	*Bothriochola intermedia*	Poaceae		+
8.	*Cenchrus ciliaris*	Poaceae	+	+
9.	*Centotheca lappacea*	Poaceae		+
10.	*Centotheca lappacea*	Poaceae	+	
11.	*Cheilocostus speciosus*	Costaceae	+	+
12.	*Chrysopogon aciculotus*	Poaceae		+
13.	*Colocasia esculenta*	Araceae	+	+

14.	*Commelina acutissima*	Commelinaceae	+	
15.	*Commelina benghalensis*	Commelinaceae	+	+
16.	*Cynodon dactylon*	Poaceae		+
17.	*Cyrtococcum accrescens*	Poaceae	+	+
18.	*Desmodium adscendens*	Fabaceae		+
19.	*Dicliptera roxburghiana*	Acanthaceae	+	
20.	*Digitaria ciliaris*	Poaceae		+
21.	*Diplazium asperum*	Woodsiaceae	+	
22.	*Diplazium esculentum*	Athyriaceae	+	
23.	*Drymaria cordata*	Caryophyllaceae	+	+
24.	*Drynaria quercifolia*	Polypodiaceae	+	+
25.	*Eclipta prostrata*	Asteraceae		+
26.	*Eragrostis gangetica*	Poaceae	+	+
27.	*Floscopa scandens*	Commelinaceae	+	
28.	*Gleichenia linearis*	Gleicheniaceae	+	+
29.	*Heliotropium indicum*	Boraginaceae		+
30.	*Heteropogon contortus*	Poaceae	+	+
31.	*Imperata cylindrica*	Poaceae		+
32.	*Merremia umbellata*	Convolvulaceae		+
33.	*Mimosa pudica*	Mimosaceae	+	+
34.	*Mollugo pentaphylla*	Molluginaceae		+
35.	*Murdannia nudiflora*	Commelinaceae	+	
36.	*Oplismenus compositus*	Poaceae		+
37.	*Polygonum plebeium*	Polygonaceae	+	+
38.	*Spermacoce articularis*	Rubiaceae	+	+
39.	*Spermacoce hispida*	Rubiaceae	+	+

Bombax insigne *Erythrina India*

Cassia siamea *Ficus hispida*

Figure 3-35 Selected plant species

Detailed list of Birds

A total of 40 species observed in core zone during field survey. The list of bird species were presented in **Table 3-22.**

Table 3-23 Cheklist of bird diversity in core zone

S.No	Family	Common Name	Scientific Name	IUCN
1.	Accipitridae	Black Kite	*Milvus migrans*	LC
2.	Apodidae	Asian Palm Swift	*Cypsiurus balasiensis*	LC
3.	Apodidae	House Swift	*Apus affinis*	LC
4.	Corvidae	Jungle Crow	*Corvus macrorhynchus*	LC
5.	Corvidae	Common Crow	*Corvus splendens*	LC
6.	Campephagidae	Scarlet Minivet	*Pericrocotus flammeus*	LC

7.	Coraciidae	Indian Roller	*Coracias benghalensis*	LC
8.	Caprimulgidae	Grey Nightjar	*Caprimulgus indicus*	LC
9.	Cuculidae	Drongo Cuckoo	*Surniculus lugubris*	LC
10.	Cuculidae	Common Hawk Cuckoo	*Heirococcyx varius*	LC
11.	Cuculidae	Indian Cuckoo	*Cuculus micropterus*	LC
12.	Cuculidae	Asian Koel	*Eudynamys scolopacea*	LC
13.	Cuculidae	Green-billed Malkoha	*Phaenicophaeus tristis*	LC
14.	Cuculidae	Greater Coucal	*Centropus sinensis*	LC
15.	Columbidae	Spotted Dove	*Streptopelia chinensis*	LC
16.	Columbidae	Red Collared Dove	*Streptopelia tranquebarica*	LC
17.	Columbidae	Emerald Dove	*Chalcophaps indica*	LC
18.	Columbidae	Eurasian Collard Dove	*Streptopelia decaocto*	LC
19.	Charadridae	Little Stint	*Calidris minuta*	LC
20.	Dicruridae	Black Drongo	*Dicrurus macrocercus*	LC
21.	Dicruridae	Ashy Drongo	*Dicrurus leucophaeus*	LC
22.	Estrildidae	Scaly-breasted Munia	*Lonchura punctulata*	LC
23.	Estrildidae	White-rumped Munia	*Lonchura striata*	LC
24.	Estrildidae	Black-headed Munia	*Lonchura malacca*	LC
25.	Motacillidae	Paddyfield Pipit	*Anthus rufulus*	LC
26.	Monarchidae	Asian Paradise Flycatcher	*Terpsiphone paradisi*	LC
27.	Megalaimidae	Coppersmith Barbet	*Megalaima haemocephala*	LC
28.	Meropidae	Green Bee-eater	*Merops orientalis*	LC
29.	Nectariniidae	Purple Sunbird	*Nectarinia asiatica*	LC
30.	Nectariniidae	Crimson sunbird	*Aethopyga siparaja*	LC
31.	Nectariniidae	Little Spider hunter	*Arachnothera longirostra*	LC
32.	Oriolidae	Black-headed oriole	*Oriolus xanthornus*	LC
33.	Passeridae	House Sparrow	*Passer domesticus*	LC
34.	Ploceidae	Baya Weaver	*Ploceus philippinus*	LC
35.	Saturnidae	Common Myna	*Acridotheres tristis*	LC
36.	Saturnidae	Pied Myna	*Sturnus contra*	LC
37.	Saturnidae	Jungle Myna	*Acridotheres fuscus*	LC
38.	Scolopacidae	Common Tailorbird	*Orthotomus sutorius*	LC
39.	Scolopacidae	Mountain Tailorbird	*Orthotomus cuculatus*	LC
40.	Upupidae	Hoopoe	*Upupa epops*	LC

Relative abundance of bird species in Core zone

The following table represent the top 10 species relative abudance.

Table 3-24 Top ten Bird species in core zone

S.No	**Scientific Name**	**Common Name**	**No. of individuals**	**Relative Abundance**
1	*Acridotheres tristis*	Common Myna	41	9.60
2	*Passer domesticus*	House Sparrow	33	7.73

3	*Nectarinia asiatica*	Purple Sunbird	28	6.56
4	*Cypsiurus balasiensis*	Asian Palm Swift	24	5.62
5	*Anthus rufulus*	Paddyfield Pipit	19	4.45
6	*Apus affinis*	House Swift	18	4.22
7	*Dicrurus macrocercus*	Black Drongo	18	4.22
8	*Merops orientalis*	Green Bee-eater	18	4.22
9	*Ploceus philippinus*	Baya Weaver	17	3.98
10	*Caprimulgus indicus*	Grey Nightjar	14	3.28

Detailed list of Birds in Buffer zone

A total of 98 species observed in buffer zone during field survey. The list of bird species were presented in **Table 3-24.**

Table 3-25 Checklist of bird diversity in buffer zone

S.No	Family	Common Name	Scientific Name	IUCN
1.	Accipitridae	Crested Serpent Eagle	*Spilornis cheela*	LC
2.	Accipitridae	Crested Goshawk	*Accipiter trivirgatus*	LC
3.	Accipitridae	Black Kite	*Milvus migrans*	LC
4.	Accipitridae	Shikra	*Accipiter badius*	LC
5.	Apodidae	Asian Palm Swift	*Cypsiurus balasiensis*	LC
6.	Apodidae	House Swift	*Apus affinis*	LC
7.	Campephagidae	Rosy Minivet	*Pericrocotus roseus*	LC
8.	Campephagidae	Scarlet Minivet	*Pericrocotus flammeus*	LC
9.	Caprimulgidae	Grey Nightjar	*Caprimulgus indicus*	LC
10.	Cettidae	Black-faced Warbler	*Abroscopus schisticeps*	LC
11.	Charadridae	Little Stint	*Calidris minuta*	LC
12.	Charadridae	Red-wattled Lapwing	*Vanellus indicus*	LC
13.	Chloropseidae	Blue-winged Leafbird	*Chloropsis cochinchinensis*	LC
14.	Chloropseidae	Golden-fronted Leafbird	*Chloropsis aurifrons*	LC
15.	Ciconnidae	Openbill stork	*Anastomus oscitans*	LC
16.	Cisticolidae	Grey-breasted Prinia	*Prinia hodgsonii*	LC
17.	Cisticolidae	Striated Prinia	*Prinia criniger*	LC
18.	Columbidae	Pompadour Green Pigeon	*Treron pompadoura*	LC
19.	Columbidae	Yellow-footed Green Pigeon	*Treron phoenicoptera*	LC
20.	Columbidae	Spotted Dove	*Streptopelia chinensis*	LC
21.	Columbidae	Red Collared Dove	*Streptopelia tranquebarica*	LC
22.	Columbidae	Emerald Dove	*Chalcophaps indica*	LC
23.	Columbidae	Eurasian Collard Dove	*Streptopelia decaocto*	LC
24.	Coraciidae	Indian Roller	*Coracias benghalensis*	LC
25.	Corvidae	Common Green Magpie	*Cissa chinensis*	LC
26.	Corvidae	Jungle Crow	*Corvus macrorhynchus*	LC
27.	Corvidae	Common Crow	*Corvus splendens*	LC

28.	Corvidae	White-throated Fantail	*Rhipidura albicollis*	LC
29.	Cuculidae	Drongo Cuckoo	*Surniculus lugubris*	LC
30.	Cuculidae	Common Hawk Cuckoo	*Heirococcyx varius*	LC
31.	Cuculidae	Indian Cuckoo	*Cuculus micropterus*	LC
32.	Cuculidae	Asian Koel	*Eudynamys scolopacea*	LC
33.	Cuculidae	Green-billed Malkoha	*Phaenicophaeus tristis*	LC
34.	Cuculidae	Greater Coucal	*Centropus sinensis*	LC
35.	Dicacidae	Fire-breasted Flower pecker	*Dicaeum ignipectus*	LC
36.	Dicacidae	Scarlet-backed Flower pecker	*Dicaeum cruentatum*	LC
37.	Dicruridae	Black Drongo	*Dicrurus macrocercus*	LC
38.	Dicruridae	Ashy Drongo	*Dicrurus leucophaeus*	LC
39.	Dicruridae	Lesser Racket-tailed Drongo	*Dicrurus remifer*	LC
40.	Dicruridae	Greater Racket-tailed Drongo	*Dicrurus paradiseus*	LC
41.	Estrildidae	Scaly-breasted Munia	*Lonchura punctulata*	LC
42.	Estrildidae	White-rumped Munia	*Lonchura striata*	LC
43.	Estrildidae	Black-headed Munia	*Lonchura malacca*	LC
44.	Lanidae	Brown Shrike	*Lanius cristatus*	LC
45.	Lanidae	Grey-backed Shrike	*Lanius tephronotus*	LC
46.	Megalaimidae	Coppersmith Barbet	*Megalaima haemocephala*	LC
47.	Meropidae	Green Bee-eater	*Merops orientalis*	LC
48.	Meropidae	Blue-bearded Bee- eater	*Nyctyornisa thertoni*	LC
49.	Monarchidae	Asian Paradise Flycatcher	*Terpsiphone paradisi*	LC
50.	Motacillidae	White Wagtail	*Motacilla alba*	LC
51.	Motacillidae	Grey Wagtail	*Motacilla cinerea*	LC
52.	Motacillidae	Paddyfield Pipit	*Anthus rufulus*	LC
53.	Muscicapidae	Little Pied-flycatcher	*Ficedula westermanni*	LC
54.	Muscicapidae	Pygmy Blue-flycatcher	*Muscicapella hodgsoni*	LC
55.	Muscicapidae	Magpie Robin	*Copsychus saularis*	LC
56.	Muscicapidae	Grey Bushchat	*Saxicola ferrea*	LC
57.	Muscicapidae	White-rumped Shama	*Copsychus malabaricus*	LC
58.	Muscicapidae	White-crowned Forktail	*Enicurus immaculatus*	LC
59.	Nectariniidae	Purple Sunbird	*Nectarinia asiatica*	LC
60.	Nectariniidae	Crimson sunbird	*Aethopyga siparaja*	LC
61.	Nectariniidae	Little Spider hunter	*Arachnothera longirostra*	LC
62.	Oriolidae	Black-headed oriole	*Oriolus xanthornus*	LC
63.	Paridae	Great Tit	*Parus major*	LC
64.	Passeridae	House Sparrow	*Passer domesticus*	LC
65.	Phalacrocoracidae	Little Cormorant	*Microcarbo niger*	LC
66.	Phasianidae	Red Jungle Fowl	*Gallus gallus*	LC
67.	Phyllocopidae	Greenish Warbler	*Phylloscopu strochiloides*	LC
68.	Picidae	Fulvous-breasted Woodpecker	*Dendrocopos macei*	LC
69.	Picidae	Grey-headed Woodpecker	*Picus canus*	LC
70.	Picidae	Rufous Woodpecker	*Celeus brachyurus*	LC
71.	Picidae	Greater Flameback	*Chrysocolaptes lucidus*	LC

72.	Picidae	Crimson-breasted Woodpecker	*Dendrocopos cathpharius*	LC
73.	Ploceidae	Baya Weaver	*Ploceus philippinus*	LC
74.	Psittacidae	Rose-ringed Parakeet	*Psittacula krameri*	LC
75.	Psittacidae	Alexandrine Parakeet	*Psittacula eupatria*	LC
76.	Psittacidae	Red-breasted Parakeet	*Psittacula alexandri*	LC
77.	Pycnonotidae	Red-vented Bulbul	*Pycnonotus cafer*	LC
78.	Pycnonotidae	Red-whiskered Bulbul	*Pycnonotus jocosus*	LC
79.	Pycnonotidae	Himalayan Bulbul	*Pycnonotus leucogenys*	LC
80.	Saturnidae	Common Myna	*Acridotheres tristis*	LC
81.	Saturnidae	Pied Myna	*Sturnus contra*	LC
82.	Saturnidae	Jungle Myna	*Acridotheres fuscus*	LC
83.	Scolopacidae	Common Sandpiper	*Actitis hypoleucos*	LC
84.	Scolopacidae	Silver-eared Mesia	*Leiothrix argentauris*	LC
85.	Scolopacidae	Rufous-vented Laughing Thrush	*Garrulax leucolophus*	LC
86.	Scolopacidae	Blue Rock-Thrush	*Monticola solitarius*	LC
87.	Scolopacidae	Long-tailed Sibia	*Heterophasia picaodes*	LC
88.	Scolopacidae	Common Tailorbird	*Orthotomus sutorius*	LC
89.	Scolopacidae	Mountain Tailorbird	*Orthotomus cuculatus*	LC
90.	Sittidae	Velvet-fronted Nuthatch	*Sitta frontalis*	LC
91.	Strigidae	Spotted Owlet	*Athene brama*	LC
92.	Turdidae	Blue Whistling Thrush	*Myophonus caeruleus*	LC
93.	Upupidae	Hoopoe	*Upupa epops*	LC
94.	Zosteropidae	Oriental white-eye	*Zosterops palpebrosus*	LC

Black Drongo

Purple Sunbird

Indian Roller

Paddyfield Pipit

Figure 3-36 Common Bird Species

Relative abundance of bird species in Buffer zone

The following table represent the top 10 species relative abudance.

Table 3-26 Top ten Bird species in buffer zone

S.No	Common Name	Scientific Name	No. of individuals	Relative Abundance
1	Spotted Dove	Streptopelia chinensis	41	6.73
2	Indian Roller	Coracias benghalensis	41	6.73
3	Black Drongo	Dicrurus macrocercus	41	6.73
4	Common Crow	Corvus splendens	28	4.60
5	House Swift	Apus affinis	24	3.94
6	Black Kite	Milvus migrans	19	3.12
7	Asian Koel	Eudynamys scolopacea	18	2.96
8	Crimson-breasted Woodpecker	Dendrocopos cathpharius	18	2.96
9	Pompadour Green Pigeon	Treron pompadoura	17	2.79
10	Jungle Crow	Corvus macrorhynchus	14	2.30

Detailed list of Butterfly

From the extensive survey, a total of 64 different butterfly species were recorded in the project site core and buffer zone in one season survey as shown in Table 000. It was found that most of the butterflies recorded belonged to the family Nymphalidae 26 species from 21 genera. Among the others, 12 species from 7 genera belonged to Pieridae, 11 species from 11 different genera belonged to Hesperiidae, 7 species from 3 genera belonged to Papillionidae and 8 species from 8 different genera belonged to Lycaenidae.

Table 3-27 List of butterfly species recorded during the study along with common name and status.

S.No	Scientific name / families	Common Name	Status
	Hesperiidae		
1	*Ampittia dioscorides (Fabricius)*	Bush Hopper	Very common
2	*Bibasis gomata (Moore)*	Pale Green Awlet	Rare
3	*Caltoris kumara (Moore)*	Blank Swift	Common
4	*Halpe homolea (Hewitson)*	Indian Ace	Common
5	*Matapa aria (Moore)*	Common Redeye	Common
6	*Notocrypta curvifascia (C. & R. Felder)*	Restricted demon	Common
7	*Pelopidas assamensis (de Nicéville)*	Great swift	Common
8	*Pseudocoladenia dan (Fabricus)*	Fulvous pied flat	Common
9	*Spialia galba (Fabricus)*	Indian skipper	Common
10	*Telicota ancilla (Herrich-Schäffer)*	Dark Palm Dart	Common
11	*Udaspes folus (Cramer)*	Grass demon	Common
	Papilionidae		
12	*Atrophaneura varuna (White)*	Common Batwing	Not rare
13	*Graphium doson (C. & R. Felder)*	Common Jay	Common
14	*Graphium sarpedon (Linnaeus)*	Common Bluebottle	Common
15	*Papilio demolius (Linnaeus)*	Lime Butterfly	Very common
16	*Papilio memnon (Linnaeus)*	Great Mormon	Very Common
17	*Papilio nephelus (Boisduval)*	Yellow Helen	Not rare
18	*Papilio polytes (Linnaeus)*	Common Mormon	Very Common
	Pieridae		
19	*Appias albino (Boisduval)*	Common Albatross	Common
20	*Appias indra (Moore)*	Plain Puffin	Not rare
21	*Appias libythea (Fabricus)*	Striped Albatross	Uncommon
22	*Catopsilla Pomona (Fabricus)*	Orientallemonemigrant	Common
23	*Delias descombesi (Boisduval)*	Red Spot jezebel	Not rare
24	*Delias pasithoe (Linnaeus)*	Red Base Jezebel	Not Rare
25	*Eurema blanda (Boisduval)*	Three spot grass yellow	Common
26	*Eurema hecabe (Linnaeus)*	Common grass yellow	Common
27	*Eurema sari (Horsfield)*	Chocolate grass yellow	Rare
28	*Gandaca harina (Horsfield)*	Tree Yellow	Not rare
29	*Leptosia nina (Fabricus)*	Psyche	Common
30	*Peries canidia (Sparrman)*	Indian Cabbage White	Common
	Lycaenidae		
31	*Arhopala centaurus*	Centaur oakblue	Common
32	*Castalius rosimon*	Common Pierrot	Common
33	*Cheritra freja (Fabricus)*	Common Imperial	Common
34	*Heliophorus epicules (Godart)*	Purple Saphhire	Common
35	*Loxura atymnus (Stoll)*	Yamfly	Common
36	*Pseudozizeeria maha (Kollar)*	Pale grass blue	Common

37	*Rapala maena (Hewitson)*	Slate flash	Common
38	*Zemeros flegyas (Cramer)*	Punchinello	Very common
	Nymphalidae		
39	*Abisara fylla (Westwood)*	Dark Judy	Common
40	*Acraea issoria (Hübner)*	Yellow coster	Common
41	*Argynnis hyperbius (Linnaeus)*	Indian fritillary	Common
42	*Ariadne merione (Cramer)*	Common castor	Common
43	*Athyma kanwa (Moore)*	Dot-dash Sergeant	Rare
44	*Athyma nefte (Cramer)*	Colour Sergeant	Not rare
45	*Athyma ranga (Moore)*	Blackvein Sergeant	Not Common
46	*Cirrochroa aoris (Doubleday)*	Large Yeoman	Common
47	*Danaus chrysippus (Linnaeus)*	Plain Tiger	Common
48	*Euploea midamus (Linnaeus)*	Blue spotted crow	Common
49	*Euthalia aconthea (Cramer)*	Common Baron	Common
50	*Hypolimnas bolina (Linnaeus)*	Great Eggfly	Common
51	*Junonia almanac (Linnaeus)*	Peacock Pansy	Common
52	*Junonia atlites (Linnaeus)*	Grey Pansy	Very common
53	*Lethe chandica (Moore)*	Angled Red Forester	Not Rare
54	*Melanitis leda (Linnaeus)*	Common EveningBrown	Common
55	*Moduza procris (Cramer)*	Commander	Common
56	*Mycalesis gotama (Moore)*	Chinese Bushbrown	Rare
57	*Mycalesis perseus (Fabricus)*	Common Bushbrown	Common
58	*Orsotriaena medus (Fabricus)*	Nigger	Very common
59	*Parantica aglea (Stoll)*	Glassy tiger	Common
60	*Symbrenthia hippoclus (Cramer)*	Common Jester	Common
61	*Tanaecia lepidea (Butler)*	Grey count	Common
62	*Tirumala limniace (Cramer)*	Blue tiger	Common
63	*Ypthima baldus (Fabricus)*	Common Five-ring	Common
64	*Ypthima hubneri (Kirby)*	Common Four-ring	Common

Detailed list of Mammal

Mammalian diversity

A total of 17 species of mammalian fauna were observed.

Checklist of Mammalian fauna

Table 3-28 Checklist of Mammalian fauna

S.No	Family	English Name	Scientific Name	Observed	IWPA status
1.	Cercopithecidae	Rehesus Macaque	*Macaca mulatta*	Visual	Sch-II
2.		Assamese Macaque	*Macaca assamensis*	Visual	Sch-II
3.	Felidae	Jungle Cat	*Felis bengalensis*	Forested Reported	Sch-II
4.	Canidae	Wild Dog	*Cuon alpinus*	Forested Reported	Sch-II
5.	Viverridae	Large Indian Civet	*Vivera zibetha zibetha*	Visual	Sch-II
6.		Small Indian Civet	*Arctictis binturang*	Visual	Sch-II
7.		Common Palm Civet	*Paradoxurus hermophroditus*	Visual	Sch-II

8.	Elephantidae	Asiatic Elephant	*Elephas maximus*	Forested Reported	Sch-I
9.	Suidae	Wild Boar	*Sus scrofa*	Forested Reported	Sch-III
10.	Cervidae	Sambar	*Cervus unicolor*	Forested Reported	Sch-III
11.	Pteromyidae	Flying Squirrel	*Petaurista petaurista*	Visual	Sch-II
12.		Pallas's Squirrel	*Callosciurus erythraeus*	Visual	Sch-II
13.	Muridae	Indian Mole Rat	*Bandicota bengalensis*	Forested Reported	Sch-V
14.		Lesser Bamboo Rat	*Cannoys badius*	Forested Reported	Sch-V
15.	Leporodae	Indian Hare	*Lepus nigricollis*	Forested Reported	Sch-II
16.	Pteropodidae	Indian Flying Fox	*Pteropus giganteus*	Visual	Sch-V
17.	Vespertilionidae	Least Pipistrelle	*Pipistrellus tenuis*	Visual	Sch-V

Source: *Wildlife conservation plan, forest and direct observation*

Table 3-29 List of Herpetofauna in Core and Buffer zone

S. No	**Scientific name**	**IWPA status**	**IUCN Status***
Family : Colubridae			
1	Amphiesma stolatum (Linnaeus, 1758)	Sch IV	NE
2	Ahaetulla nasuta (Lacepede, 1789)	Sch IV	NE
3	Lycodon aulicus (Linnaeus, 1754)	Sch IV	NE
4	Lycodon jara (Shaw, 1802)	Sch IV	NE
5	Lycodon striatus (Shaw, 1802)	Sch IV	NE
6	Oligodon arnensis (Shaw, 1802)	Sch IV	NE
7	Ptyas mucosa (Linnaeus, 1758)	Sch IV	NE
8	Fowlea piscator (Schneider, 1799)	Sch IV	NE
9	Dendrelaphis tristis (Daudin, 1803)	Sch IV	NE
Family : Elapidae			
10	Naja kaouthia (Lesson, 1831)	Sch II	LC
11	Naja naja (Linneaus, 1758)	Sch II	LC
12	Bungarus caeruleus (Schneider, 1801)	Sch IV	NE
	Family: Viperidae		
13	Daboia russelii (Shaw & Nodder, 1797)	Sch II	NE
	Family : Homalopsidae		
14	Enhydris enhydris (Schneider, 1799)	-	LC
	Family: Agamidae		
15	Calotes versicolor (Daudin, 1802)	-	NE
16	Psammophilus blanfordanus (Stoliczka, 1870)	-	LC
Family: Gekkonidae			
17	Hemidactylus flaviviridis (Ruppel, 1840)	-	NA
18	Hemidactylus parvimaculatus (Deraniyagala, 1951)	-	NA
	Family : Chamaeleonidae		
19	Chamaeleon zeylanicus (Laurenti, 1718)	Sch II	LC
	Family : Lacertidae		
20	Ophisops jerdonii (Blyth,1853)	-	LC
	Family : Scincidae		
21	Eutropis carinata (Schneider, 1801)	-	LC
22	Eutropis macularia (Blyth, 1853)	-	NA
	Family:Bufonidae		
23	Duttaphrynus melanostictus (Schneider, 1799)	-	LC

24	Duttaphrynus stomaticus (Lutken, 1864)	-	LC
Family : Dicroglossidae			
25	Euphlyctis cyanophlyctis (Schneider, 1799)	-	LC
26	Hoplobatrachus crassus (Jerdon, 1853)	Sch IV	LC
27	Hoplobatrachus tigerinus (Daudin, 1803)	Sch IV	LC
28	Sphearotheca sp.	-	LC
29	Fejervarya sp.	-	LC
Family: Microhylidae			
30	Uperodon taprobanicus (Parker, 1934)	-	LC
31	Microhyla cf. Ornata (Dumeril & Bibron, 1841)	-	LC
32	Hylarana tytleri (Theobald, 1868)	-	LC
Family: Rhacophoridae			
33	Polypedates sp. (Gray, 1838)	-	LC

*NE: Not evaluated; LC: Least concerned; NA: Not accesse

3.12 CONSERVATION PLAN

3.12.1 Biodiversity Management Plan (BMP)

Biodiversity Management Plan (BMP) of an area is of great importance as it provides a road map and blue print for further management of the biodiversity of the region. The starting point for any BMP is compilation of the primary and secondary data/ information regarding the biodiversity of the region, followed by evolution of appropriate strategy for managing the biodiversity, for conservation, sustainable use and equitable sharing of benefits. Every developmental activity in North east India, a biodiversity hotspot, requires a proper Biodiversity Management Plan (BMP), and the present plan is an attempt in that direction.

3.12.2 GreenBelt Development

A well developed green belt in project site, but some gap is present.Green belts form a surface capable of absorbing air pollutants and dust and formsinks for pollutants thus effectively reducing concentrations of pollutants in the ambientair. Often, the absorbed pollutants are incorporated in metabolic stream and thus the air is purified. It also mitigates and minimizes the impacts of mining on environment by countering air and noise pollution and also controlling soil erosion. It also helps to restorethe aesthetic aspect of the area to some extent.

The strategy worked out for development of green belt is as follows:

- Broad leaved trees growing above 20 min height and thick layer of bamboo plantation in inner side should be planted along the roads, offices and infrastructure facilities.
- Plantation of trees should be undertaken in appropriate encircling grows.
- Generally local/indigenous fast growing trees and shrubs should be planted.
- The trees should be protected by plantation of nonpalatable shrub species to avoid browsing by animals.
- Tree guards should be provided to save the plants.

3.12.3 Species to be planted

Major pollutants in any industrial areas are SO_2, NO_2, H_2S, CO, CO_2, C_2H_4, Suspended Particulate Matters and Acid Precipitates (Painter, 1974). *Mangifera indica*, *Citrus spp*, *Ficus benghalensis*, *Pithecellobium dulce*, *Nerium indicum*, *Dalbergia sissoo*, *Terminalia myriocarpa*, etc are SO_2 tolerant species and also good for dust. These species along with other local indigenous tree, shrub and herb species should be planted in different rows of the greenbelt.

While making choice of plant species for cultivation in green belts, weightage has to be given to the natural factor of bio-climate. It is also presumed that the selected plants will be grown as per normal forestry practices and authorities responsible for plantation, will also make adequate provisions for watering, and protection of the saplings. The green belt plants require some inherent characteristic including shapes of crowns for effective absorption of pollutant gases and removal of dust particles

3.12.4 Wildlife

The project will not lead to destruction or deterioration of habitat as; proposed activities are located within plot area. Emission and discharge viz. air emissions, noise, water discharge will impact the protected species or their habitats insignificantly. However, as preventive measure certain management measures have been identified for protection of the Schedule I species found in the area.

Conservation Plan and Budget Allocation

The Conservation Plan would focus on conservation of habitats of Schedule-I species identified during the study. We identified 3 IUCN red list species in 10 km buffer area.

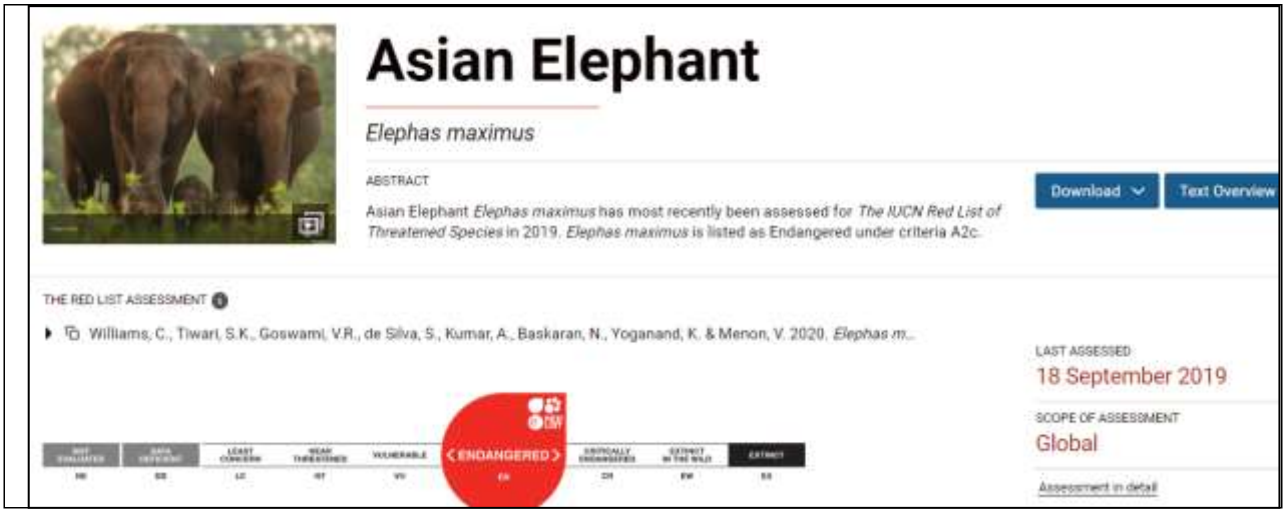
The budgetary provision has been made for implementation of wildlife conservation measures. NRL will allocate Rs.8.20 Lakh towards the conservation plan for implementing the following activities with the help of and in consultation with the Forest Department.

To, prepare the ecological report under EIA study field visits for the project area has been conducted within 10 km surrounding of the proposed project. From this study a detail report on biodiversity status have been prepared. All the direct sightings were recorded at the study period and also noted faunal species after consultation with local villagers, forest department and secondary sources. Based on our field observations and literature survey we found one important fauna species which are threatened category (IUCN) and Schedule-I species as per Wildlife Protection Act, 1972 in the study area (Based on forest department source).

There are no sightings or signs of Elephants during the study period. The presence of elephants is occasionally sighted by forest department and locals in the project area. Most of the elephant population in Assam is found in protected areas and confined to elephant reserves. The location of project area is not in the prime habitat and range of the elephant and there are no demarcated or identified corridors.

Conservation Status

Indian Elephant is classified under class Mammals of Family Elephantidae and Protected under Schedule-I, of the Indian Wildlife (Protection) Act, 1972, and cited as Endangered status in IUCN Red Data list category.



Asian Elephant

Elephas maximus

ABSTRACT

Asian Elephant *Elephas maximus* has most recently been assessed for *The IUCN Red List of Threatened Species* in 2019. *Elephas maximus* is listed as Endangered under criteria A2c.

THE RED LIST ASSESSMENT

Williams, C., Tiwari, S.K., Goswami, V.R., de Silva, S., Kumar, A., Baskaran, N., Yoganand, K. & Menon, V. 2020. *Elephas m...*

LAST ASSESSED
18 September 2019

SCOPE OF ASSESSMENT
Global

Elephant Habitats

They prefer a variety of habitats such as dry and moist deciduous forests, evergreen and semi-evergreen forests are often located adjacent to the flood plains. They avoid open mixed forests and always confined to dense thickets of bamboo mixed forests for feeding and breeding purpose. Elephants are classified as megaherbivorous and consume up to 150 kg of plant matter per day (Samansiri and Weerekoon, 2007). Hence availability of food is a major determinant of carrying capacity of elephants in a given area. Elephants keep constantly on move looking for the necessary supply of food and sources of water (Davies, 2008). The total time spent in feeding by an elephant varies between 12 and 19 hr per day. Elephants are generalist feeders and tend to eat what is available to them, but they can be very specific about which parts of a plant they eat and when.

Food and feeding habits

Elephant diet consists of grasses, herbs, wooded lianas shrubs and trees with finer fodder grasses. During summer months in the scarcity of green grasses the elephants mainly used the bark of different trees as their food and browsed on Teak and Bamboo plants.

Management Strategies

Long term survival and conservation of Elephants depends on the availability of suitable habitats, reduction of anthropogenic pressure, hence protection of plant species utilized by Elephants in its natural reserves is a significant factor. The plant species preferred by elephants should be included in green belt development zones of the project as alternative food resources to prevent raids on croplands, farm lands at villages and human- encounters.

Table 3-30 Identified elephant food plant species

S.No	Plant species	Parts eaten
1.	Polyathia longifolia	Leaf
2.	Crateva magna	Leaf
3.	Bombax ceiba	Leaf
4.	Grewia helicterifolia	Leaf
5.	Kydia calycina	Leaf
6.	Helicteres isora	Leaf
7.	Pterospermum canesces	Leaf Bark
8.	Sterculia villosa	Leaf
9.	Bridelia retusa	Leaf
10.	Emblica officinalis	Leaf
11.	Mallotus philippinensis	Leaf
12.	Trewia nudiflora	Bark
13.	Celtis cinnamomea	Leaf
14.	Artocarpus heterophyllus	Leaf, Bark,Fruit
15.	Ficus benghalensis	Leaf, Bark
16.	Ficus glomerata	Leaf, Fruit
17.	Ficus religiosa	Leaf, Twigs
18.	Streblus asper	Leaf, Twigs
19.	Hugonia mystax	Leaf, Twigs
20.	Aegle marmelos	Fruit
21.	Atalantia monophylla	Leaf
22.	Limonia acidissima	Bark, Twigs
23.	Glycosmisconmis pentaphylla	Leaf
24.	Mangifera indica	Fruit

25.	Schleichera oleasa	Leaf
26.	Zizyphus mauritiana	Leaf
27.	Zizyphus xylopyrus	Leaf
28.	Bauhinia racemosa	Leaf
29.	Tamarindus indica	Leaf, Fruit.
30.	Cassia fistula	Leaf, Twigs
31.	Acacia leucophloea	Leaf
32.	Acacia torta	Leaf
33.	Terminalia belerica	Leaf
34.	Syzygium cumini	Leaf
35.	Lagerstroemia parviflora	Bark
36.	Madhuca indica	Fruit Leaf
37.	Manilkara hexandra	Leaf
38.	Diospyros melanonxylon	Leaf, Root Fruit
39.	Carissa spinarum	Leaf

It is recommended that project proponent shall comply with all the pollution control and other conditions imposed in the environmental clearance by the authorities. Compliance of all the conditions in environment clearance would take care of major issue of habitat degradation for the species. The well pad and EPS areas shall be fenced with barbed wire so that there is no accidental electrocution of animals is created.

If elephants are passing through project area, the project management will communicate with Forest Department immediately to take necessary action. Project proponent shall also support forest department in conducting awareness of local people towards wildlife conservation and law reinforcement and anti poaching activities in the study area.

Project management shall support forest department in installing sign boards on roads and strategic locations of villages informing prohibition of killing, poaching etc. under wildlife protection act 1972.

Financial projection

Rs. 8.20 Lakh has been allocated towards conservation of scheduled fauna in the area for the implementation of conservation proposal. An effective conservation plan will help in proper management of habitat of such ecologically and nationally significant species. Implementation of conservation plan should be step by step in described format. NRL will allocate budget in assistance with the forest department, Assam. The year wise budgetary allocation for all scheduled fauna is listed table below.

Table 3-31 Budget Allocation

Sr. No.	Component	Provision in Lakhs
1.	Habitat improvement & mitigate (Food, water, shelter, movement, etc) and measure to reduce minimize the human –animal conflicts. c. Maintenance of water ponds/water holes at the periphery of project area d. Plantation at the periphery of project area	4,60,000
2.	Awareness & Extension (Forest staff will also be invited for various activities to ensure participation)	52,000
3.	Support to forest department for monitoring, rescue & Rehabilitation of wildlife (veterinary care animal health, rescue, tools and equipment's, etc.) a. Purchasing of rescue equipment's for rescue of strayed and injured wild animals and their Trans location.	52,000
4.	Contribution towards conservation of wildlife in PCCF (to be deposited in GPCCF)	52,000
5.	Administrative cost for processing inspection etc. (to be deposited in GPCCF)	52,000
6.	Miscellaneous including Eco-development a. Plantation around the water body	1,52,000
	Total	**8,20,000**

Total fund allocation for plan period 5 years is Rs. 8.20 lakh. User agency will deposit Rs.8.20 lakh in the office of Forest Department Assam.

Conclusion

The study area comprises of NRL Assam. The conservation plan has been prepared for the protection of scheduled –I fauna on the basis of habitat improvement way of conservation to facilitate the existing wildlife in terms of food shelter and water requirement for the fulfilment of the aim of this conservation plan. The baseline study was conducted for the evaluation of the floral and faunal biodiversity of the terrestrial environment of the study area (10 Km radius) and it comprises of total 51 tree, 28 shrub, 39 herb species were enlisted. The present survey within the study area which facilitate 94 birds, 64 butterflies, 17 mammals, 33 Herpetofauna species. Out of which only one species of fauna was documented which belongs to schedule-I as per Wildlife Protection Act, 1972. Hence, management/conservation Plan has been prepared for the same.

Source:

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3.13 Socio Economic Profile

A socio-economic study was undertaken in assessing aspects which are dealing with social and cultural conditions, and economic status in the study area. The study provides information such as demographic structure, population dynamics, infrastructure resources, and the status of human health and economic attributes like employment, per-capita income, agriculture, trade, and industrial development in the study area. The study of these characteristic helps in identification, prediction and evaluation of impacts on socio-economic and parameters of human interest due to proposed project activities and its developments. The parameters are:

- Demographic structure
- Infrastructure Facility
- Economic Status
- Health status
- Cultural attributes
- Awareness and opinion of people about the project and Industries in the area.

Table 3-32 Social Indicators of Golaghat District

S.No	Social Indicators	Golaghat District
1.	Decadal variation %	12.7
2.	Urban population %	9.16
3.	Sex ratio	964
4.	Population density (Persons per square Km)	305
5.	Scheduled caste population %	5.8
6.	Scheduled tribe population %	10.5
7.	Literacy rate %	77.4
8.	Main Workers %	31.04
9.	Marginal Workers %	13.94
10.	Cultivators %	39.7
11.	Agricultural labourers %	13.9
12.	Workers in household industries %	3.14
13.	Other workers %	43.3

Source:*https://censusindia.gov.in/nada/index.php/catalog/216/download/514/DH_2011_1814_PART_A_DCHB_GOLAGHAT.pdf*

(**Ref**: Directorate of Census Operations –Assam, "District Census Handbook-2011, Golaghat District", Series-19 Part XII A)

3.13.1 Population

The total population of Golaghat District as per Census 2011 is 1066888. Male comprises 543161 while female consists of 523727. Out of the total population of the district, 969152 falls under rural and 97736 are under urban areas of the district. In rural areas 493125 and 476027 are males and female respectively. Accordingly 50036 and 47700 are males and females respectively in urban of the district. The percentage of urban population in the district is only 9.2%. So it can be clearly seen that most of the population dwell in the rural areas of the district.

Source:[*https://censusindia.gov.in/nada/index.php/catalog/216/download/514/DH_2011_1814_PART_A_DCHB_GOLAGHAT.pdf*](https://censusindia.gov.in/nada/index.php/catalog/216/download/514/DH_2011_1814_PART_A_DCHB_GOLAGHAT.pdf)

(**Ref**: Directorate of Census Operations –Assam, "District Census Handbook-2011, Golaghat District", Series-19 Part XII A)

3.13.2 Population Density and Sex Ratio

The decadal growth rate of the district comes to 12.7. The Golaghat is a quite densely populated district. The density of the district is 305 persons per sq. kms.. The sex ratio is the number of females per 1000 males in the population. The district has a Sex Ratio of 964 as against 958 in the State.

Source:[*https://censusindia.gov.in/nada/index.php/catalog/216/download/514/DH_2011_1814_PART_A_DCHB_GOLAGHAT.pdf*](https://censusindia.gov.in/nada/index.php/catalog/216/download/514/DH_2011_1814_PART_A_DCHB_GOLAGHAT.pdf)

(**Ref**: Directorate of Census Operations –Assam, "District Census Handbook-2011, Golaghat District", Series-19 Part XII A)

3.13.3 Scheduled Castes and Scheduled Tribes

Considering the distribution of Scheduled Castes (SC) and Scheduled Tribes (ST) population in the district, we find that there are 62298 SC persons comprising of 31807 males and 30491 females. The percentage of Schedules Castes population to total population is 5.8. The total Scheduled Tribes population in the district is 111765 comprising of 56420 males and 55345 females. The percentage of ST population to total population in the district is only 10.5.

Source:[*https://censusindia.gov.in/nada/index.php/catalog/216/download/514/DH_2011_1814_PART_A_DCHB_GOLAGHAT.pdf*](https://censusindia.gov.in/nada/index.php/catalog/216/download/514/DH_2011_1814_PART_A_DCHB_GOLAGHAT.pdf)

(**Ref**: Directorate of Census Operations –Assam, "District Census Handbook-2011, Golaghat District", Series-19 Part XII A)

3.13.4 Education & Literacy

The number of literates and illiterates, literacy rate by sex in sub-district. The district has 7,21,764 persons who are literates, of which 3,96,475 are males and 3,25,289 are females. Again, the district has 3,45,124 persons who are illiterates , of which 1,46,686 are males and 1,98,438 are females. The literacy rate of the district is 77.43 percent with males at 83.56 percent and females at 71.09 percent. In rural, the total literacy rate is 75.94 percent with 82.44 percent males and 69.22 females. In Urban, it is 91.74 percent, with 94.25 percent males and 89.11 percent females. Education Infrastructures in Golaghat District are given below.

Source:[*https://censusindia.gov.in/nada/index.php/catalog/216/download/514/DH_2011_1814_PART_A_DCHB_GOLAGHAT.pdf*](https://censusindia.gov.in/nada/index.php/catalog/216/download/514/DH_2011_1814_PART_A_DCHB_GOLAGHAT.pdf)

(**Ref**: Directorate of Census Operations –Assam, "District Census Handbook-2011, Golaghat District", Series-19 Part XII A)

Table 3-33 Education Infrastructures in Golaghat District

Type of school	**Total schools**		**Rural Schools**	
	Government	**Private**	**Government**	**Private**
Primary	1332	43	1290	39
Primary + Upper Primary	40	42	38	37
P + UP+ Secondary + Higher Secondary	0	4	0	1
UP only	251	127	232	125

UP + Secondary + Higher Secondary	23	0	16	0
P + UP + Secondary	1	74	1	56
UP + Secondary	30	7	23	6

(***Source:*** *District Information Systems on Education (DISE report card 2016-17))*

3.13.5 Employment and Livelihood

The percentage distribution of the working and non-working population of the district is as follows.-Out of total population of the district, 45.0% are workers of which 56.9 % and 32.6 % are male and female respectively. The percentage of non- workers is 55.0 % in the district. The worker are categorised as Cultivators, Agricultural Labourers, Household Industry Workers and Other Workers. The percentages of these categories are 39.7 %, 13.9%, 3.1% and 43.3% respectively.

.***Source:***https://censusindia.gov.in/nada/index.php/catalog/216/download/514/DH_2011_1814_PART_A_DCHB_GOLAGHAT.pdf

(**Ref**: Directorate of Census Operations –Assam, "District Census Handbook-2011, Golaghat District", Series-19 Part XII A)

3.13.6 Social Economic Profile of the study area

The project area comes under the Golaghat District in the state of Assam.**Table 3-34** provides the details on population profile within study area.

Table 3-34 Population profile within study area

	Name	No of Households	Total Population Person	Total Population Male	Total Population Female	Population in the age group 0-6 Person	Scheduled Castes population Person	Scheduled Tribes population Person
0-5 Km								
Golaghat Revenue Circle-Golaghat District								
1.	Naharbari	30	155	75	80	20	0	154
2.	Kalyanpur	85	433	229	204	70	0	123
Morangi Revenue Circle-Golaghat District								
3.	Panka Pathar	51	241	129	112	33	0	7
4.	Panka Gaon	209	1039	539	500	111	14	485
5.	Ouguri Chapori	324	1564	780	784	212	4	345
6.	No.5 Rangbong Pathar	358	1682	863	819	257	177	83
7.	No.4 Rangbong Pathar	613	3054	1548	1506	466	312	59
8.	No.3 Rangbong Pathar	76	365	190	175	63	73	2
9.	No.1 Rangbong Pathar	202	1072	552	520	166	168	4
10.	No.1 Pangka	812	3313	1711	1602	496	52	277

	Grant							
11.	Morangi Bagan	510	2423	1225	1198	276	250	5
12.	Mithaam Chapori	71	361	167	194	49	0	0
13.	Letekujan Grant	895	4223	2106	2117	601	31	2
14.	Hatimora Putta	68	375	266	109	52	7	15
15.	Gubindapur Bagan	302	1567	774	793	275	6	7
16.	Dhanshiri Chapori	8	34	17	17	0	0	0
17.	Borgoria Chapori Gaon	66	369	177	192	61	0	25
18.	Borgoria	60	342	173	169	31	0	0
19.	Borchapari	71	309	155	154	28	11	100
Khumtai Revenue Circle-Golaghat District								
20.	Sungi-Hula	79	368	195	173	39	0	0
21.	Na-Gaon	276	1290	646	644	144	0	0
22.	Butolikhowa Tup	25	116	60	56	19	14	0
23.	Bogoriani	100	417	210	207	38	0	0
Silonijan Revenue Circle-Karbi Anglong District								
24.	Pator Timung	68	357	186	171	54	3	344
25.	Jamuguri	69	359	181	178	53	0	0

26.	Jasiguri No.2	84	432	198	234	54	0	19
27.	Maiso Engti	52	297	158	139	45	0	209
28.	Dongka Chingthu -2	125	635	321	314	104	16	61
29.	Anondapur	51	275	143	132	24	0	267
30.	Habe Bey	40	229	104	125	38	6	216
31.	Bagari Rongpi	14	90	45	45	16	0	90
32.	Hari Ronghang	56	352	184	168	73	0	348
33.	Kuruna Singnar Gaon	68	367	195	172	48	1	366
34.	Christian Gaon	8	41	19	22	6	0	40
35.	Santipur	51	249	126	123	29	0	1
36.	Simuluguri	52	277	147	130	55	0	0
37.	Deihari Rangpi	36	190	95	95	37	0	188
38.	Mon Hanse	23	128	68	60	27	1	123
39.	Sarthe Rongpi	13	77	39	38	11	0	77
40.	Wophang Hanse	30	181	91	90	37	0	180
41.	Sarthe Engti	18	108	50	58	21	0	106
42.	Sarthe Tisso	14	80	35	45	13	2	78
5-10 km								

Golaghat Revenue Circle-Golaghat District								
43.	No.2 Sensowa Gaon	281	1279	627	652	141	5	9
Bokakhat Revenue Circle-Golaghat District								
44.	Tikirai Chapori	34	213	121	92	30	0	212
45.	Numoligarh N.C.	62	318	164	154	31	0	0
46.	No.2 Bokuli Chapori	14	102	56	46	16	73	1
47.	No.1 Bhakat Chapori	33	236	118	118	57	0	236
Morangi Revenue Circle-Golaghat District								
48.	Shyamraipur Bagan	91	401	209	192	25	396	3
49.	Pangkial Gaon	356	1583	784	799	178	22	6
50.	No.3 Koibarto	91	403	216	187	51	162	81
51.	No.3 Doigrong Bagan	243	1168	605	563	152	0	0
52.	No.2 Sechabill Mohkhuti	12	69	33	36	12	0	0
53.	No.2 Koibarto	188	903	466	437	112	278	156
54.	No.2 Boraguhain Khat	176	862	451	411	148	30	29

55.	No.1 Boraguhain Khat	195	962	507	455	128	0	152
56.	Miripathar	169	775	395	380	120	0	0
57.	Mahara Bagan	182	786	388	398	113	457	25
58.	Kordoiguri Gaon	117	548	280	268	82	0	52
59.	Koharpar	5	16	11	5	5	0	0
60.	Kenduguri Gaon	240	1118	565	553	157	0	26
61.	Kathoni Bagan	739	3530	1777	1753	560	543	48
62.	Kalioni gaon	45	187	93	94	25	0	0
63.	Kachari Gaon	71	360	171	189	56	0	165
64.	Jackson Grant	293	1444	747	697	261	186	16
65.	Hidheshari Bagan	266	1208	628	580	223	0	0
66.	Dholaguri Bagan.	423	2121	1089	1032	292	34	35
67.	Dhola Gaon	187	876	411	465	124	4	0
68.	Chachamukh	41	192	102	90	15	0	0
69.	Bukial Bagan	588	2667	1377	1290	344	5	30
70.	Borchali Gaon	53	235	115	120	28	0	0
71.	Amlongsung gaon	49	210	117	93	26	0	4
Khumtai Revenue Circle-Golaghat District								

72.	Thengal Gaon	350	1569	781	788	161	4	692
73.	Sonari Gaon	82	387	194	193	41	4	35
74.	Sankala Gaon	226	1077	517	560	128	13	0
75.	No.2 Hautoly Habi	52	236	120	116	37	3	12
76.	No.2 Butolikhowa	64	295	146	149	45	7	57
77.	No.1 Butolikhowa	58	286	150	136	54	0	42
78.	Na-Gaon	276	1290	646	644	144	0	0
79.	Khumtai Grant No.68 (No.1 Khumtai)	321	1467	736	731	222	46	265
80.	Khumtai Gaon	353	1613	836	777	155	0	0
81.	Helochi Gaon	35	180	100	80	16	0	0
82.	Hautoley Grant	667	2940	1513	1427	372	58	2
83.	Choukana Bil	78	400	207	193	54	0	57
84.	Borua Khat	470	2102	1042	1060	239	63	5
Silonijan Revenue Circle-Karbi Anglong District								
85.	Samuguri No.3 Block 1,2	200	1160	609	551	158	419	0
86.	Samuguri No.2	133	714	378	336	102	1	0
87.	Hidi Bonglong	80	455	225	230	63	16	316

88.	Matikhula Timung Gaon	101	625	315	310	76	7	616
89.	Dharam Haboi	58	386	196	190	16	0	386
90.	Kaibong Tisso	24	118	57	61	21	0	118
91.	Pan Kumar Dimasa	91	474	243	231	65	20	158
92.	Dumukhi	126	633	334	299	91	3	5
93.	No.3 Kuli Gaon	65	312	150	162	25	0	307
94.	Pub-Dikharu	102	558	283	275	83	2	508
95.	Mistribali Gaon	81	442	226	216	55	1	280
96.	Karaijhar Gaon	52	284	134	150	31	0	283
97.	Okreng Pathar	64	398	190	208	69	2	384
98.	Hatipara Kandali Ronghang	26	184	86	98	20	0	184
99.	Pachim Kachamari	32	211	107	104	39	0	166
100.	Pub Kachamari	35	223	126	97	54	1	214
101.	Raj Pur	64	448	240	208	62	4	232
102.	Basalong Tokbi	57	321	160	161	57	1	320
Total		**15830**	**76396**	**38842**	**37554**	**10519**	**4018**	**11336**

*(**Source:** Census 2011)*

3.14 Employment and livelihood

The economy of Golaghat district is agriculturebased. Tea, rice and sugar cane are the main agricultural crops grown in the district, with tea being is the largest agricultural industry. There are 63 large tea gardens producing about 20,000 tones of tea per year. Moreover, the emergence of small tea growers has proclaimed a new improvement in the district. Smallscale tea growers have gotten considerable fame here because of large incomes compared to other high-land crops. It has caught the desire of unemployed people to take owning tea-gardens as their profession. **Table 3-35** shows the classification of workers within the study area.

A walk-through survey was conducted by visiting rural place within the 10 km radius. While doing so, many interactions with various people like farmers, women, labours, teachers, health workers, etc. were conducted.

Table 3-35 Classification of workers within study area

Sl. No	Name	Total Workers	Main Workers	Marginal Workers	Agriculture Workers				Household Industry Workers		Other Workers	
					Cultivators		Agri. Labourers					
					Main	Marginal	Main	Marginal	Main	Marginal	Main	Marginal
0-5 Km												
Golaghat Revenue Circle-Golaghat District												
1.	Naharbari	105	47	58	39	54	2	4	1	0	5	0
2.	Kalyanpur	201	105	96	71	9	10	62	0	0	24	25
Morangi Revenue Circle-Golaghat District												
3.	Panka Pathar	108	57	51	6	2	0	1	0	1	51	47
4.	Panka Gaon	326	301	25	111	0	24	11	5	6	161	8
5.	Ouguri Chapori	531	503	28	135	2	29	6	3	1	336	19
6.	No.5 Rangbong Pathar	537	328	209	78	142	20	10	8	3	222	54
7.	No.4 Rangbong Pathar	1070	821	249	249	26	13	5	16	11	543	207
8.	No.3 Rangbong Pathar	130	130	0	46	0	31	0	0	0	53	0
9.	No.1 Rangbong Pathar	405	349	56	120	5	224	32	0	1	5	18

Sl. No	Name	Total Workers	Main Workers	Marginal Workers	Agriculture Workers				Household Industry Workers		Other Workers	
					Cultivators		Agri. Labourers					
					Main	Marginal	Main	Marginal	Main	Marginal	Main	Marginal
10.	No.1 Pangka Grant	1067	1010	57	35	3	7	12	2	3	966	39
11.	Morangi Bagan	1039	874	165	132	6	6	4	2	2	734	153
12.	Mithaam Chapori	110	84	26	76	5	3	2	0	0	5	19
13.	Letekujan Grant	2045	1661	384	28	30	23	20	8	2	1602	332
14.	Hatimora Putta	218	215	3	0	0	0	0	0	0	215	3
15.	Gubindapur Bagan	801	540	261	18	34	8	37	1	0	513	190
16.	Dhanshiri Chapori	10	7	3	6	0	1	3	0	0	0	0
17.	Borgoria Chapori Gaon	92	86	6	73	1	0	4	0	0	13	1
18.	Borgoria	97	93	4	91	1	0	1	0	1	2	1
19.	Borchapari	99	97	2	63	0	0	1	0	0	34	1
Khumtai Revenue Circle-Golaghat District												
20.	Sungi-Hula	203	118	85	39	2	45	31	4	8	30	44
21.	Na-Gaon	728	307	421	103	225	28	92	13	50	163	54
22.	Butolikhowa Tup	42	29	13	21	4	8	5	0	1	0	3

Sl. No	Name	Total Workers	Main Workers	Marginal Workers	Agriculture Workers				Household Industry Workers		Other Workers	
					Cultivators		Agri. Labourers					
					Main	Marginal	Main	Marginal	Main	Marginal	Main	Marginal
23.	Bogoriani	302	101	201	81	36	18	164	0	0	2	1
Silonijan Revenue Circle-Karbi Anglong District												
24.	Pator Timung	122	66	56	38	13	4	13	1	9	23	21
25.	Jamuguri	82	82	0	28	0	0	0	0	0	41	0
26.	Jasiguri No.2	131	87	44	16	6	4	9	2	18	10	11
27.	Maiso Engti	91	46	45	16	22	4	21	0	1	22	1
28.	Dongka Chingthu -2	313	278	35	21	22	48	10	0	0	102	3
29.	Anondapur	133	68	65	5	58	0	7	0	0	13	0
30.	Habe Bey	99	69	30	15	0	0	30	1	0	21	0
31.	Bagari Rongpi	51	20	31	23	5	10	26	0	0	0	0
32.	Hari Ronghang	158	139	19	41	15	1	3	0	0	10	1
33.	Kuruna Singnar Gaon	134	75	59	60	57	0	0	0	0	10	2
34.	Christian Gaon	18	18	0	71	0	0	0	0	0	0	0
35.	Santipur	55	55	0	0	0	3	0	0	0	14	0
36.	Simuluguri	160	82	78	6	64	0	2	9	7	2	5

Sl. No	Name	Total Workers	Main Workers	Marginal Workers	Agriculture Workers				Household Industry Workers		Other Workers	
					Cultivators		Agri. Labourers					
					Main	Marginal	Main	Marginal	Main	Marginal	Main	Marginal
37.	Deihari Rangpi	57	57	0	20	0	0	0	0	0	10	0
38.	Mon Hanse	39	36	3	128	0	0	0	7	1	8	2
39.	Sarthe Rongpi	37	34	3	3	2	1	1	0	0	10	0
40.	Wophang Hanse	77	76	1	72	1	0	0	4	0	8	0
41.	Sarthe Engti	53	20	33	0	1	0	0	0	24	1	8
42.	Sarthe Tisso	40	14	26	1	4	0	3	0	12	0	7
5-10 km												
Golaghat Revenue Circle-Golaghat District												
43.	**No.2 Sensowa Gaon**	576	458	118	125	41	83	10	4	2	246	65
Bokakhat Revenue Circle-Golaghat District												
44.	**Tikirai Chapori**	126	126	0	125	0	0	0	1	0	0	0
45.	**Numoligarh N.C.**	195	195	0	0	0	0	0	0	0	195	0
46.	**No.2 Bokuli Chapori**	65	29	36	29	36	0	0	0	0	0	0
47.	**No.1 Bhakat Chapori**	130	130	0	130	0	0	0	0	0	0	0

Sl. No	Name	Total Workers	Main Workers	Marginal Workers	Agriculture Workers				Household Industry Workers		Other Workers	
					Cultivators		Agri. Labourers					
					Main	Marginal	Main	Marginal	Main	Marginal	Main	Marginal
Morangi Revenue Circle-Golaghat District												
48.	**Shyamraipur Bagan**	230	158	72	0	1	0	0	0	0	158	71
49.	**Pangkial Gaon**	528	488	40	104	16	4	10	1	1	379	13
50.	**No.3 Koibarto**	145	144	1	82	0	8	0	3	0	51	1
51.	**No.3 Doigrong Bagan**	495	483	12	117	1	93	0	11	0	262	11
52.	**No.2 Sechabill Mohkhuti**	34	34	0	0	0	0	0	0	0	34	0
53.	**No.2 Koibarto**	495	214	281	151	9	9	264	5	3	49	5
54.	**No.2 Boraguhain Khat**	356	291	65	95	1	0	3	0	2	196	59
55.	**No.1 Boraguhain Khat**	467	267	200	176	121	48	66	0	0	43	13
56.	**Miripathar**	292	204	88	20	8	7	8	6	4	171	68
57.	**Mahara Bagan**	359	316	43	155	14	39	21	4	2	118	6
58.	**Kordoiguri Gaon**	293	82	211	27	1	5	111	5	9	45	90

Sl. No	Name	Total Workers	Main Workers	Marginal Workers	Agriculture Workers				Household Industry Workers		Other Workers	
					Cultivators		Agri. Labourers					
					Main	Marginal	Main	Marginal	Main	Marginal	Main	Marginal
59.	**Koharpar**	5	5	0	1	0	0	0	0	0	4	0
60.	**Kenduguri Gaon**	402	296	106	124	4	6	10	2	8	164	84
61.	**Kathoni Bagan**	1370	922	448	272	26	22	93	10	3	618	326
62.	**Kalioni gaon**	115	114	1	3	0	0	0	2	1	109	0
63.	**Kachari Gaon**	95	77	18	71	13	0	4	1	0	5	1
64.	**Jackson Grant**	542	448	94	101	3	2	2	4	1	341	88
65.	**Hidheshari Bagan**	652	580	72	105	6	135	62	2	1	338	3
66.	**Dholaguri Bagan.**	878	587	291	45	6	16	7	1	9	525	269
67.	**Dhola Gaon**	240	239	1	55	0	56	0	3	0	125	1
68.	**Chachamukh**	64	59	5	23	0	2	1	1	1	33	3
69.	**Bukial Bagan**	1447	1262	185	3	0	0	2	2	0	1257	183
70.	**Borchali Gaon**	132	132	0	0	0	9	0	0	0	123	0
71.	**Amlongsung gaon**	96	93	3	0	0	1	0	0	0	92	3
Khumtai Revenue Circle-Golaghat District												
72.	**Thengal Gaon**	680	447	233	291	43	89	189	1	0	66	1

Sl. No	Name	Total Workers	Main Workers	Marginal Workers	Agriculture Workers				Household Industry Workers		Other Workers	
					Cultivators		Agri. Labourers					
					Main	Marginal	Main	Marginal	Main	Marginal	Main	Marginal
73.	**Sonari Gaon**	114	110	4	59	4	0	0	3	0	48	0
74.	**Sankala Gaon**	325	79	246	25	120	0	99	0	3	54	24
75.	**No.2 Hautoly Habi**	141	91	50	5	3	38	8	5	7	43	32
76.	**No.2 Butolikhowa**	185	119	66	54	0	39	33	3	8	23	25
77.	**No.1 Butolikhowa**	177	123	54	40	1	4	18	54	6	25	29
78.	**Na-Gaon**	728	307	421	103	225	28	92	13	50	163	54
79.	**Khumtai Grant No.68 (No.1 Khumtai)**	586	551	35	0	0	24	31	23	3	504	1
80.	**Khumtai Gaon**	792	284	508	140	411	6	21	1	32	137	44
81.	**Helochi Gaon**	98	26	72	9	0	0	7	0	61	17	4
82.	**Hautoley Grant**	1336	826	510	156	137	72	246	23	21	575	106
83.	**Choukana Bil**	208	70	138	46	1	6	12	1	125	17	0
84.	**Borua Khat**	917	562	355	12	15	1	6	3	4	546	330
Khumtai Revenue Circle-Golaghat District												

Sl. No	Name	Total Workers	Main Workers	Marginal Workers	Agriculture Workers				Household Industry Workers		Other Workers	
					Cultivators		Agri. Labourers					
					Main	Marginal	Main	Marginal	Main	Marginal	Main	Marginal
85.	**Samuguri No.3 Block 1,2**	366	352	14	216	9	4	0	1	0	131	5
86.	**Samuguri No.2**	250	230	20	103	0	107	19	0	0	20	1
87.	**Hidi Bonglong**	210	111	99	98	2	9	8	0	3	4	86
88.	**Matikhula Timung Gaon**	255	124	131	108	5	1	85	0	39	15	2
89.	**Dharam Haboi**	63	63	0	62	0	1	0	0	0	0	0
90.	**Kaibong Tisso**	40	29	11	17	1	2	7	1	2	9	1
91.	**Pan Kumar Dimasa**	282	111	171	95	1	5	169	0	0	11	1
92.	**Dumukhi**	214	162	52	110	0	20	32	1	2	31	18
93.	**No.3 Kuli Gaon**	88	83	5	79	4	0	0	0	0	4	1
94.	**Pub-Dikharu**	363	144	219	100	126	15	37	3	39	26	17
95.	**Mistribali Gaon**	128	111	17	64	4	21	8	1	3	25	2
96.	**Karaijhar Gaon**	133	8	125	1	106	0	18	0	0	7	1
97.	**Okreng Pathar**	170	46	124	38	12	1	112	0	0	7	0

Sl. No	Name	Total Workers	Main Workers	Marginal Workers	Agriculture Workers				Household Industry Workers		Other Workers	
					Cultivators		Agri. Labourers					
					Main	Marginal	Main	Marginal	Main	Marginal	Main	Marginal
98.	**Hatipara Kandali Ronghang**	77	11	66	4	60	0	6	0	0	7	0
99.	**Pachim Kachamari**	97	48	49	43	1	2	48	0	0	3	0
100.	**Pub Kachamari**	100	45	55	42	2	2	53	1	0	0	0
101.	**Raj Pur**	188	87	101	68	3	13	92	0	1	6	5
102.	**Basalong Tokbi**	82	81	1	29	1	47	0	0	0	5	0
TOTAL		**32333**	**23059**	**9274**	**6541**	**2461**	**1677**	**2762**	**293**	**618**	**14194**	**3433**

*(**Source:** Census 2011)*

3.15 Educational infrastructure within study area

The district has good primary and secondary education infrastructure in urban and rural areas. The people around the study area have well connected to educational infrastructures. Details of Literacy population available in the study area are given in **Table 3-36.**

Table 3-36 Details of Literacy population in the study area

Sl. No	Name	Total Population Person	Literates Population Person	Literates Population Male	Literates Population Female	Illiterate Persons	Illiterate Male	Illiterate Female
0-5 Km								
Golaghat Revenue Circle-Golaghat District								
1.	Naharbari	155	99	57	42	56	18	38
2.	Kalyanpur	433	286	165	121	147	64	83
Morangi Revenue Circle-Golaghat District								
3.	Panka Pathar	241	123	79	44	118	50	68
4.	Panka Gaon	1039	762	404	358	277	135	142
5.	Ouguri Chapori	1564	1010	549	461	554	231	323
6.	No.5 Rangbong Pathar	1682	945	542	403	737	321	416
7.	No.4 Rangbong Pathar	3054	1802	997	805	1252	551	701
8.	No.3 Rangbong Pathar	365	207	122	85	158	68	90
9.	No.1 Rangbong Pathar	1072	519	303	216	553	249	304

Sl. No	Name	Total Population Person	Literates Population Person	Literates Population Male	Literates Population Female	Illiterate Persons	Illiterate Male	Illiterate Female
10.	No.1 Pangka Grant	3313	2407	1321	1086	906	390	516
11.	Morangi Bagan	2423	1263	739	524	1160	486	674
12.	Mithaam Chapori	361	225	116	109	136	51	85
13.	Letekujan Grant	4223	1836	1100	736	2387	1006	1381
14.	Hatimora Putta	375	320	237	83	55	29	26
15.	Gubindapur Bagan	1567	592	376	216	975	398	577
16.	Dhanshiri Chapori	34	30	17	13	4	0	4
17.	Borgoria Chapori Gaon	369	212	113	99	157	64	93
18.	Borgoria	342	243	134	109	99	39	60
19.	Borchapari	309	271	135	136	38	20	18
Khumtai Revenue Circle-Golaghat District								
20.	Sungi-Hula	368	209	119	90	159	76	83
21.	Na-Gaon	1290	1031	533	498	259	113	146
22.	Butolikhowa Tup	116	49	31	18	67	29	38
23.	Bogoriani	417	222	125	97	195	85	110
Silonijan Revenue Circle-Karbi Anglong District								
24.	Pator Timung	357	224	124	100	133	62	71
25.	Jamuguri	359	243	140	103	116	41	75
26.	Jasiguri No.2	432	251	126	125	181	72	109
27.	Maiso Engti	297	182	109	73	115	49	66
28.	Dongka Chingthu -2	635	339	187	152	296	134	162

Sl. No	Name	Total Population Person	Literates Population Person	Literates Population Male	Literates Population Female	Illiterate Persons	Illiterate Male	Illiterate Female
29.	Anondapur	275	188	101	87	87	42	45
30.	Habe Bey	229	144	75	69	85	29	56
31.	Bagari Rongpi	90	38	22	16	52	23	29
32.	Hari Ronghang	352	177	105	72	175	79	96
33.	Kuruna Singnar Gaon	367	226	139	87	141	56	85
34.	Christian Gaon	41	16	7	9	25	12	13
35.	Santipur	249	159	88	71	90	38	52
36.	Simuluguri	277	90	55	35	187	92	95
37.	Deihari Rangpi	190	111	62	49	79	33	46
38.	Mon Hanse	128	81	47	34	47	21	26
39.	Sarthe Rongpi	77	58	33	25	19	6	13
40.	Wophang Hanse	181	104	55	49	77	36	41
41.	Sarthe Engti	108	68	31	37	40	19	21
42.	Sarthe Tisso	80	65	31	34	15	4	11
5-10 km								
Golaghat Revenue Circle-Golaghat District								
43.	No.2 Sensowa Gaon	1279	1083	542	541	196	85	111
44.	Tikirai Chapori	213	118	70	48	95	51	44
45.	Numoligarh N.C.	318	167	101	66	151	63	88
46.	No.2 Bokuli Chapori	102	40	25	15	62	31	31
47.	No.1 Bhakat	236	66	40	26	170	78	92

Sl. No	Name	Total Population Person	Literates Population Person	Literates Population Male	Literates Population Female	Illiterate Persons	Illiterate Male	Illiterate Female
	Chapori							
48.	Shyamraipur Bagan	401	234	145	89	167	64	103
49.	Pangkial Gaon	1583	1297	659	638	286	125	161
50.	No.3 Koibarto	403	308	170	138	95	46	49
51.	No.3 Doigrong Bagan	1168	837	464	373	331	141	190
52.	No.2 Sechabill Mohkhuti	69	36	22	14	33	11	22
53.	No.2 Koibarto	903	756	396	360	147	70	77
54.	No.2 Boraguhain Khat	862	495	287	208	367	164	203
55.	No.1 Boraguhain Khat	962	570	313	257	392	194	198
56.	Miripathar	775	469	274	195	306	121	185
57.	Mahara Bagan	786	470	275	195	316	113	203
58.	Kordoiguri Gaon	548	312	172	140	236	108	128
59.	Koharpar	16	6	4	2	10	7	3
60.	Kenduguri Gaon	1118	681	367	314	437	198	239
61.	Kathoni Bagan	3530	1913	1080	833	1617	697	920
62.	Kalioni gaon	187	94	57	37	93	36	57
63.	Kachari Gaon	360	194	106	88	166	65	101
64.	Jackson Grant	1444	789	455	334	655	292	363
65.	Hidheshari Bagan	1208	448	262	186	760	366	394
66.	Dholaguri Bagan.	2121	913	543	370	1208	546	662

Sl. No	Name	Total Population Person	Literates Population Person	Literates Population Male	Literates Population Female	Illiterate Persons	Illiterate Male	Illiterate Female
67.	Dhola Gaon	876	695	341	354	181	70	111
68.	Chachamukh	192	148	82	66	44	20	24
69.	Bukial Bagan	2667	1223	763	460	1444	614	830
70.	Borchali Gaon	235	45	30	15	190	85	105
71.	Amlongsung gaon	210	52	35	17	158	82	76
72.	Thengal Gaon	1569	1215	635	580	354	146	208
73.	Sonari Gaon	387	337	170	167	50	24	26
74.	Sankala Gaon	1077	812	419	393	265	98	167
75.	No.2 Hautoly Habi	236	135	77	58	101	43	58
76.	No.2 Butolikhowa	295	217	114	103	78	32	46
77.	No.1 Butolikhowa	286	171	93	78	115	57	58
78.	Na-Gaon	1290	1031	533	498	259	113	146
79.	Khumtai Grant No.68 (No.1 Khumtai)	1467	798	462	336	669	274	395
80.	Khumtai Gaon	1613	1286	698	588	327	138	189
81.	Helochi Gaon	180	92	46	46	88	54	34
82.	Hautoley Grant	2940	1822	1057	765	1118	456	662
83.	Choukana Bil	400	166	82	84	234	125	109
84.	Borua Khat	2102	1473	778	695	629	264	365
85.	Samuguri No.3 Block 1,2	1160	821	469	352	339	140	199

Sl. No	Name	Total Population Person	Literates Population Person	Literates Population Male	Literates Population Female	Illiterate Persons	Illiterate Male	Illiterate Female
86.	Samuguri No.2	714	551	296	255	163	82	81
87.	Hidi Bonglong	455	298	160	138	157	65	92
88.	Matikhula Timung Gaon	625	348	202	146	277	113	164
89.	Dharam Haboi	386	139	81	58	247	115	132
90.	Kaibong Tisso	118	66	34	32	52	23	29
91.	Pan Kumar Dimasa	474	338	190	148	136	53	83
92.	Dumukhi	633	347	198	149	286	136	150
93.	No.3 Kuli Gaon	312	215	119	96	97	31	66
94.	Pub-Dikharu	558	367	205	162	191	78	113
95.	Mistribali Gaon	442	263	142	121	179	84	95
96.	Karaijhar Gaon	284	187	101	86	97	33	64
97.	Okreng Pathar	398	229	120	109	169	70	99
98.	Hatipara Kandali Ronghang	184	132	73	59	52	13	39
99.	Pachim Kachamari	211	107	60	47	104	47	57
100.	Pub Kachamari	223	104	69	35	119	57	62
101.	Raj Pur	448	258	152	106	190	88	102
102.	Basalong Tokbi	321	158	87	71	163	73	90
TOTAL		**76396**	**46369**	**25853**	**20516**	**30027**	**12989**	**17038**

3.16 Summary

The Socioeconomic profile of the study area shows that more than half of people in the study area work in other sector. The average literacy rate of the study area is 60.69%. The people in the study area are well connected to Government primary health centres and Primary health sub-centres.

Table 3-37 Summary of Socioeconomic indicators within the study area

S.No	Particulars	Study Area	Unit
0-5 Km			
1.	Number of villages and Town in the Study Area	42	Nos.
2.	Total Households	6163	Persons
3.	Total Population	29836	Persons
4.	Children Populati on (0-6 Years Old)	4252	Persons
5.	SC Population	1148	Persons
6.	ST Population	4406	Persons
7.	Total Working Population	12116	Persons
8.	Main Workers	9185	Persons
9.	Marginal Workers	2931	Persons
10.	Cultivators	3042	Persons
11.	Agricultural Labourers	1207	Persons
12.	Household Industries	249	Persons
13.	Other Workers	7264	Persons
14.	Literates population	17427	Persons
15.	Illiterates population	12409	Persons
5-10 km			
16.	Number of villages and Town in the Study Area	60	Nos.
17.	Total Households	9667	Persons
18.	Total Population	46560	Persons
19.	Children Population (0-6 Years Old)	6267	Persons
20.	SC Population	2870	Persons
21.	ST Population	6930	Persons
22.	Total Working Population	20217	Persons
23.	Main Workers	13874	Persons
24.	Marginal Workers	6343	Persons
25.	Cultivators	5960	Persons
26.	Agricultural Labourers	3232	Persons
27.	Household Industries	662	Persons
28.	Other Workers	10363	Persons
29.	Literates population	28942	Persons
30.	Illiterates population	17618	Persons

*(**Source:** Census 2011)*

CHAPTER 4

ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

4 ANTICIPATED ENVIRONMENTAL IMPACTS & MITIGATION MEASURES

4.1 Details of Investigated Environmental Impacts due to project location, possible accidents, project design, project construction, regular operations, final decommissioning or rehabilitation of a completed project

One of the important components in the process of environmental impact assessment is identification of significant impacts as it leads to other elements such as quantification and evaluation of impacts. Any change in environment whether adverse or beneficial, wholly or partially, resulting from impacting activity is called Environmental Impact. Each individual activity with respect to each environmental parameter will have its own impact potential. Proposed project activities will be carried out in such a way so that potential adverse/negative impacts are avoided, wherever possible. While for remaining impacts which are inevitable, practicable mitigation measures will be recommended to minimize the adverse impacts.

The prediction of impacts helps to develop and implement mitigation measures/environment management plan in such a way that the developmental activity will minimize the deterioration of environmental quality

4.1.1 Environmental Impacts during Construction Phase

As the main impacts of the construction phase are envisaged in terms of air pollution only, this natural mitigation would be significantly helpful in elimination of predicted impacts of the phase. The overall impact of the pollution on the environment during construction phase is localised in nature, reversible and is for a short period. However, the following principal major impacts to the environment are considered for further planning of mitigation measures:

- The use of automobiles and machinery during construction can deteriorate the air quality and generate temporary emission.
- The use of automobiles and machinery generates noise pollution from construction activities.
- The irregular working hours, & traffic, night-working, flood-lighting and transportation damage the socioeconomic balance of surrounding region.
- Effects may occur due to the accumulation of the contaminant in water resources & soil due to uptake of construction material.

- Short term heavy construction might cause increase in noise level
- Effects on work place condition & human health due to the accidents during the construction works.
- Effects on the socio-economic activity due to direct impacts or indirect impacts on socio-economic activities.

Measures for minimizing adverse impacts for Construction Phase

- The entire construction activities will be confined to the designated area inside the premises.
- The small amount of unused construction material shall be stored in proper area to utilise further in- construction activities and surplus excavated material shall be disposed off in suitable pre-identified areas.
- Construction material shall be stored at adequate distance from the water storage in order to prevent any chance of accidental leakage or spillage which could pollute the water storage
- Wherever required impervious lining shall be provided to the storage premises to avoid accidental mixing or mixing due to fugitive losses.
- To reduce the dust generation on site wherever & whenever required water shall be sprinkled on ground or stock pile of excavated soil.
- Equipments / machineries shall be used efficiently and shall be kept shut in order to reduce air emission, noise pollution and consumption of energy resource
- Emission from the equipments/machineries shall be monitored on regular basis and possible implementation shall be provided on site
- Transport vehicles shall be monitored & maintained regularly to control the emission quality and fuel consumption
- Provision of necessary PPEs like face mask & eye-glasses to employees /labours engaged in construction activities.
- The machineries/equipment used on site shall be maintained so they do work with optimum efficiency generating less noise pollution
- Operation of machineries/equipment causing high noise level shall be stopped during the night time and all such operations shall be planned for day time only.
- Transportation activities shall not be conducted during the night (other than in case of emergency) to avoid high noise level in nearby villages/locality.

4.1.1.1 Air environment

In order to predict the impact of constructional and operational activities on the ambient air quality, the data on emission, micrometeorology and from Indian meteorological department (IMD) were collected. All these data will be used to predict ground level concentration of (GLCs) of SO_2, NO_X and PM_{10} for different temporal variations.

In the construction phase, activities like site clearance, site levelling, movements of workers and material, construction of road, transportation activities will generate dust, gaseous pollutants and particulate matter and affect the air quality. Other impacts include -

1. Site Preparation-fencing, boundary and clearing of site will cause disturbance to the surroundings.
2. Excavation, backfilling and levelling.
3. Hauling and dumping of earth materials and construction spoils.
4. Foundation works can cause dust generation which will decrease the air quality and it can impact the labourers working.
5. Fabrication, erection of steel structures such as tanks, pipelines and sheds.
6. Construction of internal roads drains and water supply.
7. Cleaning and landscaping.
8. Emission from Construction DG & Construction Equipment's.

4.1.1.2 Water environment

a) Impacts

1. Contamination of watercourses by leakage from fuel and materials storage areas.
2. Oil and suspended solids in run-off from vehicles and access roads.
3. Use of heavy machineries and vehicles causes compaction of topsoil due to which a change in the surface water drainage pattern may occur.
4. Generation of sewage / process effluent and blow down.

4.1.1.3 Noise environment

a) Impacts

During construction phase, the noise will mostly be produced because of building activities and machineries used for carrying out construction. Construction activities mainly involve diesel generators, laying of foundation, erection of superstructure, clearing of obstruction and trees if any from the proposed area. Activities such as construction of labour camps, onsite office, pneumatic hammers, compressors, concrete mixers, construction material plants however, do not cause significant noise pollution. But if the work continuous for longer duration, it can affect the health of local people and workers involved in the project work.

4.1.1.4 Waste generation

The source of waste are metal pieces, cardboards, wooden scrap, sand gravels etc., generation of chemical waste by general site practices (e.g. vehicle and plant maintenance/servicing), municipal waste generated by site workers.

a) Impacts

The proposed process units are to be implemented adjacent to the north boundary of existing M/s NRL premises. The proposed project will be done in land area, which is identified as appropriate location based on environmental and engineering requirements. The activities carried out during the construction phase will involve a change in the land use from vacant industrial land to a built up industrial land, which will pose the following impacts on the land environment.

1. Compaction of soil and a change in the soil structure due to the use of heavy construction vehicles and machinery.
2. Removal of soil from the site.
3. Mixing of the topsoil and subsoil.
4. Dispersion of dust.

Transportation of construction material (quarry material, cement &steel, paint, bricks etc) during construction phase of the project results in use of public infrastructure like roads, railways, drainage, water and power supply which in turn results in extra burden.

During the construction phase of the project there will be short term employment generation in the form of skilled and semiskilled labours. This could be for a period of 1 to 2years. Also majority of the works will be sub-contracted. Construction personnel will be employed from nearby area.

Except for the removal of weeds, the ecological status of the site will be well maintained by conserving/ developing the greenbelt at the site.

A socio-economic study was undertaken with the help of secondary sources in assessing aspects, which are dealing with social and cultural conditions, and economic status in the study area. The study provides information such as demographic structure, population dynamics, infrastructure resources, and the status of human health and economic attributes like employment, per-capita income, agriculture, trade, and industrial development in the study area. There will be temporary employment for manpower required during construction phase available from local communities. Overall, socioeconomic effect of construction phase will be positive due to direct and indirect employment opportunities for the local population.

4.1.2 Environmental Impacts during Construction Phase

From an Environmental perspective, this phase is of paramount significance due to its potential to invoke long term impacts. The adverse effects that are likely to occur during this operational phase of the project are Air pollution (gaseous Emissions), Effluent generation, Noise Generation, Solid waste Generation etc

Because of its potential to create long-term impacts, this phase is very important from the environmental impact point of view. The basic impacts like gaseous emissions, water consumption/ pollution and solid waste will have the potential to adversely affect air, water and land / soil in the vicinity of the project site.

This phase will broadly include the following direct and indirect activities / actions:

- Storage and transportation of raw materials and finished products.
- Gaseous emissions
- Effluent Generation, treatment and disposal
- Noise Generation
- Solid waste generation

Base line data reveals that the ambient air quality has been monitored at 8 locations for 11 parameters as per NAAQS/CPCB guidelines within the study area. These are the minimum and maximum baseline levels of PM_{10} (48.65 µg/m³ to 86.25 µg/m³), $PM_{2.5}$ (22.09 µg/m³ to 49.47 µg/m³), SO_2 (8.25 µg/m³ to 23.03 µg/m³), NO_2 (15.96 µg/m³ to 33.95µg/m³). However, the average baseline levels of PM_{10} (58.34 to 72.58 µg/m³), $PM_{2.5}$ (26.49 to 41.63 µg/m³), SO_2 (9.90 to 19.38 µg/m³), NO_2 (19.14 to 28.57µg/m³).

4.1.2.1 Air environment

Base line data reveals that ambient air quality in the study area for the Parameters PM, SO2, NOx and CO are well within the permissible Limits as prescribed by the National Ambient Air Quality Standards (NAAQS) for Industrial Area, Residential, Rural & Other areas.

Meteorological data

The meteorological data for a month, i.e. from 01/12/2022 to 28/02/2023 was considered for the study. Data included for AERMET were daily wind speed, wind direction, temperature, relative humidity, air pressure, precipitation, and solar radiation recorded during the period. AERMET reformats meteorological data so that it can be used as input for AERMOD model.

The wind rose for the study period is given as the **Figure 4-1**

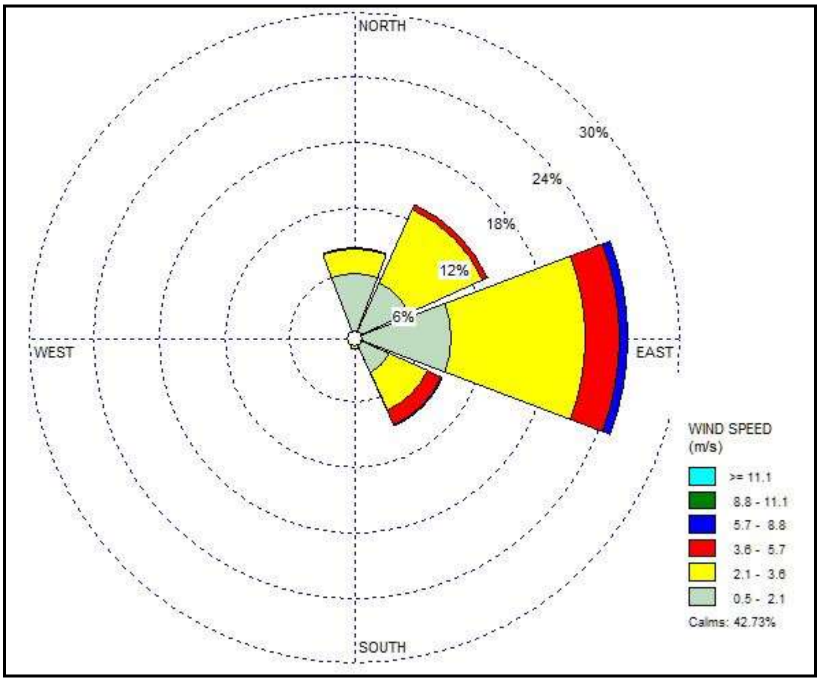


Figure 4-1 Wind rose diagram of Meteorological data considered for Modelling (December 2022 to February 2023)

AERMET Process

For the 3 phase AERMET processing of the meteorological data, specifications of the land use in the area are required to determine the terrain roughness for modelling. The land use was characterized for in and around the site. The surface characteristics for the site and surroundings were selected and used to calculate the Albedo, Bowen ratio and surface roughness parameters.

AERMOD Process

AERMOD Software Version 8.0.5 was used for air dispersion modelling and is applicable to a wide range of buoyant or neutrally buoyant emissions up to a range of 50 km. In addition to more straight forward cases, AERMOD is also suitable for complex terrain and urban dispersion scenarios.

AERMOD is a steady-state plume model. In the stable boundary layer (SBL), it assumes the concentration distribution to be Gaussian in both the vertical and horizontal. In the convective boundary layer (CBL), the horizontal distribution is also assumed to be Gaussian, but the vertical distribution is described with a bi-Gaussian probability density function (pdf). This behavior of the concentration distributions in the CBL was demonstrated by Willis and Deardorff (1981) and Briggs (1993). Additionally, in the CBL, AERMOD treats “plume lofting,” whereby a portion of plume mass, released from a buoyant source, rises to and remains near the top of the boundary layer before becoming mixed into the CBL. AERMOD also tracks any plume mass that penetrates into the elevated stable layer, and then allows it to re-enter the boundary layer when and if appropriate. For sources in both the CBL and the SBL AERMOD treats the enhancement of lateral dispersion resulting from plume meander. The emissions from proposed stacks are estimated and used for the air dispersion modeling as shown in **Table 4-1**respectively. Maximum incremental values for PM, SO2, NOx and CO have been represented as pictorial concentration contours and as tabular concentration values in following sections.

Emissions-Point Source

Table 4-1 Proposed Project Stack Emission details

S.No	Source	Fuel Type	Stack Details					Emission(g/s)		
			No.of stacks	Height(m)	Dia(m)	Temp(°C)	Exit velocity(m/s)	PM	SO2	NOX
1	EMDG 750 KW	HSD	1	14	0.05	220	9.8	0.0115	0.0107	0.1632
Total(g/s)								**0.0115**	**0.0107**	**0.1632**

Source:

1. AP 42 Compilation of Air Pollutant Emission Factors (DG)

In addition to the above, the additional Process emission (discontinuous), Off-gas - Purge Gas Recovery (continuous), Extruder Vacuum Unit (continuous), due to PPU will be routed to existing Flare in NREP and Vent Streams of proposed PP unit to Atmosphere is given below:

Most of the continuous streams to vent are actually purge gases comprising of Nitrogen with traces of hydrocarbon having minimal flowrate.

Flare Stack is not a part of PP unit scope of work. This is considered under NREP only.

Emissions to Flare

Source of Emission	Name	Mode of Operation	Frequency	Flow Rate approx. [Nm^3 / h]	Flow Rate approx. [kg / h]	Temperature BL [°C]	Pressure at BL [Kg/cm2(g)]	Composition
1P39-R-1171, Propylene Treater (COS, Arsine, Phosphine)	Regeneration Gas	Discontinuous during bed replacement only	Once / 3 yrs.	**(Note 1)**		ambient	counter pressure flare system	Nitrogen with traces of Hydrocarbons (Propylene), COS, Arsine, Phosphine

Source of Emission	**Name**	**Mode of Operation**	**Frequency**	**Flow Rate approx. [Nm^3 / h]**	**Flow Rate approx. [kg / h]**	**Temperature BL [°C]**	**Pressure at BL [Kg/cm2(g)]**	**Composition**
1P39-R-1172A/B, Propylene Treater (H2O, Oxygenates, Methanol)	Regeneration Gas	Discontinuous for regeneration only	Once / 17 days For 60 hrs **(Note 1)**	4319 **(Note 1)**		35 - 250	counter pressure flare system	Nitrogen with traces of Hydrocarbons (Propylene), H2O, Oxygenates, Methanol
1P39-R-1173A/B, Propylene Treater (CO)	Regeneration Gas	Discontinuous for regeneration only	Once / 180 days For 28 hrs **(Note 1)**	1400 **(Note 1)**		35 - 200	counter pressure flare system	Nitrogen with traces of Hydrocarbons (Propylene), CO
1P39-R-1174, Propylene Treater (MAPD, Acetylene)	Regeneration Gas	Discontinuous during bed replacement only	Once / 5 yrs.	**(Note 1)**		ambient	counter pressure flare system	Nitrogen with traces of Hydrocarbons (Propylene), MAPD, Acetylene
1P39-VV-1131, Propylene Seal Gas Drum	Liquid Drain	Discontinuous	NNF	NNF		ambient	counter pressure flare system	Hydrocarbons (propylene)
1P39-VV-1331, White Oil Preparation Vessel	Off-Gas	Discontinuous during filling of Preparation Vessel	Once / week for 1 to 3 hr	< 1		ambient	counter pressure flare system	Nitrogen with traces of White Oil
1P39-R-1571, Hydrogen Treater (CO, CO2)	Regeneration Gas	Discontinuous during bed replacement only	Once / 5 yrs.	(**Note 1)**		ambient	counter pressure flare system	Nitrogen with traces of Hydrogen, CO, CO2

Source of Emission	**Name**	**Mode of Operation**	**Frequency**	**Flow Rate approx. [Nm^3 / h]**	**Flow Rate approx. [kg / h]**	**Temperature BL [°C]**	**Pressure at BL [Kg/cm2(g)]**	**Composition**
1P39-R-1572A/B, Hydrogen Dryer (H2O)	Regeneration Gas	Discontinuous for regeneration only	Once / 19 days For 24 hrs **(Note 1)**	26 **(Note 1)**		35 - 235	counter pressure flare system	Nitrogen with traces of Hydrogen, H2O
Nitrogen Treater O2 Removal (N2 Purification Package for TEA system	Regeneration Gas	Discontinuous during bed replacement only	Once / 3 yrs.	**(Note 1)**	-	ambient	counter pressure flare system	Nitrogen
Nitrogen H2O Dryer (N2 Purification Package for TEA system	Regeneration Gas	Discontinuous for regeneration only	Once / 7 days For 30 hrs **(Note 1)**	113 **(Note 1)**	-	35 - 288	counter pressure flare system	Nitrogen
1P39-BL-1681, Regeneration Recycle N2 Blower	Nitrogen	Discontinuous for regeneration only	NNF	NNF	-	120	counter pressure flare system	Nitrogen
1P39-VV-1733, Waste White Oil Tank	Off-Gas	Discontinuous during filling of tank	Once / year up to few minutes	< 1	-	ambient.	counter-pressure flare system	Nitrogen with traces of White Oil, Isopropanol.
1P39-VV-1931, Silane Holding Tank	Off-gas	Discontinuous during filling of holding tank	5 times / year- for 30 min	1.5	-	ambient.	counter pressure flare system	Nitrogen with traces of Silane

Source of Emission	**Name**	**Mode of Operation**	**Frequency**	**Flow Rate approx. [Nm^3 / h]**	**Flow Rate approx. [kg / h]**	**Temperature BL [°C]**	**Pressure at BL [Kg/cm2(g)]**	**Composition**
1P39-RB-3121, Reactor via S/D cyclone 1P39-CY-3173	Vent gas	Discontinuous	emergency shutdown	-	50,000 for 25 min. (Peak for 5 min.)	80	counter pressure flare system	Propylene, Propane, Hydrogen
1P39-VV-3134, Powder K. O. Drum	Vent gas	Discontinuous	**(Note 2)**	-	75 **(Note 2)**	20 - 60	counter pressure flare system	Hydrocarbons, Nitrogen, traces of PP fines
1P39-VV-3131, RG Compressor Suction Drum	Liquid Drain	discontinuous	NNF	-	NNF Before start-up	70	counter pressure flare system	Propylene, Propane, Hydrogen
1P39-VV-3433A/B, Purge Silos	Purge Gas	Discontinuous (In case of 1P39-Z-6581 shutdown)	Continuously during membrane unit shutdown	-	1339	73	counter-pressure flare system	Nitrogen, Propylene, Propane, Hydrogen, Ethane
1P39-VV-3432, Powder Drop out pot	Vent gas	Discontinuous	Once / month for 30 min **(Note 3)**	-	<5 **(Note3)**	50	counter pressure flare system	Hydrocarbons, Nitrogen, traces of PP fines

Source of Emission	**Name**	**Mode of Operation**	**Frequency**	**Flow Rate approx. [Nm^3 / h]**	**Flow Rate approx. [kg / h]**	**Temperature BL [°C]**	**Pressure at BL [Kg/cm2(g)]**	**Composition**
1P39-Z-6081, Carrier Gas Compressor suction	Carrier Gas	Discontinuous (In case of 1P39-Z-6081 shutdown)	Continuously during CG compressor emergency shutdown	-	11,251	121	counter pressure flare system	Propylene, Ethane, Propane, Nitrogen, Hydrogen
1P39-EE-6057, Carrier Gas Cooler	Carrier Gas	Discontinuous	NNF	-	NNF	70	counter pressure flare system	Propylene, Ethane, Propane, Nitrogen, Hydrogen
1P39-Z-6581, Purge Gas Recovery (Membrane Unit)	Off-gas	Continuous	8000 h / year	-	128	20	counter pressure flare system	Nitrogen, with traces of methane, ethane,Propylene, Propane
1P39-Z-6681, Extruder Vacuum Unit	Off-gas	Continuous	8000 h / year	-	20 - 66	50	counter pressure flare system	Nitrogen, Methane, Water, Hydrocarbons, Organics (acetone, tert. butanol)
1P39-VV-9331 Flare K.O. Drum	Vent Gas	discontinuous	-	<1	-	60	counter pressure flare system	Hydrocarbon, N2, PP fines (Traces)

Notes:

(1) Dependent on dryer & treater requirements for regeneration.

(2) Dependent on filter maintenance (e.g., twice per year) & powder sampling frequency (e.g., once per hour)

(3) Used for special PP grades only; depends on BOPP production

(*) The values and data in this table are estimates only, actual values and data may differ, depending on the equipment used and the operation methods

Vent Streams to Atmosphere at safe location

Source of Emission	**Name**	**Mode of Operation**	**Frequency / Time**	**Flow Rate approx. [Nm^3 / h]**	**Composition**	**Concentration**
1P39-R-1173A/B, Propylene Treater (CO)	Off-gas	Discontinuous for catalyst oxidation only	Once / 3 years For 24 hrs **(Note 1)**	1475 **(Note 1)**	Nitrogen	
TEAL Container unloading (Via TEA Vent Pot 1P39-VV-1731)	Off-gas	discontinuous during filling of holding tank	24 times per year (max.) for 30 min.	10	Nitrogen with traces of White oil	Max. 50 mg/Nm^3
1P39-VV-2131, Peroxide Holding Tank	Off-gas	continuous	8000 h / year	0.5	Nitrogen with traces of Peroxide	max 120 mg/Nm^3
1P39-VV-2231, Additive Feed Hopper Vent Pot	Vent	Continuous	8000 h / year	< 1	Nitrogen with Traces of White Oil	max. 10 mg/Nm^3
1P39-ZFA-2292, Additive Vent Fan	Vent	Discontinuous during filling of Solid Additives	5 times / day for 1 bags of 500 kg	500 (By vendor)	Air with Stabilizer Powder	max. 10 mg/Nm^3
1P39-ZWF-2291, GMS Additive loss in weight feeder	Vent	Continuous	8000 h / year	< 1	Nitrogen Stabilizer Powder (Traces)	max. 10 mg/Nm^3

Source of Emission	Name	Mode of Operation	Frequency / Time	Flow Rate approx. [Nm^3 / h]	Composition	Concentration
1P39-ZWF-2290A/B, Talcum / Silica Additive loss in weight feeder	Vent	Continuous	8000 h / year	< 1	Nitrogen Stabilizer Powder (Traces)	max. 10 mg/Nm^3
1P39-ZWF-22890A/B, Additive loss in weight feeder	Vent	Continuous	8000 h / year	< 1	Nitrogen Stabilizer Powder (Traces)	max. 10 mg/Nm^3
1P39-VV-3033, Catalyst Vent Pot	Vent	Discontinuous	1 time /day for 30 min	10	Nitrogen with Traces of White Oil	max. 10 mg/Nm^3
1P39-ZGN-3684, Extruder Feed Vent Filter	Vent	Continuous	8000 h / year	67	Nitrogen with propylene Polypropylene dust / Stabilizer powder	max. 100 mg/Nm^3 HC max. 10 mg/Nm^3 particles
1P39-ZFA-3789, Drying Air Exhaust Fan	Off-gas	Continuous	8000 h / year	18700 (By Extrusion package vendor)	Air with moisture and traces of Hydrocarbons	max. 50 mg / Nm^3 H2O max. 10 mg / Nm^3 HC
1P39-Z-6681, Extruder Vacuum Unit	Off-gas	discontinuous (in case of Oxygen detection in off-gas line to flare)	NNF. for approx. 2 hr until the oxygen level is reduced	20 – 66 kg/h	Nitrogen with moisture and organics	4 mol% H2O 15 mol% organics
1P39-ZGN-7185A/B, Silo Exhaust Filter	Vent	Continuous	8,000 h / year	12400 (By Conveying Package vendor)	Air with polypropylene dust	max. 150 mg/Nm^3 HC max. 17 mg/Nm^3 particles

Source of Emission	**Name**	**Mode of Operation**	**Frequency / Time**	**Flow Rate approx. [Nm^3 / h]**	**Composition**	**Concentration**
1P39-ZCY-7583, Elutriator Cyclone	Vent	Continuous	8,000 h / year	7100 (By Conveying Package vendor)	Air with polypropylene dust	max. 150 mg/Nm^3 HC max. 17 mg/Nm^3 particles

Notes:

(1) Dependent on dryer & treater requirements for regeneration.

(*) The values and data in this table are estimates only, actual values and data may differ, depending on the equipment used and the operation methods

Most of the continuous streams to vent are actually purge gases comprising of Nitrogen with traces of hydrocarbon having minimal flowrate.

Flare Stack is not a part of PP unit scope of work. This is considered under NREP only.

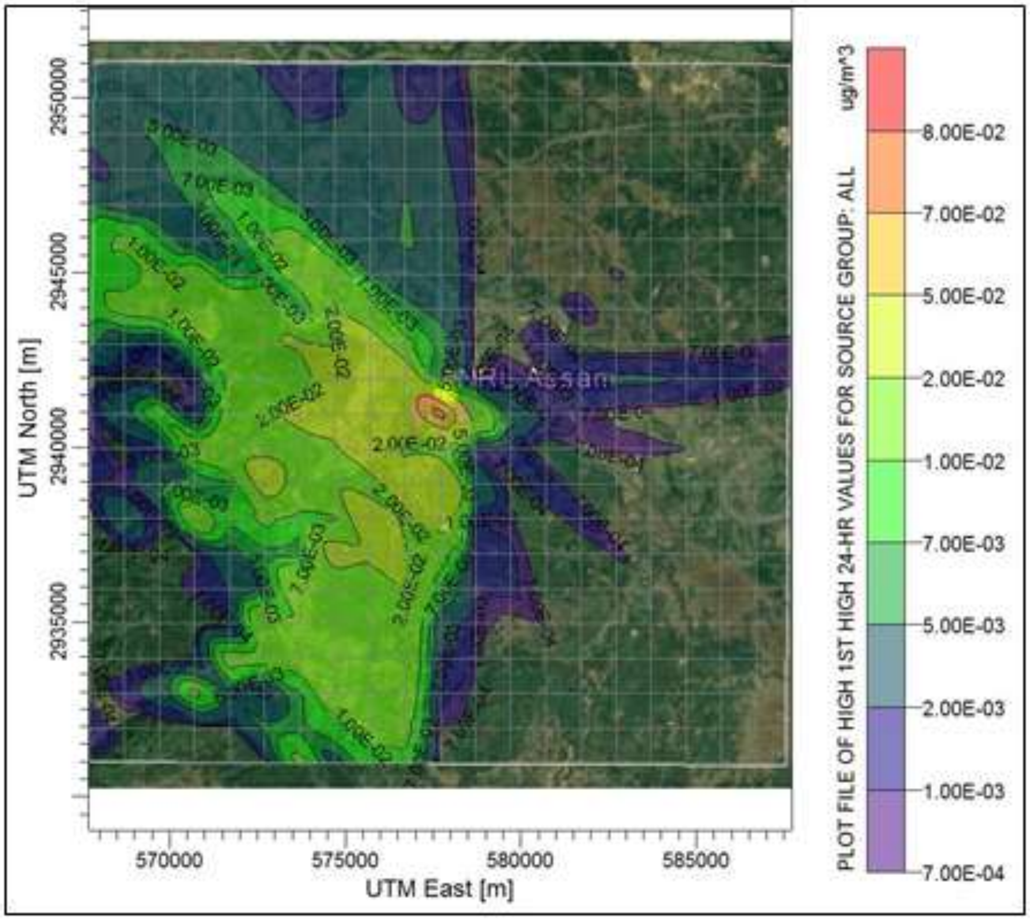


Figure 4-2Predicted 24-Hrs GLC's of Particulate matter PM within 10 km Radius of the Study Area

Table 4-2Estimated Top 10 Highest Concentrations of Particulate Matter PM obtained through Modeling

S. No	UTM coordinates (m)		Conc. (μg/m^3)	Distance from Centre of Project Site (~Km)	Direction from Centre of Project Site
	E	N			
1	577705	2940954	0.0797	Project Site	Project Site
2	577705	2938954	0.0492	2.00	S
3	575705	2939954	0.0378	2.23	WSW
4	576705	2940954	0.0378	1.00	W
5	575705	2937954	0.03352	3.60	SSW
6	574705	2941954	0.03249	3.16	WNW
7	575705	2940954	0.03223	2.00	W
8	576705	2938954	0.03134	2.23	SSW
9	576705	2941954	0.03123	1.41	NW
10	575705	2942954	0.02694	2.82	NW

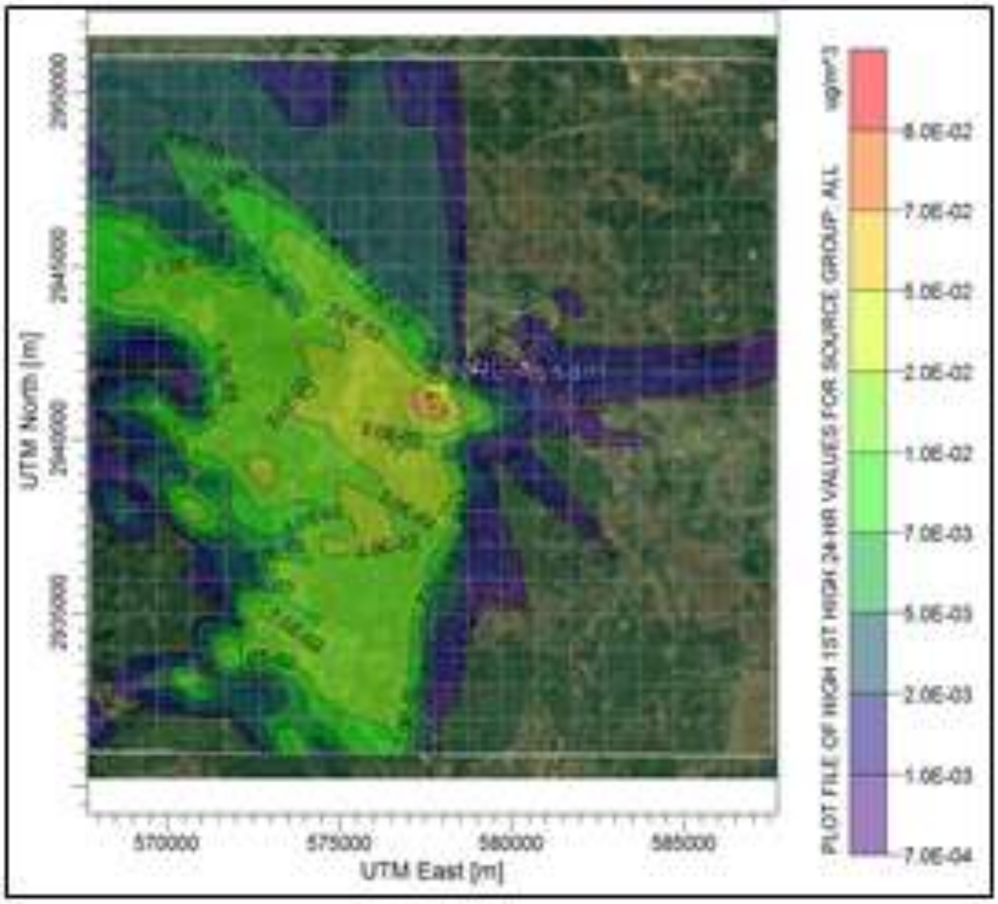


Figure 4-3Predicted 24-Hrs' GLC's of SO_2 within 10 km Radius of the Study Area

Table 4-3Estimated Top 10 Highest Concentrations of SO_2 Obtained through Modeling

S. No	UTM coordinates (m)		Conc. (µg/m^3)	Distance from Centre of Project Site (~Km)	Direction from Centre of Project Site
	E	N			
1	577705	2940954	0.07427	Project Site	Project Site
2	577705	2938954	0.04585	2.00	S
3	576705	2940954	0.03523	1.00	W
4	575705	2939954	0.03522	2.23	WSW
5	575705	2937954	0.03123	3.60	SSW
6	574705	2941954	0.03028	3.16	WNW
7	575705	2940954	0.03003	2.00	W
8	576705	2938954	0.0292	2.23	SSW
9	576705	2941954	0.0291	1.41	NW
10	575705	2942954	0.0251	2.82	NW

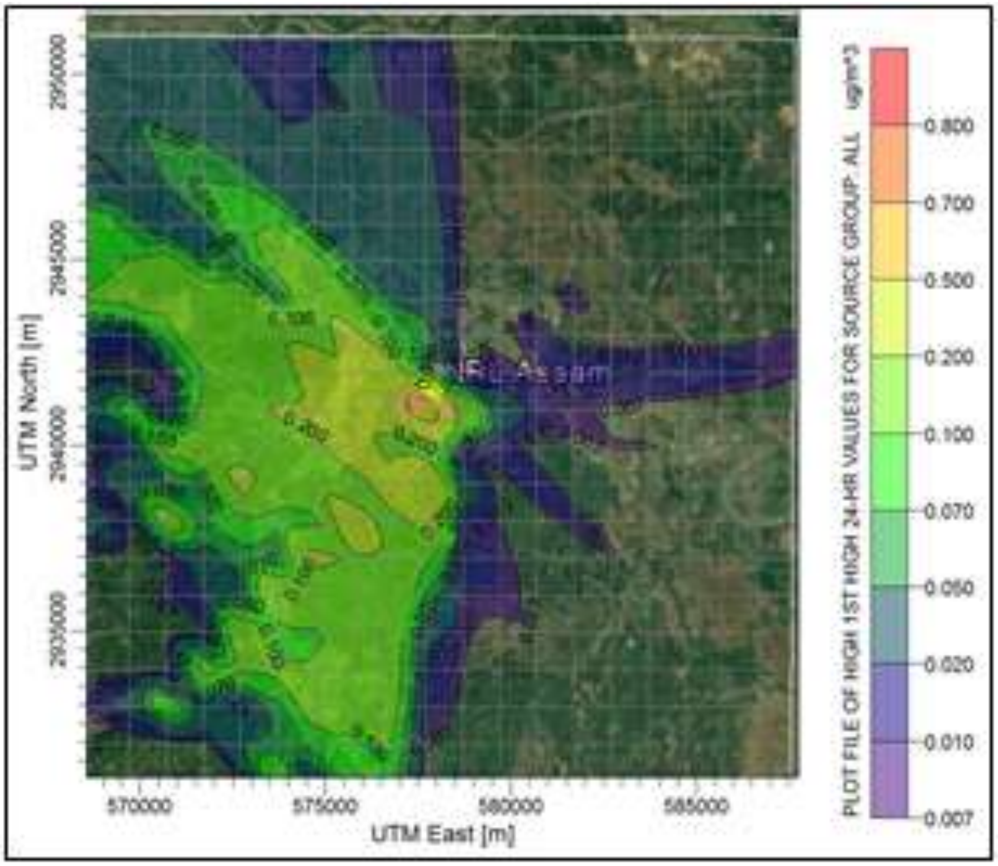


Figure 4-4Predicted 24-Hrs' GLC's of NO_x within 10 km Radius of the Study Area

Table 4-4Estimated Top 10 Highest Concentrations of oxide of Nitrogen Obtained through Modeling

S. No	UTM coordinates (m)		Conc. ($\mu g/m^3$)	Distance from Centre of Project Site (~Km)	Direction from Centre of Project Site
	E	N			
1	577705	2940954	0.70945	Project Site	Project Site
2	577705	2938954	0.438	2.00	S
3	576705	2940954	0.3365	1.00	W
4	575705	2939954	0.33644	2.23	WSW
5	575705	2937954	0.29833	3.60	SSW
6	574705	2941954	0.28925	3.16	WNW
7	575705	2940954	0.28691	2.00	W
8	576705	2938954	0.27893	2.23	SSW
9	576705	2941954	0.278	1.41	NW
10	575705	2942954	0.23979	2.82	NW

Conclusion

Maximum pollutant concentrations of PM, SO2 and NO$_x$observed due to proposed for an 24hr-average period have been studied and COobserved due to proposed for an 24hr-average period have been studied. The total increase in concentrations above baseline status to estimate the percentage increase and summarized in **Table 4-5**

Table 4-5 Total Maximum GLCs from the Stack Emissions

Pollutant	Max. Base line Conc. (µg/m^3)	Estimated Incremental Conc. (µg/m^3)	Total Conc. (µg/m^3)	NAAQ standard (µg/m^3)
PM$_{10}$	86.25	0.079	86.329	100
SO$_2$	23.03	0.074	23.104	80
NO$_x$	33.95	0.709	34.659	80

Emissions-Line Source

Table 4-6 Proposed Project Transportation Emission details

S.no	Type of Vehicle	No.of.Vehicle	Emission(g/s)	
			PM	NOX
1	Truck	70	2.92E-04	1.34E-02
Total(g/s)			**2.92E-04**	**1.34E-02**

Source:

Indian Emission Regulations by the Automotive Research Association of India

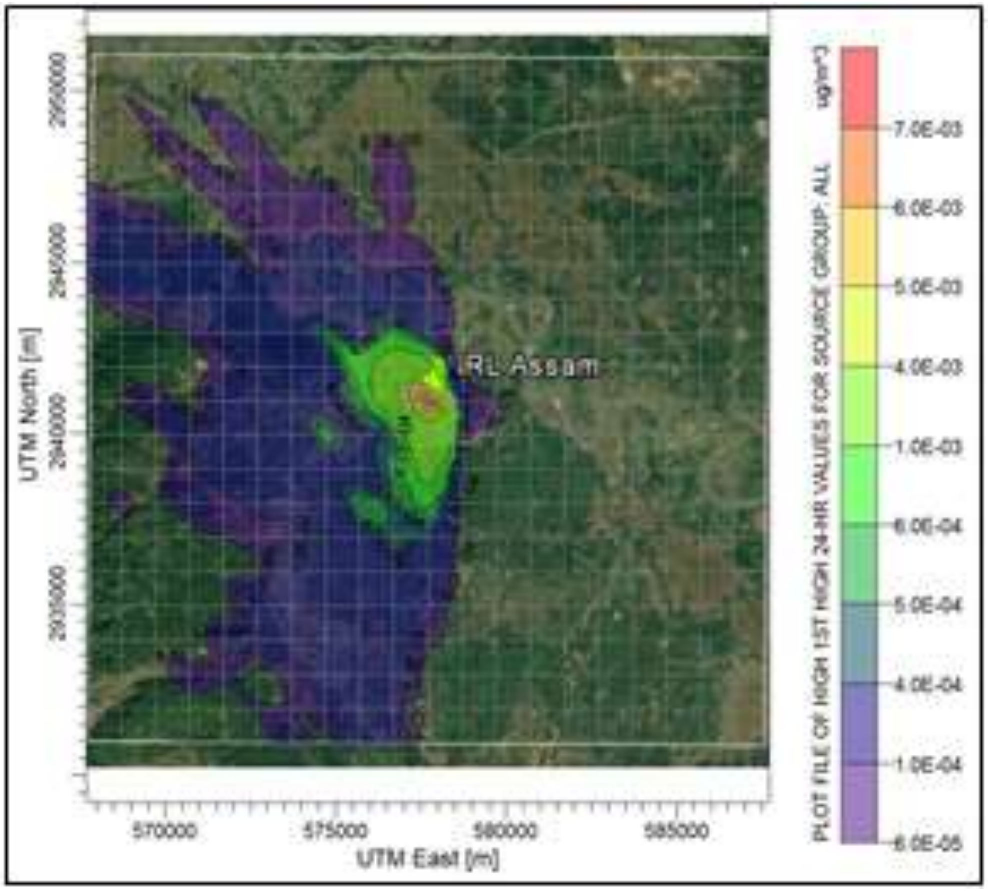


Figure 4-5 Predicted 24-Hrs GLC's of Particulate matter PM within 10 km Radius of the Study Area

Table 4-7 Estimated Top 10 Highest Concentrations of Particulate Matter PM obtained through Modeling

S. No	UTM coordinates (m)		Conc. ($\mu g/m^3$)	Distance from Centre of Project Site (~Km)	Direction from Centre of Project Site
	E	N			
1	577705	2940954	0.00678	Project Site	Project Site
2	577705	2939954	0.0028	1.00	S
3	576705	2940954	0.00168	1.00	W
4	576705	2941954	0.00143	1.41	NW
5	577705	2938954	0.00133	2.00	S
6	577705	2941954	0.00129	1.00	N
7	575705	2941954	0.00072	2.23	WNW
8	577705	2937954	0.00067	3.00	S
9	575705	2937954	0.00061	3.60	SSW
10	576705	2937954	0.00262	3.16	SSW

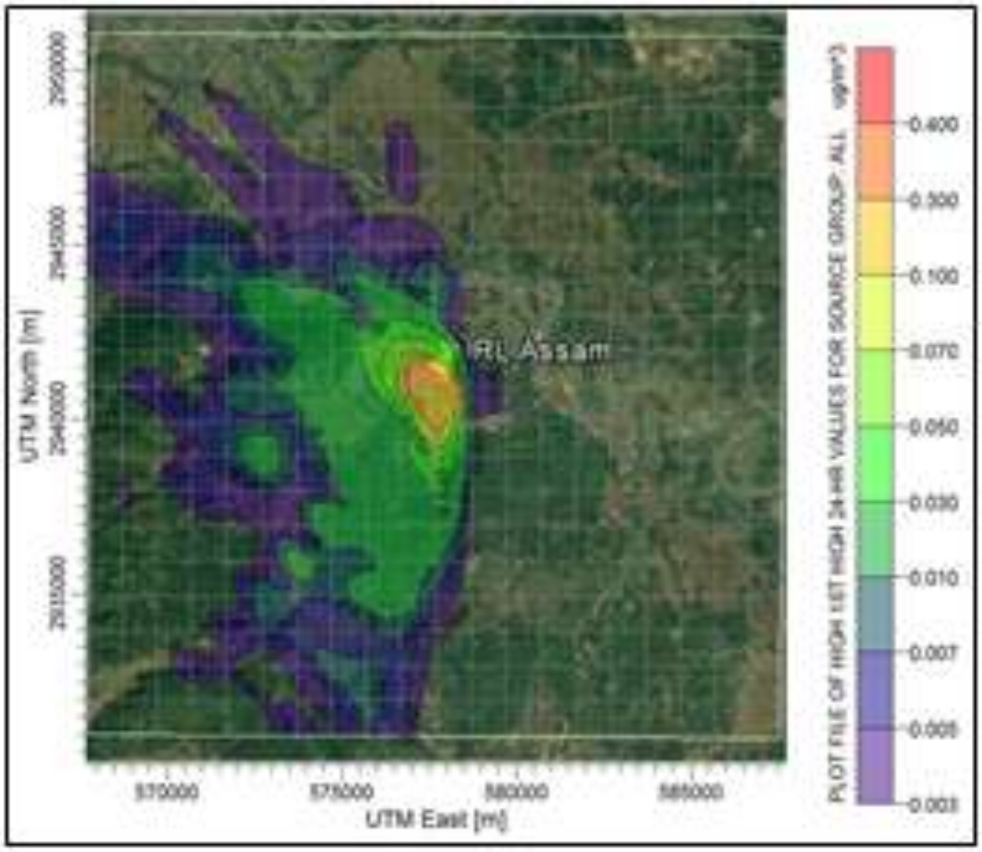


Figure 4-6 Predicted 24-Hrs' GLC's of NO_x within 10 km Radius of the Study Area

Table 4-8 Estimated Top 10 Highest Concentrations of oxide of Nitrogen Obtained through Modeling

S. No	UTM coordinates (m)		Conc. (µg/m^3)	Distance from Centre of Project Site (~Km)	Direction from Centre of Project Site
	E	N			
1	577705	2940954	0.31186	Project Site	Project Site
2	577705	2939954	0.12853	1.00	S
3	576705	2940954	0.07721	1.00	W
4	576705	2941954	0.06553	1.41	NW
5	577705	2938954	0.06107	2.00	S
6	577705	2941954	0.05924	1.00	N
7	575705	2941954	0.03311	2.23	WNW
8	577705	2937954	0.03063	3.00	S
9	576705	2942954	0.02808	2.23	NNW
10	575705	2937954	0.02789	3.60	SSW

Conclusion

Maximum pollutant concentrations of PM and NO_xobserved due to proposed for an 24hr-average period have been and CO observed due to proposed for an 24 hr-average period have been studied. The total increase in concentrations above baseline status to estimate the percentage increase and summarized in **Table 4-9.**

Table 4-9 Total Maximum GLCs from the Transportations Emissions

Pollutant	Max. Base line Conc. (µg/m^3)	Estimated Incremental Conc. (µg/m^3)	Total Conc. (µg/m^3)	NAAQ standard (µg/m^3)
PM_{10}	86.25	0.006	86.256	100
NOx	33.95	0.311	34.261	80

Emissions-Point and Line Source (Cumulative)

Table 4-10 Proposed project Stack & Transportations Emission (Cumulative)

S.No	Source	Fuel Type	Stack Details					Emission(g/s)		
			No.of stacks	Height(m)	Dia(m)	Temp(°C)	Exit velocity(m/s)	PM	SO2	NOX
1	EMDG 750 KW	HSD	1	14	0.05	220	9.8	0.0115	0.0107	0.1632
Transportations										
S.No	**Type of Vehicle**	**No.of.Vehicle**						**PM**	**SO2**	**NOX**
1	Truck	70						2.92E-04	-	1.34E-02
Total(g/s)								**0.0118**	**0.0107**	**0.1766**

Source:

1. Emission reference: AP-42: Compilation of Air Emissions Factors - DG (USEPA)
2. Indian Emission Regulations by the Automotive Research Association of India (Transportations)

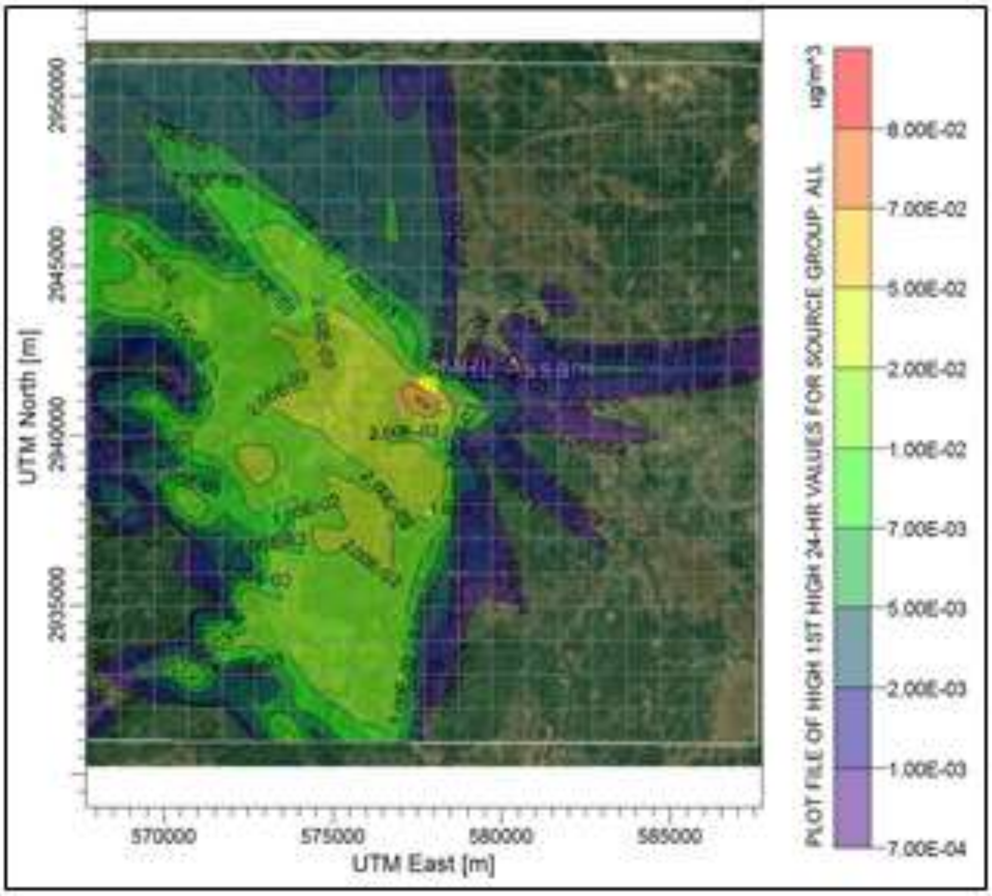


Figure 4-7 Predicted 24-Hrs GLC's of Particulate matter PM within 10 km Radius of the Study Area

Table 4-11 Estimated Top 10 Highest Concentrations of Particulate Matter PM obtained through Modeling

S. No	UTM coordinates (m)		Conc. (µg/m^3)	Distance from Centre of Project Site (~Km)	Direction from Centre of Project Site
	E	N			
1	577705	2940954	0.07974	Project Site	Project Site
2	577705	2938954	0.0498	2.00	S
3	575705	2939954	0.03807	2.23	WSW
4	576705	2940954	0.03794	1.00	W
5	575705	2937954	0.03403	3.60	SSW
6	575705	2940954	0.03254	2.00	W
7	574705	2941954	0.03251	3.16	WNW
8	576705	2938954	0.03183	2.23	SSW
9	576705	2941954	0.03135	1.41	NW
10	577705	2937954	0.02711	3.00	S

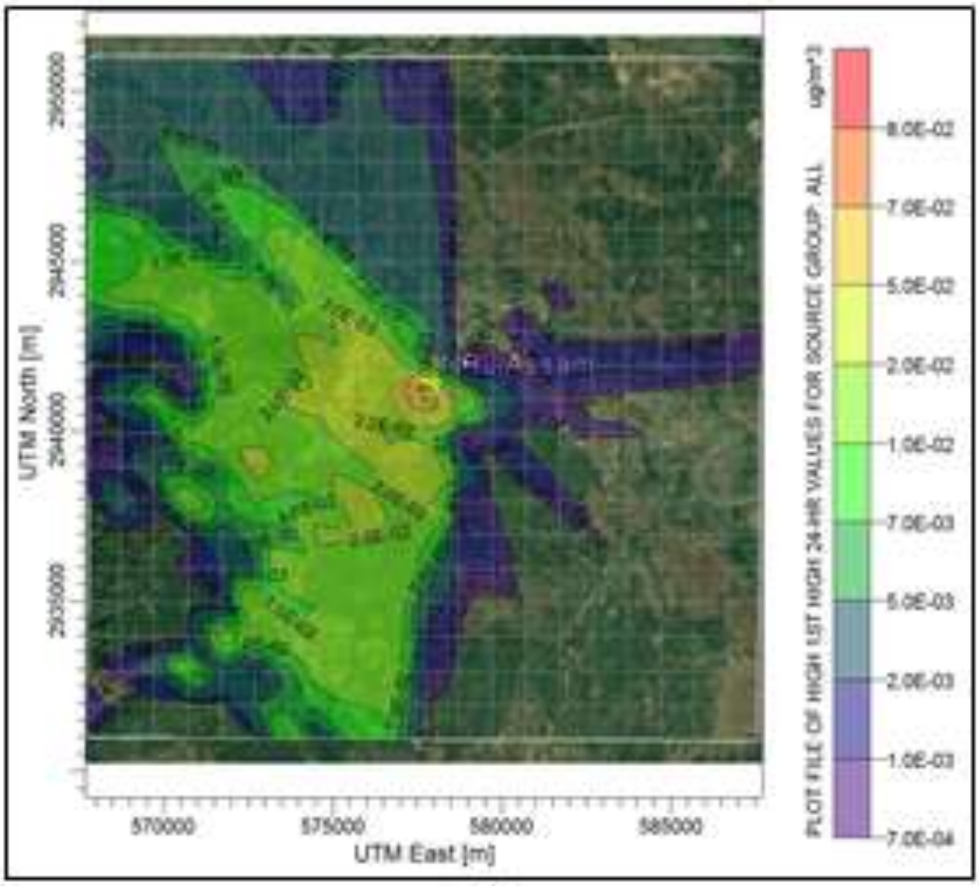


Figure 4-8 Predicted 24-Hrs' GLC's of SO_2 within 10 km Radius of the Study Area

Table 4-12 Estimated Top 10 Highest Concentrations of SO_2 Obtained through Modeling

S. No	UTM coordinates (m)		Conc. (µg/m^3)	Distance from Centre of Project Site (~Km)	Direction from Centre of Project Site
	E	N			
1	577705	2940954	0.07427	Project Site	Project Site
2	577705	2938954	0.04585	2.00	S
3	576705	2940954	0.03523	1.00	W
4	575705	2939954	0.03522	2.23	WSW
5	575705	2937954	0.03123	3.60	SSW
6	574705	2941954	0.03028	3.16	WNW
7	575705	2940954	0.03003	2.00	W
8	576705	2938954	0.0292	2.23	SSW
9	576705	2941954	0.0291	1.41	NW
10	575705	2942954	0.0251	2.82	NW

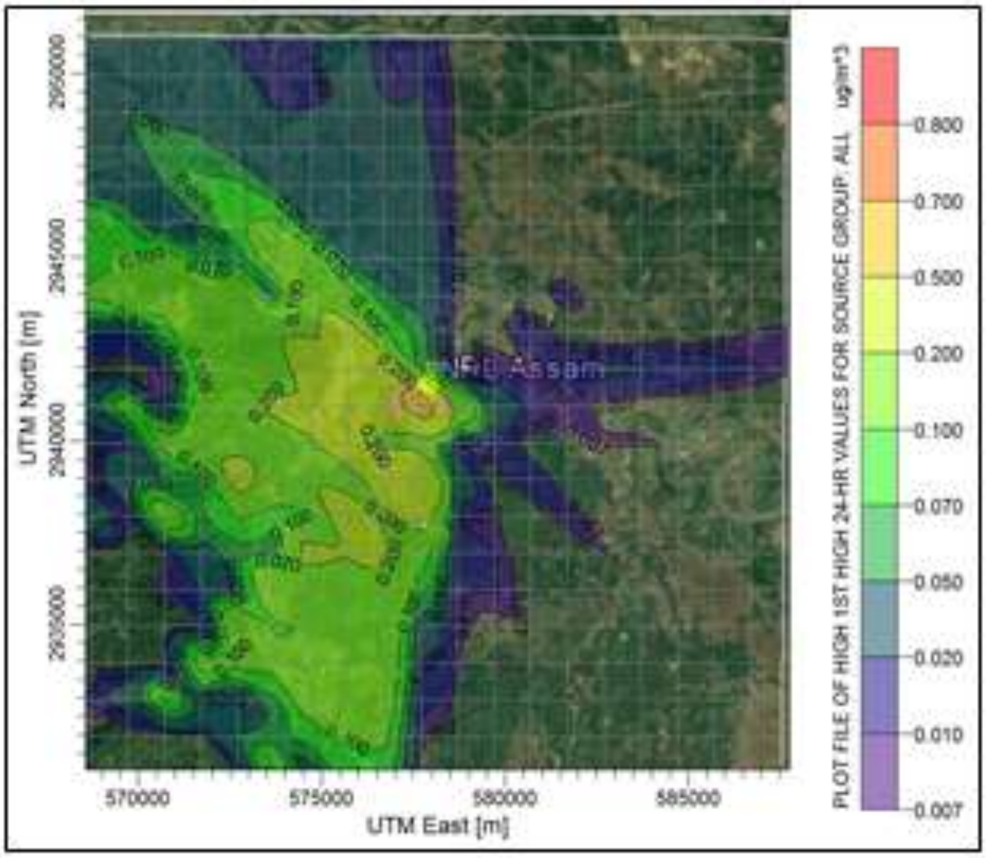


Figure 4-9 Predicted 24-Hrs' GLC's of NO_x within 10 km Radius of the Study Area

Table 4-13 Estimated Top 10 Highest Concentrations of oxide of Nitrogen Obtained through Modeling

S. No	UTM coordinates (m)		Conc. (µg/m^3)	Distance from Centre of Project Site (~Km)	Direction from Centre of Project Site
	E	N			
1	577705	2940954	0.71108	Project Site	Project Site
2	577705	2938954	0.46537	2.00	S
3	575705	2939954	0.34913	2.23	WSW
4	576705	2940954	0.34263	1.00	W
5	575705	2937954	0.32195	3.60	SSW
6	576705	2938954	0.30149	2.23	SSW
7	575705	2940954	0.30114	2.00	W
8	574705	2941954	0.28998	3.16	WNW
9	576705	2941954	0.2833	1.41	NW
10	577705	2937954	0.26604	3.00	S

Conclusion

Maximum pollutant concentrations of PM, SO2 and NO$_x$observed due to proposed for an 24hr-average period have been studied and COobserved due to proposed for an 24hr-average period have been studied. The total increase in concentrations above baseline status to estimate the percentage increase and summarized in **Table 4-14.**

Table 4-14 Total Maximum GLCs from the Stack & Transportations Emissions

Pollutant	Max. Base line Conc. (μg/m^3)	Estimated Incremental Conc. (μg/m^3)	Total Conc. (μg/m^3)	NAAQ standard (μg/m^3)
PM$_{10}$	86.25	0.079	86.329	100
SO2	23.03	0.074	23.104	80
NO$_x$	33.95	0.711	34.661	80

Impact due to traffic and transportation

Table 4-15 Existing &Proposed Vehicular movement per Peak hour- NRL Assam SH 129-Dimapur-Numaligarh Highway

S. No	Type of Vehicle	Existing vehicles	Existing PCU	Proposed vehicles	Proposed PCU	Total vehicles after project implementation	PCU Factors IRC (SP 41)	Total PCU after project implementation
1	Motor Cycles or Scooters etc.	511	383	0	0	511	0.75	383
2	Three Wheelers/ Auto Rickshaw	24	29	0	0	24	1.2	29
3	Four Wheelers/ Cars	424	424	0	0	424	1.0	424
4	Truck/Bus	170	629	70	259	240	3.7	888
5	Agricultural Tractor	26	104	0	0	26	4.0	104
6	Light Commercial Vehicle	51	102	0	0	51	1.4	71
	Total	**1206**	**1671**	**70**	**259**	**1276**	**--**	**1899**

Table 4-16 Traffic Volume after Implementation of the Project

For the Road	Volume of Traffic	Volume (V)	Road Capacity (C)	V/C Ratio	LOS Category*	Traffic Classification
Existing	1206	1671	15000	0.11	"A"	Free Flow Traffic
After implementation	1276	1899	15000	0.13	"A"	Free Flow Traffic

*LOS categories are A-Free Flow, B- Reasonably Free Flow, C-Stable Flow, D-Approaching unstable flow, E- Unstable flow, F- Forced or breakdown flow.

LEVEL OF SERVICE	V/C	CLASSIFICATION
A	<0.35	Free Flow Traffic
B	0.35-0.55	Stable Traffic Flow
C	0.55-0.77	Restricted Flow
D	0.77-0.92	High Density Flow
E	0.92-1.0	Unstable Flow
F	>1.0	Forced Traffic Flow

Due to propose project there will be slight increment in the vehicle movement but the level of service (LOS) anticipated will be Free flow traffic.

4.1.2.2 Water Environment

1. Storehouse will be located at a distance away from the water storage area to prevent accidental release or spillage.
2. Proper management of rain water run-off during monsoon and creating bunds to utilize the rain water for construction purpose.
3. An appropriate water management system will be implemented.

4.1.2.3 Noise Environment

a) Impacts

The noise generated during the operational phase can be divided into two categories

A) Stationary source due to heavy duty machineries at the project site such as compressors, DG sets, pumps etc.

B) Mobile source corresponding to mainly vehicular traffic for staff mobilization, materials, material transportation, liquid fuel transportation to project site, etc.

Vibrations are expected to be generated by various activities associated with the proposed project during operational phase. The impact of vibrations beyond the site would be negligible during normal operation phase. However, the impacts on workers engaged in the plant area would be considerable due to occupational exposure. The proposed fixed major equipment/units such as compressors, pumps, DG sets etc., also generate vibrations during operational phase and may cause exposures to the workers/operators engaged at these units.

All equipment’s in the plant produce 40 to 55 dB(A) after control measures and equipment’s are designed/operated to have a noise level not exceeding 85 to 90 dB(A) as per the requirement of Occupational Health and Safety Administration Standard (OHSAS). In addition, since most of the noise generating equipment would be in closed structures, the noise transmitted outside would be still lower and for any other case of higher noise sufficient safety ear plugs and ear muffs will be provided to the employees.

4.1.2.4 Waste water Quality, Quantity and Treatment Method

Only effluent generation of 50.23 m^3/hr and sewage of 0.212 m^3/hr will be generated due to this proposed project and treated in the existing NREP ETP.

Description	Proposed(m^3/hr)	Disposal Method & Facility Details (m^3/hr)
Effluent generation		
Cooling tower blowdown	50	Cooling tower blowdown from PP unit will be diverted to RO plant (Design: 600 m3/hr) under existing NREP ETP Package.
Process effluent	0.23	PP process effluent to be treated in existing NREP ETP (Design: 450 m3/hr and cnormal flow is 360 m3/hr
Sub-Total	**50.23**	
Sewage	0.212	Diverted to existing NREP ETP for treatment
Total waste water generation	**50.442**	

The sewage generated will be routed to the existing NREP ETP for further treatment.The processeffluent from PP unit will be routed to NREP ETP for treatment.The treated effluent from NREP ETP is planned to be reused in cooling tower, fire water and Horticulture (greenbelt).

4.1.2.5 Land environment

a) Impacts

Potential Impact Due to Location

The Land document for the Plot No.11 is attached in **Annexure 1,** there will be no additional land acquisition and resettlement or Rehabilitation required. Therefore, there will not be any direct impacts.

Impacts Due to Changes in Land Use Pattern

For NREP, a total of 11 plots were identified requiring NDZ clearance, out of which Forest Department, Govt. of Assam had recommended 9 plots including Plot no.11 (Rajabari TE). However, out of the 9 plots, 8 plots of Land were shortlisted by NRL for NREP related activities.

Now, the proposed PP unit will be installed in Plot no.11 which comes under NDZ zone and the site has been under the 9 recommended plots by Forest Dept. of Assam and has been recommended for Project activities.

4.1.2.6 Solid waste Management

During operation phase, various types of solid waste are likely to be generated which can be broadly categorized as Hazardous Waste and Non-hazardous Waste. Further, the generated solid waste generation may include Biodegradable, Recyclable and Inert compounds. The details of solid waste generation and its management proposed are discussed in **Chapter 2**, **Section 2.7.2.20.** If the solid waste generated is not properly managed and disposed in unauthorized manner, it will impact soil quality, groundwater and air quality

4.1.3 Measures for minimizing and/or offsetting adverse impacts identified

4.1.3.1 Air Pollution Control Measures

For this PP unit, only Emergency DG will be proposed and operated only during power failure.

- Floating roof tanks with secondary seals have been provided for raw material and products to reduce hydrocarbon and fugitive emissions.
- Stack heights have been provided as per norms, for effective dispersion of emission.
- VOC reduction achieved with closed tanks for all applications & with no open surge ponds.
- Adoption of LDAR &inventorisation of Fugitive Emission
- Linking all AAQM with SPCB / CPCB

4.1.3.2 Water Environment

Various mitigation measures are proposed to be adopted to minimize the impact if any on the water environment due to the wastewater/runoff generation during the operation phase of the project.

- Institutional arrangement for monitoring of water pollution.
- Corrective and preventive measures if any contamination happens.
- Monitoring should ensure early determination of any threats to water resources in terms of contamination.

- If contaminated, proper expertise will be brought to schematize the various recharge mechanism to reduce or nullify the impact effects.

4.1.3.3 Noise Environment

- The major noise generating equipment like Compressors, DG sets etc. will be enclosed in an acoustic enclosure designed for an insertion loss of 25 dB (A) and silencers to other equipment etc.
- Major noise generating equipment will be designed with 85 dB (A) ensuring cumulative noise at 1.0 m remains at 85 dB (A).
- The occupational noise exposure to the workers in the form of eight hourly time weighted average will be maintained well within the prescribed Occupational Safety and Health Administration (OSHA) standard limits.
- Adequate PPE will be provided to the staff exposing to noise risks.
- Acoustic silencers will be provided in equipment wherever necessary.
- Acoustic design with sound proof glass panelling will be provided for critical operator cabins / control rooms of individual modules as well as central control facilities.
- Use of personal protective equipment's/devices such as ear-muffs, ear plugs etc. will be strictly enforced for the workers engaged in high noise areas.
- Periodic maintenance of the equipment to be used in the developmental works will be carried out. Worn out parts will be replaced and rotating parts will be lubricated to minimize noise emissions.
- Implementation of greenbelt for noise attenuation will be undertaken: shrub plantation; landscaping with horticulture; and Tree plantation at vehicle parking areas and along approach roads.
- Ambient noise levels will be monitored at regular intervals during operational phase of the project.
- Low vibration generating machines/equipment will be selected to meet international standards and foundations will be so designed to minimize vibrations and secured properly.
- Vibration generating sources and their platforms should be maintained properly to minimize vibrations and related impacts.
- Various standards pertaining to vibrations are formulated by statutory bodies like Bureau of Indian Standards (BIS) and Director General of Mines Safety (DGMS),

which is being practiced would be continued to mitigate the workers' health effects due to vibrations.

- Vibration dampers will be provided around the source of generation.
- Transportation Management Plan will be prepared and the transportation of construction materials will be planned in line with the same.

4.1.3.4 Land Environment

The following mitigation measures will be explored:

- Periodic maintenance and check of wastewater conveyance pipelines
- Attempt to restore by replacing a part to immediately clamp the conveyance pipeline in case of any leakage is detected.
- Necessary preventive measures for spillage from pipelines, such as surface RCC channels along the pipelines shall be adopted.

Treated wastewater quality shall be ensured as per standards before using for internal consumption.

4.1.3.5 Solid Waste Management

The hazardous waste generated will be properly disposal as per HWA. The biodegradable waste generated can be disposed in municipal bins.

4.2 Irreversible and Irretrievable commitments of Environmental Components

Irreversible and Irretrievable commitments of Environmental Components are not envisaged in the proposed project.

4.3 Assessment of Significance of Impacts

Objective

- Identify project activities that could positively or negative impact the environment
- Predict and assess the impacts of the such activities
- Examine each aspect-impact relationship and identify its degree of significance
- Identify possible mitigation measures based on the reduction in significance achieved and practicality in implementation.

4.3.1 Methodology for Identification of Environmental Impacts & its Assessment

Environmental Aspect

Environmental Aspect is an element of an organization's activities, products or services that can interact with the environment.

Environmental aspects selected for further study should be in such a way that large enough for meaningful examination and small enough to be easily understood.

Environmental Impact

Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization’s environmental aspect.

Environmental Components

- The environmental components (or parts of the receiving environment on which impacts are being assessed) include: Land use/land cover, air quality, noise quality, surface water environment, ground water environment, soil, ecology and bio diversity, socio economics, occupational health, community health and safety.
- After the identification of impacting activities, impacts require to be assessed based on subjective /Objective criteria.

4.3.1.1 Identification of Impacts

- Listing of organization’s activities, raw materials, products and services
- Listing of environmental aspects (i.e. elements of an organization’s activities or raw materials, products or services that can cause environmental impacts)
- Identifying applicable components of the environment on which the environmental aspects can cause an environmental impact
- Making notes of the reason / possible inter-relationships that lead to environmental impact creation
- Listing the environmental components likely to receive impacts, along with the key impacting activities on each component

4.3.1.2 Component Wise Environmental Impact Assessment and Mitigation

A component wise approach to environmental impact assessment and mitigation is now applied. For each environmental component (Air Pollution and Air Quality, Noise, Water, Land, EB, RD, SE, OH&HS), this is carried through a series of steps as follows.

Step 1: Review and Assessment of the Specific Aspects Generating Environmental Impact

Several scientific techniques and methodologies are also used to predict impacts on the environment. Mathematical models are useful tools (where applicable) to quantitatively describe the cause and effect relationships between sources of pollution and different components of environment. In cases where it is not possible to identify and validate a model for a particular situation, predictions have been arrived at based on logical reasoning / consultation / extrapolation or overlay methods. In any case, for each component of the environment, the methods used to arrive at the likely impacts require to be described.

Step 2: Arriving at the Environmental Impact Significance, Identifying Aspects Causing Unacceptable Levels of Environmental Impact Significance and Prioritizing Aspects Requiring Mitigation Measures

Once a general understanding of the impacts has been obtained, efforts are made to compare significance of different impacts so as to prioritize mitigation measures, focusing on those impacting activities (i.e. Aspects) that require urgent mitigation. For ease of comparison across different activities, a summary environmental significance score is calculated. Two key elements are taken into consideration based on standard environmental impact significance assessment methodologies:

- **Severity:** The seriousness or the extent of environmental impact due to an activity and its interaction with the physical, biological and/or socio-economic environments.
- **Likelihood of Occurrence:** The likelihood that an impact may occur due to the project activity/aspect.

A combination of severity and likelihood of occurrence gives a reasonable measure of environmental impact significance, which aids in decision making.

Scoring the Impact Severity

The impacts resulting from activities which need to comply with legal requirement, EP Rules /

NOC / Other Statutory permissions, shall not require scoring, and shall be considered Significant.

The severity on various environmental receptors have been ranked into 5 levels ranging from Acceptable (1 point) to Unacceptable (5 points) as given in as given in **Table 4-19.** A component wise approach to environmental impact assessment and mitigation is now applied. For each environmental component (Air Pollution and Air Quality, Noise, Water, Land, EB, RD, SE, OH&HS), this is carried through a series of steps as follows.

Table 4-17 Severity on various environmental receptors

S. No .	Env. Component Impacted	Impact Severity Levels and Scores*				
		Severity Level: Insignificant	Severity Level: Minor	Severity Level: Moderate	Severity Level: Major	Severity Level: Catastrophic
		Points: ± 1	Points: ± 2	Points: ± 3	Points: ± 4	Points: ± 5
C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**
1	Land use / land cover	**Duration**				
		Very short term	Short term	Medium term	Long term	Very long term
		(up to 1 year)	(>1 - 3 years)	(>3 - 5 years)	(> 5-10 years)	(>10 years)
		Extent (Area affected)				
		Very Limited	Limited	Medium Range	Long Range	Extensive
		(Within core zone)	(<1 km around core zone)	(>1 – 3.0 km around core zone)	(>3 – 7 km around core zone)	(>7.0 km around core zone)
		Change in land Use/Cover (conversion to Industrial/ Residential from)				
		Non-agricultural land, Land without Scrub, Industrial area with scrub land/ Reversible	Scrub Land/ Change in Topography	Water Body	Agricultural land, Open and Close vegetation/ Change in Drainage pattern	Forest Area/ Irreversible
2	Air Quality	Temporary nuisance due to controlled/uncontrolled release of air emissions, odour / dust or greenhouse gases	Minor environmental impact due to controlled/uncontrolled release of air emissions, odour / dust or greenhouse gases with no lasting detrimental effects	Moderate environmental impact due to controlled/uncontrolled release of air emissions, odour / dust or greenhouse gases leading to visual impacts, at	Significant environmental impact due to release of air emissions, odour / dust or greenhouse gases leading to exceedance of limits specified in EP Rules’	Unacceptable environmental impact due to release of air emissions, odour / dust leading to possibility of chronic / acute health issues, injuries or fatalities

				significant nuisance levels		
3	Ambient Noise - give the mean score from the three categories, rounded to the nearest decimal	**Background Noise Levels, with respect to Applicable Limit** as per The Noise Pollution (Regulation and Control) Rules, 2000, as Measured at Boundary of Relevant Noise Generating Unit**				
		10% of limit or less	Between 10% to 5% of limit	Between 5% and the limit	Up to 5% above the limit	5% or more above the limit
		Incremental Noise Levels due to Relevant Noise Generating Unit, as Predicted at Boundary				
		1 dB(A) or less	1 dB(A) – 2 dB(A)	2 dB(A) – 3 dB(A)	3 dB(A) –4 dB(A)	4 dB(A) or more
		Incremental Noise Levels due to Relevant Noise Generating Unit, as Predicted at Boundary of Nearest Human Settlement / Sensitive Receptor				
		0.5 dB(A) or less	0.5 dB(A) – 1 dB(A)	1 dB(A) – 1.5 dB(A)	1.5 dB(A) – 2 dB(A)	2 dB(A) or more
4	Surface Water - give the mean score from the three categories, rounded to the nearest decimal	**Water Consumption (KL/D)**				
		< 50	51 - 100	101 - 250	251 – 500	> 500
		Water Consumption Duration (Years)				
		< 1	1-3 years	3-5 years	5-10 years	> 10
		Wastewater Discharge Quality				
		No wastewater generation	Zero Discharge	Discharge to an authorized, functional CETP	Other discharge within limits specified by the EP Rules	Other discharge, outside limits specified by the EP Rules
5	Ground Water - give the mean score fromthe three categories, rounded to	**Ground Water - Location of drawl, as per CGWA/CGWB regulations**				
		Safe	Semi-critical	Critical	Over-exploited	Notified
		Water Drawl (KL/D)				
		< 50	51 - 100	101 - 250	251 - 500	> 500
		Water Drawl Duration (Years)				
		< 1	1-3 years	3-5 years	5-10 years	> 10
		Wastewater Discharge Quality				

	the nearest decimal	No wastewater generation	Zero Discharge	Discharge to an authorized, functional CETP	Other discharge within limits specified by the EP Rules	Other discharge, outside limits specified by the EP Rules
		Accidental Discharge				
		Negligible leakages of chemicals/oil that only require periodic maintenance for both storage / transport routes	Minor but frequent leakages of chemicals/oil that require provision safety measures and proper maintenance	Moderate leakages of chemicals/oil that may contaminate groundwater if proper safety measures not provided	Major leakages of chemicals/oil that contaminate groundwater if safety measures not provided	Heavy leakage that can adversely contaminate groundwater and must require urgent remediation actions
6	Soil Quality	Loss of up to 20% topsoil, or minor contamination of soil that can be easily restored close to original condition for volume <10 m3	Loss of up to 40% topsoil, or actual or possible contamination of soil volume <25 m3 but below Dutch Intervention Values	Loss of up to 60% topsoil, or actual or possible contamination of soil volume <25 m3 but above Dutch Intervention Values	Loss up to 80% topsoil, or actual or possible contamination of soil volume >25 m3 and above Dutch Intervention Values, but not deemed to require urgent remediation	Loss up to 100% topsoil, or actual or possible contamination of soil volume >25 m3 and above Dutch Intervention Values*** , and deemed to require urgent remediation
7.1	Flora / Fauna Habitat/ Ecosystem	Site specific loss (removal) of common floral species (but not any tree or trees).	Site specific loss (removal) of some saplings of trees.	Site specific loss (removal) of some common well grown tree / trees species.	Site specific impact on threatened species but impacted species are widely distributed outside the project site. Short term impacts may lead to loss of abundance or extent, but unlikely to cause local population extinction.	Impact on threatened species listed in as an endemic / Schedule-I as per IWPA 1972, Red Data Book, ZSI, BSI or literature published by any State Govt. Institute, University and College etc.
		Vegetation composition does not	Minor temporary impacts on ecosystem	Site specific loss of nesting / breeding	Site specific habitat loss of fauna listed in IUCN,	Loss of habitat of above said flora- fauna.

		form a habitat character for any species of conservation significance.	functioning or habitat ecology of common / general species.	habitat of common / general species of flora-fauna but will not result in permanent loss of habitat.	WCMC, Birdlife International, or any other international literature - secondary information.	
		No short term or long term impacts are likely to adversely affect the surrounding habitat / ecosystem.	Minor short term / long term impacts on surrounding / immediate / adjacent habitats and are resilient to changes in habitat structure or condition.	Short term or long term impacts are likely to adversely affect the surrounding habitat character/ habitat ecology/ functioning of ecosystem.	Impacts on habitats / ecosystems of international importance.	Impact on genetic diversity of NP /PF
		Site specific disturbance to common / general faunal species (e.g. movement pattern, displacement etc.).	Impact on surrounding agro-ecosystem / agriculture when environmental data / parameters are within permissible limits.	Impact on surrounding agro-ecosystem / agriculture when physical parameters with marginal increase but can be mitigated.		/WLS /ESZ /IBA / tiger reserve / elephant corridor / wild life corridor. Impact on ecosystem like river, forest,
		No negative impacts on surrounding ecosystem functioning or habitat ecology.				wetland (e.g. RAMSAR site etc.) etc.

7.2	Ecology and Bio-diversity: Aquatic	Occasional short term impact and / or disruption to aquatic flora and fauna.	Impact on aquatic ecosystem, including flora, fauna and habitat but not destruction of species diversity or density.	Significant localised impacts but without long term impact on Phytoplankton, zooplankton habitat.Temporary impact on benthos ecosystem or fisheries ecosystem. Some loss of fisheries ecosystem.	Significant widespread impact on protected wildlife (corals/mangroves/turtles/ any marine mammals). Significant impact on mangroves habitat	Damage to an extensive portion of aquatic ecosystem resulting in severe impacts on aquatic population and habitats and / or long term impact on aquatic habitat. Permanent or long term impact on protected wildlife (corals/mangroves/turtles/ any marine mammals) and mangroves
8.1	Socio-economic Environment: Social Aspects - give the mean score from the categories, rounded to the nearest decimal	**Possible Temporary or Permanent Migration, Persons as a % of Population of Study Area**				
		Less than 0.5%	Between 0.5% and 1%	Between 1% and 1.5%	Between 1.5% and 2%	More than 2%
		Possible Change in Ethnicity, vis-à-vis Major Existing Ethnicities Present in Study Area				
		Not likely	Possible	Limited	Significant	Severe
		Gender Imbalance, as a Proportion to Existing Sex-Ratio				
		Not likely	Possible	Limited	Significant	Severe
		Possibility of Return to Original Status in Terms of Any or All of the Above Changes				
		Less than 1 year	Between 1 and 2 years	Between 2 and 3 years	Between 3 to 5 years	Permanent change
8.2	Socio-economic	**No. of Jobs Gained or Lost**				
	Environment:	Less than 50	Between 50 and 75	Between 75 and 100	Between 100 and 250	More than 250
	Economic	**Persons Having Loss or Gain in Income**				

	Aspects -					
	give the mean score	Less than 50	Between 50 and 100	Between 100 and 250	Between 250 and 500	More than 500
	from the categories,	**Land Losers**				
	rounded to the	Less than 10	Between 10 and 20	Between 20 and 50	Between 50 and 100	More than 100
	nearest decimal	**Losers of Homesteads**				
		Less than 5	Between 5 and 10	Between 10 and 25	Between 25 and 50	More than 50
8.3	Socio-economic Aspects: Cultural	Minor repairable damage to commonplace structures	Minor repairable damage to structures/ items of cultural significance, or minor infringements of cultural values	Moderate damage to structures/items of cultural significance, or significant, infringement of cultural values/ sacred location	Major damage to structures/ items of cultural significance, or major infringement of cultural values/sacred locations	Irreparable damage to highly valued structures/ items/ locations of cultural significance or sacred value
Consequence distance						
9.1	Impact on People	Slight injury or health effects(including first aid case and medical treatment case). Not affecting work performance or causing disability	Minor injury or health effects- Affecting work performance, e.g.restriction to activities, or need to take a time off work to recover. Limited, reversible health effects e.g. skin irritation, food poisoning.	Major injury of health effects (including permanent disability). Affecting work performance in the longer term, e.g. prolonged absence from work. Irreversible health damage without loss of life,e.g. noise induced hearing loss,	Single fatality or permanent total disability- from an accident or occupational illness	Multiple Fatalities-From an accident of occupational illness

				Chronic back injuries.		
9.2	Impact on Environment	Slight Effect- Local Environment damage. Within the fence and within system. Negligible financial consequences.	Minor effect- contamination. Damage sufficiently large to attack the environment. Single exceeding of statutory or prescribed criterion. Single complaint. No permanent effect on the environment.	Localized effect- Limited loss of discharges of known toxicity. Repeated exceeding of statutory or prescribed limit. Affecting neighbourhood. Spontaneous recovery of limited damage within one year.	Major effect- Severe environmental damage. The company is required totake extensive measures to restore polluted or damaged environment to its original state. Extended exceeding of statutory or prescribed limits.	Massive effect- Persistent severe environmental damage or severe nuisance extending over a large area. In terms of commercial or recreational use or nature conservation, a major economic loss for the company. Constant, high exceeding of statutory or prescribed limits.
*In case none of the impacts are applicable, Not Applicable (NA) is written in the appropriate cell. A '+' sign indicates a beneficial impact while '-' sign indicates a adverse impact.						
**For leq (day) or leq (night), whichever is higher						
*** Source: Ministry of Housing Spatial Planning and the Environment, Netherlands; Soil Remediation Circular 2009, Annex A.						

4.3.1.3 Quantifying the Likelihood of Occurrence of the Impact

After identifying the severity as shown in **Table 4-19** the likelihood of occurrence also needs to be estimated to arrive at a complete picture of environmental impact significance. **Table 4-18** provides likelihood ratings on a scale of 1-5. These ratings are used for estimating the likelihood of each occurrence.

Table 4-18 Likelihood of Occurrence

Description	Environment/Health and Safety	Likelihood of occurrence
Regular	Continues or will happen every time	5
Frequent/ Often	Occur several times	4
Periodic/ Likely	Might occur at least once	3
Occasional/Possible	Might occur	2
Rare	Very rarely encountered	1

4.3.1.4 Quantifying Environmental Impact significance except for Land use land Cover Component

The level of environmental impact significance is calculated by multiplying the consequence score and the probability of occurrence together. Thus,

Significance of Impact = Severity Score × Probability of Occurrence

The final score is in relative point score, rather than actual impact. The impact estimation is carried out on the assumption that all operations are carried out with standard safety measures.

Table 4-21 below assigns significance criteria, based on the scale of 1-25, used for prioritizing mitigation measures for reducing the environmental impact significance and thereafter, formulating and implementing Environmental Management Plans.

To do this, environmental impact significance levels are first scored and identified as mentioned earlier and then evaluated on the evaluation scale that follows in **Table 4-22.**

Table 4-19 Environmental Impact Significance Criteria

Likelihood of Occurrence	Impact Significance				
	Insignificant	Minor	Moderate	Major	Catastrophic
	1	2	3	4	5
Rare (1)	1	2	3	4	5
Possible (2)	2	4	6	8	10

Likely (3)	3	6	9	12	15
Often (4)	4	8	12	16	20
Certain (5)	5	10	15	20	25

4.3.1.5 Categorizing Environmental Impact Significance

Environmental impacts are now categorized into five categories from extreme significance to low significance. Activities resulting into extremely significant impacts are unacceptable and therefore need to be either stopped or modified such that they are brought to a lower level of environmental impact significance.

Activities resulting into High and moderately severe impacts, although acceptable, require being evaluated and mitigated in a manner that significance of their impacts is lowered. Activities resulting into Low severe significant impacts do not require further mitigation.

Table 4-20 Environmental Risk Categorization

Score	Type of risk	Action required
21-25	Extreme Risk	Activity should not proceed in current form
13-20	Highly Severe	Activity should be modified to include remedial planning and actions and be subject to detailed EHS assessment
7-12	Moderately Severe	Activity can operate subject to management and / or modification
04-06	Less Significant	No action required unless escalation of risk is possible
01-03	Minor / Negligible	Negligible Risk of activity

Mitigation Measures

Mitigation measures require being formulated and implemented for all ‘Highly Significant’ and ‘Moderately Significant’ impact activities. Programmes to implement all mitigation measures are then prepared and presented as an Environmental Management Programme.

Environmental impacts have been identified based on an assessment of environmental aspects associated with the project. Environmental impacts based on project activities have been identified. The symbol '●' indicates a negative impact & 'o' indicates a beneficial (positive) impact. While Impact indicates (Type One Time: **O** Normal: **N**, Abnormal: **AN** Emergency: **E** Duration Temporary: **T** Long-Term/ Permanent: **P**) (Type, Duration) Summary of these activities and significant aspect due to such activities are listed below.

Table 4-21 Impact identification from proposed project

S.No	**Project Activity**	**Identified Aspect**	**O/N/AN/E/T/P**	**Potential Impacts**											
				AIR		**WATER**		**LAND**		**ECOLOGY AND BIODIVERSITY**		**RESOURCE DEPLETION**	**SOCIAL**		
				AP/AQ	**NV**	**SW**	**GW**	**LU/LC**	**S**	**TER.**	**AQUA.**	**RD**	**Infrastructure**	**Economic**	**OH (H&S)**
C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**	**C11**	**C12**	**C13**	**C14**	**C15**	**C16**
1	**Project Location**														
1.1	Selection of site	Densely populated area near project site and the project location is adjacent to existing refinery complex	O & N, P										•	o	•
2	**Project Design**														
2.1	Selection of Technology	Non - compliance	N, P	•	•	•	•		•				•	•	•

S.No	**Project Activity**	**Identified Aspect**	**O/N/AN/E/T/P**	**Potential Impacts**											
				AIR		**WATER**		**LAND**		**ECOLOGY AND BIODIVERSITY**		**RESOURCE DEPLETION**	**SOCIAL**		
				AP/AQ	**NV**	**SW**	**GW**	**LU/LC**	**S**	**TER.**	**AQUA.**	**RD**	**Infrastructure**	**Economic**	**OH (H&S)**
C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**	**C11**	**C12**	**C13**	**C14**	**C15**	**C16**
	Designs of plant components	of Environmental Standards													
3	**Project Construction**														
A	***Pre-Construction***														
3.A.1	Site Preparation activities like Clearing of scrub cover,	Generation of Dust, Solid waste & Noise	O & N, T	•	•			•	•	•					•
	removal of top soil, leveling and filling of earth														
	material	Labor requirement	O & N, T											o	
B	***Construction***														
3.B.1	Demolition of unused plant/tank farm	Dust generation	O & N, T	•											•
		Generation of scraps	O & N, T					•						o	
		Noise generation	O & N, T		•										•

S.No	Project Activity	Identified Aspect	O/N/AN/E/T/P	Potential Impacts											
				AIR		WATER		LAND		ECOLOGY AND BIODIVERSITY		RESOURCE DEPLETION	SOCIAL		
				AP/AQ	NV	SW	GW	LU/LC	S	TER.	AQUA.	RD	Infrastructure	Economic	OH (H&S)
C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16
3.B.2	Excavation and paving of site	Generation of Debris & Noise	O & N, T											o	•
		Generation of debris	O & N, T												
		Fall in pit, land sliding from sidewalls	O & N, T	•					•						•
3.B.3	Heavy fabrication work for erecting major plant equipment including operation of equipment like concrete mixtures, vibrators etc.	Generation of scraps	O & N, T					•						o	
		Emission of Heat Radiation	O & N, T	•											•
		Noise generation	O & N, T		•										•
		Breaking of pulley, chains of cranes during lifting of	O & N, T												•

S.No	Project Activity	Identified Aspect	O/N/ AN/ E/T/ P	Potential Impacts											
				AIR		**WATER**		**LAND**		**ECOLOGY AND BIODIVERSITY**		**RESOURCE DEPLETION**	**SOCIAL**		
				AP/AQ	**NV**	**SW**	**GW**	**LU/LC**	**S**	**TER.**	**AQUA.**	**RD**	**Infrastructure**	**Economic**	**OH (H&S)**
C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**	**C11**	**C12**	**C13**	**C14**	**C15**	**C16**
		equipment													
		Work force requirement	O & AN, T											o	
3.B. 4	Vehicular movement for transportation of materials	Dust generation and emission of HC & CO	N, T	•					•	•					•
	and equipment	Noise generation	N, T		•										•
		Hiring of vehicles and transport equipment	N, T											o	
		Potential damage to roads	N, T										•		
C	***Commissioning***														
2.C. 1	Startup activities like operation of equipment for all the proposed Polypropylene	Emissions due to Emergency D.G.	N, T	•					•	•					•

S.No	**Project Activity**	**Identified Aspect**	**O/N/AN/E/T/P**	**Potential Impacts**											
				AIR		**WATER**		**LAND**		**ECOLOGY AND BIODIVERSITY**		**RESOURCE DEPLETION**	**SOCIAL**		
				AP/AQ	**NV**	**SW**	**GW**	**LU/LC**	**S**	**TER.**	**AQUA.**	**RD**	**Infrastructure**	**Economic**	**OH (H&S)**
C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**	**C11**	**C12**	**C13**	**C14**	**C15**	**C16**
	Unit)	,CO etc. which can deposit on soil and contaminate													
		Noise generation	N, T		•										•
		Leakage of chemicals and fuel. Waste water generation	N, T			•	•		•			•			•
		from vessels & chemical cleaning													
		Generation of discarded packing material	N, T					•						o	
4	**Project Operation**														
A	***Storage Tank***														

S.No	Project Activity	Identified Aspect	O/N/AN/E/T/P	Potential Impacts											
				AIR		WATER		LAND		ECOLOGY AND BIODIVERSITY		RESOURCE DEPLETION	SOCIAL		
				AP/AQ	NV	SW	GW	LU/LC	S	TER.	AQUA.	RD	Infrastructure	Economic	OH (H&S)
C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**	**C11**	**C12**	**C13**	**C14**	**C15**	**C16**
4.A.1	Pumping, loading & unloading activities in storage area	Fugitive emission	N, P	•						•					•
4.A.2	Plant Shutdown and Start up, Floor cleaning & heat exchanger chemical cleaning	Gas venting when flare is off	AN, T	•											•
		Wastewater generation	AN, T			•	•				•			•	
5	**General & Utilities**														
5.1	Workforce during operation of plants	Generation of sewage	N, P			•									
		Solid & Kitchen waste generation	N, P					•							
		Workforce requirement for proposed plants	N, P											o	

S.No	Project Activity	Identified Aspect	O/N/AN/E/T/P	Potential Impacts											
				AIR		WATER		LAND		ECOLOGY AND BIODIVERSITY		RESOURCE DEPLETION	SOCIAL		
				AP/AQ	NV	SW	GW	LU/LC	S	TER.	AQUA.	RD	Infrastructure	Economic	OH (H&S)
C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**	**C11**	**C12**	**C13**	**C14**	**C15**	**C16**
5.2	Raw water intake	Consumption of surface water	N, P			●						●			
5.3	Operation of waste water treatment facilities	Discharge of treated waste water in emergency situation	AN, T			●					●			●	
		High quantum of waste water generation	N, T			●	●								
		Soil contamination due to improper handling of hazardous material from ETP & storage area	N, T				●		●						
		Sludge generation	N, P					●	●						
5.4	Overflow with contaminated	Surface water	AN, T			●					●			●	

S.No	**Project Activity**	**Identified Aspect**	**O/N/AN/E/T/P**	**Potential Impacts**											
				AIR		**WATER**		**LAND**		**ECOLOGY AND BIODIVERSITY**		**RESOURCE DEPLETION**	**SOCIAL**		
				AP/AQ	**NV**	**SW**	**GW**	**LU/LC**	**S**	**TER.**	**AQUA.**	**RD**	**Infrastructure**	**Economic**	**OH (H&S)**
C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**	**C11**	**C12**	**C13**	**C14**	**C15**	**C16**
	water during rain	contamination due to													
	season	overflow of storm water drainage line													
5.5	Equipment maintenance and washing during	Generation of used or waste oil, lubricants, etc.	N, T					•							
	analysis in laboratory	Generation of scraps and used spares, etc.	N, T					•						o	
		Occupational risk during maintenance work	AN, T												•
5.6	Housekeeping and packing/unpacking activities	Solid waste generation	N, P					•							
		Temporary job creation for such activities	N, P											o	
5.7	Vehicular	Increase in	N, P										•		

S.No	Project Activity	Identified Aspect	O/N/AN/E/T/P	Potential Impacts											
				AIR		WATER		LAND		ECOLOGY AND BIODIVERSITY		RESOURCE DEPLETION	SOCIAL		
				AP/AQ	NV	SW	GW	LU/LC	S	TER.	AQUA.	RD	Infrastructure	Economic	OH (H&S)
C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16
	movement for transportation of	traffic on NH													
	materials	Emission of HC & CO	N, T	●						●					●
		Noise generation	N, T		●										●

Table 4-22 Impact scoring for Air Environment

S.No	Project Activity	Identified Aspect	O/N/AN/E/T/P	Impact Scoring			Significance/Consequence	Operational controls/Mitigation measures	EMP required
				Severity, S	Probability, P	Final score, S x P			
C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
1	Project Design								
1.1	Selection of Technology	Non - compliance of Environmental Standards	N,P	-	-	-	Significant	Approved designs of Air pollution control equipment & process equipment shall be implemented to meet environmental standards	No
	Designs of plant components								
2	**Project Construction**								
A	***Pre-Construction***								
2.A.1	Site Preparation activities like Clearing	Dust generation	O & N, T	1	5	5	Low	Water Sprinkling shall be done. Quantification	No

	of scrub cover, removal of top soil, leveling and filling of earth material							of cut and fill will be recorded to minimize the losses	
B	***Construction***								
2.B.1	Excavation and paving of site	Dust generation	O & N, T	1	3	3	Minor	Barricading will be done wherever required	No
2.B.2	Heavy fabrication work for erecting major plant equipment including operation of equipment like concrete mixtures, vibrators etc.	Emission of Heat Radiation	O & N, T	1	3	3	Minor	Properly certified, tested and calibrated equipment will be used	No
2.B.3	Vehicular movement for transportation of materials and equipment	Dust generation and emission of HC & CO	N, T	2	4	8	Moderate	PUCC Certified vehicles will be used. Traffic management will be ensured	No
C	***Commissioning***								
2.C.1	Startup activities like operation of equipment for all the proposed plants	Emissions due to Emergency D.G.	N, T	3	3	9	Moderate	D.G. sets will be operated only during emergency situations and APC will be provided.	No
3	**Project Operation**								
B	***Storage Tank***								
3.B.1	Pumping, loading & unloading activities in storage area	Fugitive emissions	N, P	1	5	5	Low	Timely maintenance of pumps, glands, seals, valves will be carried out. Workplace monitoring shall be carried out regularly	No
3.B.2	Plant Shutdown and Start up, Floor	Gas venting when flare is off	AN, T	3	1	3	Minor	SOP's will be followed during startup and	No

	cleaning & heat exchanger chemical cleaning							shutdown	
4	**General & Utilities**								
4.1	Vehicular movement for transportation of materials	Emission of HC & CO	N, T	-	-	-	Significant	PUCC Certified vehicles will be used. Traffic management will be ensured	Yes

Table 4-23 Impact scoring for Noise Environment

S.No	**Project Activity**	**Identified Aspect**	**O/N/ AN/ E/T/P**	**Impact Scoring**			**Significance/Consequence**	**Operational controls/Mitigation measures**	**EMP required**
				Severity, S	**Probability, P**	**Final score, S x P**			
C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**
1	Project Design								
1.1	Selection of Technology Designs of plant components	Non - compliance of Environmental Standards	N, P	-	-	-	Significant	Approved designs of Noise pollution control equipment & process equipment shall be implemented to meet environmental standards	No
2	**Project Construction**								
A	***Pre-Construction***								
2.A.1	Site Preparation activities like Clearing of scrub cover, removal of top soil, leveling and filling of earth	Noise generation	O & N, T	2	3	6	Low	Barricading will be done wherever required	No

	material								
B	***Construction***								
2.B.1	Excavation and paving of site	Noise generation	O & N, T	2	3	6	Low	Barricading will be done wherever required	No
2.B.2	Heavy fabrication work for erecting major plant equipment including operation of equipment like concrete mixtures, vibrators etc.	Noise generation	O & N, T	2	3	6	Low	Properly certified, tested and calibrated equipment will be used. Ear muffs and ear plugs will be provided to workers	No
2.B.3	Vehicular movement for transportation of materials and equipment	Noise generation	O & N, T	2	3	6	Low	Preventive maintenance of vehicles is to be adopted. Traffic management will be ensured	No
C	***Commissioning***								
2.C.1	Startup activities like operation of equipment for all the proposed plants	Noise generation	N, T	3	3	9	Moderate	SOP's, OCP and OEP will be followed during startup. Acoustical Enclosures & Room Acoustical Treatment will be done	Yes
3	**Project Operation**								
B	***Storage Tank***								
3.B.3	Delivery and transfer in storage tank/ failure of compressor and blowers or poor	Explosion (Noise generation)	E, T	-	-	-	Significant	Emergency plans and OCP will be made and followed	No

	insulation								
4	**General & Utilities**								
4.1	Vehicular movement for transportation of materials	Noise generation	N, T	2	2	4	Low	Preventive maintenance of vehicles is to be adopted. Traffic management will be ensured	No

Table 4-24 Impact scoring for Water Environment

S.No	**Project Activity**	**Identified Aspect**	**O/N/ AN/ E/T/P**	**Impact Scoring**			**Significance/Consequence**	**Operational controls/Mitigation measures**	**EMP required**
				Severity, S	**Probability, P**	**Final score, S x P**			
C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**
1	Project Design								
1.1	Selection of Technology Designs of plant components	Non - compliance of Environmental Standards	N, P	-	-	-	Significant	Proper adequate ETP, STP system & maintenance of equipment to meet the environmental standards	No
2	**Project Construction**								
A	***Commissioning***								

S.No	Project Activity	Identified Aspect	O/N/ AN/ E/T/P	Impact Scoring			Significance/Consequence	Operational controls/Mitigation measures	EMP required
				Severity, S	Probability, P	Final score, S x P			
2.A.1	Startup activities like operation of equipment for all the proposed plants	Leakage of chemicals and fuel. Waste water generation from vessels & chemical cleaning	N, T	-	-	-	Significant	Properly designed dyke walls will be provided. SOP's, OCP and OEP will be followed during startup.Effluent will be treated in ETP & treated water will be reused in process	No
3	**Project Operation**								
B	***Storage Tank***								
3.B.2	Delivery and transfer in storage tank/ failure of compressor and blowers or poor insulation	Heavy leakage or explosion	E,T	-	-	-	Significant	Emergency plans and OCP will be made and followed. Dyke wall will be provided.	No
3.B.3	Plant Shutdown and Start up, Floor cleaning & heat exchanger chemical cleaning	Wastewater generation & draining of acidic water	AN, T	-	-	-	Significant	Effluent will be treated in ETP & treated water willbe reused in process	Yes

S.No	Project Activity	Identified Aspect	O/N/ AN/ E/T/P	Impact Scoring			Significance/Consequence	Operational controls/Mitigation measures	EMP required
				Severity, S	Probability, P	Final score, S x P			
4	**General & Utilities**								
4.1	Workforce during operation of plants	Generation of sewage	N,P	-	-	-	Significant	Generated Sewage will be treated in STP & will be reused after treatment	Yes
4.2	Raw water intake	Consumption of surface water	N,P	2	5	10	Moderate	Reuse & recycle methods will be adopted	
4.3	Operation of waste water treatment facilities	Discharge of treated waste water in emergency situation	AN, T	-	-	-	Significant	Initial rain water will be treated & consumed. Records will be maintained of treated effluent quality and quantity. Performance evaluation of Effluent Treatments will be carried out on regular basis.	Yes
		High quantum of waste water generation	N,T						
4.4	Overflow with contaminated water during rainy season	Surface water contamination due to overflow of storm water drainage line	AN, T						

S.No	Project Activity	Identified Aspect	O/N/ AN/ E/T/P	Impact Scoring			Significance/Consequence	Operational controls/Mitigation measures	EMP required
				Severity, S	Probability, P	Final score, S x P			

Table 4-25 Impact scoring for Land use/ Land cover

S.No	Project Activity	Identified Aspect	O/N/ AN/ E/T/P	Impact Scoring			Significance/Consequence	Operational controls/Mitigation measures	EMP required
				Severity, S	Probability, P	Final score, S x P			
C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**
1	**Project Construction**								
A	***Pre-Construction***								
1.A.1	Site Preparation activities like Clearing of scrub cover, removal of top soil, leveling and filling of earth material	Generation of Dust & Solid waste	O & N, T	1	2	2	Minor	Only scrubs will be removed.	No

B	***Construction***								
1.B.1	Demolition of unused plant/tank farm	Generation of scraps	O & N, T	1	2	2	Minor	SOP's, OCP and OEP will be followed. Generated Scraps & Debris will be sent to recyclers/ vendorsas per Rules.	No
1.B.2	Excavation and paving of site	Generation of Debris	O & N, T	1	2	2	Minor	SOP's, OCP and OEP will be followed. Generated Scraps & Debris will be sent to recyclers/ vendors as per rules	No
		Fall in pit, land sliding from sidewalls	O & AN, T	1	2	2	Minor	Emergency safety norms will be followed	No
1.B.3	Heavy fabrication work for erecting major plant equipment including operation of equipment like concrete mixtures, vibrators etc.	Emission of Heat Radiation	O & N, T	1	2	2	Minor	SOP's, OCP and OEP will be followed. Generated Scraps will be sent to recyclers/ vendors as per Rules	No
C	***Commissioning***								

1.C.1	Startup activities like operation of equipment for all the proposed plants	Generation of discarded packing material	N,T	-	-	-	Significant	Will be sent to recyclers/ vendors as per criteria	No
2	**Project Operation**								
A	***Storage Tank***								
2.A.1	Delivery and transferin storage tank/ failure of compressor and blowers or poor insulation	Heavy leakage or explosion	E, T	4	1	4	Low	Emergency safety norms will be followed	No
3	**General & Utilities**								
3.1	Workforce during operation of plants	Solid & Kitchen waste generation	N, P	2	4	8	Moderate	Will be used for Vermicompost	No
3.2	Operation of waste water treatment facilities	Sludge generation	N, P	-	-	-	Significant	Disposal site followed by Sludge drying beds	No
3.3	Equipment maintenance and washing during analysis in laboratory	Generation of scraps and used spares, etc.	N, T	-	-	-	Significant	Generated Scraps will be sent to recyclers/ vendors as per Rules	No

3.4	Housekeeping and packing/unpacking activities	Solid waste generation	N, P	1	3	3	Minor	Generated waste will be handled/ disposed as per Rules	No

Table 4-26 Impact scoring for Soil conservation

S.No	Project Activity	Identified Aspect	O/N/ AN/ E/T/P	Impact Scoring			Significance/Consequence	Operational controls/Mitigation measures	EMP required
				Severity, S	**Probability, P**	**Final score, S x P**			
C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**
1	Project Design								
1.1	Selection of Technology	Non - compliance of Environmental Standards	N, P	-	-	-	Significant	Contract will be given to well established firm. Prevalidation, adequacy Of DPR will be done with Vendors frequently before commencement	No
	Designs of plant components								
2	**Project**								

	Construction								
A	***Pre-Construction***								
2.A.1	Site Preparation activities like Clearing of scrub cover, removal of top soil, leveling and filling of earth material	Generation of Dust, Solid waste	O & N, T	1	3	3	Minor	Boundary wall should be prepare	No
B	***Construction***								
2.B.1	Excavation and paving of site	Dust generation	O & N, T	1	3	3	Minor	Boundary wall should be prepare	No
		Fall in pit, land sliding from sidewalls	O & AN, T	2	2	4	Low	Emergency safety norms will be followed	No
2.B.2	Vehicular movement for transportation of materials and equipment	Dust generation and emission of HC & CO	N, T	1	4	4	Low	PUC Certified vehicles & maintenance of vehicles. Proper training will be given to driver	No
C	***Commissioning***								
2.C.1	Startup activities like operation of equipment for all the proposed	Negligible Emissions due to Emergency D.G.	N, T	-	-	-	Significant	SOP's, OCP and OEP will be followed duringstartup. APC will be provided.	Yes

	plants							Firefighting & emergency response team will be at place during startups	
		Leakage of chemicals and fuel. Waste water generation from vessels & chemical cleaning	N, T	-	-	-	Significant	Proper handling, storage facility with dyke will be maintained	Yes
3	**Project Operation**								
A	***Storage Tank***								
3.A.1	Delivery and transfer in storage tank/ failure of compressor and blowers or poor insulation	Heavy leakage or explosion	E, T	-	-	-	Significant	Emergency plans and OCP will be made and followed. Proper flooring, Dyke wall will be provided	Yes
3.A.2	Unforeseen situation damaging storage tank	Leakages from storage tank	E, T	-	-	-	Significant	Emergency plans and OCP will be made and followed. Proper flooring, Dyke wall will be provided	Yes

4	**General & Utilities**								
4.1	Operation of waste water treatment facilities	Soil contamination due to improper handling of hazardous material/ Sludge from ETP & storage area	N, T	-	-	-	Significant	Proper flooring will be provided. Install proper facilities to prevent rain/storm water contamination during the storage of solid raw materials	No

Table 4-27 Impact scoring for Ecology and Biodiversity

S.No	**Project Activity**	**Identified Aspect**	**O/N/ AN/ E/T/P**	**Impact Scoring**			**Significance/Consequence**	**Operational controls/Mitigation measures**	**EMP required**
				Severity, S	**Probability, P**	**Final score, S x P**			
C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**
1	**Project Construction**								
A	***Pre-Construction***								

1.A.1	Site Preparation activities like Clearing of scrub cover, removal of top soil, leveling and filling of earth material	Generation of Dust	O & N, T	1	2	2	Minor	Boundary wall should be prepared	No
B	***Construction***								
1.B.1	Vehicular movement for transportation of materials and equipment	Dust generation and emission of HC & CO	N, T	1	4	4	Low	PUC Certified vehicles will be used done regularly & maintenance of vehicle will be	No
C	***Commissioning***								
1.C.1	Startup activities like operation of equipment for all the proposed plants	Negligible Emissions due to Emergency D.G. which can deposit on soil and contaminate	N, T	2	3	6	Low	Pollution Control Equipment will be provided	No
2	**Project Operation**								
A	***Storage Tank***								

2.A.2	Pumping, loading & unloading activities in storage area	Fugitive emissions	N, P	2	4	8	Moderate	Existing greenbelt will be maintained	No
2.A.3	Plant Shutdown and Start up, Floor cleaning & heat exchanger chemical cleaning	Wastewater generation	AN,T	-	-	-	Significant	Proper storm water drainage line & treatment system will be provided, reuse of treated waste water will be highly recommended	Yes
2.A.4	Delivery and transfer in storage tank/ failure of compressor and blowers or poor insulation	Heavy leakage or explosion	E,T	5	1	5	Low	Emergency plans and OCP will be made and followed. Dyke wall will be provided.	No
2.A.5	Unforeseen situation damaging storage tank	leakages from storage tank	E,T	4	1	4	Low	OCP will be made and followed. Dyke wall will be provided.	No
3	**General & Utilities**								

3.1	Operation of waste water treatment facilities	Discharge of treated waste water in emergency situation	AN,T	-	-	-	Significant	Initial rain water will be treated & consumed. Records will be maintained of treated effluent quality and quantity. Performance evaluation of Effluent Treatments will be carried out on regular basis.	No
3.2	Overflow with contaminated water during rainy season	Surface water contamination due to overflow of storm water drainage line	AN,T	-	-	-	Significant		No
3.3	Vehicular movement for transportation of materials	Emission of HC & CO	N,T	1	4	4	Low	PUC Certified vehicles will be used done regularly & maintenance of vehicle will be	No

Table 4-28 Impact scoring for Socio-Economic Environment

S.No	Project Activity	Identified Aspect	O/N/ AN/ E/T/ P	Impact Scoring			Significance/Consequence	Operational controls/Mitigation measures	EMP required
				Severity, S	Probability, P	Final score, S x P			
C1	C2	C3	C4	C6	C7	C8	C9	C10	C11
1	Project Location								

1.1	Selection of site	Densely populated area near project site and the project location is adjacent to existing refinery complex	O & N, P	2	2	4	Low	Ancillary developments in nearby areas.	No
2	**Project Construction**								
A	***Pre-Construction***								
2.A.1	Site Preparation activities like Clearing of scrub cover, removal of top soil, leveling and filling of earth material	Labor requirement	O & N, T	2	4	(+8)	Moderate	Employment opportunities for locals	No
B	***Construction***								
2.B.	Excavation and	Generation	O &	2	2	4	Low	Will be reutilize	No

1	paving of site	of debris	N, T					for refilling or will send it to local contractors	
2.B. 2	Heavy fabrication work for erecting major plant equipment including operation of equipment like concrete mixtures, vibrators etc.	Generation of scraps	O & N, T	3	3	(+9)	Moderate	Will send to local recyclers/ Vendors	
		Work force requirement	O & N, T	3	3	(+9)	Moderate	Employment opportunities for locals	No
2.B. 3	Vehicular movement for transportation of materials and equipment	Hiring of vehicles and transport equipment	N, T	3	3	(+9)	Moderate	Employment opportunities for locals	No
		Potential damage to roads	N, T	2	2	4	Low	Proper precaution will be followed	No
C	***Commissioning***								
2.C. 1	Startup activities like operation of equipment for all	Generation of discarded packing	N, T	3	3	(+9)	Moderate	Will send to local recyclers/ Vendors	No

	the proposed plants	material							
3	**Project Operation**								
B	***Storage Tank***								
3.B. 1	Plant Shutdown and Start up, Floor cleaning & heat exchanger chemical cleaning	Wastewater generation & draining of acidic water	AN,T	-	-	-	Significant	Proper Storm water drainage system & regular treatment of effluent will be done	No
3.B. 2	Delivery and transfer of in storage tank/ failure of compressor and blowers or poor insulation	Heavy leakage or explosion	E, T	5	1	5	Low	Emergency preparedness & safety measures like double integrity wall tank will be provided	No
4	**General & Utilities**								
4.1	Workforce during operation of	Workforce requirement	N, P	3	3	(+9)	Moderate	Employment opportunities for	No

	plants	for proposed plants						locals	
4.2	Operation of waste water treatment facilities	Discharge of treated waste water in emergency situation	AN, T	-	-	-	Significant	Proper Storm water drainage system & regular treatment of effluent will be done	No
4.3	Overflow with contaminated water during rain season	Surface water contamination due to overflow of storm water drainage line	AN, T	-	-	-	Significant	Proper Storm water drainage system & regular treatment of effluent will be done	No
4.4	Equipment maintenance and washing during analysis in laboratory	Generation of scraps and used spares, etc.	N, T	3	3	(+9)	Moderate	Will send to local recyclers/ Vendors	No
4.5	Housekeeping and packing/unpackin	Temporary job creation for such	N, P	3	3	(+9)	Moderate	Employment opportunities for locals	No

	g activities	activities							
4.6	Vehicular movement for transportation of materials	Increase in traffic on NH	N, P	2	2	4	Low	Traffic Management will be followed	No

CHAPTER 5

ANALYSIS OF ALTERNATIVES

5 ANALYSIS OF ALTERNATIVES

5.1 Introduction

M/s.Numaligarh Refinery Limited proposes, “Proposed Poly Propylene Unit (PPU) OF Capacity 360KTPA”.The proposed PP unit will be set up at a Green field land located at North side of the Numaligarh Refinery

The range of alternatives selected for the purpose of analysis includes:

- Site alternative
- Water supply alternative
- Technology alternative

5.2 Description of each alternatives with its adverse impacts

Alternate sites were not considered since the proposed projectwill be near to the existing Numaligarh Refinery in south direction to utilize the major utilities present in NREP. Adequate land is available with Numaligarh Refinery for the proposed petrochemical complex.

The total Plot no. 11 area is 600 Bigha (8,02,681.92 sq.m) (80.27 Ha). Out of which Total plot area required for the PP Unit and its associated facility is 348093 SQM (34.8 Ha). The plant area is 232821 sq.m (23.28Ha) and Greenbelt area is 115272 sq.m (11.52 Ha) i.e, (33.1 % of total area) at Plot No.11 located at North side of the Numaligarh Refinery. The remaining 454588.92 sq.m (45.45 Ha) will be utilized for future project activities.

For NREP, a total of 11 plots were identified requiring NDZ clearance, out of which Forest Department, Govt. of Assam had recommended 9 plots including Plot no.11 (Rajabari TE). However, out of the 9 plots, 8 plots of Land were shortlisted by NRL for NREP related activities.

Now, the proposed PP unit will be installed in Plot no.11 which comes under NDZ zone and the site has been under the 9 recommended plots by Forest Dept. of Assam and has been recommended for Project activities.

5.3 Mitigation measures proposed for each alternative

Appropriate measures are considered for each selected site, out of which the best site will be selected.

5.4 Selection of Alternative Sites

No alternative site selection was carried out for the project.

5.5 Site Connectivity

Table 5-1Connectivity to the site

Nearest Highway	NH-129(Dimapur-Numaligarh), ~1.31km, SW
Nearest State Highway	SH-1(Kamargaon-Joypur), ~3.12km, N
Nearest Railway Station	Khumtai Railway Station, ~7.38km, ENE
Nearest Airport	Jorhat Airport, ~39.57km, ENE
Nearest Town	Golaghat, ~16.50km, ESE
Nearest City	Jorhat, ~39km, ENE
Nearest Village	Pankagaon, ~0.01km, W

5.6 Other Alternatives

5.6.1 Fuel Alternatives

No additional Fuel Requirement for the NRL PP Project. The fuel requirement of 125 kg/hr for the Emergency DG will be utilised from the existing NREP fuel requirement.

5.6.2 Water Supply Alternatives

Treated Raw water requirement of 210 m3/hr for the PP complex will be provided from existing NREP treated raw water header. The raw water requirement of existing refinery and NREP is met from River Dhansiri. Since the proposed project uses the water source as the existing refinery site, there is no alternative water supply considered

5.7 Technology Alternatives

Under NREP a high severity PFCC unit with a capacity of 1.955MMTPA is being implemented. The LPG that will be generated in the high severity mode will contain a significant potential of propylene which can be recovered for value addition. The Polymer Grade Propylene produced in the PRU section of the PFCC Unit is further processed in the downstream unit i.e. PP unit to produce Homo-polymer grade Polypropylene product.

CHAPTER 6

ENVIRONMENTAL MONITORING PROGRAM

6 ENVIRONMENTAL MONITORING PROGRAM

6.1 Introduction

Environmental monitoring is an essential tool for sustainable development & ensuring effective implementation of environmental management plan & mitigation measures adopted. Environmental monitoring will undertake primarily to determine the environmental effects of human activities and secondarily to increase understanding of cause – effect relationships between human activity and environmental change. Environment monitoring is a repetitive & systematic measurement of the characteristics of environmental components to test specific hypotheses of the effect of human activities on the environment. Environmental monitoring program enables the proponent to identify the deviation of environmental quality due to the proposed project activities.

6.2 Environmental Effects Monitoring in EIA

Environmental effects monitoring programs provide the necessary information to:

- Verify the accuracy of EIA predictions;
- Determine the effectiveness of measures to mitigate adverse effects of projects on the environment.

Environmental monitoring program is a vital process of any management plan of the development project. This helps in signalling the potential problems resulting from the proposed project and will allow for prompt implementation of effective corrective measures. The environmental monitoring will be required for the construction and operational phases. The main objectives of environmental monitoring area:

i. To assess the changes in environmental conditions,
ii. To monitor the effective implementation of mitigation measures,
iii. Warn significant deterioration in environmental quality for further prevention action.
iv. In order to meet the above objectives, the following parameters need to be monitored:
    - Afforestation,
    - Water Quality and Public Health,
    - Air and Noise quality,

- Soil Conservation, and
- Sanitation and Waste Disposal

6.2.1 Technical Aspects of Post Project Environment Monitoring Program

The summarized forms of post monitoring details are presented in the following **Table 6-1.**

Table 6-1 Post Project Environmental Monitoring Plan

S. No	Details of Location	Frequency and reporting schedules	Parameters for data analysis
1.	**Air pollution monitoring**		
	Ambient air quality within the premises	Continuous	PM, SO_x, NO_X , CO and VOC
	Ambient air quality within the premises	Twice in a week	All 12 parameters as given in NAAQS
	Ambient air quality at 1 location in Prevalent Down Wind Direction	Twice in a week	All 12 parameters as given in NAAQS
	Ambient air quality at 1 location in Up Wind Direction	Twice in a week	All 12 parameters as given in NAAQS
2.	**Noise monitoring**		
	At two locations within the premises	Once in 2 months	Noise Levels in dB(A)
3.	**Ground water quality monitoring**		
	One location at site	Quarterly	Physicochemical properties and Heavy Metals The groundwater results are compared with the acceptable and permissible water quality standards as per IS: 10500 (2012)
4.	**Soil Quality monitoring**		
	One location near Hazardous waste storage	Annually	Physicochemical properties, Nutrients, Heavy metals as per IS 2720 (All Parts)

S. No	Details of Location	Frequency and reporting schedules	Parameters for data analysis
	area at site and one location outside site		
5.	**Effluent Quality Monitoring**		
	Inlet and outlet of ETP in Refinery area	Once a month	pH, Temp, TDS, TSS, Chloride, Sulphide, Sulphate, fluoride, ammoniacal Nitrogen, Sodium, Copper, Zinc, Phenolic compounds, Oil and Grease, Boron, BOD, COD, Total Residual Chlorine, Arsenic, Cadmium, Total Chromium, Hexavalent Chromium, Lead, Selenium, Mercury, Pesticides, Alpha emitters, Free Ammonia, Dissolved Phosphates, Total Kjeldhal nitrogen, Cyanide, Nickel, Residual Sodium Carbonate. All the Parameters are to be verified as per CPCB Standard Guidelines.
6.	Work place Monitoring	Quarterly	Noise, VOC, Lux levels

6.2.2 Measurement Methodologies

Monitoring of environmental samples shall be done as per the guidelines provide by MoEF&CC/CPCB/SPCB-Assam. The methods conducted or applied shall be approved or sanctioned by the any recognized body or authority i.e. MoEF&CC/CPCB/SPCB-Assam.

01 no. CAAQMS will be proposed for PP unit. NRL already having 02 CAAQMS and one more will come as a part of NREP. NRL already having 3 manual monitoring station within 10 km range and 01 in Kaziranga National Park.

6.3 Emergency procedures on reporting &documentation

All the necessary reports and documents shall be prepared complying with the statutory rules & regulations. Proper and due care shall be taken to adhere to the laid down rules and regulation by the government. Regular and periodic record shall be kept in order to ensure easier, comparable and brisk review and projection of past, present and future performances. Also, the management shall ensure to prepare separate records for water, wastewater, solid waste, air, emission, regularly and periodically in order to provide better and smooth vigilance.

The management shall look into the fact that as soon as the preparation of reports gets over it shall be forwarded to the concerned authority with due care for the purpose of reviewing. Adhering to the rules and regulations the management shall ensure that the outcome of the reports and the conclusions been drawn shall be prepared as per the laid down regulations and procedures. No breach of any convention shall be availed.

These reports/documents shall be regularly and periodically reviewed and any changes/ discrepancies found in mitigation measures/ operation/ management/ technology shall be brought into notice instantaneously and all possible corrective actions shall be taken to match the discrepancies been witnessed.

6.4 Detailed Budget for implementing Environmental Monitoring Plan

Particulars and frequency of environmental Monitoring is given in **Table 6-2**

Table 6-2 Annual Budgetary allocation for Environmental Monitoring

S. No	Particulars	Frequency of monitoring	Cost in Lakhs
1.	**Air pollution monitoring**		
	Ambient Monitoring within as well as outside	Continuous	8.00
2.	**Noise monitoring**		
	At 2 locations within the premises	Once in 2 Months	3.00
3.	**Ground water quality monitoring**		5.00
	One location at site and one location	Once in a season	

	outside site		
4.	**Soil Quality monitoring**		2.00
	One location near Hazardous waste storage area at site and one location outside site	Once in a season	
6.	**VOC monitoring**		4.00
7.	**Miscellaneous activities (study)**		10.00
Total			**32.00**

CHAPTER 7

ADDITIONAL STUDIES

7 ADDITIONAL STUDIES

7.1 Public Consultation

The project is falling under ‘A’ category as per EIA Notification 2006 and Public Hearing is mandatory as per ToR obtained. Hence draft EIA report has been prepared as per the ToR vide F. No.**J-11011/274/2015- IA II(I)**, Dated 15 July 2022.

7.2 Risk Assessment

Risk Assessment is performed for the instrument leaks and failure for different scenarios is incorporated as **Annexure 6.**

A detailed Hazard Identification and Risk Assessment (HIRA) study has been conducted for the facility and contours for different scenarios have been prepared using PHAST software and the analysis along with HIRA matrix is given in the report.

The scope of the study mainly involves:

- Identifications of Hazards
- Consequence modelling of:
    - Dispersion of Vapour cloud
    - Flash fire
    - Pool fire
    - Jet fire
- Impact limits identifications
- Contour mapping of the risk on the layouts.
- Mitigating measures for handling and storage to reduce impacts & prevent incidents.

The details of the chemicals used are given below:

- Propylene
- Triethyl aluminium
- Silane
- Peroxide
- Hydrogen

The following data were collected to envisage scenarios:

- ➢ Chemical storage conditions (Operating temperature, pressure)
- ➢ Capacity of the storage containers and process pipelines
- ➢ Atmospheric conditions viz. Temperature, Humidity and Wind direction

In addition to this, a detailed HIRA study has also been conducted and major hazards & recommendations, especially for the construction phase, are given in the report.

A detailed Disaster Management Plan has also been prepared for the following emergencies:

- Fire
- Explosion
- Toxic gas release
- Large Spills or release of toxic/corrosive/flammable chemicals
- Natural Calamities like Earthquake, Flood, cyclone etc.

The plan identifies the roles and responsibilities of key personnel along with details of procedures to be followed and communication system during emergencies.

The following pro-active steps have been taken to reduce the overall risk rating.

3. **Risk Assessment**: A detailed risk assessment has been conducted and the report is attached as **Annexure 6**

4. **Training**: Proper periodical trainings are given to the employees and management for various topics, as per the nature of work, in which they are involved.

4. **Record Keeping**: Proper Records will be kept, for any incidents, including near misses.

5. **Medical Checkup**: Periodical health heck up is being conducted for the employees

6. **PPEs:** Provision of proper PPEs to the employees and visitors.

The following recommendations are given in the report to improve the safety system.

The following measures be considered for enhancing the safety standards at site:

- Quantitative Risk analysis needs to be carried out for the entire facility for overall risk assessment.
- To enable rapid detection of leak/ fire, flammable gas detector shall be located in strategic location in the PP Unit, mounded bullet, Loading gantry & Pump house.
- For positively pressurized building, both Hydrocarbon & Toxic detectors need to be placed at suction duct of HVAC. HVAC to be tripped automatically in event of the detection of any Hydrocarbon / toxic material by detector.
- Proper checking of contract people for Smoking or Inflammable materials to be ensured at entry gates to avoid presence of any unidentified source of ignition.
- It shall be ensured that all the vehicles entering the plant shall be provided with spark arrestors at the exhaust.
- Employees and Truck drivers must be well trained and must be aware of the hazards involved in the loading operation.
- The critical operating steps shall be displayed on the board near the location where applicable.
- It is suggested that any person within the affected zone of (4 kW/m2) without proper PPE should immediately leave the area and fire fighting shall be done with proper PPEs by fire and safety/authorized personnel only
- Installation of fire detectors in the dyke area for earliest response in the control room and field may be reviewed by M/s NRL considering status of liquid HC holdup in other tanks along with Surge Relief Tank.
- Automatic Shut down system shall be installed
- All the project premises shall be monitored by surveillance cameras.
- Loading operations shall be immediately suspended in the event of leak, a fire in the vicinity, lightning and thunder storm.
- Clearly marked escape routes shall be provided in the gantry for ease of escape.
- Chemicals should be stored in a well-ventilated room.
- Electrical fixtures in the storage areas should be vapour-proof.
- Manual call point, Gas detection system and smoke detection system to be provided.
- Smoking and carrying smoking accessories are to be strictly prohibited.
- Storage of propylene should be in a place where temperature does not exceed 52°C.

- Periodic training and refresher courses should be provided to employees addressing all the hazards prevailing in the process
- Training should be provided on firefighting.
- Work Permit System should be strictly enforced.
- Any incidents including near misses should be recorded and root cause analysis should be done.
- The hazards identified shall be communicated to the neighbouring facilities and the employees shall be well aware of the hazards related to their facilities.
- MSDS shall be made easily available and the safety instructions to be communicated to all employees periodically.
- Periodic thickness survey to be conducted for pipelines.
- Safety Procedures and Do's and Don'ts should be prepared and displayed in handling and storage area.
- Mock Drills should be carried out regularly basis.
- Occupational health surveillance programmes are to be done six monthly & their documentation should be maintained
- Periodic health check-up employees to be conducted and recorded.
- Provision and use of proper PPEs to be confirmed.

Employees are being trained for First aider and made available in each shift.

7.3 Details on NDZ

The Environmental clearance for the "Expansion of Numaligarh Refinery from 3 MMTPA to 9 MMTPA at Pankagrant, Golaghat tehsil & district, Assam" has been granted on 27 th July, 2020. With reference to the Minutes of the 18th Meeting of the Expert Appraisal Committee (Industry-2 Sector) Held During 13-15 April, 2020 dated 24.04.2020 for this project it was informed that:

"The proposed project requires environmental clearance as per the EIA Notification, 2006 for its operations and prior approval of the central government as per the Ministry Notification vide S.O. 481 (E) dated 5th July, 1996, for any developmental/associated activities which could lead to pollution and congestion.

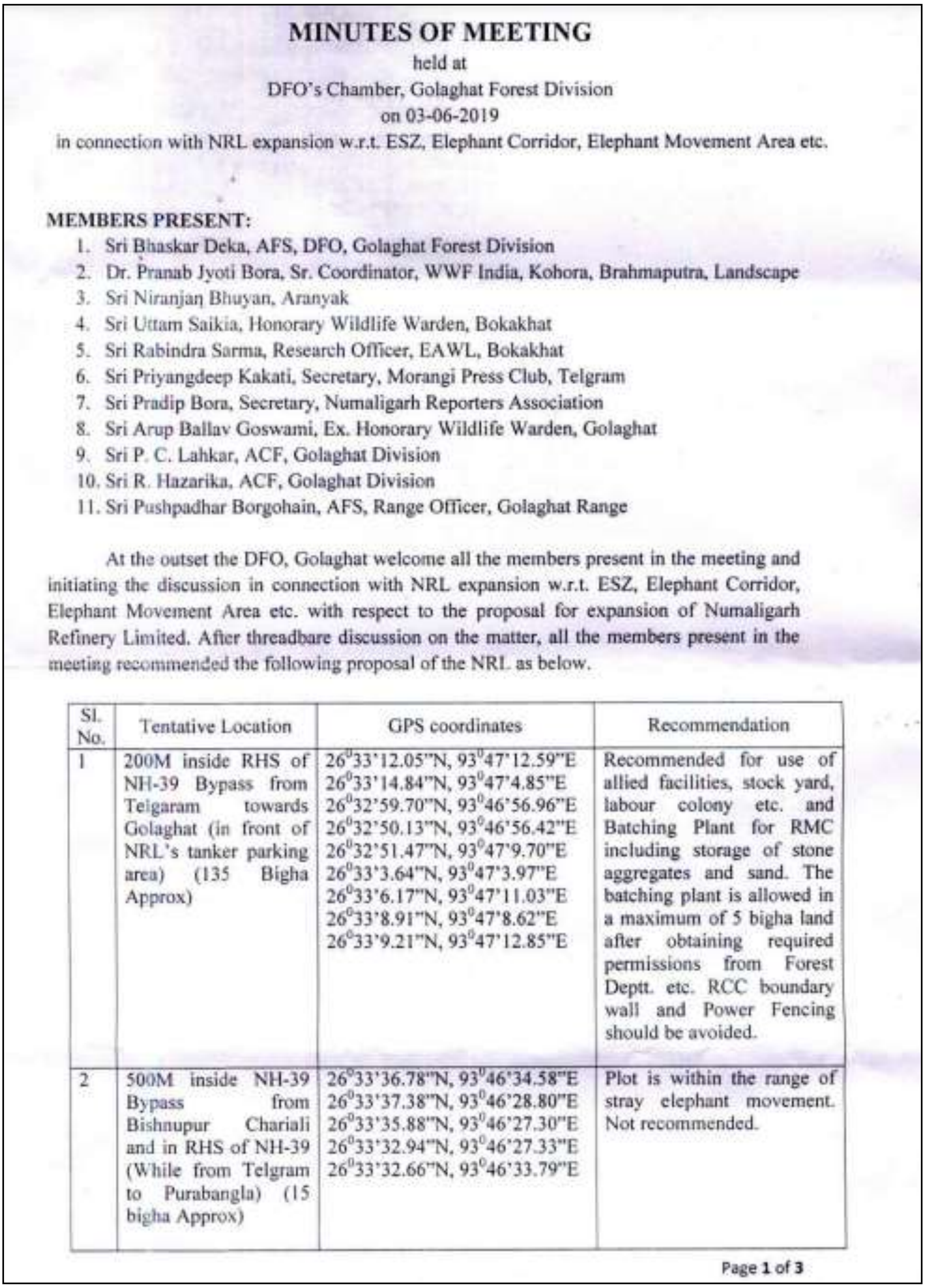
A meeting in this regard has been convened in the Ministry to consider approval for undertaking various associated activities in the NDZ area for the Numaligarh refinery".

Forest Department, Govt. of Assam, after due deliberations and discussions held with representatives of NGOs, WWF, Wildlife Warden and local press dated 03.06.2019 have cleared 9 out of 11 plots suitable for the intended purposes. Minute of Meeting of Forest Department, Govt. of Assam dated 03.06.2019 on the clearance/ recommendations of the plots is attached as **Annexure 2** and Kaziranga NDZ notification is attached as **Annexure 3.**

Plot Nos. 2 and 5 was rejected by Forest Department, Govt. of Assam due to elephant movements in these areas.NRL has not proposed any activity in Plot No. 11 (Tea garden) due to difficulty in acquisition.However NRL has obtained Plot no.11 and land document of the same is attached as **Annexure 1**

As plot no. 11 is falling in the No Development Zone (NDZ) notified by MoEFCC dated 05.07.1996, Forest Department, NRL to obtain NDZ clerance from MoEFCC to carry out any activities as per the condition laid down for the said NDZ notification.

Minute of Meeting of Forest Department, Govt. of Assam on the clearance/ recommendations of the plots



MINUTES OF MEETING

held at
DFO’s Chamber, Golaghat Forest Division
on 03-06-2019
in connection with NRL expansion w.r.t. ESZ, Elephant Corridor, Elephant Movement Area etc.

MEMBERS PRESENT:

1. Sri Bhaskar Deka, AFS, DFO, Golaghat Forest Division
2. Dr. Pranab Jyoti Bora, Sr. Coordinator, WWF India, Kohora, Brahmaputra, Landscape
3. Sri Niranjan Bhuyan, Aranyak
4. Sri Uttam Saikia, Honorary Wildlife Warden, Bokakhat
5. Sri Rabindra Sarma, Research Officer, EAWL, Bokakhat
6. Sri Priyangdeep Kakati, Secretary, Morangi Press Club, Telgram
7. Sri Pradip Bora, Secretary, Numaligarh Reporters Association
8. Sri Arup Ballav Goswami, Ex. Honorary Wildlife Warden, Golaghat
9. Sri P. C. Lahkar, ACF, Golaghat Division
10. Sri R. Hazarika, ACF, Golaghat Division
11. Sri Pushpadhar Borgohain, AFS, Range Officer, Golaghat Range

At the outset the DFO, Golaghat welcome all the members present in the meeting and initiating the discussion in connection with NRL expansion w.r.t. ESZ, Elephant Corridor, Elephant Movement Area etc. with respect to the proposal for expansion of Numaligarh Refinery Limited. After threadbare discussion on the matter, all the members present in the meeting recommended the following proposal of the NRL as below.

Sl. No.	Tentative Location	GPS coordinates	Recommendation
1	200M inside RHS of NH-39 Bypass from Telgaram towards Golaghat (in front of NRL’s tanker parking area) (135 Bigha Approx)	26^{0}33’12.05"N, 93^{0}47’12.59"E 26^{0}33’14.84"N, 93^{0}47’4.85"E 26^{0}32’59.70"N, 93^{0}46’56.96"E 26^{0}32’50.13"N, 93^{0}46’56.42"E 26^{0}32’51.47"N, 93^{0}47’9.70"E 26^{0}33’3.64"N, 93^{0}47’3.97"E 26^{0}33’6.17"N, 93^{0}47’11.03"E 26^{0}33’8.91"N, 93^{0}47’8.62"E 26^{0}33’9.21"N, 93^{0}47’12.85"E	Recommended for use of allied facilities, stock yard, labour colony etc. and Batching Plant for RMC including storage of stone aggregates and sand. The batching plant is allowed in a maximum of 5 bigha land after obtaining required permissions from Forest Deptt. etc. RCC boundary wall and Power Fencing should be avoided.
2	500M inside NH-39 Bypass from Bishnupur Chariali and in RHS of NH-39 (While from Telgram to Purabangla) (15 bigha Approx)	26^{0}33’36.78"N, 93^{0}46’34.58"E 26^{0}33’37.38"N, 93^{0}46’28.80"E 26^{0}33’35.88"N, 93^{0}46’27.30"E 26^{0}33’32.94"N, 93^{0}46’27.33"E 26^{0}33’32.66"N, 93^{0}46’33.79"E	Plot is within the range of stray elephant movement. Not recommended.

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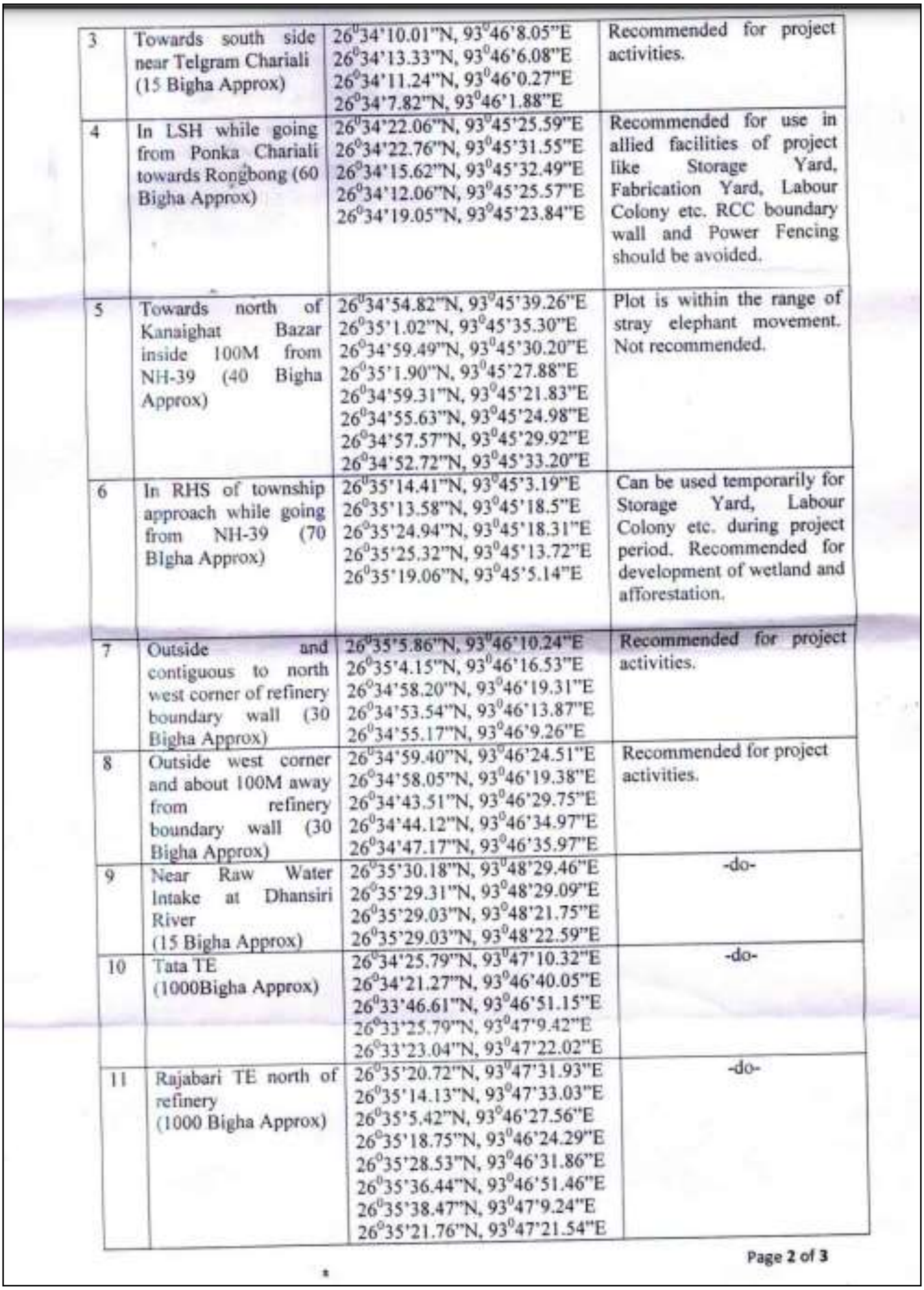
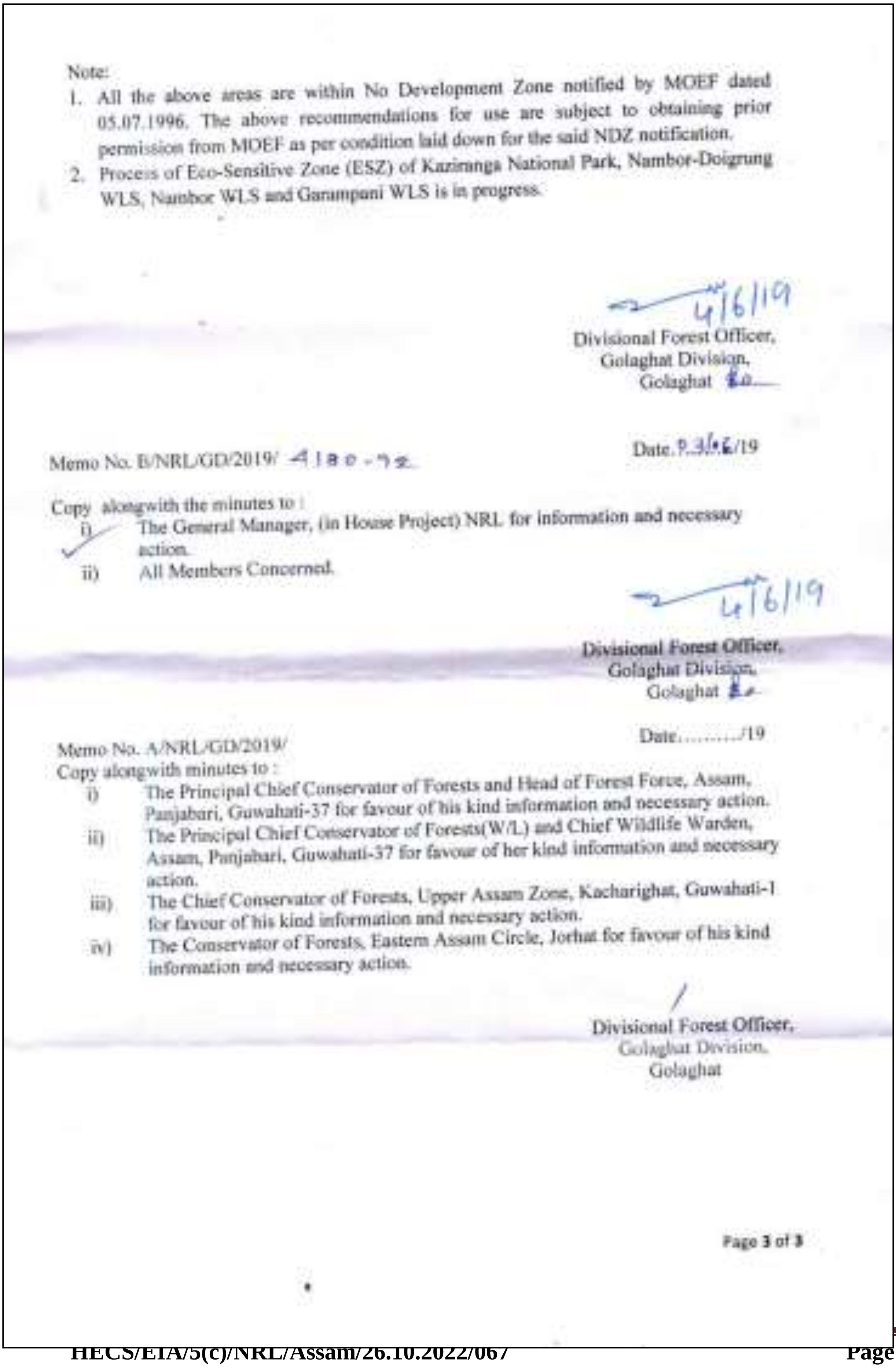


3	Towards south side near Telgram Chariali (15 Bigha Approx)	26^{0}34’10.01”N, 93^{0}46’8.05”E 26^{0}34’13.33”N, 93^{0}46’6.08”E 26^{0}34’11.24”N, 93^{0}46’0.27”E 26^{0}34’7.82”N, 93^{0}46’1.88”E	Recommended for project activities.
4	In LSH while going from Ponka Chariali towards Rongbong (60 Bigha Approx)	26^{0}34’22.06”N, 93^{0}45’25.59”E 26^{0}34’22.76”N, 93^{0}45’31.55”E 26^{0}34’15.62”N, 93^{0}45’32.49”E 26^{0}34’12.06”N, 93^{0}45’25.57”E 26^{0}34’19.05”N, 93^{0}45’23.84”E	Recommended for use in allied facilities of project like Storage Yard, Fabrication Yard, Labour Colony etc. RCC boundary wall and Power Fencing should be avoided.
5	Towards north of Kanaighat Bazar inside 100M from NH-39 (40 Bigha Approx)	26^{0}34’54.82”N, 93^{0}45’39.26”E 26^{0}35’1.02”N, 93^{0}45’35.30”E 26^{0}34’59.49”N, 93^{0}45’30.20”E 26^{0}35’1.90”N, 93^{0}45’27.88”E 26^{0}34’59.31”N, 93^{0}45’21.83”E 26^{0}34’55.63”N, 93^{0}45’24.98”E 26^{0}34’57.57”N, 93^{0}45’29.92”E 26^{0}34’52.72”N, 93^{0}45’33.20”E	Plot is within the range of stray elephant movement. Not recommended.
6	In RHS of township approach while going from NH-39 (70 BIgha Approx)	26^{0}35’14.41”N, 93^{0}45’3.19”E 26^{0}35’13.58”N, 93^{0}45’18.5”E 26^{0}35’24.94”N, 93^{0}45’18.31”E 26^{0}35’25.32”N, 93^{0}45’13.72”E 26^{0}35’19.06”N, 93^{0}45’5.14”E	Can be used temporarily for Storage Yard, Labour Colony etc. during project period. Recommended for development of wetland and afforestation.
7	Outside and contiguous to north west corner of refinery boundary wall (30 Bigha Approx)	26^{0}35’5.86”N, 93^{0}46’10.24”E 26^{0}35’4.15”N, 93^{0}46’16.53”E 26^{0}34’58.20”N, 93^{0}46’19.31”E 26^{0}34’53.54”N, 93^{0}46’13.87”E 26^{0}34’55.17”N, 93^{0}46’9.26”E	Recommended for project activities.
8	Outside west corner and about 100M away from refinery boundary wall (30 Bigha Approx)	26^{0}34’59.40”N, 93^{0}46’24.51”E 26^{0}34’58.05”N, 93^{0}46’19.38”E 26^{0}34’43.51”N, 93^{0}46’29.75”E 26^{0}34’44.12”N, 93^{0}46’34.97”E 26^{0}34’47.17”N, 93^{0}46’35.97”E	Recommended for project activities.
9	Near Raw Water Intake at Dhansiri River (15 Bigha Approx)	26^{0}35’30.18”N, 93^{0}48’29.46”E 26^{0}35’29.31”N, 93^{0}48’29.09”E 26^{0}35’29.03”N, 93^{0}48’21.75”E 26^{0}35’29.03”N, 93^{0}48’22.59”E	-do-
10	Tata TE (1000Bigha Approx)	26^{0}34’25.79”N, 93^{0}47’10.32”E 26^{0}34’21.27”N, 93^{0}46’40.05”E 26^{0}33’46.61”N, 93^{0}46’51.15”E 26^{0}33’25.79”N, 93^{0}47’9.42”E 26^{0}33’23.04”N, 93^{0}47’22.02”E	-do-
11	Rajabari TE north of refinery (1000 Bigha Approx)	26^{0}35’20.72”N, 93^{0}47’31.93”E 26^{0}35’14.13”N, 93^{0}47’33.03”E 26^{0}35’5.42”N, 93^{0}46’27.56”E 26^{0}35’18.75”N, 93^{0}46’24.29”E 26^{0}35’28.53”N, 93^{0}46’31.86”E 26^{0}35’36.44”N, 93^{0}46’51.46”E 26^{0}35’38.47”N, 93^{0}47’9.24”E 26^{0}35’21.76”N, 93^{0}47’21.54”E	-do-



Note:

1. All the above areas are within No Development Zone notified by MOEF dated 05.07.1996. The above recommendations for use are subject to obtaining prior permission from MOEF as per condition laid down for the said NDZ notification.
2. Process of Eco-Sensitive Zone (ESZ) of Kaziranga National Park, Nambor-Doigrung WLS, Nambor WLS and Garampani WLS is in progress.

4/6/19

Divisional Forest Officer,
Golaghat Division,
Golaghat

Memo No. B/NRL/GD/2019/ 4180-92

Date.03/06/19

Copy alongwith the minutes to :

i) The General Manager, (in House Project) NRL for information and necessary action.
ii) All Members Concerned.

4/6/19

Divisional Forest Officer,
Golaghat Division,
Golaghat

Memo No. A/NRL/GD/2019/

Date........../19

Copy alongwith minutes to :

i) The Principal Chief Conservator of Forests and Head of Forest Force, Assam, Panjabari, Guwahati-37 for favour of his kind information and necessary action.
ii) The Principal Chief Conservator of Forests(W/L) and Chief Wildlife Warden, Assam, Panjabari, Guwahati-37 for favour of her kind information and necessary action.
iii) The Chief Conservator of Forests, Upper Assam Zone, Kacharighat, Guwahati-1 for favour of his kind information and necessary action.
iv) The Conservator of Forests, Eastern Assam Circle, Jorhat for favour of his kind information and necessary action.

Divisional Forest Officer,
Golaghat Division,
Golaghat

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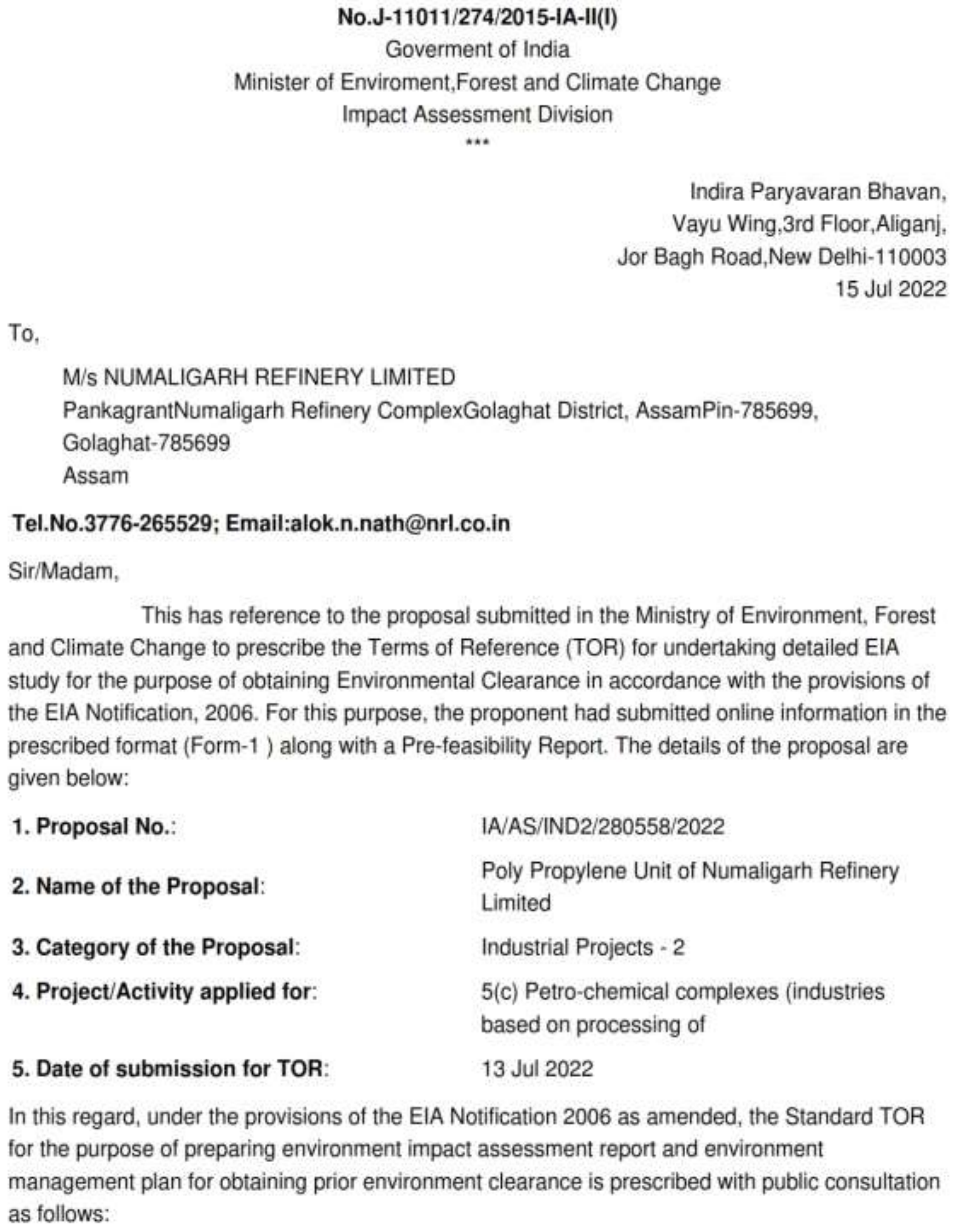
7.4 TOR issued by MoEF



No.J-11011/274/2015-IA-II(I)
Goverment of India
Minister of Enviroment,Forest and Climate Change
Impact Assessment Division
***

Indira Paryavaran Bhavan,
Vayu Wing,3rd Floor,Aliganj,
Jor Bagh Road,New Delhi-110003
15 Jul 2022

To,

M/s NUMALIGARH REFINERY LIMITED
PankagrantNumaligarh Refinery ComplexGolaghat District, AssamPin-785699,
Golaghat-785699
Assam

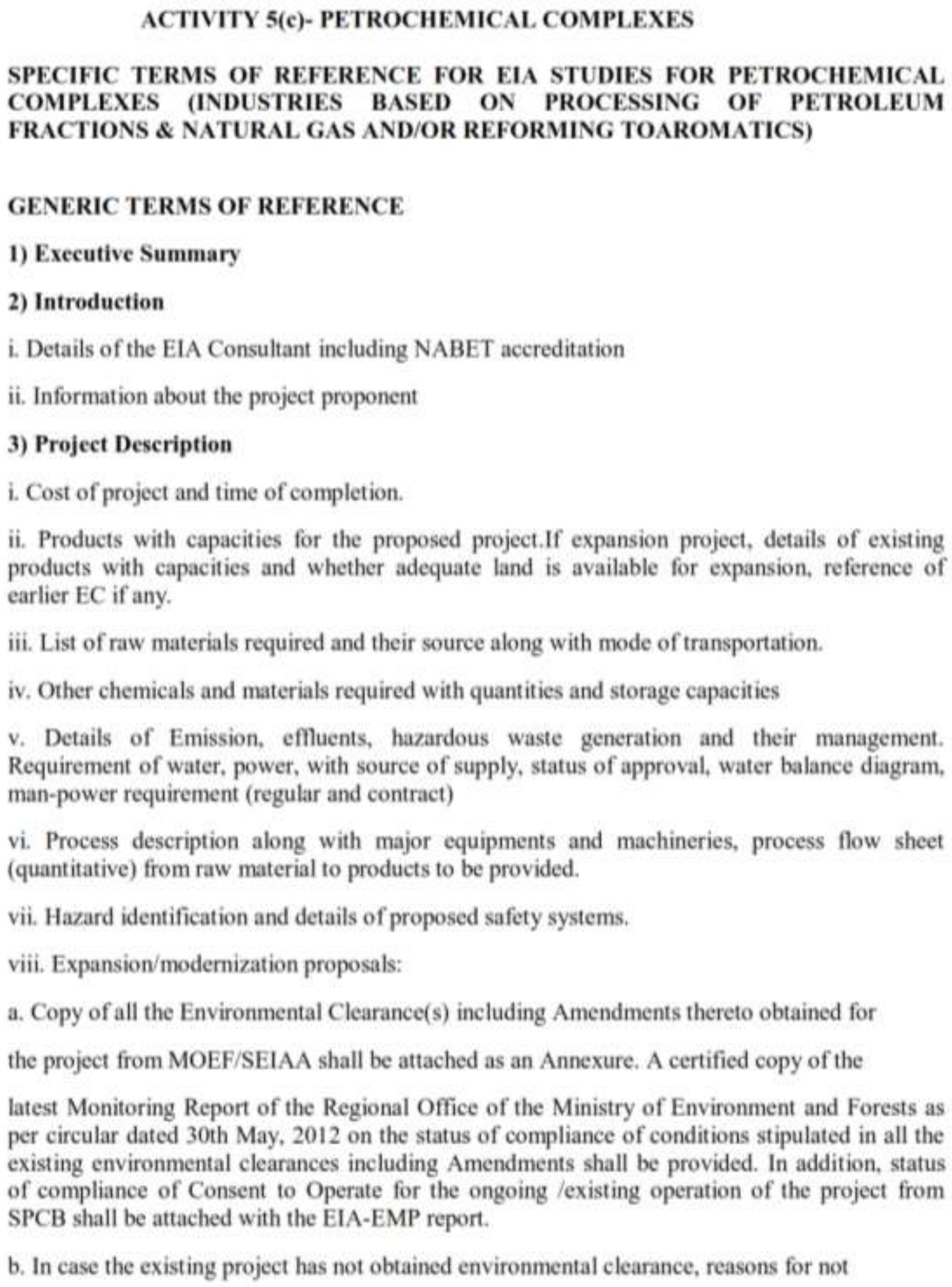
Tel.No.3776-265529; Email:alok.n.nath@nrl.co.in

Sir/Madam,

This has reference to the proposal submitted in the Ministry of Environment, Forest and Climate Change to prescribe the Terms of Reference (TOR) for undertaking detailed EIA study for the purpose of obtaining Environmental Clearance in accordance with the provisions of the EIA Notification, 2006. For this purpose, the proponent had submitted online information in the prescribed format (Form-1) along with a Pre-feasibility Report. The details of the proposal are given below:

1. Proposal No.:	IA/AS/IND2/280558/2022
2. Name of the Proposal:	Poly Propylene Unit of Numaligarh Refinery Limited
3. Category of the Proposal:	Industrial Projects - 2
4. Project/Activity applied for:	5(c) Petro-chemical complexes (industries based on processing of
5. Date of submission for TOR:	13 Jul 2022

In this regard, under the provisions of the EIA Notification 2006 as amended, the Standard TOR for the purpose of preparing environment impact assessment report and environment management plan for obtaining prior environment clearance is prescribed with public consultation as follows:



ACTIVITY 5(c)- PETROCHEMICAL COMPLEXES

SPECIFIC TERMS OF REFERENCE FOR EIA STUDIES FOR PETROCHEMICAL COMPLEXES (INDUSTRIES BASED ON PROCESSING OF PETROLEUM FRACTIONS & NATURAL GAS AND/OR REFORMING TOAROMATICS)

GENERIC TERMS OF REFERENCE

1) Executive Summary

2) Introduction

i. Details of the EIA Consultant including NABET accreditation

ii. Information about the project proponent

3) Project Description

i. Cost of project and time of completion.

ii. Products with capacities for the proposed project.If expansion project, details of existing products with capacities and whether adequate land is available for expansion, reference of earlier EC if any.

iii. List of raw materials required and their source along with mode of transportation.

iv. Other chemicals and materials required with quantities and storage capacities

v. Details of Emission, effluents, hazardous waste generation and their management. Requirement of water, power, with source of supply, status of approval, water balance diagram, man-power requirement (regular and contract)

vi. Process description along with major equipments and machineries, process flow sheet (quantitative) from raw material to products to be provided.

vii. Hazard identification and details of proposed safety systems.

viii. Expansion/modernization proposals:

a. Copy of all the Environmental Clearance(s) including Amendments thereto obtained for

the project from MOEF/SEIAA shall be attached as an Annexure. A certified copy of the

latest Monitoring Report of the Regional Office of the Ministry of Environment and Forests as per circular dated 30th May, 2012 on the status of compliance of conditions stipulated in all the existing environmental clearances including Amendments shall be provided. In addition, status of compliance of Consent to Operate for the ongoing /existing operation of the project from SPCB shall be attached with the EIA-EMP report.

b. In case the existing project has not obtained environmental clearance, reasons for not taking EC under the provisions of the EIA Notification 1994 and/or EIA Notification 2006 shall be provided. Copies of Consent to Establish/No Objection Certificate and Consent to Operate (in case of units operating prior to EIA Notification 2006, CTE and CTO of FY 2005-2006) obtained from the SPCB shall be submitted. Further, compliance report to the conditions of consents from the SPCB shall be submitted.

4) Site Details

i. Location of the project site covering village, Taluka/Tehsil, District and State, Justification forselecting the site, whether other sites were considered.

ii. A toposheet of the study area of radius of 10 km and site location on 1:50,000/1:25,000 scale on an A3/A2 sheet. (including all eco-sensitive areas and environmentally sensitive places)

iii. Co-ordinates (lat-long) of all four corners of the site. Google map-Earth downloaded of the project site. Layout maps indicating existing unit as well as proposed unit indicating storage area, plant area, greenbelt area, utilities etc. If located within an Industrial area/Estate/Complex, layout of Industrial Area indicating location of unit within the Industrial area/Estate.

iv. Photographs of the proposed and existing (if applicable) plant site. If existing, show photographs of plantation/greenbelt, in particular.

v. Land use break-up of total land of the project site (identified and acquired), government/

private - agricultural, forest, wasteland, water bodies, settlements, etc shall be included. (not

required for industrial area).

vi. A list of major industries with name and type within study area (10km radius) shall be

incorporated.

vii. Details of Drainage of the project up to 5km radius of study area. If the site is within 1 km radius of any major river, peak and lean season river discharge as well as flood occurrence frequency based on peak rainfall data of the past 30 years. Details of Flood Level of the project site and maximum Flood Level of the river shall also be provided. (mega green field projects).

viii. Status of acquisition of land. If acquisition is not complete, stage of the acquisition process and expected time of complete possession of the land.

ix. R&R details in respect of land in line with state Government policy.

5) Forest and wildlife related issues (if applicable):

i. Permission and approval for the use of forest land (forestry clearance), if any, and recommendations of the State Forest Department. (if applicable)

ii. Land use map based on High resolution satellite imagery (GPS) of the proposed site delineating the forestland (in case of projects involving forest land more than 40 ha).

iii. Status of Application submitted for obtaining the stage I forestry clearance along with latest status shall be submitted.

iv. The projects to be located within 10 km of the National Parks, Sanctuaries, Biosphere Reserves, Migratory Corridors of Wild Animals, the project proponent shall submit the map duly authenticated by Chief Wildlife Warden showing these features vis-à-vis the project location and the recommendations or comments of the Chief Wildlife Warden-thereon

v. Wildlife Conservation Plan duly authenticated by the Chief Wildlife Warden of the State

Government for conservation of Schedule I fauna, if any exists in the study area

vi. Copy of application submitted for clearance under the Wildlife (Protection) Act, 1972, to the Standing Committee of the National Board for Wildlife.

6) Environmental Status

i. Determination of atmospheric inversion level at the project site and site-specific micrometeorological data using temperature, relative humidity, hourly wind speed and direction and rainfall.

ii. AAQ data (except monsoon) at 8 locations for PM10, PM2.5, SO2, NOX, CO and other parameters relevant to the project shall be collected. The monitoring stations shall be based CPCB guidelines and take into account the pre-dominant wind direction, population zone and sensitive receptors including reserved forests.

iii. Raw data of all AAQ measurement for 12 weeks of all stations as per frequency given in the NAQQM Notification of Nov. 2009 along with - min., max., average and 98% values for each of the AAQ parameters from data of all AAQ stations should be provided as an annexure to the EIA Report.

iv. Surface water quality of nearby River (100m upstream and downstream of discharge point) and other surface drains at eight locations as per CPCB/MoEF&CC guidelines.

v. Whether the site falls near to polluted stretch of river identified by the CPCB/MoEF&CC, if yes give details.

vi. Ground water monitoring at minimum at 8 locations shall be included.

vii. Noise levels monitoring at 8 locations within the study area.

viii. Soil Characteristic as per CPCB guidelines.

ix. Traffic study of the area, type of vehicles, frequency of vehicles for transportation of materials, additional traffic due to proposed project, parking arrangement etc.

x. Detailed description of flora and fauna (terrestrial and aquatic) existing in the study area shall be given with special reference to rare, endemic and endangered species. If Schedule- I fauna are found within the study area, a Wildlife Conservation Plan shall be prepared and furnished.

xi. Socio-economic status of the study area.

7) Impact and Environment Management Plan

i Assessment of ground level concentration of pollutants from the stack emission based on site specific meteorological features. In case the project is located on a hilly terrain, the AQIP Modeling shall be done using inputs of the specific terrain characteristics for determining the potential impacts of the project on the AAQ. Cumulative impact of all sources of emissions (including transportation) on the AAQ of the area shall be assessed. Details of the model used and the input data used for modeling shall also be provided. The air quality contours shall be plotted on a location map showing the location of project site, habitation nearby, sensitive receptors, if any.
ii. Water Quality modeling - in case of discharge in water body

iii. Impact of the transport of the raw materials and end products on the surrounding environment shall be assessed and provided. In this regard, options for transport of raw materials and finished products and wastes (large quantities) by rail or rail-cum road transport or conveyor cum- rail transport shall be examined.

iv. A note on treatment of wastewater from different plant operations, extent recycled and reused for different purposes shall be included. Complete scheme of effluent treatment. Characteristics of untreated and treated effluent to meet the prescribed standards of discharge under E(P) Rules.

v. Details of stack emission and action plan for control of emissions to meet standards.

vi. Measures for fugitive emission control

vii. Details of hazardous waste generation and their storage, utilization and management. Copies of MOU regarding utilization of solid and hazardous waste in cement plant shall also be included. EMP shall include the concept of waste-minimization, recycle/reuse/recover techniques, Energy conservation, and natural resource conservation.

viii. Proper utilization of fly ash shall be ensured as per Fly Ash Notification, 2009. A detailed plan of action shall be provided.

ix. Action plan for the green belt development plan in 33 % area i.e. land with not less than1,500 trees per ha. Giving details of species, width of plantation, planning schedule etc. shall be included. The green belt shall be around the project boundary and a scheme for greening of the roads used for the project shall also be incorporated.

x. Action plan for rainwater harvesting measures at plant site shall be submitted to harvest rainwater from the roof tops and storm water drains to recharge the ground water and also to use for the various activities at the project site to conserve fresh water and reduce the water requirement from other sources.

8) Occupational health

i. Plan and fund allocation to ensure the occupational health & safety of all contract and casual workers.

ii. Details of exposure specific health status evaluation of worker. If the workers' health is being evaluated by pre designed format, chest x rays, Audiometry, Spirometry, Vision testing (Far &

Near vision, colour vision and any other ocular defect) ECG, during pre placement and periodical examinations give the details of the same. Details regarding last month analyzed data of above mentioned parameters as per age, sex, duration of exposure and department wise.

iii.Details of existing Occupational & Safety Hazards. What are the exposure levels of hazards and whether they are within Permissible Exposure level (PEL). If these are not within PEL, what measures the company has adopted to keep them within PEL so that health of the workers can be preserved.

iv. Annual report of heath status of workers with special reference to Occupational Health and Safety.

9) Corporate Environment Policy

i. Does the company have 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 have system of reporting of non compliances / violations of environmental norms to the Board of Directors of the company and / or shareholders or stakeholders at large? This reporting mechanism shall be detailed in the EIA report.

10) Details regarding infrastructure facilities such as sanitation, fuel, restroom etc. to be provided to the labor force during construction as well as to the casual workers including truck drivers during operation phase.

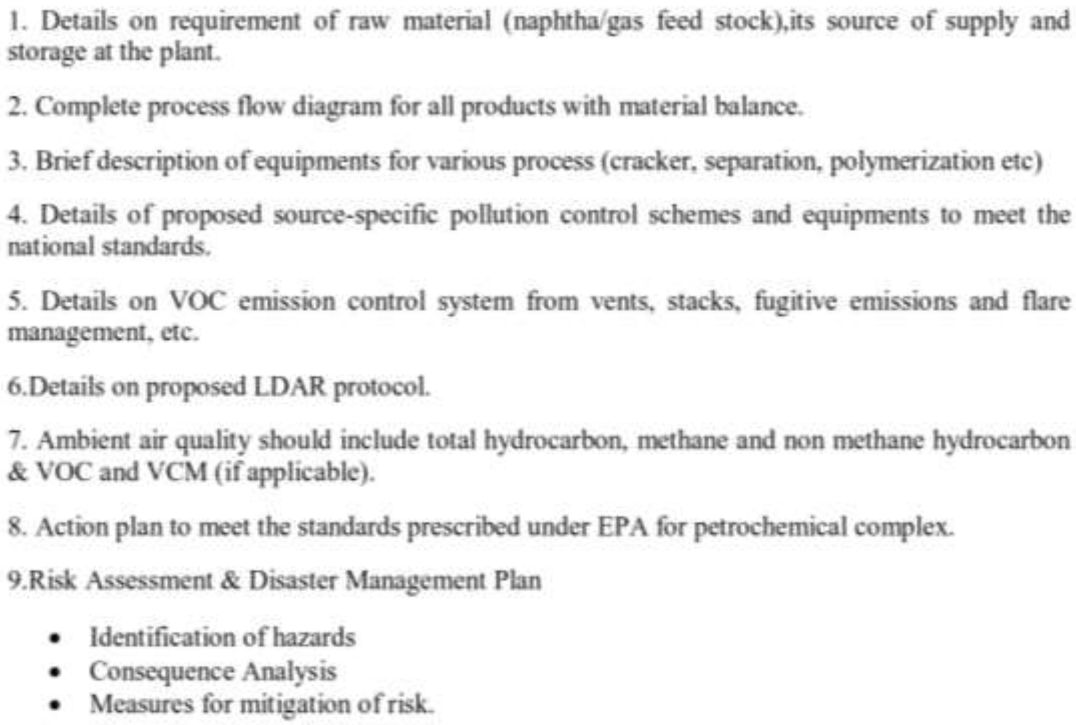
11) Enterprise Social Committment (ESC)

i. Adequate funds (at least 2.5 % of the project cost) shall be ear marked towards the Enterprise Social Commitment based on Public Hearing issues and item-wise details along with time bound action plan shall be included. Socio-economic development activities need to be elaborated upon.

11) Any litigation pending against the project and/or any direction/order passed by any Court of Law against the project, if so, details thereof shall also be included. Has the unit received any notice under the Section 5 of Environment (Protection) Act, 1986 or relevant Sections of Air and Water Acts? If so, details there of and compliance/ATR to the notice(s) and present status of the case.

13) A tabular chart with index for point wise compliance of above TOR.

SPECIFIC CONDITIONS



1. Details on requirement of raw material (naphtha/gas feed stock),its source of supply and storage at the plant.

2. Complete process flow diagram for all products with material balance.

3. Brief description of equipments for various process (cracker, separation, polymerization etc)

4. Details of proposed source-specific pollution control schemes and equipments to meet the national standards.

5. Details on VOC emission control system from vents, stacks, fugitive emissions and flare management, etc.

6.Details on proposed LDAR protocol.

7. Ambient air quality should include total hydrocarbon, methane and non methane hydrocarbon & VOC and VCM (if applicable).

8. Action plan to meet the standards prescribed under EPA for petrochemical complex.

9.Risk Assessment & Disaster Management Plan

- Identification of hazards
- Consequence Analysis
- Measures for mitigation of risk.

CHAPTER 8

PROJECT BENEFITS

8 PROJECT BENEFITS

8.1 Project Benefits

Polypropylene (PP) is very versatile product and can be used for injection moulding, fibre, film, and other extrusion processes. It is used in a wide range of market segments including packaging, consumer products, automotive, textile and building and construction. The followings are the benefits of the proposed PP project:

This project will meet the domestic PP demand, reduce import and reduce outgoing of foreign currency.

- Value addition of propylene content of LPG for production of high value polypropylene (PP)
- Will help in meeting the domestic PP demand by reducing import thereby reducing outgoing of foreign currency
- Employment generation
- Increase petrochemicals domestic market share
- Helps in achieving the dream of “AatamNirbhar Bharat” by having self-sufficient production of PP and further value addition to make the finished products, which are specifically made from Polypropylene (PP).
- In view of expected growth in demand for petrochemicalsproducts in India and to remain competitive in the market with products self sufficiency
- Major applications are in the medical industry, fashion and sports industry, automotive industry and consumer products industry (housewares, toys, luggage etc.)

Improvements in Physical Infrastructure

No major physical infrastructural change or improvement has been envisaged due to establishmentof the proposed project. All the required infrastructural facilities such as township, hospital, school etc.are readily available in Golaghat to support the establishmentof proposed project.

Improvements in Social Infrastructure

Economic infrastructure is essential for improving the productive capacity of the nation. But social infrastructure is also required to improve the quality of human resources. It consists of services like education, medical facilities, sanitation, housing, drinking water supply etc.these altogether constitute the social infrastructure of an economy. Various CSR activities will be done by NRL every year to satisfy the basic requirements of the social infrastructure.

Employment Potential-Skilled, Semi-Skilled & unskilled

The project will provide employment potential for construction Labour during implementation phase.

During operational phase, thisprojectwillalsogenerate Direct &Indirectemp

loyment in the form of contractors, workers, transporters, marketing and ancillary facilities and general utility services.

CHAPTER 9

ENVIRONMENTAL COST BENEFIT ANALYSIS

9 ENVIRONMENTAL COST BENEFIT ANALYSIS

This Chapter is not in Scoping Stage

- No specific TOR has been issued by MOEF&CC pertaining to Environmental Cost BenefitAnalysis.
- All environmental measures will be implemented and operated to comply with norms.

CHAPTER 10

ENVIRONMENTAL MANAGEMENT PLAN

10 ENVIRONMENTAL MANAGEMENT PLAN

10.1 Description of the administrative aspects of ensuring that mitigative measures are implemented and their effectiveness monitored

This Environmental Management Plan (EMP) for M/s.Numaligarh Refinery Limited identifies the principles, procedures and methods that will be used to control and minimize the environmental impacts of the proposed minor construction and operational activities associated with the proposed project. It is intended to ensure that commitments made by NRL to minimize project related environmental and social impacts are upheld throughout all project phases.

As part of our ongoing commitment to excellence in environmental and social performance we will ensure the following:

- Fulfill all environmental conditions associated with project approvals.
- Develop, promote and foster a shared sense of responsibility for environmental and performance of the project.
- Promote environmental awareness and understanding among employees and contractors through training, identification of roles and responsibilities towards environmental management and linking project performance to overall environmental performance.
- Monitor environmental performance throughout the project and implement an adaptive management approach to continuous improvement and to meet the future regulations.

10.2 Objectives of EMP

- To suggest the formation of a core group (Environment Management Cell) responsible for implementation of environmental control & protective measures as well as monitoring of such implementation.
- To ensure project components are compliant with all laws and approval conditions
- Continue baseline monitoring
- Facilitate a continual review of post construction and operation activities.
- To suggest preventive and mitigation measures to minimize adverse impact and to maximize beneficial impacts like

- Preparation of Afforestation or Greenbelt Development scheme.
- Preparation of rain water harvesting scheme and energy conservation actions
- To prepare a capital cost estimate and annual recurring cost for Environmental Management Plan.
- To prepare a detailed action plan for implementation of mitigation measures.
- Measure the effectiveness and success of proposed mitigation measures

10.3 EMP Structure and Organization

This EMP is designed as an overriding document in a hierarchy of control plans, and sets out the overarching framework of environmental management principles that will be applied to the project during preconstruction, construction and operation phase of the project.

The EMP contains guiding environmental principles and procedures for communication, reporting, training, monitoring and plan review to which all staff, contractors and subcontractors are required to comply with throughout the preconstruction, construction and operation phases of the proposed projects. Organogram of environmental cell is given in **Figure 10-1**

Figure 10-1 Organogram of Environmental Cell

The EMP should also be considered as an overall framework document that establishes the terms of reference for all project environmental and social sub-plans including the following:

- Environmental Supervision Plan (construction);
- Environmental Monitoring Plan (construction and operation); and
- Social and Health Management Plan (construction and operation).

10.4 EMP Roles and Responsibilities

This section describes the organizational structure and responsibilities for implementation of the EMP as shown in **Table 10-1**

Table 10-1Responsibility for EMP Implementation

S.No	Organization	Responsibility

1	Chief General Manager, TS (HOD)	• To liaise with all Regulatory Bodies such as -MOEF& CC, CPCB and SPCB. Keeping communication and providing necessary inputs to SPCB, CPCB Board, MOP & NG , MOEF& CC and other Govt agencies as per requirement and as & when required.. • To give necessary inputs for obtaining Environmental clearance for New projects • Providing inputs to the higher authority in the areas of environment management. • To ensure and implement the management system confirming to ISO-14001 • Co-ordination with other department regarding the implementation of the management system. • To ensure optimum operation of Pollution Control systems and instrumentation in the areas of Effluent Treatment Plant, Refinery Units" Refinery stacks, SRU, OMS in coordination with concern departments • To ensure compliance of statutory requirements in relation to effluent, water, emissions, waste management /disposal • Attending Apex Committee Meeting /FCM and highlighting the achievement to Higher Authority and put forward the area of concern for needful solution.
2	Deputy General Manager, (TS, I/C Energy &Environment)	• To ensure optimum operation of Pollution Control systems and instrumentation in the areas of Effluent Treatment Plant, Refinery Units,, Refinery stacks, SRU etc by coordination with concern departments. • To ensure compliance of statutory requirements in relation to effluent, water, emissions, waste disposal etc. • Monitoring of plant efficiency of furnaces, boilers etc and suggesting improvements. • Regular technical audit of critical areas like furnace

		efficiency etc and suggesting for improvements. • Maintaining effective co-ordination with other departments viz. operation, maintenance, CPP, quality control, finance etc in the area of environmental performance • Co-ordination with other department regarding the implementation of the management system confirming ISO-14001. • Providing inputs /highlighting any concern / issues to the higher Authority including HR in the areas of environmental practice
3	Deputy General Manager, (TS, Environment)	• Regular monitoring of environmental performance of all operating units including NRMT & township. • Follow up the requirement of ISO-1400I Environment Management system • and ensuring all the compliances under environmental regulations. • Dealing with the related activities for upcoming new projects Carrying out suggested measure for improvement and also actions taken thereof. Deals with EC, Consent, approval. for new projects as well for existing Refinery setup. • Coordinating for environmental and other activities with other dept. • Preparing Consent Application, HYR, Renewal Authorization for Hazarodus Waste , monitoring ETP and EIA IEC related issue,documents /reports etc. • Planning and action for Public Hearing , dealing with budget related issues and R TI related issues etc , Dealing with ne projects and necessary arrangement /action there on . • Actions I steps for disposal of hazardous waste like - oily sludge/ spent catalyst , e waste to recognized/

		approved recycler coordinating with Commercial dept./Warehouse and Operation Dept.
4	• Assistant Manager, TS (Environment.)	• Monitoring of environmental activities of the refinery on day to day basis and suggesting for the improvement measures. • Preparation of monthly environmental performance report for submission to SPCB/CPCB and regulatory bodies. • Preparation of yearly environmental performance report, annual return of hazardous wastes, half yearly return of buck consumers of Batteries, Environmental statement etc for submission to different statutory authorities. • Co-ordination of AAQM, TLV, Fugitive Emission survey, Stack monitoring etc carrying out by different agencies. Supervising & monitoring contractual activities. • To ensure compliance of ISO-1400I for environmental Management System • Preparing various contract proposal, raising PR , certifying bills • Coordination with various Dept. on various environmental issues • To face ISO/IA/ESA audits as & when required • Other related departmental activities as per requirement for the refinery.

10.5 Environmental Management Plan for Construction Phase

Environmental impacts during the construction phase can be attributed to the site preparation activity and the mobilization of workforce. The impacts of the construction phase on the environment would be basically of transient nature and are expected to wear out gradually on completion of the construction programme. However, once the construction of the project is completed and its operations started, these operation stage impacts would overlap the impacts due to the construction activities.

In order to mitigate such impacts and restrict them within tolerable levels, the following measures shall be adopted:

1. Proper and prior planning of approach and access roads, and appropriate sequencing and scheduling of all major construction activities.
2. Adoption of appropriate soil conservation programme and its timely implementation in the proposed project site.
3. Water sprinkling in the vulnerable areas to suppress the dust generated during excavation, levelling and other operations.
4. Use of properly tuned construction machinery & vehicles in good working condition with low noise & emission and engines turned off when not in use.
5. Control of quality of construction wastewater within the construction site through suitable drainage system with traps for arresting the sediment load for its proposed disposal into the main natural drainage system around the site.
6. Implementation of suitable disposal methods of sediment/ construction debris at designated places to avoid water logging at construction site.
7. Provision of protective gears such as ear mufflers etc. for construction personnel exposed to high noise levels and locating the temporary labour sheds for housing the construction labourers away from the construction site.

10.5.1 Air Quality

There will be major construction activities for the project, civil work like foundation for new vessels and supporting infrastructure for the new machineries will be carried out. During construction activities, dust emission and emissions from the movement of vehicles and construction activity is expected. However, following measures will be taken to reduce / contain such emissions.

- Water will be sprinkled on inner roads to prevent re-suspension of dust into ambient air due to movement of heavy vehicles etc.

- Roads shall be kept free from mud, debris and other obstacles.
- Separate civil construction material storage yard will be created within the site and it will be enclosed.
- Cement bags will be separately stored under cover in bales. Sand will be stacked under tarpaulin cover.
- Transport vehicles and construction equipment’s/ machineries will be properly maintained to reduce air emissions.
- All construction workers will be provided appropriate PPEs like dust mask, ear plug, helmet, safety belt etc. and it will be mandatory for them to wear while entering the site itself.
- Increase signage and speed limit postings

10.5.2 Noise Environment

Following measures are proposed during construction period to mitigate adverse impacts of noise:

- Construction activities will be done on round the clock basis.
- All machineries to be used for construction purpose will be of highest standard of reputed make and compliance of noise pollution control norms by this equipment’s will be emphasized.
- All construction workers working in high noise areas will be provided appropriate PPEs like ear muffs and made to wear them during working hours.

10.5.3 Water Quality and Water Resources

- Since the construction workers are hired from nearby villages there will be no housing facility at the site for construction workers and hence lesser water requirement
- Proper and sufficient sanitary facility will be created at the site in the form of Toilets &ETP in NRL will be used for treatment of effluent generated.

10.5.4 Solid Waste

- Main solid waste generation during construction phase will be construction debris like rubble, brick bats, debris, steel scrap, wooden scrap, sand, gravel etc. However, these materials are inert in nature and will not result into leaching of any substance or it's constituent.

- These materials will be carefully sorted and will be used within premises for filling of low lying areas.
- Wooden scrap, steel scrap will be given to authorized scrap dealers.
- On completion of civil work, all debris etc. will be completely removed from site to avoid any incompatibility with future use.
- All the wastes will be stored at a designated site within the premises to prevent scattered discharge on land.

10.5.5 Land Environment

- Top soil layers shall be stored for reclamation and re-vegetation and reforestation at approved locations.
- Storm water drainage facility will be used for disposal of storm water.

10.5.6 Ecology

Project site is a green field so there will be clearance of minimal vegetation for proposed projects and adequate measures will be taken to replant the same to maintain the greenbelt for the proposed project.

10.5.7 Socio Economic

There will be temporary employment for manpower required during construction phase available from local communities. Overall socioeconomic effect of construction phase will be positive due to direct and indirect employment opportunity for the local population.

10.6 Environmental Management Plan for Operation Phase

Monitoring during the operation phase shall reflect those environmental and socio-economic issues that may persist upon completion of construction activities. Monitoring shall focus on evaluating the effectiveness of project mitigation measures and continue baseline monitoring and sampling. The mitigation measures to prevent adverse impact during the operation phase of the project shall focus on the following:

- Air quality

- Noise environment
- Solid and hazardous waste
- Land environment

10.6.1 Air Quality Management

The gaseous emissions from the proposed project will be controlled to meet all the relevant standards stipulated by the regulatory authorities. Standards applicable to this project are classified into three categories:

- Ambient Air Standards
- Emission Standards
- VOC control, Emission and Monitoring

Following measures are proposed to mitigate negative impact during the operation phase of the project on the surrounding air environment.

Air Pollution Control Measures

- Provision of stack of sufficient height as required by per CPCB's guidelines for the proposed DG sets.
- 01 no. CAAQMS will be proposed for PP unit. NRL already having 02 CAAQMS and one more will come as a part of NREP. NRL already having 3 manual monitoring station within 10 km range and 01 in Kaziranga National Park
- Monitoring of fugitive emissions from NRL with the help of VOC (Volatile Organic Carbon), LDAR (Leak Detection and Repair) program will be done annually with the help of an external agency. Thus observed leaks will beidentified and rectified

Fugitive Emission Control Measures

Monitoring of fugitive emissions from NRL with the help of VOC (Volatile Organic Carbon), LDAR (Leak Detection and Repair) program will be done annually with the help of an external agency. Thus observed leaks will be identified and rectified.

10.6.2 Water Environment

Several measures are proposed to be incorporated at the designs stage towards minimizing the generation of wastewater and treatment of the generated effluent. Some of these measures are described below:

- Closed blow down system will be incorporated for hydrocarbon liquid discharges in all the process units, which will reduce the wastewater load to ETP both in terms of quantum load and quality. This is another of the in-plant control measures.
- Appropriate segregation and collection philosophy (separate sewers for process waste, contaminated rainwater, cooling tower blow down etc.,) will be incorporated for various effluents depending on individual stream characteristics.
- A comprehensive wastewater management system to comply with treated effluent quality for disposal as specified by CPCB (as per The Environment (Protection) Rules, 1986) shall be established.
- Process area will be paved to avoid contamination of soil/sub-soil/ground water in case of accidental spill/leakage of hydrocarbon liquids

10.6.3 Water and waste water management

The wastewater generation from the proposed project will be mostly Intermittent liquid effluent streams containing White Oil/TEA/Atmer/IPA/other organic components. A continuous liquid effluent having various organic components like Acetone, Isopropanol, Tert-butanol will be generated from Phase Separator Process which will have very less flow. These waste water streams along with non-process effluents like floor wash, contaminated rain water will be sent to existing ETP of NREP and treated there. The concentrated organic components and PP powder will be thermally incinerated. 50 m3/hr of Cooling tower blown down already considered in RO design will be routed to existing RO-DM plant of adjacent NRL refinery for treatment and reuse. Condensate generated will also be recovered.

The process effluent generation from PPU unit (0.23 m3/hr) is very negligible and ETP of NREP (Design:450 m3/hr) is adequate to process the same. This will not have any impact on effluent and subsequent sludge generation of NREP ETP."

Table 10-2 Wastewater Management.

Description	Proposed(m^3/hr)	Disposal Method & Facility Details (m^3/hr)
Effluent generation		
Cooling tower blowdown	50	Cooling tower blowdown from PP unit will be diverted to RO plant (Design: 600 m3/hr) under

Description	Proposed(m^3/hr)	Disposal Method & Facility Details (m^3/hr)
		existing NREP ETP Package.
Process effluent	0.23	PP process effluent to be treated in existing NREP ETP (Design: 450 m3/hr and cnormal flow is 360 m3/hr
Sub-Total	**50.23**	
Sewage	0.212	Diverted to existing NREP ETP for treatment
Total waste water generation	**50.442**	

The sewage generated will be routed to the existing NREP ETP for further treatment. The process effluent from PP unit will be routed to NREP ETP for treatment.The treated effluent from NREP ETP is planned to be reused in cooling tower, fire water and Horticulture (greenbelt).

Details of Liquid Effluent from the proposed project

Source of Emission	Name	Mode of Operation	Frequency	Quantity	Composition	Treatment (OSBL)
1P39-VV1632, Nitrogen Regeneration Recycle K.O. Vessel	Waste Water	discontinuous	1 time per year	Approx. 0.6 m^3 **(Note 1)**	Condensed moisture during regeneration	Sewer
1P39-Z-3681, Extruder Pelletizer	Waste Water	Discontinuous	during start-up during emptying	max. 1 m^3 / Start-up max. 40 m^3 for 1 min. (by Extrusion package vendor)	Clean water with polypropylene pellets and powder (fines)	Separation of solids in waste water basin (designed with separator)
1P39-ZVV-3783, Pellet Water Tank	Wastewater	Discontinuous	during start-up during emptying of tank (maintenance)	max. 1 m^3 / Start-up max. 25 m^3 during emptying of tank (by Extrusion package vendor)	Demin. Water with PP Solids	Separation of Solids

Source of Emission	Name	Mode of Operation	Frequency	Quantity	Composition	Treatment (OSBL)
1P39-VV-6631, Phase Separator	Wastewater	Continuous	8,000 h / year	max 0.23 m^3/h	Water; pH = 6-9 Typical average valu COD (chemical oxyg demand) < 50 BOD (5 day) < 35 TOC < 600 mg/l Typical organic cont - Acetone (~10%) - Isopropanol (~20% - Terbutanol (~70%)	Separation of insoluble Organic Compounds
Waste Water Collection Pit	Waste Water / Rain Water	discontinuous / continuous			Water; pH = 6-9	Separation of insoluble Organic Compounds

10.6.4 Land Environment

Following measures are proposed to mitigate negative impact during operational phase of the project on the land environment.

- Air emissions are effectively controlled by appropriate air pollution control systems and therefore deposition of air pollutants in and around the premises and surrounding area is not envisaged.
- As the treated effluent is reused within the system, the impact on land environment is not envisaged.

10.6.5 Noise Environment

The following Noise sources will be part of the proposed project:

- Extruder Gears and Motors
- Recycle Gas Compressors
- Powder and Pellet Conveying Compressors
- Carrier Gas Compressors

All noise sources exceeding the noise standard will be encapsulated. It is further recommended to separate extruder motors and gear boxes by a brick wall from the extruder on the ground level of the extruder building. All mentioned compressors will either have a noise hood each or they will be placed in a common hood. Personnel working in such noise areas have to wear the relevant noise protection equipment

The following measures for noise control will be followed at the design stage:

- Noise level specification of various rotating equipment as per Occupational Safety and Health Association (OSHA) standards.
- Equipment layout considering segregation of high noise generating sources.
- Erecting suitable enclosures, if required, to minimize the impact of high noise generating sources

10.6.6 Material Handling Storage and Transportation

- All transfers from drums / tanks are being done through pumps in closed pipelines.
- The loading of finished products to trucks and drums is done through automated filling systems with overflow protections.
- All key raw materials are charged to the reactors through closed pipeline systems including pneumatic systems for solid handling.
- Raw materials/ intermediates/ products are stored in closed tanks/drums provided with breather arrangements to avoid fugitive emissions.

10.6.7 Green belt development

As per the rules and regulations laid by Ministry of Environment Forest and Climate Change, Central Pollution Control Board (CPCB) and State Pollution Control Board (SPCB), it is legally mandatory to earmark 33% of the project area for greenbelt development to promote integration of environmental issues with industrial development projects

Table 10-3Greenbelt details

S.No.	Description	Proposed
1	Area proposed incremental for green belt (in Ac)	115272sq.m (11.52 Ha)
2	Width of green belt (in m) along the boundary of the project or activity	15m
3	Percentage of the total area covered under green belt (%)	33.1%
4	No. of tree saplings to be planted	34560
5	Funds allocated for plantation in Lakhs.	207.36

Design of Green Belt

Green belt will be developed as per CPCB guidelines with concept of three tier greenbelt development with tall, medium and short height in general.

A survey was conducted with respect to existing forest types and vegetation diversity in the study area for development of greenbelt around project components. The following guidelines will be considered in green belt development.

The following guidelines will be considered in green belt development.

- The spacing between the trees will be maintained at 2x2m
- Planting of trees in each row will be in staggered orientation
- In the front row shrubs will be grown.
- The short trees (< 10 m height) will be planted in the first two rows (towards plant side) of the green belt. The tall trees (> 10 m height) will be planted in the outer three rows (away from plant side)
- One line of tall trees and another line of short trees will be planted near the industrial blocks to control the fugitive emissions and to reduce the noise.
- Expose the manure pits to direct sunlight for about 15 days.
    - If the soil at the site is reasonably good, pits may be filled with 80% site-soil + 20% composted cow-dung. About 200 gmNeem-cake and leaf-litter, grass or agricultural residue may be added
    - If the soil at the site is poor, pits may be filled with 35% site-soil + 35% fertile soil (from an external source) + 30% composted cow-dung. Neem-cake and other organic matter may be added as in the previous instance
- Saplings will ideally be planted after the annual rains begin. The saplings would need to be watered once the rains cease.
- Saplings shall be suitably nurtured and maintained. Soil conditioning and fertilizer application shall be undertaken. If required, suitable soil treatment shall be provided to ensure good growth of tree cover.
- Construction of temporary shelters of locally available materials such as bamboo and grass around the growing saplings is recommended in the summer, to help the plants withstand the hot sun.
- During construction period:

  - Ground-vegetation should be allowed to shed seeds before cutting or moving it for mulching. This would leave behind a seed-bank to flourish in the next growing season, providing a natural source of mulch for the following year.
  - Open Burning of bushes and other waste on land must be avoided, as it reduces soil-quality, and harms the ground-vegetation, amphibians, reptiles and ground nesting birds.
- Development of greenbelt shall start with construction phase and shall be continued full fledge with operation phase
- As a part of improving biodiversity areas need to be ear marked for the growth of creepers that are always neglected in green belt development category. Creepers are becoming increasingly threatened due to lack of concerns and selective dereliction of this species.

The purpose of developing the greenbelt in and around the industrial site is for:

- Containment and abatement of pollution in the industrial environment, capturing of fugitive emissions if any and thereby improving the quality of the surrounding environment.
- Substantially reducing the adverse environmental impacts due to the proposed industrial activity.
- Serving as a barrier for attenuating the intensity of noise generated.
- Enhancing the biodiversity index of the region.
- Adding aesthetic value to the project site.
- Maintaining the ecological equilibrium of the area.

The following general guidelines and measures will be adopted:

- The greenbelt development programme will be drawn to conform to natural climatic conditions and adaptability of the species.
- Proper drainage system and proper plantation techniques will be adopted.
- Plantation will be properly maintained and protected by fencing from grazing and felling.

The plantations will consist of a mixture of carefully chosen locally available species of trees, shrubs and herbs, preferably evergreen and resistant to pollution

10.6.8 Rainwater Harvesting

Capital cost of INR50 lakhs and recurring cost of 3 lakhs has been considered in EMP for Rainwater Harvesting.

Rainwater harvesting measures will be planned during detailed engineering stage

10.6.9 Socio – Economic Environment

The proponent is committed to the socio – economic upliftment of the people in region and has actively involved in formulating and implementing proactive measures as part of the corporate social responsibility. Moreover, various modes of indirect employment i.e., transportation, increased business opportunities to shopkeepers, small scale business entrepreneurs etc. will lead to development of the area.

10.7 Occupational Health and Safety

The workers will be provided with proper health and safety measures. Personal protection equipment's will be given to the employers and made sure they wear it during the work. Regular health camps will be conducted for all the workers alike. The Health & Safety department makes sure all the workers are not exposed to any kind of toxicity and is within the prescribed limit. All the occupational health related expenditure of casual & contract workers incorporated in the scope of contractor and compliance to the statutory rules in this regard is ensured. Approximate cost for OHC checkup is Rs.4815 per person. Copy of EHS policy enclosed as **Figure 10-2** and Organogram for HSE is given in

The main objectives are:

1. Maintenance and promotion of workers' health and working capacity.
2. Improvement of working environment by following well-being program for its employees.
3. Monitor the workplace to maintain industrial hygiene practices.
4. Development of work culture in a direction which will support health and safety at work and thereby promoting positive social climate for smooth operation that will enhance productivity.
5. Area monitoring
6. Employees to undergo annual health check-up.
7. All personnel will be provided with personal protective equipment's individually as required.

10.7.1 Construction Phase

During the construction phase the following measures will be employed;

1. Occupational Health Centre will be facilitated to address the emergencies that may arise.
2. Regular monitoring of occupational health of employees.
3. Personnel will be trained about fire fighting systems and first aid practices.
4. Personal Protective equipment’s will be provided to the workers.

10.7.2 Operational phase

General functions of the safety committee will be;

1. Conduct routine workplace inspections.
2. Develop and implement safe work procedures and rules.
3. Provide on-going safety training & Enforce safety rules and appropriate discipline.
4. Promote safety awareness and reduce the potential for injury/loss.
5. Identify workplace hazards.
6. Enforce of safety rules, measure safety performance & reduce frequency/severity of injuries.
7. Provide Personal Protective Equipment.

10.7.3 Fire Detection & Alarm System

The Fire Detection and Alarm System shall be an independent, micro-processor based Analogue Addressable system comprising of individual break glass type manual call points, automatic sensors e.g. smoke/heat detectors, hooters, exit signs, Main DGFAP, battery, battery charger and other hardware. The system shall be designed to provide audio-visual indication at the main fire alarm panel to be located in fire station and zonal panels.

The fire detection system shall be interfaced with fire suppression system, HVAC system, pressurization system, plant communication system and any other systems as required

10.7.4 Fire Protection & Fire water system

The Fire Protection system shall be conceived to operate both in prevention and fightingmode, depending on the relevant actions selected, either manual or automatic.

The fire fighting system shall be designed & provided as per OISD 116 as follows:

- Fire Water system (including Hydrants, monitors, HVLRM, automatic spray system on process equipments)
- Clean Agent System for Control room/SRR
- DCP extinguishing system for catalyst/TEAL storage area as per NFPA 17
- CO2 extinguishing system as per NFPA 12
- Automatic Water spray system in product warehouse
- HV spray system on transformers
- Portable extinguishers
- Mobile fire fighting system

For fire water system, tapings (minimum two number) shall be taken from the existing fire water network of NREP to cater to the fire water demand of PPU. The NREP fire water system is designed for fighting two major fires and same is adequate to cater to the fire water demand of PPU facilities.

Pressure available at tap off point of pp unit (in blocked case) is considered as 9.5 bar(g).

10.7.5 First aid Boxes

A first aid kit is a collection of supplies and equipment for use in giving first aid. First Aid boxes will be kept available in Control Room, canteen, Admin Building and at OHC. First Aid items will be issued to injure only by authorized persons.

Following are the contents of First Aid Box,

a. Dettol – Antiseptic solution
b. Ciplox – Eye Drops
c. Soframycin – Skin ointment
d. Silverex – Burn ointment
e. Betadine – Microbicidal solution
f. Iodex – Pain reliever
g. Sterilized Cotton Wool
h. Surgical Paper Tape
i. Small Sterilized Dressings

j. Medium Sterilized Dressings
k. Roller Bandage – 5 cm wide
l. Roller Bandage – 10cm wide
m. Band Aid
n. Crocin / Paracetamol Tablet

Along with the above safety systems, company also ensured the below safety features to ensure Zero Accident.

1. No ignitable zones are declared and marked so.
2. Work permit system with strict compliance.
3. Dedicated chemical storage area with good ventilation and exhaust system and all chemical are stored as per compatibility.
4. Dyke walls provided for the day storage chemical tanks.
5. All reactors provided with safety valves followed by rupture discs and relief valve outlets are extended.
6. Calibration is ensured for the gauges of pressure, temperature and vacuum.
7. All reactors will be hydro tested and certified by the competent person once in a year.
8. Body earthing provided to all equipment's involved in the process, electrical earthing, static earthing and instrument earthing provided wherever required.
9. Ventilation air units (VAUs) and Exhaust air units (EAUs) and are provided to ensure good ventilation in the work environment. The tentative Emergency Organization Chart will be prepared and followed.

10.8 Environmental Management Cell

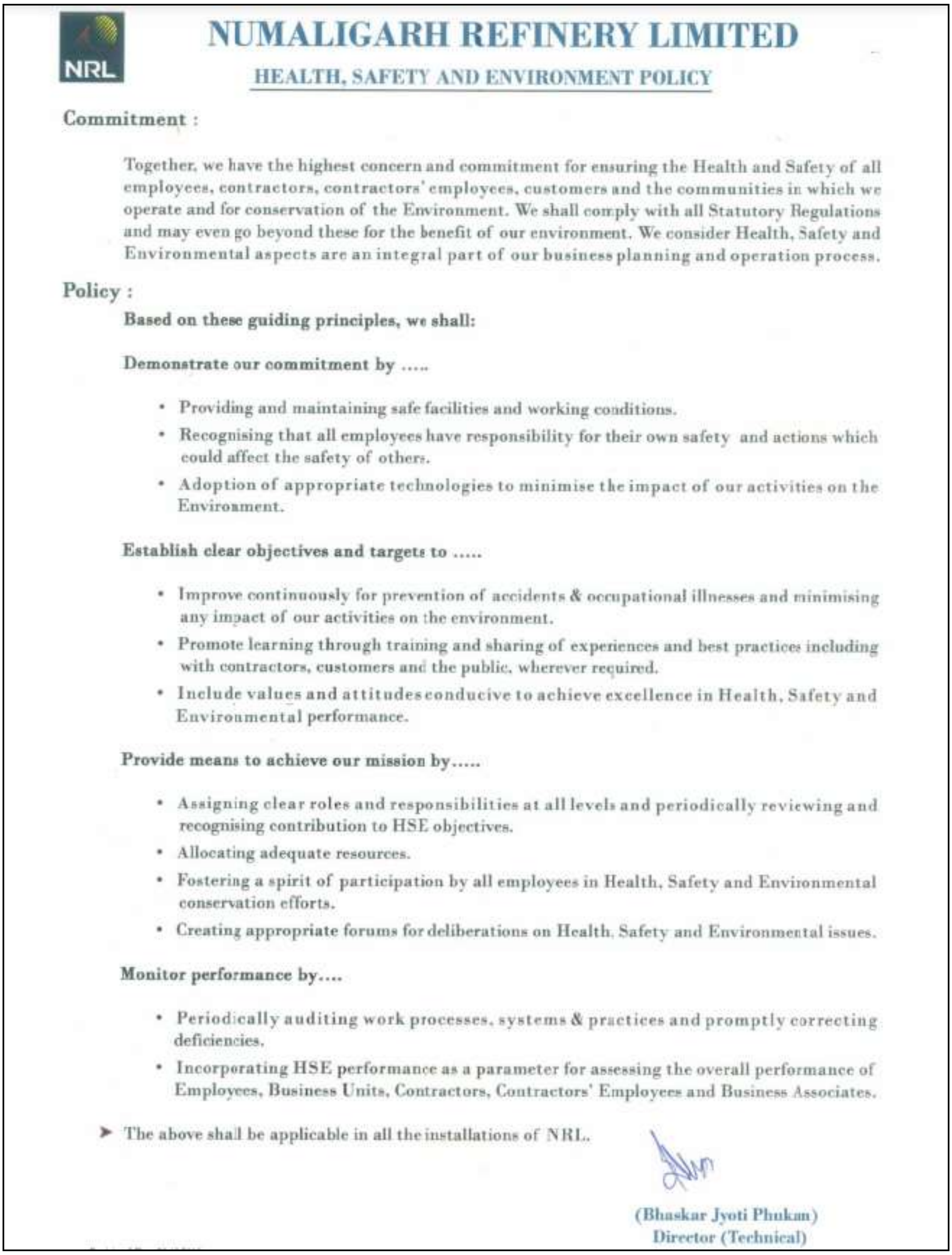
A separate environment management cell, HSE department consisting of qualified engineers will be in place which monitors all aspects of environmental impacts being caused due to process units.

The Environmental Management Cell will meet every three months and discuss on the latest Environment Rules/ Acts, Compliance status, Environmental monitoring, Pollution Control equipment performances and suggest improvement if any, to be implemented.

The minutes of the meeting will be communicated to the management for review and implementation towards meeting the environmental/statutory compliance

10.9 Corporate Environmental Policy

The environmental health and safety policy of NRL is given in **Figure 10-5**.



NUMALIGARH REFINERY LIMITED

HEALTH, SAFETY AND ENVIRONMENT POLICY

Commitment :

Together, we have the highest concern and commitment for ensuring the Health and Safety of all employees, contractors, contractors' employees, customers and the communities in which we operate and for conservation of the Environment. We shall comply with all Statutory Regulations and may even go beyond these for the benefit of our environment. We consider Health, Safety and Environmental aspects are an integral part of our business planning and operation process.

Policy :

Based on these guiding principles, we shall:

Demonstrate our commitment by .....

- Providing and maintaining safe facilities and working conditions.
- Recognising that all employees have responsibility for their own safety and actions which could affect the safety of others.
- Adoption of appropriate technologies to minimise the impact of our activities on the Environment.

Establish clear objectives and targets to .....

- Improve continuously for prevention of accidents & occupational illnesses and minimising any impact of our activities on the environment.
- Promote learning through training and sharing of experiences and best practices including with contractors, customers and the public, wherever required.
- Include values and attitudes conducive to achieve excellence in Health, Safety and Environmental performance.

Provide means to achieve our mission by.....

- Assigning clear roles and responsibilities at all levels and periodically reviewing and recognising contribution to HSE objectives.
- Allocating adequate resources.
- Fostering a spirit of participation by all employees in Health, Safety and Environmental conservation efforts.
- Creating appropriate forums for deliberations on Health, Safety and Environmental issues.

Monitor performance by....

- Periodically auditing work processes, systems & practices and promptly correcting deficiencies.
- Incorporating HSE performance as a parameter for assessing the overall performance of Employees, Business Units, Contractors, Contractors' Employees and Business Associates.

➤ The above shall be applicable in all the installations of NRL.

(Bhaskar Jyoti Phukan)
Director (Technical)

Figure 10-2 Environmental Health & Safety policy

10.10 Budget of Environmental Management Plan

The detailed breakup of Expenditure on Environmental measures is given in **Table 10-4**

Table 10-4 Expenditure on Environmental measures

S.No	Equipment	Capital cost (Lakhs)	Recurring Cost (Lakhs) per Annum
1	**Air Environment**		
1.1	Additional Plantation Activities (Trees and Shrubs)	207.36	50
1.2	Air quality monitoring	100	20
2	**Noise Environment**		
2.1	Additional Plantation Activities	Included in 1.1	Included in 1.1
2.2	Audiometric tests	5	2
3	**Water Environment**		
3.1	Rain water Harvesting pits	50	3
3.2	Storm Water Management	20	-
4	**Land Environment**		
4.1	Additional Plantation Activities	Included in 1.1	Included in 1.1
4.2	Solid waste management	20	10
5	**Biological environment**		
5.1	Additional plantation activities	Included in 1.1	Included in 1.1
Total INR		**402.36**	**85**

10.11 Corporate Social Responsibility(CSR)

CSR activities shall be carried out as per corporate’s CSR policy**.**

10.12 Corporate Environmental Responsibility (CER)

The company is aware of the obligations towards the Environment and to fulfill the social obligations. As per OM **F. No: 22-65/2017-IA.III** dated 1st May 2018 M/s. NRL will Allocate 0.5% of the project cost (7231Crores) towards CER i.e. 0.5% of 7231Crores = 36.155Crores**.**

After completion of public hearing, CER budget allocation will be made in the Action Plan to address the issues raising during public hearings.

Note:In Form-1 the project cost is mentioned as 4735Cr and it has been revised as 7231Cr.*

CHAPTER 11

SUMMARY & CONCLUSION

11 SUMMARY & CONCLUSION

11.1 Overall justification implementation of the project

An Environmental Impact Assessment Study has been carried out and assessed for the proposed project based on the ToR 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 the EIA report prepared.

Based on the above evaluation the significance, value addition, impact on various components of environment during construction and operation phases is summarized below

- The project proponent will follow all the statutory norms and guidelines as per MoEF&CC to safeguard environment.
- The proposed project falls under Plot No.11 for which land document is obtained.As plot no. 11 is falling in the No Development Zone (NDZ) notified by MoEFCC dated 05.07.1996, Forest Department, NRL to obtain NDZ clerance from MoEFCC to carry out any activities as per the condition laid down for the said NDZ notification.
- Base line data reveals that the ambient air quality has been monitored at 8 locations for 11 parameters as per ToR obtained vide No.J-11011/274/2015-IA-II(I) dated 15.07.2022 in addition to it remaining 5 parameters as per CPCB guidelines are also monitored. These are the minimum and maximum baseline levels of PM10 (48.65 µg/m³ to 86.25 µg/m³), PM2.5 (22.09 µg/m³ to 49.47 µg/m³), SO2 (8.25 µg/m³ to 23.03 µg/m³), NO2 (15.96 to 33.95µg/m³). However, the average baseline levels of PM10 (58.34 to 72.58µg/m³), PM2.5 (26.49 to 41.63µg/m³), SO2 (9.90 to 19.38µg/m³), NO2(19.14 to 28.57µg/m³).
- The incremental concentrations of PM10, SO2 and NOx are observed to be 0.079 µg/m3, 0.074µg/m3and 0.709µg/m3 respectively. The total pollutant concentrations of PM10, SO2 and NOx are 86.329µg/m3,23.104µg/m3 and 34.659 µg/m3.
- Total water requirement for the proposed project is 210 m^3/hr and Treated Raw water for the PP complex will be provided from existing NREP treated raw water header.

The source of raw water for existing NREP is River Dhansiri.No water will be drawn from ground water sources.

- In this proposed project, 0.212 m^3/hr of sewage will be generated and 0.23 m^3/hr of effluent and 50 m^3/hr of cooling tower blowdown will be generated. The sewage generated will be routed to the existing NREP ETP for further treatment.The process effluent from PP unit will be routed to NREP ETP for treatment.The treated effluent from NREP ETP is planned to be reused in cooling tower, fire water and Horticulture (greenbelt).

- The process effluent generation from PPU unit is very negligible and the same will not have any impact on NREP ETP effluent and subsequent sludge generation.In addition, spent oil/ Used oil which will be generated from the emergency DG will be minimal which will be disposed to authorized recyclers. Other solid and hazardous waste will be disposed as per CPCB guidelines.

The project will induce direct and indirect employment generation for local communities as well as state & region as a whole and preference will be given to the local communities.

CHAPTER 12

DISCLOSURE OF CONSULTANTS

12 DISCLOSURE OF CONSULTANTS

In order to assess the potential environmental impacts due to the "**Proposed Poly Propylene Unit (PPU) of Capacity 360KTPA",** M/s NRL has engaged Hubert Enviro Care Systems (P) Limited, Chennai to undertake EIA study. The nature of consultancy service rendered covers terrestrial environmental assessment.

12.1 The names of the Consultants engaged with their brief resume and nature of Consultancy rendered

12.2 Brief Profile of Hubert Enviro Care Systems (P) Limited (HECS)

HECS is a total Environmental management company which provides Environmental consultancy services, Analytical testing services, turnkey solutions and Operation-Maintenance services for water and wastewater facilities.

The company provides solutions to several industries like Refineries, Thermal Power Plant, Pharma, R&D Facilities, Electroplating and Manufacturing, IT Parks, Residential Complexes, Mines, Dairies, Food Processing, Textile mills, Breweries, etc.

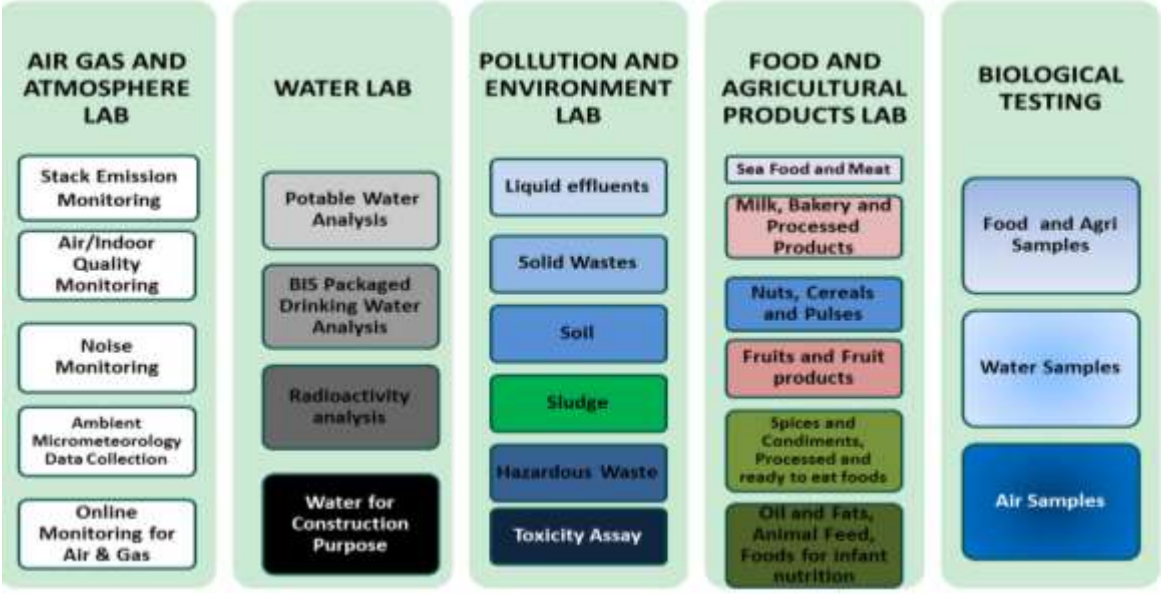
The company is specialized in executing projects right from concept development, supply, erection, commissioning and operation on turnkey basis. HECS has successfully executed more than 300 environmental engineering projects for various industrial sectors both in India and overseas

Consultancy Profile:

- HECS is accredited by QCI-NABET
- An approved consultant for carryout EIA studies across India
- India's leading multidisciplinary Environmental Consultancy organization
- HECS- Consultancy division comprises of technical skilled and competent Team of 40 people. The team consists of Three Doctorates & about thirty postgraduates
- HECS has industry specific prominent expert to provide solutions & recommendations
- Serving client more than 25 years & pan India presence in the following sectors:
    - Environmental Clearance
    - Coastal Regulation Zone
    - Risk Assessment, DMP, HAZOP studies
    - Feasibility/ treatability studies

- Due diligence studies
- Ground water Clearance
- DISH, PESO and other statutory approvals
- Consent to Establish, Consent to Operate
- Hazardous waste, bio- medical waste authorization
- Other environmental approvals

- Has an in-house laboratory wherein the following activities are being carried out:



12.3 QCI – NABET Accreditation

Consultancy	Hubert Enviro Care Systems Pvt. Ltd., Chennai
NABET Certificate No	NABET/EIA/2224/SA 0190Valid up to 27/07/ 2024
MoEF Reg. Lab	F.No. Q-15018/13/2016-CPW

12.4 Copy of QCI NABET Accreditation

QUALITY COUNCIL OF INDIA
QCI Creating an Ecosystem for Quality

NABET

National Accreditation Board
for Education and Training

NABET

Certificate of Accreditation

Hubert Enviro Care Systems Pvt. Ltd.,

A-21, (Behind Lions Club School) III Phase, Thiru Vi Ka Industrial Estate, Guindy, Chennai - 600 032.

*The organization is accredited as **Category-A** under the QCI-NABET Scheme for Accreditation of EIA Consultant Organization, Version 3: for preparing EIA-EMP reports in the following Sectors –*

S. No	Sector Description	Sector (as per)		Cat.
		NABET	MoEFCC	
1	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	7	2 (b)	A
6	Metallurgical industries (ferrous & nonferrous)- both primary & secondary	8	3 (a)	B
7	Cement plant	9	3 (b)	A
8	Petroleum refining industry	10	4 (a)	A
9	Pesticides industry and pesticide specific intermediates(excluding formulations)	17	5 (b)	A
10	Petro-chemical complexes (industries based on processing of petroleum fractions & natural gas and/or reforming to aromatics)	18	5 (c)	A
11	Petrochemical based processing (processes other than cracking & reformation and not covered under the complexes	20	5 (e)	A
12	Isolated storage & handling of hazardous chemicals (As per threshold planning quantity indicated in column 3 of Schedule 2 & 3 of MSIHC Rules 1989 amended 2000)	28	-	B
13	Synthetic organic chemicals industry	21	5 (f)	A
14	Industrial estates/ parks/ complexes/ Areas, export processing zones(EPZs), Special economic zones (SEZs), Biotech parks, Leather complexes	31	7 (c)	A
15	Ports, harbours, break waters and dredging	33	7 (e)	A
16	Highways	34	7 (f)	B
17	Common Effluent Treatment Plants (CETPs)	36	7 (h)	B
18	Common municipal solid waste management facility (CMSWMF)	37	7 (i)	B
19	Building and construction projects	38	8 (a)	B
20	Townships and Area development projects	39	8 (b)	B

Note: Names of approved EIA Coordinators and Functional Area Experts are mentioned in SAAC minutes dated Feb 3, 2023 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/23/2696 dated March 6, 2023. The accreditation needs to be renewed before the expiry date by Hubert Enviro Care Systems Pvt. Ltd, following due process of assessment

Sr. Director, NABET **Dated: March 6, 2023**	**Certificate No.** **NABET/EIA/2224/SA 0190**	**Valid up to** **July 27, 2024**

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

Further details may be seen on the following URL: www.hecs.in

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