Environmental and Social Impact Assessment (ESIA) for Integrated Manufacturing Facility comprising of Particle Board and Captive Resin

Project Location: Naidupeta Tehsil, Tirupati District, Andhra Pradesh

Final Report

November 2023

Client: Greenlam South Limited

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1 Introduction

M/s Greenlam South Limited (hereinafter referred to as ''Greenlam'' or ''Client'' or "GSL"), a Special Purpose Vehicle (SPV) of Greenlam Industries, is in the process of developing an Integrated Manufacturing Facility with captive resin plant for manufacturing of high pressure laminated boards, plain particle board, pre-laminated boards and UV coated boards (Particle Boards, Medium Density Fiberboards (MDF), High Pressure Laminate (HPL) Sheets & Compact Boards) at Andhra Pradesh Industrial Infrastructure Corporation (APIIC) managed Industrial Park at Naidupeta, Menakuru Village, Naidupeta mandal, Tirupati District[1] of Andhra Pradesh (hereinafter referred to as "Plant/ Site" or "Manufacturing Facility" or "Integrated Manufacturing Facility"). Currently the plant is under construction.

The proposed manufacturing facility is primarily dependent on agro plantation activity for the core wood and proposes to use 100% hardwood of eucalyptus species. The wood is proposed to be procured from suppliers and farmers distributed across 87 Mandals falling in 10 Revenue Divisions of 3 Districts.

The Integrated Manufacturing Facility and its associated supply chain will be hereinafter referred to as the Project.

The Production capacity of the proposed Integrated Manufacturing Facility will be 62,287.5 TPA (188.75 TPD). Details for the capacities for the products is as presented below.

Table 1-1: Details of Production Capacity

Sr.No.	Name of the products	Capacity
1	High Pressure Laminates	90,00,000 Nos/annum
2	Plain Particle Board	2,62,500 Cbm/annum
3	Pre-laminated Particle Boards	1,65,00,000 Sq.mtr/annum
4	UV Coated boards (Particle boards, MDF, HPL sheets & compact boards)	12,67,200 Nos./annum
5	Veneer	40,000 TPA

Source: Greenlam

1.1 Project Background

GSL is in the process of developing an Integrated manufacturing facility with captive resin plant of capacity of 62,287.5 TPA (188.75 TPD) for manufacturing of High-Pressure Laminates, Plain Particle Board, Pre-Laminated Boards and UV Coated Boards (Particle boards, MDF, HPL Sheets & Compact Boards).[2] The Integrated manufacturing facility is currently being developed in Naidupeta mandal of Tirupati District, whereas the plantation and wood procurement (raw material sourcing) is proposed to be done from 87 Mandals falling in 10 Revenue Divisions of 3 districts.

An Environment Impact Assessment (EIA) study for the resin manufacturing unit was undertaken as per the requirements of EIA Notification, 2006 and the EIA report was prepared and submitted to State Environmental Impact Assessment Authority (SEIAA), Andhra Pradesh. Environment Clearance (EC) for the facility was granted via EC identification number EC22B021AP157099 dated 6th January 2022.

Greenlam has obtained financial assistance from IFC to fund the Project, and as per IFC requirement, An ESIA is being undertaken to cover the Integrated Manufacturing Facility and supply chain / raw material souring (i.e. "Project") compliant with the IFC Performance Standards. Greenlam has engaged an independent E&S Advisor (hereinafter referred to as "advisors" or "E&S

[1] Newly formed district, "Tirupati" is the project district for the manufacturing plan as well as for wood procurement and plantation activities. Tirupati District came into existence on 4th April 2022. Tirupati district comprise of 4 revenue divisions i.e., Gudur, Sullurupeta, Srikalahasti and Tirupati and 34 Tehsils (also known as "mandals" in the state of Andhra Pradesh). The revenue divisions Gudur & Sullurupeta were initially part of Nellore district and Srikalahasti & Tirupati revenue divisions were part of Chittoor District. Due to the recent formation of Tirupati district, no official government reports are found for the same. Thus, for the purpose of this report, reference for the aforementioned revenue divisions and tehsils has been taken from the official data of their previous districts There has been no change in geographical boundary for any of the tehsils that have been moved into Tirupati district, therefore the data present in the secondary domain from their original district can be considered.

[2] Source: Final EIA report for the facility dated July 2021

Advisors") to undertake the ESIA. The aim of the assessment is to document potential environmental and social impacts associated with the Project activities.

1.2 Objective

The primary objective of the ESIA is to assess environmental, social and ecological impacts associated with the Project. The specific objectives are to:

- Develop a baseline environmental, social and ecological profile of the Project and its surrounding areas.
- Analyze, evaluate and propose measures to prevent, control, mitigate, restore and/or compensate for the potential environmental and social impacts of the Project.
- Assist in preparation of Environmental and Social Management Plan (ESMP) for the construction and operation phase of the project.
- Provide recommendations in the form of management plans and other instruments detailing environmental and social requirements, in particular, to guide on specific actions to be taken by the Project management including contractors and subcontractors.
- Develop a consultation/stakeholder engagement plan, including an analysis of interested and affected parties, detailing documentation requirements, and dissemination of information about the project. It also includes providing support to Greenlam in carrying out focused consultations during the ESIA process.

1.3 Applicable Reference Framework

Applicable reference framework (ARF) for this assignment includes the following:

- Applicable local, national, and international environmental and social legislations
- IFC Performance Standards, 2012
- IFC/WB Group General EHS Guidelines, April 2007
- WBG EHS Guidelines for Board and Particle-Based Products
- WBG EHS Guidelines for Forest Harvesting Operations (as applicable for plantations)
- IFC / EBRD Guidance on Worker Accommodation
- Other applicable laws and regulations pertaining to environment, health, safety, social, land acquisition and resettlement, and labour in India, including country obligations under relevant international treaties such as the UN Declaration on the Rights of Indigenous Peoples, and International Covenant on Economic, Cultural and Social Rights

1.4 Scope of Work

The specific scope of work for ESIA includes the following:

- Review of the policy, legal and regulatory framework that is relevant for the Project including identification of national and state environment and social legislations appliable to the Project and their requirements; and comparison of the regulations against Applicable Reference Framework (ARF). The various approvals and permits required and the status of the approvals are described.
- Analysis of E & S alternatives - Review the activities, operations, processes, utilities, machinery, equipment, materials & requisites related to the construction and operation phase of the Project. Review includes analysis of alternatives if any possible at the current implementation stage of the Project in terms of technologies alternatives in processing, environmental pollution control; facilities design and layout; loading and unloading operations for wood, fuel type alternatives, etc.
- Review the existing EIA study for the resin plant, identify any E&S gaps in the ongoing construction and common facilities, review the EPC contractor's Construction Environmental Management Plan (CEMP), and propose corrective actions to update/supplement the CEMP if needed. Assess the capacity of the EPC contractor to implement Environmental, Health, Safety, and Social (EHSS) as per ARF. Assist the Client in incorporating such requirements in the respective contracts/agreements with EPC contractor(s).
- Baseline data updation and generation:
    - Develop a relevant social baseline for the project capturing the industrial zone, neighboring settlements and villages potentially impacted by the Project activities including the plantation activities and the supply chain using information collected from both primary as well as secondary sources. Use consultations and Focus Group Discussions (FGD) to map stakeholders and identify potential social impacts;
    - Update the baseline for the project for ambient air quality, noise, ground water, surface water, land use especially from an agriculture and agroforestry perspective;

  - Update the biodiversity assessment by screening for critical habitat triggers using the Integrated Biodiversity Assessment Tool (IBAT) and any other online databases. Identify proximity to any protected areas and Key Biodiversity Areas. It also including screening of available information to determine if there are any critical habitat values within the Project area and landscape and prepare a natural/modified habitat map and estimate habitat loss.
- Stakeholder Consultation and Analysis - Prepare a Stakeholder Engagement Plan and conduct stakeholder consultations in the forms of Focused Group Discussions, interviews, and other applicable methods in presence of a Client representative to identify and record their needs, concerns, problems, and suggestions and share the findings of the ESIA. Document all consultations, public hearings, and publications related to the Project.
- Identify risks and impacts of the supply chain of wood and paper including agroforestry activity in the catchment area. This would inter alia include impacts and risk related to child and forced labour, occupational health and safety, pesticide use and management, and community health and safety.
  - Undertake a review of ecosystem services to establish the extent of potential displacement of access to priority ecosystem services (i.e., those upon which communities have a high dependence) because of the project.
  - Undertake water availability-demand study to estimate water usage before and after planting of Eucalyptus in the catchment area, and potential impacts on water supply on surrounding wetlands and groundwater.
- Hazard and Risk Assessment - This includes identification of potential hazard operations and areas, identification of representative failure cases, scenario analysis, assess damage potential and impact zones, plant layout suitability from hazard perspective and recommended layout for hazard minimization, provide recommendations for Client's consideration covering mitigation plan for hazard minimization, control and management, preparation of Disaster Management Plan, on-site and off-site emergency plan which includes elements of occupational and health safety plan.
- Assess the capability of the Client to identify, assess and manage the EHSS risks and impacts from its business operations including supply chain, and to meet the requirement of IFC PSs and national regulations.
- Impact Assessment and Mitigation Measures - Assess environment and social impacts using the mitigation hierarchy Environmental and Social Management Plan (ESMP). It includes formulation of an environment and social management plan to minimize any impact on environment and social parameters and mechanism for continuous consultation and involvement of the community throughout the various stages of project life.
- Framework Management Plans: Preparation of following management plans for client's consideration:
  - Community Health and Safety Management;
  - Emergency Preparedness Plan including climate change risk and supply chain risk during transportation of hazardous materials and wood logs;
  - Traffic Management;
  - Grievance Redressal Management;
  - Occupational Health and Safety;
  - Supply Chain Management Plan that includes E&S screening of wood sources;
  - Waste Management Plan;
  - Hazardous Material Management Plan;
  - Pesticide Usage Management and Plan;
  - Air Emission Control and Management Plan (including a plan for control and monitoring of indoor fugitive emissions especially the VOCs and formaldehyde);
  - Stakeholder consultation and disclosure;
  - Resource management plan (water, energy, and raw material);
  - Sustainable Agroforestry Plan including Integrated Pest Management; and
  - Monitoring and Review Plan including Environmental Monitoring Plan (includes compliance monitoring and environmental quality monitoring).

1.5 Approach & Methodology

Approach & Methodology for undertaking ESIA is as presented below.

1.5.1 Project Kick Off

Project mobilization and kick off was organized with Greenlam to get an overview of the Project. Activities during the kick-off included:

- Brief presentation of the Project by Greenlam
- Brief discussion on the approach, methodology and workplan
- Identification of continuous points of contacts from all the parties

- Understanding of site visit and deliverables with timelines
- Overview of the role and responsibilities of the organizational setup of the project and agencies involved including contractors engaged for the Project
- Logistical arrangements

List of Project related documents required to be reviewed for undertaking the ESIA study was also shared with the client.

1.5.2 Desk Based Screening and Scoping

A desk-based screening and scoping was conducted for the Project prior to the detailed ESIA study to understand the project study area and associated environmental, social, and ecological sensitive receptors. The screening and scoping study was conducted based on review of the following:

- Project specific documents shared by client in Virtual Data Room (VDR)
- Google Earth Imagery
- Secondary data on land use, climate, water, rainfall, social demographic profile for Project revenue division and district available on public domain

The initial desk-based screening and scoping report prepared for the Project was shared with client on 9th March 2022.

1.5.3 Site Reconnaissance

Team comprising of EHS expert, social expert and ecological experts undertook site visit to the Project site (and its surrounding) and supply chain (raw material sourcing) from 20 March 2023 to 24 March 2023 to understand key environmental, social and ecological sensitivities within the project footprint and area of influence. Site visit also included reconfirmation of the features identified in the screening & scoping report and identification of preliminary environmental, social, and ecological impacts associated with the Project. Location for environmental baseline (primary) monitoring at the Project site were also identified during the site visit.

The focus of this visit was to better understand the site settings, sensitivities with respect to the Project including associated facilities and supply chain. Visual observation of the on-going construction activity and consultation with key stakeholder groups was also undertaken during site visit. For the supply chain districts, consultations/ focused group discussions were undertaken with sample suppliers in few of the revenue divisions and mandals to understand typical supply chain issues. Selection of such locations was done in accordance with Client during scoping stage. Details of activities undertaken during site visit are as presented below.

Table 1-2: Details of Activities undertaken during Site Visit

Day	Activities
Day 1: 20th March 2023	• Introductory meeting with the management team of Greenlam • Visit to the under construction manufacturing facility • Visit to the labour camp • Consultation with the nearby communities and workers working within the manufacturing facility • Ecological survey in and around the manufacturing facility • Consultation with the locals from the villages of buffer area (5 km from the boundary of manufacturing facility)
Day 2: 21st March 2023	• Consultation with farmers and wood suppliers in Padiri and Tripuranthakapuram Kota (Repallevada) villages • Consultation with Andhra Pradesh Forest Development Corporation (APFDC) officials and plantation site visit at Satyavdu APFDC Plantations • Consultation with the locals of above-mentioned villages to understand the current status of the plantation and existing biodiversity in the area
Day 3: 22nd March 2023	• Consultation with farmers and wood suppliers in Arimenupadu, Rachapalem and Sydapuram villages. • Consultation with the land owners and labourers (workers) undertaking tree harvesting, debarking, loading activity in the field near Ojilli, Sullurpeta • Consultation with Forest officials to understand the current status of the floral and faunal diversity in the study area
Day 4: 23rd March 2023	• APFDC Plantation site visit near Podalakur, Nellore district • Consultation with farmers and wood suppliers in Muttukuru and Ravullakollu village, Nellore district • Consultation with farmers and wood suppliers in DC Palli village

Day	Activities
	• Consultation with the locals of above-mentioned villages to understand the current status of the plantation and existing biodiversity in the area
Day 5: 24th March 2023	• Consultation with owners of weigh bridge & transporter at Kandakur, Nellore • Consultation with farmers and wood suppliers in Chowdaripalem (Ramulavari Gudi) village and Yedlurupadu village • Consultation with the locals of above-mentioned villages to understand the current status of the plantation and existing biodiversity in the area

Environmental Baseline Data Collection: Environmental baseline data was collected through primary monitoring and surveys of the study area (5 km distance from manufacturing facility). Secondary information through literature surveys was also collected for the study area of the manufacturing facility. The baseline study undertaken included the following.

- Primary baseline data consisting of ambient air quality, noise quality, ground water, surface water, traffic and soil quality from the nearest receptors through the commissioning of a National Accreditation Board for Testing and Calibration Laboratories (NABL) accredited laboratory. The details of the environmental baseline data collection has been provided in ***Section - 4.2***.
- Study of water availability in the supply chain was also undertaken through collection & analysis of available secondary data

Ecological Baseline Assessment: Ecological Baseline was prepared for the area around the manufacturing facility (5 km radius) and for the conceptualized "Catchment Area" for the wood collection as well as for the promotion of the plantation. Along with a secondary data review, a primary survey was also conducted to prepare the baseline. The details of the ecological baseline have been provided in ***Chapter 4.***

Primary Social Baseline Assessment: The social baseline for the integrated plant was prepared considering 5 Km radius from the proposed project. The Study area is divided into core 2 KM from the plant and buffer 3 Km from core area respectively. The baseline data is generated using both primary and secondary data sources. As per the Greenlam's wood procurement strategy the wood both for raw material and fuel will be procured form the 87 mandal falling within district Tirupati, Nellore and Chittoor respectively. In order to understand the socio-economic profile of the communities /stakeholder involved in wood plantation business, 11 sample villages were selected for primary data collection and secondary data was for all the 87 mandal were collected for the baseline. The detailed social baseline with detailed Socio-economic profile is presented in ***Section - 4.4***

1.5.4 Environmental and Social Impact Assessment Reporting

This ESIA report has been prepared based on site assessment; documents made available by client; consultation with client representative, labourers working on site, contractors, and other key stakeholders including local community, APFDC, farmers, wood suppliers, transporters, etc.

The structure for the ESIA study report has been presented below:

- Project Description- An overview of the technical description of the manufacturing facilities & related infrastructure, resource requirement, etc. are presented based on the data provided by client and information collected as part of the ESIA study.
- Baseline Condition- A detailed baseline condition of the project area has been presented (in line with the preliminary baseline data presented in the screening report) based on secondary as well as primary data collected from the study area (for manufacturing facility).
- Stakeholder Consultation and Analysis: An outline of the engagement with the stakeholder groups undertaken as part of the assessment process and the key issues identified from the same.
- Analysis of E & S alternatives - Review the activities, operations, processes, utilities, machinery, equipment, materials & requisites related to the construction and operation phase of the Project. Review includes analysis of alternatives if any possible at the current implementation stage of the Project in terms of technologies alternatives in processing, environmental pollution control; facilities design and layout; loading and unloading operations for wood, fuel type alternatives, etc.
- Impact Assessment: Based on the project details, outcomes of screening and scoping exercises and primary baseline information collected, an assessment of impacts on the environmental, ecological and social components has been undertake which includes:
    - Predicting and assessing the project's likely positive and negative impacts and assigning significance to each type of impact.

  - Identifying mitigation measures and any residual negative impacts that cannot be mitigated.
  - Impacts and risks from associated facilities have been evaluated
- Environmental and Social Management and Monitoring Plan: Environmental and Social Management and Monitoring Plan (ESMP) suggesting economically feasible technologies and procedures to minimize any impact on environment and social receptors throughout the project life cycle have been developed. Detailed Project specific management Plans have also been developed.

1.6 Limitations

This report has been developed based on the Project level information provided by GSL and professional judgment to certain facts with resultant subjective interpretation. If information to the contrary is discovered, the findings in this ESIA may need to be modified accordingly. This ESIA report has following limitations:

- The secondary data utilized for the purpose of baseline assessment is limited to that available in the public domain or made available during the consultations with the GSL site representative.
- Currently the project is in construction phase, mitigation measures or embedded controls undertaken during the construction phase have been mentioned basis the site observation and document review
- Specific taluks or villages for wood sourcing are yet to be identified by the client, hence the supply chain issues are district level and sub district level based on baseline data from secondary sources (where available and relevant) and stakeholder consultations.
- E&S advisors will not support Client in implementation of the recommendation or corrective action plan as part of this scope of work
- The Project report is not intended to meet any national, state, or local statutory requirements and for any regulatory submission (as part of any permitting process or otherwise)
- This is a non-assurance work with no audit/loan staffing services to be provided and there are no other client-side / other-side parties involved in this engagement.
- The Social Baseline is largely based on the secondary census 2011 data hence due temporal gap of nearly 10 years there might be changes in the current baseline conditions which might not be captured in the baseline.

1.7 Structure of the Report

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Chapter 4	Environment & Social Baseline Conditions
Chapter 5	Stakeholder Identification & Engagement
Chapter 6	Impact Assessment & Mitigation Measures
Chapter 7	Hazard Analysis & Risk Assessment
Chapter 8	Environment & Social Management and Monitoring Plan
Chapter 9	Impact Summary & Conclusion
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Appendix 3	Detailed Resin Manufacturing Process
Appendix 4	Physical and Chemical Properties of Chemicals
Appendix 5	Waste Management Plan
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Appendix 7	Community Health & Safety Management
Appendix 8	Emergency Preparedness and Response Plan

Appendix 9	Traffic Management Plan
Appendix 10	Occupational Health & Safety
Appendix 11	Air Emission Management Plan
Appendix 12	Noise Emission Management Plan
Appendix 13	Water Quality and Wastewater management Plan
Appendix 14	Sustainable Agroforestry Plan including Integrated Pest Management
Appendix 15	Stakeholder Engagement Plan and Grievance Redressal Mechanism
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2 Project Description

This section provides an overview of the Project, in terms of location, site settings, resource requirement, land details and status of the Project.

2.1 Project Overview

M/s. Greenlam South Limited (GSL) is in the process of developing an Integrated manufacturing facility with captive resin plant of capacity of 62,287.5 TPA (188.75 TPD) for manufacturing of High-Pressure Laminates, Plain Particle Board, Pre-Laminated Boards and UV Coated Boards (Particle boards, MDF, HPL Sheets & Compact Boards).[3] The Integrated manufacturing facility is currently being developed in Naidupeta mandal of Tirupati District, whereas the plantation and wood procurement (raw material sourcing) is proposed to be done from 3 districts, 10 revenue divisions and 87 mandals, details as provided in the ***Section 2.2 2.2*** (Plantation activities).

Environment Impact Assessment (EIA) study for the captive resin manufacturing plant was undertaken as per the requirements of EIA notification and the EIA report was prepared and submitted to State Environmental Impact Assessment Authority (SEIAA), Andhra Pradesh. Environment Clearance (EC) for the facility was granted via EC identification number EC22B021AP157099 dated 6th January 2022.

The total area identified for the integrated manufacturing facility is 66.49 acres (26.90 ha), of which 1.13 acres (0.46 ha) is used for setting up the resin plant and 26.84 acres (10.86 ha) for the manufacturing, storage of raw materials and manufactured particle boards. 33% of the total area i.e., 21.91 acres (8.87 ha) is proposed to be used for greenbelt development wherein a total of 13,300 trees will be planted. 7.01 acres (2.84 ha) has been earmarked as open area while 10.70 acres (4.33 ha) for road & parking. The salient features of the manufacturing facility have been presented in Table 2-1.

Table 2-1: Salient Features of the Manufacturing Facility

<table>
<tr><th>Sr.No.</th><th>Particular</th><th>Details</th></tr>
<tr><td>1.</td><td>SPV Name</td><td>M/s. Greenlam South Limited (GSL)</td></tr>
<tr><td>2.</td><td>Production Capacity</td><td>62,287.5 TPA (188.75 TPD)</td></tr>
<tr><td>3.</td><td>Project Location</td><td>Industrial Park, Naidupeta, APIIC, Menakuru Village, Naidupeta mandal, Tirupati District, Andhra Pradesh.</td></tr>
<tr><td>4.</td><td>Project Coordinates</td><td>Boundary point coordinates are as provided below:
13° 55 '54.79 "N, 79° 49' 33.39" E
13° 55' 54.12 "N, 79° 49' 55.84" E
13° 55' 42.16 "N, 79° 49' 55.71" E
13° 55' 43.34 "N, 79° 49' 32.29" E</td></tr>
<tr><td>5.</td><td>Current Project status</td><td>Under construction</td></tr>
<tr><td>6.</td><td>Production Capacity Details</td><td><table><tr><th>Sr.No.</th><th>Name of Product</th><th>Capacity</th></tr><tr><td>1</td><td>High Pressure laminates</td><td>90,00,000 Nos/annum</td></tr><tr><td>2</td><td>Plain Particle Board</td><td>2,62,500 Cbm/annum</td></tr><tr><td>3</td><td>Pre-laminated Particle Boards</td><td>1,65,00,000 Sq.mtr/annum</td></tr><tr><td>4</td><td>UV Coated boards (Particle boards, MDF, HPL sheets & compact boards)</td><td>12,67,200 Nos./annum</td></tr><tr><td>5</td><td>Veneer</td><td>40,000 TPA</td></tr></table></td></tr>
<tr><td>7.</td><td>Hot water generator</td><td>2 x 80 Lakh K.cal/hr</td></tr>
<tr><td>8.</td><td>Thermic Fluid Heater</td><td>2 x 80 Lakh K.cal/hr</td></tr>
<tr><td>9.</td><td>Thermal energy plant</td><td>300 Lakh K.cal/hr</td></tr>
<tr><td>10.</td><td>Boiler Capacity</td><td>1 x 8 TPH</td></tr>
</table>

[3] Source: Final EIA report for the facility dated July 2021

Sr.No.	Particular	Details
11.	D.G. Sets	4 x 1000 KVA & 1 x 750 KVA
12.	Total water requirement for operation phase	~ 365 KLD (Fresh water – ~ 276 KLD & Recycled water – ~ 89 KLD)
13.	Estimated amount of ash to be generated	9.12 TPD
14.	Fuel for Boiler	Wood Trimming loss – 13.51 TPD Paper Waste - 33 TPD
15.	Total Power Requirement	9000 KVA
	Ecological Status	
16.	Presence of National Park, Protected Area, or ecologically sensitive sites in near vicinity	**Manufacturing Unit** There is no Protected Area (PA)[4] as well as Important Bird and Biodiversity Area (IBA)[5] within the proximity of 10 km. The nearest protected area (also an IBA), Nelapattu Bird Sanctuary is about 15 km away from the manufacturing facility in the southeast direction. **Catchment Area** Nelapattu Bird Sanctuary (also an IBA) is present within the conceptualized boundary of the catchment area. Sri Penusila Narasimha Wildlife Sanctuary (also an IBA), and Sri Venkateshwara National Park & Sanctuary (also an IBA) are also situated in the surroundings of catchment area.
	Land Requirement	
17.	Land Requirement for the Project	26.90 ha (66.49 acres).

Source: Greenlam

2.2 Plantation Activity

Based on the discussion carried out with the Project team it was understood that currently no field based plantation activities are being carried out for the project. Presently, Greenlam team is carrying out the survey for the potential areas for wood procurement and development of the plant nursery. As informed the plantation activity will be carried out in phases with an annual target of 6000 ha and will be covering 30000 ha in five years. Plantation activity and wood procurement for the manufacturing facility is proposed to be done from 87 Mandals falling in 10 Revenue Divisions of 3 Districts as detailed in Table 2-2.

Table 2-2: Wood Procurement & Plantation District and Mandals

Sr.No.	District	Revenue Division	Mandals	Original District
Manufacturing Facility				
1	Tirupati District[6]		Naidupeta	SPS Nellore
Plantation & Wood Procurement[7]				
2	Tirupati	Tirupati	• Chandragiri • Chinnagottigallu • Tirupati Rural • Tirupati Urban	Chittoor

[4] http://wiienvis.nic.in/Database/Maps_PAs_1267.aspx

[5] Rahmani A.R., Islam M.Z. and Kasambe R.M. (2016) Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated). Bombay Natural History Society, Indian Bird Conservation Network, Royal Society for the Protection of Birds and BirdLife International (U.K.), p. 1992 + xii.

[6] Newly formed district, "Tirupati" is the project district for the manufacturing plan as well as for wood procurement and plantation activities. Tirupati District came into existence on 4th April 2022. Tirupati district comprise of 4 revenue divisions i.e., Gudur, Sullurupeta, Srikalahasti and Tirupati and 34 Tehsils (also known as "mandals" in the state of Andhra Pradesh). The revenue divisions Gudur & Sullurupeta were initially part of Nellore district and Srikalahasti & Tirupati revenue divisions were part of Chittoor District. Due to the recent formation of Tirupati district, no official government reports are found for the same. Thus, for the purpose of this report, reference for the aforementioned revenue divisions and tehsils has been taken from the official data of their previous districts There has been no change in geographical boundary for any of the tehsils that have been moved into Tirupati district, therefore the data present in the secondary domain from their original district can be considered.

[7] Names of the mandals have not been finalized as yet from which raw material procurement will be done

Sr.No.	District	Revenue Division	Mandals		Original District
			• Pakala • Puttur • Ramachandrapuram	• Vadamalapeta • Yerravaripalem	
		Srikalahasti	• K.V.B Puram • Nagalapuram • Narayanavanam • Pichatur	• Renigunta • Srikalahasti • Thottambedu • Yerpedu	
		Sullurupeta	• Buchi Naidu Kandriga • Doravarisatram • Naidupeta • Ozili • Pellakuru	• Satyavedu • Sullurpeta • Tada • Varadaiahpalem	SPS Nellore
		Gudur	• Balayapalli • Chillakuru • Chittamuru • Dakkili	• Gudur • Kota • Vakadu • Venkatagiri	
3	Sri Potti Sriramulu Nellore (SPS Nellore)	Nellore	• Nellore urban • Nellore rural • Indukurpet • Tp gudur • Muthukur • Venkatachalam	• Podalakur • Rapur • Kovur • Buchireddypalem • Manubolu • Sydapuram	N.A
		Atmakur	• Atmakur • Kaluvoya • Chejerla • A sagaram • As pet	• Sangam • Sr puram • Udayagiri • Marripadu	
		Kavali	• Kavali • Allur • Kodavalur • Vidavalur • Vinjamur	• Dagadarthi • Bogole • Jaladanki • Duttalur • Kaligiri	
		Kandukuru	• Kondapuram • Varikuntapadu • Kandukuru • Lingasamudram	• Gudluru • Ulavapadu • Voletivaripalem	
4	Chitoor	Chitoor	• Chittoor • Gudipala • Gangadhara Nellore • Yadamari • Irala • Puthalapattu	• Penumuru • Thavanampalle • Pulicherla • Rompicherla • Srirangarajapuram • Vedurukuppam	N.A
		Nagari	• Nagari • Nindra • Vijayapuram	• Karvetinagar • Palasamudram	

Source: Wood Strategy Details, as provided by Greenlam

2.3 Site Setting

The integrated manufacturing facility is currently being developed in Naidupeta Mandal, Tirupati District. It is located in an area with flat to gentle slope. The manufacturing facility can be accessed by an industrial park road which finally connects the facility to SH 397, present at an aerial distance of 1.4 kms in south direction. Since the facility is situated in an industrial park, there are multiple other industries present in the vicinity, such as Ultramarine Pigments Limited (at an aerial distance of ~ 720m), Brakes

India PVT. Ltd. (at an aerial distance of ~ 700m) and ARDEE industries (at an aerial distance of ~ 900m). A list of industries within the 2 km radius of the boundary of the manufacturing facility has been provided in the Table 2-3.

Menakuru village is located 1.8 km (aerial distance) from manufacturing facility towards South-East direction. A water body is located ~ 100 m (aerial distance) from facility towards north direction and a water canal (Minor canal of Telugu Ganga Project) flows at an aerial distance of 1.1 km in the west direction . Swarnamukhi River flows 5.6 km (aerial distance) of the facility location, towards east direction. Another water canal (seasonal water body of Swarnamukhi River) flows toward east direction, located at a distance of 1.6 km (aerial distance).

Nearest town to the site of the manufacturing facility is Naidupeta at an aerial of 6.5 km and nearest city is Nellore city at an aerial distance of ~ 58 kms towards southeast and northeast direction respectively. The nearest airport to the Plant location is Tirupati airport, located at an aerial distance of 32.2km, while the nearest railway station is Naidupeta Station, located at an aerial distance of 5.54km. The site location map for the manufacturing facility has been presented in Figure 2-1.

As per the available information, the manufacturing facility is situated on the Deccan Peninsula – Deccan South (6E) Biogeographical Province; while the catchment area (raw material resourcing area) is spread over the Deccan Peninsula – Deccan South (6E) and Coasts – East Coast (8B) Biogeographical Provinces of India[8]; Eastern Coastal Plains (Hot, subhumid transitional zone with coastal and deltaic alluvial soils) Agro-ecological Region[9] and East Coast Plains and Hills region (XI) Agro-Climatic Region[10]. The surrounding areas of manufacturing facility and catchment area consists of forests, open scrubs / wastelands, agricultural lands, water bodies, and human settlements.

Table 2-3: List of other industries present near the Integrated Manufacturing Facility

Sr. No	Names	Distance from the facility
1	M/s. Loyal Textile Mills Ltd.	1.54km
2	M/s. Crest Cellulose Private Limited	1.5km
3	M/s. National Plastic Industries Ltd.	1.48km
4	M/s. Hindustan National Glass and Industries Ltd	1.48km
5	M/s. BASF India Limited	1.62km
6	M/s. Gelcaps Industries	1.35km
7	Brakes India Pvt Ltd	700m
8	M/s. Kanoria chemicals	1.47km
9	M/s. Ultramarine Pigments Limited	720m
10	M/s. ARDEE Industries	900m

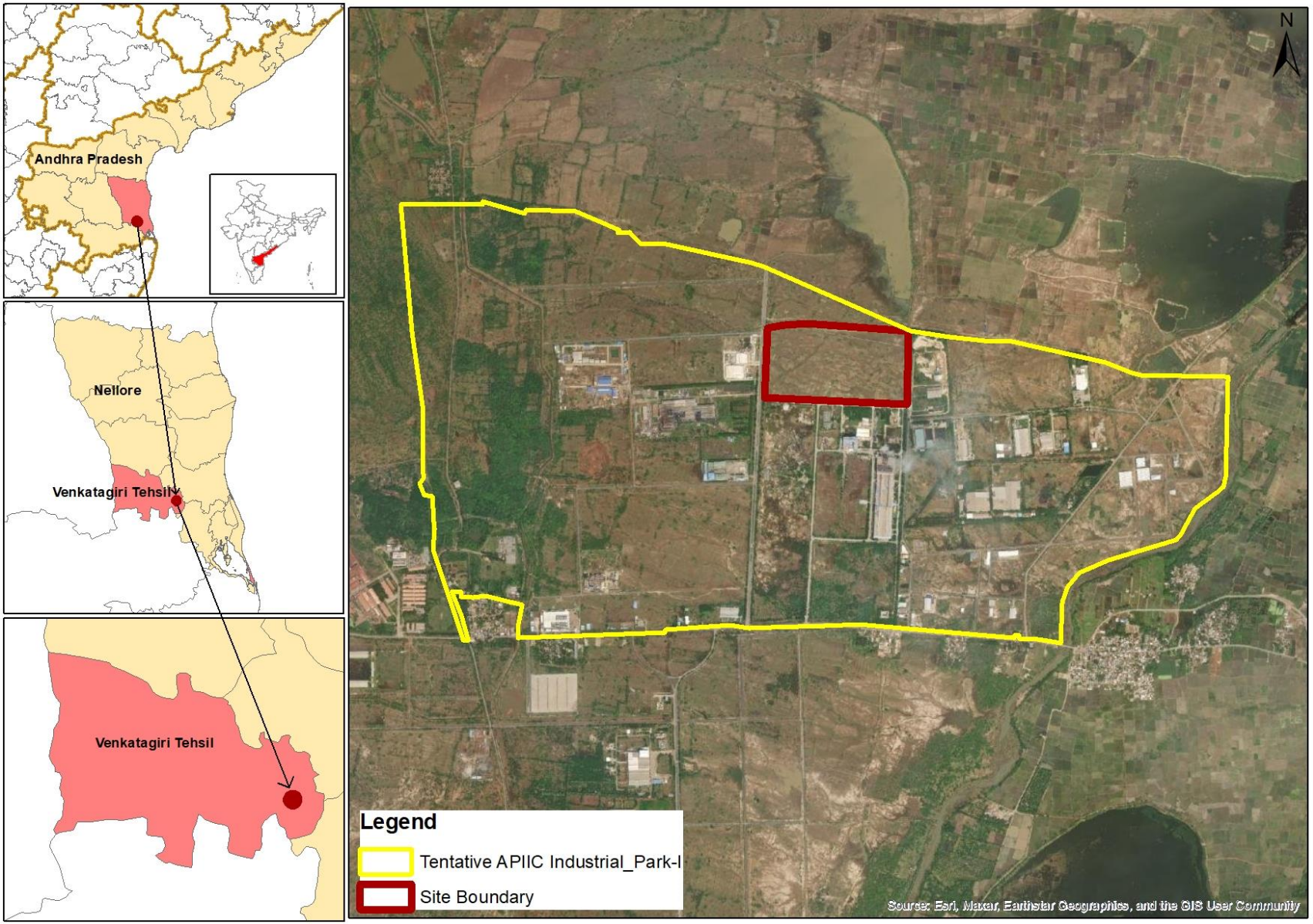
Source: Site visit & Google Earth Imagery dated 06/22/2022

[8] http://wiienvis.nic.in/database/htmlpages/bioprovincemap.htm

[9] Mandal D.K., Mandal C. and Singh S.K. (2015) Delineating Agro-Ecological Regions. ICAR-NBSSLUP technology, p. 8.

[10] http://apps.iasri.res.in/agridata/19data/chapter1/db2019tb1_2.pdf

Figure 2-1 Manufacturing Facility Location Map



Source: Independent E&S Advisor and GIS Mapping

2.4 Facility Overview

The Plant is an integrated manufacturing facility with capacity of 62,287.5 TPA (188.75 TPD) for manufacturing of High-Pressure Laminates, Plain Particle Board, Pre-Laminated Boards and UV Coated Boards (Particle boards, MDF, HPL Sheets & Compact Boards). Four different types of resins will be manufactured for captive use. Glue will be used for bonding of wood chips together in particle board process to laminate design/decor papers with particle board and to use in Kraft paper and design paper layers in High Pressure Laminate manufacturing process. A boiler will be installed within the plant to generate 8TPH of steam. Capacity of products to be manufactured have been presented in ***row 6 of Table 2-1***Table 2-1. Raw material requirement for the integrated manufacturing facility has been presented below in ***Section 2.5.1***Table 2-5. Process flow for resin manufacturing and particle board manufacturing and veneering[11] has been presented in ***Section 2.4.1***.

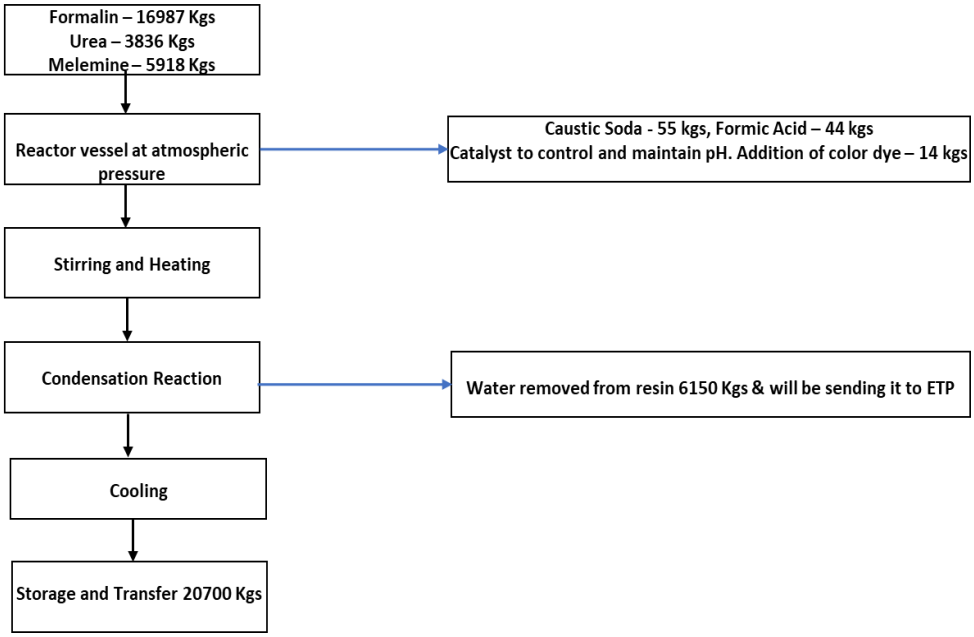
2.4.1 Manufacturing Process Description

2.4.2 Resin Manufacturing

The manufacturing process for Phenol Formaldehyde Resin, Melamine Formaldehyde Resin, Urea Formaldehyde Resin and Melamine Urea Formaldehyde Resin, High Pressure Laminate/Compact Board are almost the same except for the chemical solutions used for each manufacturing process which differs. Since the manufacturing process for all the resins are same, the manufacturing process for Melamine Urea- Formaldehyde (MUF) Resin has been detailed below and flow diagram has been presented in Figure 2-2. Manufacturing process for the rest of the resins have been presented in ***Appendix 3.***

Manufacturing process of Melamine Urea- Formaldehyde (MUF) Resin for particle board includes mixing of formalin (HCHO), urea ($CO(NH_2)_2$) & melamine ($C_3H_6N_6$) in a kettle and the pH of the solution is adjusted with caustic soda (NaOH) solution which should be between 7.3 to 9. The mixture formed is stirred well while increasing the temperature up to 90 degrees with the help of steam. This is an exothermic reaction which is accomplished by adding caustic soda (NaoH) in the solution. Caustic soda acts as catalyst and maintains the pH level. The mixture is then aged for 1-6 hours and is cooled during this duration. Post the completion of reaction, resin is cooled down to room temperature and transferred to resin storage tank.

Figure 2-2: Process Flow Chart of Melamine Urea Formaldehyde Resin Process



Source: Greenlam EIA Report

2.4.3 Particle Board Manufacturing

Particleboard is made by combining wood with a resin and molding the combination into a sheet. The steps in the manufacturing process of Particle Board are:

- Preparation of Raw material which is then fed into a disc chipper.
- Drying of the particles and too large or too small particles are screened away.
- Spraying of the particles with resin in a thin mist.

[11] As understood, based on site visit and confirmation from GSL, Veenering process will also be undertaken at this facility

- Other chemicals such as wax, dyes, wetting agents and releasing agents are used in panel production to help with processing. The particles are then piled into a continuous carpet after passing through a mist of resin sufficient to coat all surfaces.
- Splitting of the 'carpet' into discrete, rectangular 'blankets,' which is followed by compression in a cold press.
- The flakes are weighed and are distributed by an air jet in graded-density particle board, which throws finer particles further than the coarse ones.
- The particles may build up from fine to coarse and back to fine using two of these jets, which are reversed.
- To minimize thickness, the produced sheets are cold compressed. After that, the boards are cooled and sanded.

Produced sheets are offered as raw board or with a wood veneer or laminate surface added to improve the appearance.

2.4.4 Veneer Manufacturing

GSL will be using eucalyptus wood logs to produce required veneers within the project site. It is understood that waste generated from veneering process like bark, wood waste etc. is proposed to be used as fuel in hot water generator, thermic fluid heaters and as a raw material in Particle board process. Four (04) peeling lines will be installed, of which 3 peeling lines would be 4 feet peeling line while 1 would be 8 feet peeling line.

Steps involved in veneer manufacturing proposed at the facility includes the following:

- Log Yard - The timber[12] will be purchased for producing veneer and will be stored in log yard. As per requirement these logs are sectioned in 8' to 3' length which are then supplied to the Peeling section for processing.
- De-barker & Peeling –The logs are first put in the de-barker machine where the bark of the logs is removed and then it goes to the spindle-less peeling machine where thin sheets of veneer, from 0.50mm to 2.50 mm, are produced as per the market order / requirement.
- Clipping / Chopping – The sheets are then cut into different sizes after removing defects such as holes, heavy cross fiber etc.
- Storage & Dispatch – The veneers are than stacked size wise and thickness wise and subsequently loaded in the truck and dispatched.

2.5 Resource Requirement

The resource requirement during construction and operation phase of the facility has been summarised in Table 2-4**.** The construction Phase is bifurcated in two phases, Phase 1 includes construction of laminates manufacturing facility and Phase 2 includes particle board manufacturing facility. As understood during the site visit, construction for Phase 1 was initiated in January 2021 and as on the date of site visit (20th March 2023) 70% of the civil works was observed to be completed with machinery installation in progress. Operations of laminates and resin manufacturing is anticipated to be initiated by September 2023, as of August 2023, dry run and process testing has been initiated. For Phase 2, civil works and machine delivery process is complete, Particle Board machine installation has been initiated and operations of particle board manufacturing are anticipated to be initiated by Q4 of FY 2023-2024.

Table 2-4: Resource Requirement

Sr.No.	Resource	Approximate Quantity	Source
1.	Manpower	. Manpower requirement during construction phase of plant will be about 1200 to 1500 persons. 50% of total requirement will be in Phase 1 and Phase 2. Total estimated manpower requirement during operation phase is estimated to be 850.	The total manpower for the facility will be met from nearby villages, towns and cities.
2.	Water	**Construction Phase** **Domestic & Drinking Requirement at the facility and labour camp** • Domestic water requirement is estimated to be ~2 to 3 KLD, considering workforce of 1200 to 1500 deployed during the construction phase, assuming the water requirement would be 80-180 litres/person/day[13]. • Potable water requirement is and will be met through packaged drinking water.	**Construction Phase** The facility is located in a developing industrial area, and the water supply from APIIC has not yet started. The Plant has installed borewells within the project boundary for fulfilling the water requirement during construction phase. **Operation Phase**

[12] the timber/wood procured will be the same as the agroforestry produce sourced for the board and particle board production. Supply chain for the wood to be procured for veneering will be same as the wood being procured for manufacturing process

[13] IFC Worker's accommodation Guideline

Sr.No.	Resource	Approximate Quantity	Source
		Construction Works, Dust Suppression activities, Batching Plant • Water requirement during construction phase for civil work and dust suppression activities etc is estimated to be approximately 150 KLD. **Operation Phase** • The total water requirement for the integrated manufacturing facility is estimated to be ~ 365 KLD consisting of ~ 276 KLD fresh water and the remaining ~ 89 KLD recycled water. • Water during operation phase will also be required for washings, cooling tower make-up, steam generation and domestic purposes. Detailed breakup of water requirement has been presented section 2.6	Water supply from APIIC will be the main source of water for the facility. Exact date for initiation of water supply from APIIC is not known. Till the APIIC water supply is initiated, GSL will use borewell water and tanked water for their operations. As observed during site visit, the facility has installed 4 borewells within the premises. Permission of installation of four (04) borewells has been received from government of Andhra Pradesh, Ground Water and Water Audit Department via letter no 1168/Hg-II/2018 dated 31st August 2021 and the facility is withdrawing the ground water during the construction phase as well. As per the approval received, GSL is permitted to pump out 220 KLD of groundwater from four (4) newly recommended bore wells with I0 hours of pumping per day against the requirement of 275 KLD duly following the terms and conditions as mentioned in the report. As per Central Groundwater Authority (CGWA), Ministry of Jal Shakti, Notification dated 24 September 2020[14], industries will have to obtain authorization from CGWA before abstraction and use of groundwater. As per CGWB, Nellore District, Naidupeta Mandal (location of manufacturing facility) falls is an area marked as "critical" in terms of groundwater development, whereas as per the ground water assessment report developed by Andhra Pradesh Ground water and water audit department, Menakuru village (location of manufacturing facility) is categorised as Over-Exploited. Furthermore, as per CGWA notification dated 24 September 2020, all industries drawing ground water in safe, semi-critical and critical assessment units shall be required to pay ground water abstraction charges as applicable as per Tables 5.2A and 5.3A of the said notification. Where as in Over-exploited assessment units, No Objection Certificate shall not be granted for ground water abstraction to any new industry except those falling in the category of Micro, Small and Medium Enterprises (MSME). The project does not falls in Micro, Small and Medium Enterprises category. It is a large category industry. Since the manufacturing facility falls in over-exploited category and the mandal falls in Critical category, ground water withdrawal by GSL has been permitted only by constructing the recommended artificial recharge structures and by recharging twice the quantum of groundwater extracted within their premises. For the remaining water requirement for fresh water, i.e. 56KLD. The required water shall be met via tanker. The source of tanker water will be Telugu Ganga Canal and/or Swarnamukhi River. Tanker water will only be used till the water supply

[14] Central Groundwater Authority (CGWA), Ministry of Jal Shakti ((Department Of Water Resources, River Development and Ganga Rejuvenation), Notification dated 24 September 2020. Link: http://jalshakti-dowr.gov.in/sites/default/files/CGWA_GWExtraction_Notification_24-09-2020.pdf

Sr.No.	Resource	Approximate Quantity	Source
			from APIIC is not available. Water supply from APIIC will be the main source of water for the project operations.
3.	Construction Material	**Construction Phase** **Material** / **Quantity (MT)**: Phase 1 / Phase 2 Cement: 11077 / 13830 Sand: 28562 / 29222 Metal: 55559 / 68272	Sourcing and transportation of the construction material is in the scope of the contractors and is sourced from the local supplier All the suppliers are authorized sellers for the construction material and have required permission for storage and transportation of the materials. As ensured that sand is being sourced from suppliers who have a valid royalty challan
4.	Major Equipment's	**Construction Phase:** Major equipment used for construction activity includes tractors and levellers, mobile batching plant, dumper, transit mixer, concrete pump, JCB (Extractor & Bull dozer), Vibrio Roller, Bar cutting, Bar Bending, Concrete Drilling etc. **Operation Phase** **Equipment** / **Capacity & Nos**: Kettle with condenser: $20m^3$ (3 Nos) + $10m^3$ (1 Nos) + $5m^3$ (5 Nos) +$3m^3$ (1 Nos) Phenol evaporation kettle: $10m^3$ (2 Nos) Urea & Melamine transfer/feeding system: 6TPH, 2 Nos Steam boiler: 8 TPH (1 Nos) Cooling Towers: $500m^3$ (2 Nos) Compressor: 100CFM (1 Nos) Forced Evaporative system: 15 KLD (1 Nos) Transfer pumps & pipe lines: 1 Set	**Construction Phase** As understood, local authorised suppliers and vendors are being hired for providing the required equipment's during the construction phase. **Operation Phase** Major Equipment and Machinery to be used during process and operations are being procured from identified and selected vendor with the required technology. As understood, most of the machinery is being sourced from overseas.
5.	Power	**Construction Phase:** Power requirement during construction phase is estimated to be ~ 13000 kwh/month **Operation Phase:** The total power requirement for the integrated manufacturing facility during operational phase is estimated to be about 9000 KVA.	Source of power for the manufacturing facility during both construction and operation phase is AP TRANSCO Naidupeta Industrial Park APIIC Substation (33 KV sub-station). Also, for backup during operational phase, 5 (five) standby DG sets of various capacity including 4 D.G. sets of 1000 kVA each and 1 D.G. set of 750 kVA are proposed to be installed
6.	Fuel Requirement	**Construction Phase** **Name** / **Quantity (Liters)**: Phase 1 / Phase 2 LPG: 1.50 / 1.50 Diesel: 190 / 190 Petrol: 1.20 / 2.0 **Operation Phase** Fuel requirement for operation phase is as presented in section 2.5.3	Source of fuel during construction and operation will be nearby dispensing stations.

Source: EIA Report and site visit

2.5.1 Raw Material

Wood will be the main raw material in the manufacturing process, which is proposed to be sourced from farmers, suppliers, traders, etc. and will be transported by road. In addition to the wood, packing paper, padding paper, kraft paper will also be used in the process. List of raw material with annual estimated quantity is as presented in Table 2-5below.

Table 2-5: Raw Material Requirement (Operation Phase)

Name	Total Quantity required (TPA)	Storage Capacity (MT)	Type of Storage	Source and Mode of Transportation
Wood	495000	10000	Open Storage Area	Farmers/Wood suppliers, Transported by road via trucks/tractors
Kraft paper	42821	3000	Rolls	Traders/Manufacturer, Transported by road via truck
Design/decor paper & tissue paper	6217	3000	Rolls	
Biaxially Oriented Polypropylene (BOPP) film	229.35	10	Rolls	
Padding paper	9121.2	300	Rolls	
Packing paper	442.2	20	Rolls	
Packing LDP film	1471.8	50	Rolls	

Source: Greenlam

2.5.2 Chemical Requirement

Proposed manufacturing process will involve usage of chemicals like formaldehyde, phenol, melamine, methanol, urea etc. Detailed list of chemicals proposed to be stored within the facility with storage capacity is as presented in Table 2-6. Facility will have dedicated location for storage of the chemicals. The storage arrangements for all chemicals will include secondary containment for spillage control. The storage location has been presented as ***Figure 2-3.***

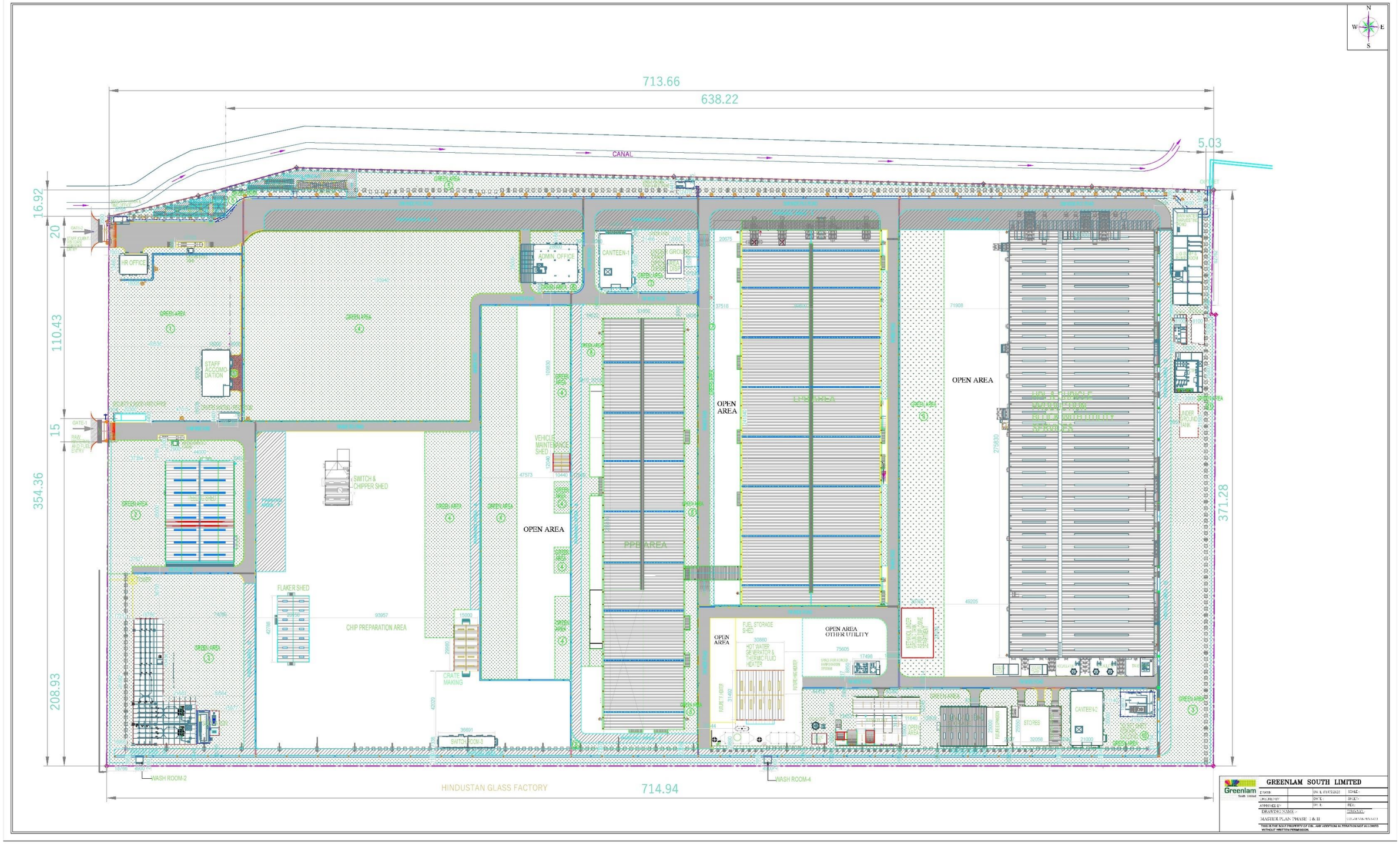
Table 2-6: Chemical Requirement (Operation Phase)

Name	Total Quantity required (TPA)	Storage Capacity (MT)	Type of Storage	Source and Mode of Transportation
Raw Material				
Formaldehyde	39847.50	300	Liquid: Vertical Storage Tanks	Manufacturer or traders, transported by road via trucks
Phenol	12662.1	400	Liquid: Vertical Storage Tanks	
Melamine	6570.30	100	Powder: Storage in Bags	
Di-ethylene glycol (DEG)	247.50	50	Vertical Storage Tanks	
Liquid Ammonia	1.65	0.1	Liquid: Stored in Drums	
Cardinol	1102	100	Vertical Storage Tanks	
Methanol	123	40	Liquid: Underground tank	
Caustic	75.90	1	Solid/Flakes: Stored in Bags	
Formic acid	49.50	1	Liquid: Stored in Drums	
Urea	9164.10	100	Solid/Granules: Stored in Bags	
Ammonium chloride	619	50	Solid/Flakes: Stored in Bags	
Releasing Agent	5.28	0.5	Liquid: Stored in Drums	
Wetting Agent	10.56	0.5	Liquid: Stored in Drums	

Name	Total Quantity required (TPA)	Storage Capacity (MT)	Type of Storage	Source and Mode of Transportation
Caprolactam	153.78	10	Crystalline: Stored in Bags	
Wax Emulsions	619	50	Liquid: Vertical Storage Tanks	
Green Dye	3.3	1	Powder: Storage in Drums	
Manufactured for Particle board and High Pressure Laminate boards				
Urea formaldehyde resin	56.52 TPD	200	Storage Tanks	Manufactured in the captive resin plant
Melamine urea formaldehyde	20.7 TPD	200		
Melamine formaldehyde resin	37.33 TPD	125		
Phenol formaldehyde resin	74.2 TPD	160		

Source: GSL

Figure 2-3: Facility Layout showing storage and utility areas



Source: GSL

2.5.3 Fuel Requirement

Estimated quantity of wood[15] and biomass for the manufacturing facility is 175200[16] MT/Annum (480MT/day), additionally inhouse wood waste (~129210[17] MT/Annum) will also be used in the boiler. Coal usage (4032[18] MT/Annum) will only be during exigency/emergency situations or during any sudden shortage of wood due to unavoidable circumstances. Coal will be sourced from coal traders and suppliers in India who will further import from South Africa/ Indonesia etc.

As understood, wood and biomass will be used in combination depending on availability. All types of biomass that are and will be available will be used in boiler since the boiler is a multifuel boiler. Requirement of fuel with storage capacity and type of storage is presented in ***Table 2-7***Table 2-7 below.

Table 2-7: Fuel Requirement (Operation Phase)

Name	Total Quantity required (MT/Annum)	% share of fuel requirement (in terms of weightage)	Energy & Share % (Per Annum) GJ	Storage Capacity (MT)	Type of Storage	Source and Mode of Transportation
Sourced Wood & biomass	Sourced Wood: 122640[19]	39.76%	2493695.61[20] (43.4%)	1200	Open Storage Area	Farmers, wood suppliers, traders. Transported by road via trucks
	Sourced Biomass: 13797[21]	17.04%	504404.76[22] (8.8%)			
In house wood waste	129210	41.89%	2627286.45[23] (45.8%)			Leftover wood from veener and particle board manufacturing
Coal	4032	1.30%	116926.43[24] (2%)	100	Open Storage Area	Coal Traders and Suppliers
Total fuel requirement	179232	100	--	--	--	--
Diesel[25] for in house for lift trucks, company tractors and vehicles (KL)	0.165	--	--	25	Underground Storage Tank	Traders, Transported by road via trucks/small vehicles

Source: Documents from Greenlam

2.5.4 Steam Requirement

About 8 TPH of steam is required for the resin plant generated through steam boilers. Refer ***Table 2-4*** for details on boilers.

2.6 Water Requirement

Water requirement during operation will be for washing, cooling tower make up, stream generation, landscaping and domestic purposes. Total water requirement is estimated to be ~ 363 KLD which comprises of 276 KLD fresh water and 89 KLD recycled water. Detailed breakup of water requirement during operation phase has been presented below Table 2-8.

[15] Sourced Eucalyptus wood as well as inhouse wood waste
[16] As Per EIA report, 480 MT/Day of fuel (wood & biomass) is required for the integrated plant. Based on the 480 MT/Day, annual requirement (i.e for 365 days) is calculated as 175200 MT/Annum and considering approximately 354 MT/Day of wood waste will be generated within the facility and will be reused in the boiler.
[17] In house Wood Waste generated will be 354 MT/Day, therefore 129210 MT/Annum of inhouse wood waste will be generated and used in the boiler
[18] Considering coal consumption for emergency use : 21 days x 192 MT/Day= 4032 MT/Annum (max 21 days consumption in a year).
[19] Total Fuel for boiler comprising of Wood & biomass is 480 MT/Day (175200 MT/Annum), considering 30% is biomass. Therefore 122640 MT/Annum of wood will be sourced
[20] Considered HHV of 17.48 MMBtu per short ton (20.33 GJ/MT) for Eucalyptus Wood (1 MMBtu per short ton = 1 MMBtu * 1.05506 GJ per MMBtu * (1 / 0.907) short ton per metric ton)
[21] Total Fuel for boiler comprising of Wood & biomass is 480 MT/Day (175200 MT/Annum), considering 30% is biomass. Therefore 13797 MT/Annum of biomass will be sourced
[22] Considered HHV of 8.25 MMBtu per short ton (9.60 GJ/MT) for Biomass (Agricultural Byproducts)
[23] Considered HHV of 17.48 MMBtu per short ton (20.33 GJ/MT) for Eucalyptus Wood
[24] Considered HHV of 24.93 MMBtu per short ton (29 GJ/MT) for Bituminous Coal
[25] for in house for lift trucks, company tractors and vehicles (KL)

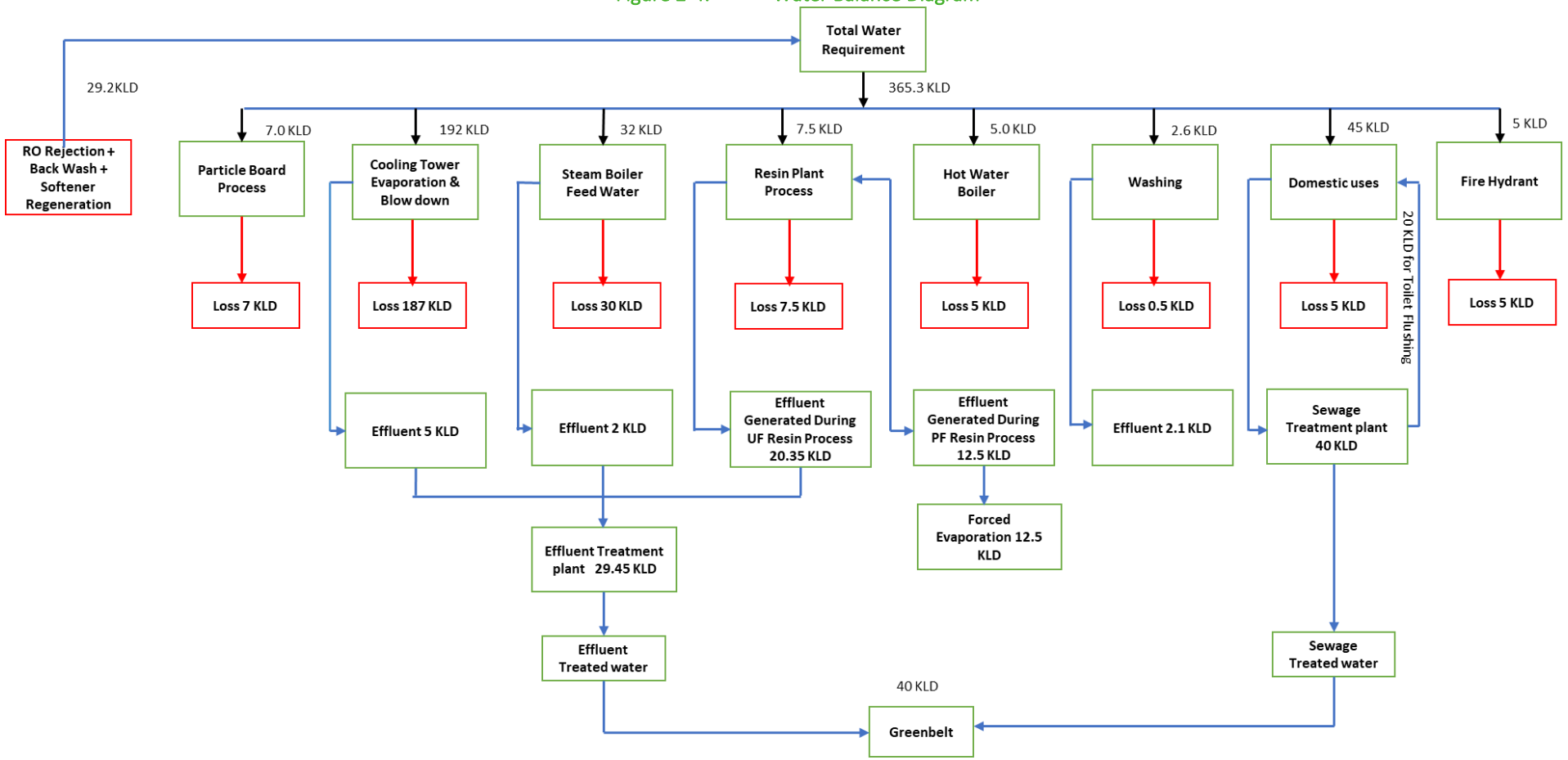
Table 2-8: Detailed breakup of Water Requirement for Integrated Manufacturing facility (Operation Phase)

Purpose	Input (KLD)		Output (KLD)		Use or treatment of output water
	Fresh Water	Recycled Water	Loss	Effluent	
Particle board process	7	0	7	0	Process consumption
Cooling Tower, Evaporation and Blow Down	192	-	187	5	Will be treated at inhouse Effluent Treatment Plant
Steam Boiler and Feed Water	32	-	30	2	
Resin Plant Process	7.5	-	7.5	-	
Hot Water Boiler	5	-	5	-	Evaporation Loss
Washing	2.6	-	0.5	2.1	Will be treated at inhouse Effluent Treatment Plant
Toilets & Canteen (Will be using Raw water, approximately 1000 workforce has been considered)	20	20	0	40	Will be treated at inhouse STP & treated water will be used for gardening/toilet flushing
Drinking water	5	0	5	0	Consumption
Fire hydrant - Raw water	5	0	5	0	Consumption
Ro rejection + backwash + softener regeneration	0	29.2	0	29.2	Will be treated at inhouse water treatment plant or zero discharged system.
Process effluent generated during process of Urea Formaldehyde & Melamine Urea formaldehyde resin	--	--	--	20.35	Will be treated at inhouse Effluent treatment plant and treated water will be used for gardening[26]
Process effluent generated during process of phenol formaldehyde resin	--	--	--	12.5	Will be treated at inhouse forced evaporation system
Recycled water used for gardening	--	40	40	--	--
Gross total	276.1	89.2	292	111.15	--
Total	**365.3**		**398.15**		-

Source: EIA Report

[26] Project area experience very less rainfall. In case of excess water during monsoon, membership for the existing CETP will be taken and water will be transported to the CETP, however this option is yet to be explored. As of now, GSL estimates that the facility will be zero discharge and the treated wastewater will be used within the facility.

Figure 2-4: Water Balance Diagram



Source: GSL

2.7 Wastewater Management

The main sources of effluent for the Project will be process, washing, cooling tower, boiler, RO/ DM plant and toilets. Wastewater / effluent generated at site is proposed to be treated and reused on site. The effluent generated from process, washings, cooling tower, RO/DM plant, boiler blow down will be sent to ETP and treated effluent reused for gardening and landscaping. Effluent from phenol formaldehyde resin is proposed to be sent to forced evaporation system. Domestic effluent (sewage) is proposed to be sent to STP and treated sewage will be used on site for secondary purposes including flushing and landscaping. As per the consent for establishment, received for the facility, the maximum waste water generation shall not exceed the quantity as mentioned in Table 2-9.

Table 2-9: Quantity of waste water generation

Purpose	Effluent (KLD)	Use or treatment of output water
Cooling Tower Bleed Off	5	Will be treated at Inhouse Effluent Treatment Plant
Boiler Blow Down	2	
Washing	2.1	
Ro rejection + backwash + softener regeneration	29.2	
Process effluent generated during process of Urea Formaldehyde & Melamine and Urea formaldehyde resin	20.35	
Process effluent generated during process of phenol formaldehyde resin	12.5	Will be treated at Inhouse forced evaporation system and further the waster will be sent to ETP for treatment
Toilets & Canteen (Will be using Raw water, approximately 1000 workforce has been considered)	40	Will be treated at Inhouse STP & treated water will be used for gardening/toilet flushing
Gross total	111.15	--

Source: Consent for Establishment (CFE) as applicable to the facility

2.7.1 Effluent Treatment Plant

Source of effluents from the facility will be from process effluents as well as phenolic distillate effluents. Details of the effluent generation from the facility have been presented below. Also as observed the design capacity for the ETP is more than the total effluent generated from the project.

Table 2-10: Source of Effluents

Source of Effluent	Quantity Generated (KLD)
Process Effluent	
Floor Washings	2.1
Process Effluent (UF/MUF Resin)	20.35
Total Blow Down (Boiler & Cooling Tower)	7
RO Rejection & Backwash and Softener Regeneration	29.2
ETP Mechanical Evaporator Condensate Effluent	12.5
Total Effluent Generated	71.15
ETP Design Capacity	73KLD
Phenolic distillate effluent	
Process effluent generated during Process Phenol Resin	12.5
Total Effluent Generated	12.5
Mechanical Evaporator Designed Capacity	15

Source: Greenlam EIA Report

Total effluent estimated to be generated (from floor washing, process, boiler and cooling tower blow down, RO reject, etc.) is ~71 KLD. The Effluent treatment plant proposed to be installed is designed to treat the 73KL / day of effluent from the various sources. The following treatment methodology is proposed to be adopted. Flow Diagram for ETP has been presented as Figure 2-5.

- Oil Skimming Systems (Belt Skimmer)
- Effluent collection tank
- Chemical Dosing
- Flash Mixer
- Flocculator Tank
- Primary Settling Tank
- Anaerobic Tank
- Aeration Tank 1 & 2 (Biological Treatment)
- Secondary Settling Tank
- Sludge Drying Beds for Chemical & Bio Sludge Dewatering
- Filter Feed Tank
- Pressure sand filter
- Activated Carbon Filter
- UF System
- Mechanical Evaporator of capacity 15 KLD

Characteristic of raw effluent considered for the adopted capacity and methodology for ETP along with the characteristics of treated effluent is presented in Table 2-11 below. The treated effluent when compared with the IFC WB guideline values (for effluent) for board and particle board based products, is well within the guideline values and is meeting the requirement.

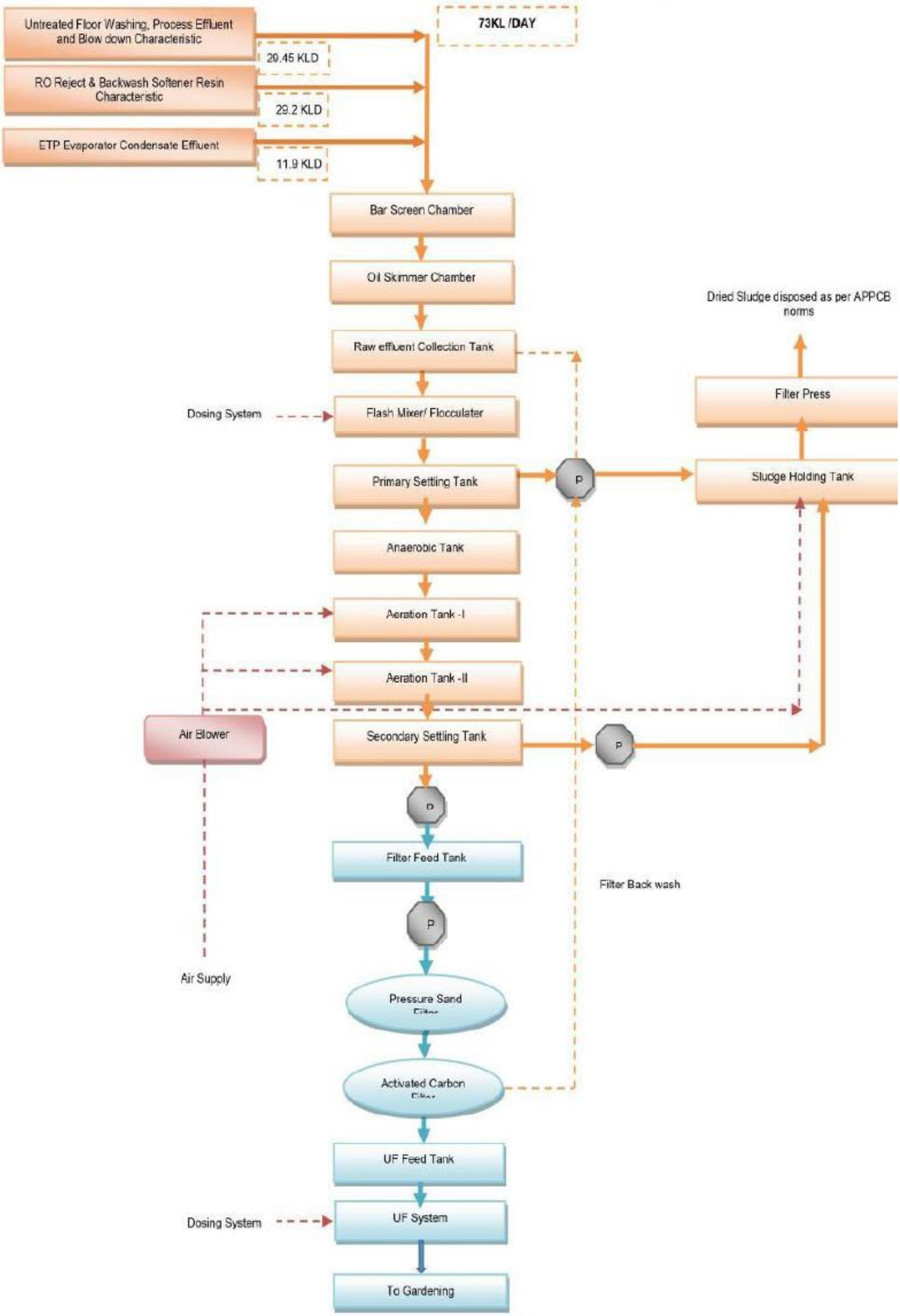
Table 2-11: Characteristics of untreated effluent considered for the adopted capacity and methodology for ETP and treated effluent characteristics

Parameters	Untreated Floor Washing, Process Effluent and Blow down	Untreated RO Reject & Backwash and Softener Resin Characteristic	Untreated ETP Evaporator Condensate Effluent	Untreated Combined Effluent Characteristic	Combined Pre-treated Effluent and UF Feed	Treated UF Permeate Tank	Treated Effluent Standards for Chemical Industry[27]	General Standards for Discharge of Effluents (Inland Surface water)[28]	IFC WB Effluent Guidelines values[29]
Flow (KLD)	29.45	29.2	11.9	70.55	72.8 72.8	72.8 72.8	--	--	--
pH	6.2	6.5 – 8.5	6.5 – 8.5	6.5 – 8.5	6.5 – 8.5	6.5 – 8.5	6.5 – 8.5	5.5-9	6-9
TSS (mg/l)	875	< 10	< 10	430	< 20	< 10	--	100	50 mg/l
TDS (mg/l)	1280	3100	< 200	1800	1900	1900	--	--	-
BOD @ 27oC for 3 days (mg/l)	6050	< 30	< 1500	3125	< 30	< 25	100	30	50 mg/l
COD (mg/l)	36019	< 250	< 4000	18690	< 200	< 200	250	250	150 mg/l
Oil & Grease (mg/l)	8.0	< 5	NIL	< 5	< 1	Nil	10	10	--
Formaldehyde	--	--	--	--	--	--		10 mg/l	

Source: Greenlam EIA Report, IFC/EHS Guidelines and CPCB guidelines

[27] https://cpcb.nic.in/displaypdf.php?id=SW5kdXN0cnktU3BlY2lmaWMtU3RhbmRhcmRzL0VmZmx1ZW50L09SR0FOSUNDSEVNSUNBTC5wZGY=
[28] The project is not discharging its treated water to any inland surface water body/public sewers/land for irrigation/marine coastal areas. However general discharge standards for inland surface water are being considered as they are the most stringent among the other parameters that are present.
[29] Environmental, Health, and Safety Guidelines BOARD AND PARTICLE-BASED PRODUCTS (https://documents1.worldbank.org/curated/en/693331489584857393/pdf/113494-WP-ENGLISH-Board-and-PBP-PUBLIC.pdf), Applicable for direct discharges of treated effluent to surface water for general use

Figure 2-5: Schematic Flow Diagram for Effluent Treatment Plant (ETP)



Source: GSL

2.7.1.1 Multi-Effect Evaporator (MEE)

The effluent generated from the process of phenol resin will be collected in the collection tank and further sent to multiple effect evaporators with agitated thin film dryer (ATFD) of designed capacity 15 KLD whereas the total Concentration of Phenol Effluent Generation is 12.5KLD . Treated effluent from double stage evaporator is proposed to be sent to ETP and the rejects to be further sent to ATFD and post treatment from ATFD it will be further sent to ETP.

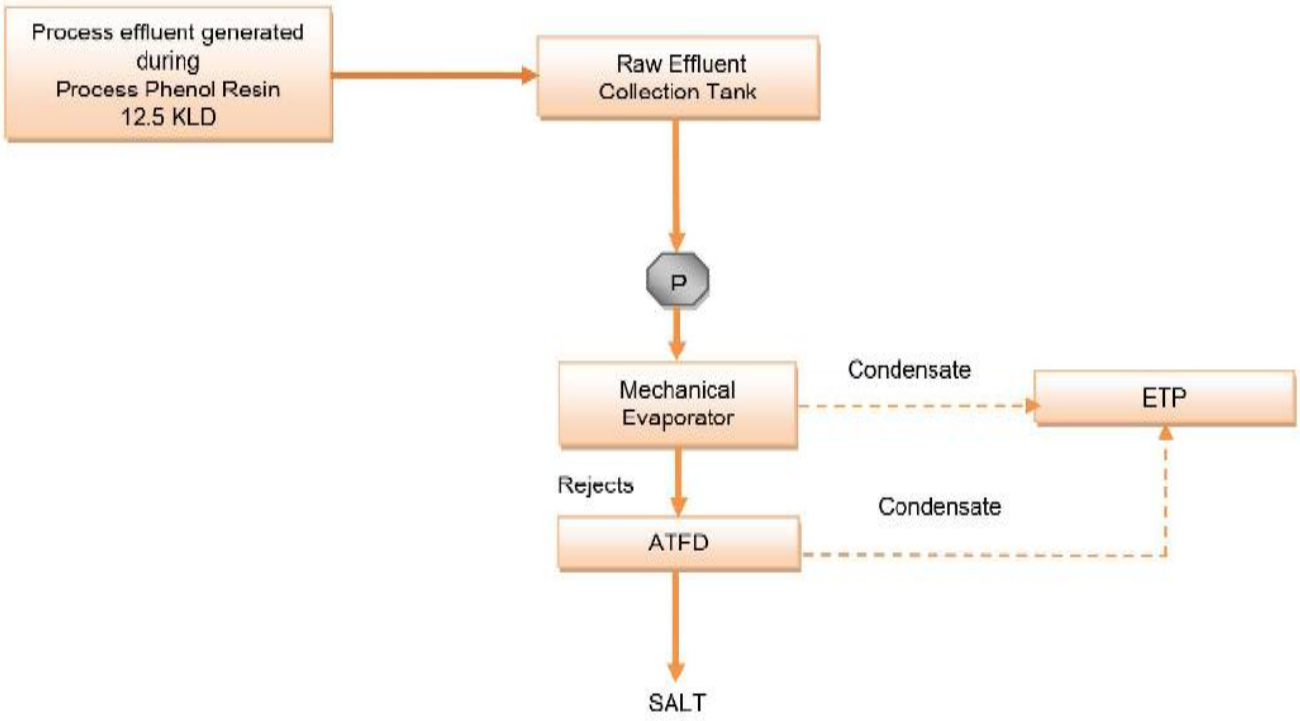
Characteristic of untreated effluent considered for the MEE is as presented in ***Table 2-12*** below. Flow Diagram for MEE has been presented as Figure 2-6.

Table 2-12: Characteristics of untreated and treated effluent considered for the adopted capacity and methodology for MEE

Parameters	Untreated Process effluent generated during the process of Phenol resin	Treated Evaporator Condensate Effluent Characteristic
Flow (KLD)	12.5	11.9
pH	6.1	6.5 – 8.5
TSS (mg/l)	510	< 10
TDS (mg/l)	1670	< 200
BOD @ 27oC for 3 days (mg/l)	6000-7000	< 1500
COD (mg/l)	136000	< 4000
Oil & Grease (mg/l)	0.8	Nil

Source: Greenlam EIA Report

Figure 2-6: Schematic Flow Diagram for MEE



Source: GSL

2.7.2 Sewage Treatment Plant

The **Sewage Treatment Plant** is proposed to be designed for 40cum/day. The sewage treatment process involves the treatment units as given below. Flow Diagram for STP has been presented as Figure 2-7

- Screening
- Collection / Equalization Tank
- Aeration (MBBR) Tank – 1 for Phase 1
- Aeration (MBBR) Tank – 2 for Phase 2 & Future

- Settling Tank – 1 for Phase 1
- Settling Tank – 2 for Phase 2 & Future
- Filtration through sand and carbon paper
- Sludge Disposal
- UF System
- Sludge Drying Beds

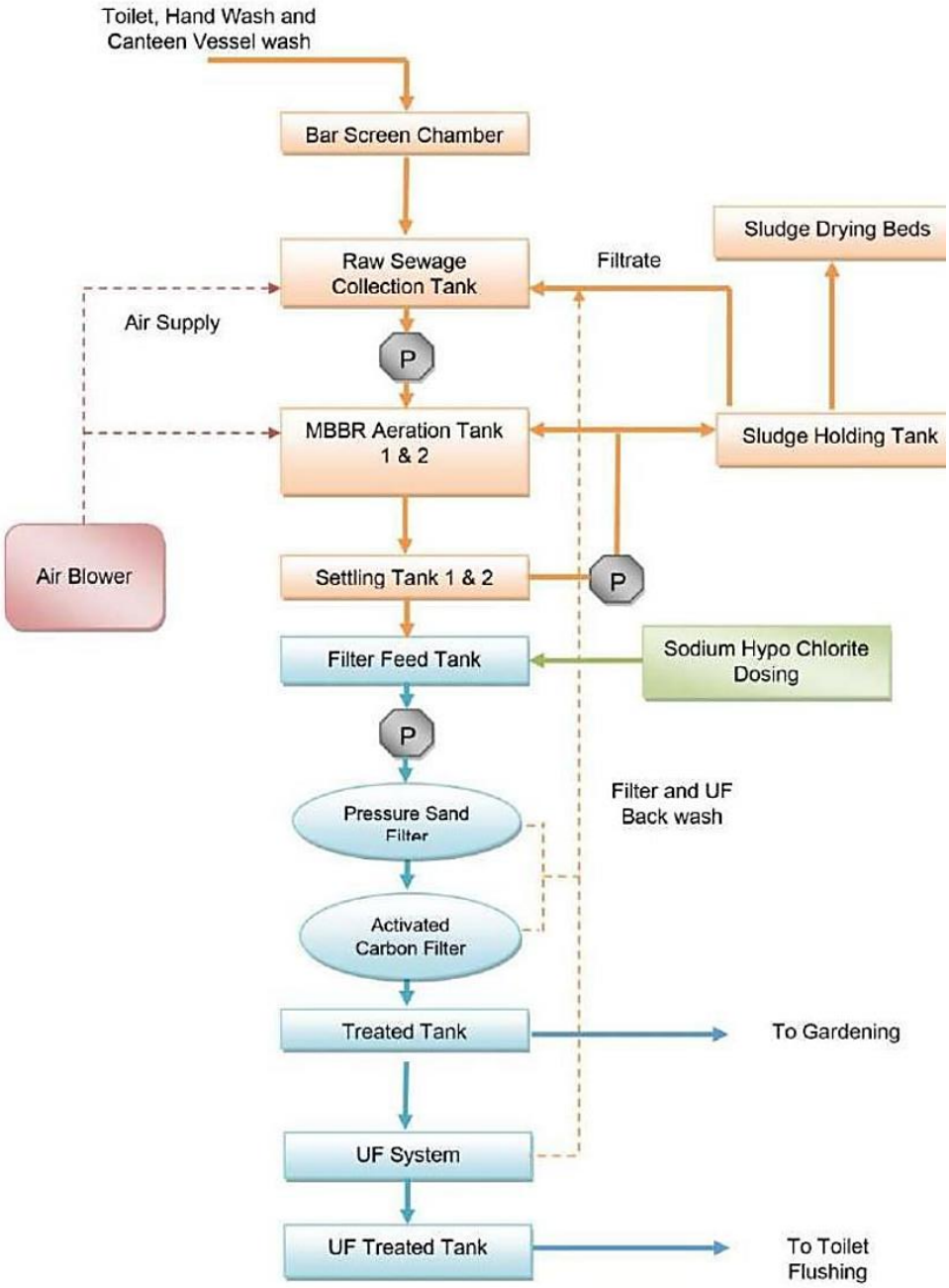
Table 2-13: Characteristics of untreated and treated sewage for the adopted capacity and methodology for STP

Parameters	Influent Characteristics	Treated sewage characteristics	UF Treated Sewage Characteristic	General Standards for Discharge of Effluents (Inland Surface water)[30]	IFC WB Sanitary Sewage Discharge values[31] (Applicable for direct discharges of treated effluent to surface water for general use)
Flow (KLD)	40	40	40	--	--
pH	6-7	6.5-7.5	6.5-8	5.5-9	6-9
BOD @20C (mg/l)	300-350	20-30	< 10	30	30
COD (mg/l)	600-700 mg/l	75-120	< 75	250	125
Oil and Grease (mg/l)	<50 mg/l	<5	<5	10	10
TSS (mg/l)	200-250 mg/l	20-25	<5	-	50

Source: Greenlam EIA Report, CPCB Standards and IFC/WB guidelines

[30] The project is not discharging its treated water to any inland surface water body/public sewers/land for irrigation/marine coastal areas. However general discharge standards for inland surface water are being considered as they are the most stringent among the other parameters that are present.
[31] https://documents1.worldbank.org/curated/en/157871484635724258/pdf/112110-WP-Final-General-EHS-Guidelines.pdf

Figure 2-7: Schematic Flow Diagram for STP



Source: GSL

2.8 Rainwater Harvesting

The run-off from the paved surfaces, rooftop of the facility (during monsoon) will be routed through storm water drainage network having harvesting pits and collected in the storm water pond. The rainwater run-off from the paved surfaces will be directly routed to storm water drainage without treatment.

A total of 1,63,370 cu.m of rain water will be harvested from rooftop, pavement and green belt areas in response to the normal rainfall of 1063mm in Naidupeta Mandal. Details of calculation of quantum of runoff availability from the project premises have been mentioned below.

Table 2-14: Details of quantum of runoff availability

Location	Area in sq.m	Rainfall in mm	Runoff Coefficient	Quantity of available runoff in cu.m
Buildings/Sheds	102633	1063	0.85	92734
Paved Area	77616	1063	0.60	53628
Others	80000	1063	0.20	7008
Total Rainwater that can be Harvested				163370

Source: Ground water report for GSL site, Ground water and water audit department

To compensate the groundwater losses and enhance the groundwater recharge, 3 recharge ponds are proposed to be developed. It is estimated that ~ 67,500 KL of water will be stored and 50% of it i.e. 33,750 KL of water can be recharged. The recharge ponds to be developed will be as per the terms and conditions mentioned in the CGWB ground water extraction permit obtained for the manufacturing facility. However, since the village is falling in over-exploited category, as recommended GSL shall take all necessary measures to recharge twice the quantum of groundwater extraction in their premises, i.e. 440KLD (1,60,600KL/Annum) to be recharged .

Table 2-15: Details of recharge ponds

Structure	Total Storage in Cu.m	Contribution to ground water recharge (50% of the storage) in Cu.m
Recharge Pond-1	22,500	11,250
Recharge Pond-2	22,500	11,250
Recharge Pond-3	22,500	11,250

Source: Ground water report for GSL site, Ground water and water audit department

2.9 Air Pollution Control Devices

Emission anticipated due to project operations are from process operation that will contribute to VOC, Particulate Matter (PM_{10}, $PM_{2.5}$), Flue Gases (HBr, HCl, NH3, HF, H2S and Mercaptans) and exhaust emissions from vehicles, DG sets and operation of equipment's that will contribute to marginal increase in NO_2, PM_{10}, CO. Sources of emission are :

- VOC from chemical handling/liquid raw material transferring to reactor.
- Emission of Flue gases from the Heating process of resin and Steam by boilers

To manage the VOC emissions, Kettle will be connected to the vapor condenser. The VOC emission in terms of handling losses will be reduced by storing liquid material in closed storage tanks as well closed loop transfer system. There will be no process gas emissions from the unit. The VOC emissions from storage tanks will be condensed. To control air pollution, GSL will install Air Pollution Control Devices (APCD) such as bag filters and electrostatic precipitator across the 4 stacks as mentioned below. The integrated plant will have various air pollution control equipment to control dust emission at respective process locations. The dust will be collected from the bag filters or other close loop systems and be used as fuel for boiler, dryer etc. All the emissions from the stacks will be maintained as per APPCB/CPCB/IFC World Bank norms and guidelines, details have been provided below. The emissions are compliant with the MOEFCC as well as IFC guidelines (Refer *Table 2-16)* . Also,

Table 2-17 includes the details for the Bag Filters and ESP proposed to be installed.

Table 2-16: Details of APCD proposed to be installed

Details	Stack 1	Stack 2	Stack 3	Stack 4
Stack Attached To	Boiler	Hot Water Generator	Thermic Fluid Heater	Thermal Energy Plant
Capacity	8 TPH	2 x 80 lakh k.cal/hr	2 x 80 Lakh K.cal/hr	300 Lakh K.cal/hr
Fuel used	Wood, Biomass and Coal	Wood, Biomass and Coal	Wood, Biomass and Coal	Dust from Screens and sanding
Stack height above ground	30 m	30 m	30 m	30 m
Air Pollution Control Equipment for the stack	Bag filters and ESP	Bag filters and ESP	Bag filters and ESP	Bag filters and ESP

Details	Stack 1	Stack 2	Stack 3	Stack 4
PM_{10} Maximum Incremental Concentration[32] from the stacks	0.097 µg/m3			
$PM_{2.5}$ Maximum Incremental Concentration from the stacks	0.029 µg/m3			
SO_2 Maximum Incremental Concentration from the stacks	0.302 µg/m3			
NO_2 Maximum Incremental Concentration from the stacks	0.325 µg/m3			
Air Emission guideline for small combustion facilities[33] with solid fuel as per IFC WB EHS guideline	• PM: 50 or up to 150 mg/m³ (if justified by environmental assessment) • SO_2: 2000 mg/m³ • NO_x : 650 mg/m³			
IFC/WB Air Emission guideline for Board and Particle Based Products[34]	• PM: 20 (MDF), 20 (Wood Dryers) and 50 (Other Sources) • SO_2: 2000 mg/m³ • NO_x : 650 mg/m³			
MOEFCC Emission Standards for Boiler of capacity 2 to less than 10TPH (Steam generation capacity, ton/hour) for other fuels	• Particulate Matter mg/Nm³: 150			

Table 2-17: Details of Bag Filters and ESP proposed to be installed

Type of Bag Filter	Capacity (m³/hr)	No of Bags	Dust Emission Output
Sanding machine bag filter	136000	480	<5mg/m3
Sanding dust bag round filter	1800	21	<5mg/m3
Cutting and sizing bag filter	65100	240	<5mg/m3
Cutting and sizing round bag filter	4000	34	<5mg/m3
Forming bag filter	117000	480	<5mg/m3
Forming bag round filter	1800	21	<5mg/m3
Wind forming bag filter	50000	180	<5mg/m3
Particle preparation bag filter 1	35000	180	<5mg/m3
Screen dust round bag filter	3600	34	<5mg/m3
Dust screen oversize round bag filter	1770	21	<5mg/m3
Air grader bag filter 1	26100	120	<5mg/m3
Chipping bag filter	14000	90	<5mg/m3
Flaking bag filter	50000	240	<5mg/m3
HPL sanding machine bag filter	24000	108	< 50 mg/m3
HPL cutting machines bag filter	40000	168	< 50 mg/Nm3
Cutting machine portable bag filter	6000	2	< 50 mg/Nm3
Thermic fluid heater bag filter	79000	768	< 75 mg/Nm3

[32] Emission rate from the stack for the pollutants such as PM, SO2 and NO2 have been referred from the EIA report, detailed air emission modelling is not included as part of the scope for this ESIA

[33] Small combustion processes are systems designed to deliver electrical or mechanical power, steam, heat, or any combination of these, regardless of the fuel type, with a total, rated heat input capacity of between three Megawatt thermal (MWth) and 50 MWth.

[34] https://documents1.worldbank.org/curated/en/693331489584857393/pdf/113494-WP-ENGLISH-Board-and-PBP-PUBLIC.pdf

Type of Bag Filter	Capacity (m^3/hr)	No of Bags	Dust Emission Output
Hot water generator bag filter	66150	600	< 75 mg/Nm3
Energy plant ESP	42000	1	< 50 mg/Nm3

Source: GSL

2.10 Waste Management

Hazardous waste generated from the facility such as organic residue, salts, spent solvents, waste oils, used oils etc., shall be disposed as per the Hazardous and other Wastes (Management and Tran boundary movement) Rules, 2016 and its amendments thereof.

Different types of waste anticipated from the operation of the facility and its associated management practices has been provided in the ***Table 2-18*** belowTable 2-18. Dedicated waste storage area will be developed to store and manage waste within the facility with separate area for storage such as

- Dedicated space of 32sq.m will be developed for storage of empty drums/bag/liners
- Dedicated space of 16sq.m will be developed for storage hazardous waste
- Dedicated space of 180sq.m will be developed for process waste (Non-hazardous) such as paper/packing film etc
- Dedicated space of 1000 sq.m will be developed for storage of wood/biomass, biomass and wood waste as well

Table 2-18: Waste Management at the Manufacturing Facility

Waste Type	Quantity expected	Proposed Management Practice
Operation Phase		
Ash from Boiler	9.12TPD	To brick manufacturers
ETP Sludge	100Kg/day	To TSDF[35] (secured landfill) located at a distance of 64 km from the facility. GSL has undertaken membership from the hazardous waste management and disposal organization i.e Coastal waste management project (unit 2)
Wood Trimming Loss	13.51TPD	Will be used as fuel in boilers
Paper Waste	33.0TPD	To authorised recyclers or can be used as fuel in boilers
Dust from Screens and Sanding	84 TPD	To thermal energy plant or for press heating and fuelling
Detoxified containers or drums	12 Nos/Day	Post detoxification, will be sent to third party agencies
Used Bags	2018 Nos/Day	To be sent to authorised recyclers Authorised recyclers are yet to be identified since the Project is in construction stage. However, the same will be undertaken prior to initiation of operations.
Waste Oil	7.84 KL.annum	
Used Batteries	8 No. / annum	Sent to dealers on buy back basis
MEE Salt	-	Sent to authorised vendor for disposal (landfill)
Discarded bags and liners	55495 Nos/annum	To traders/ Suppliers for recycling after complete detoxification
Empty big drums	138 Nos/annum	

Source: Greenlam Report

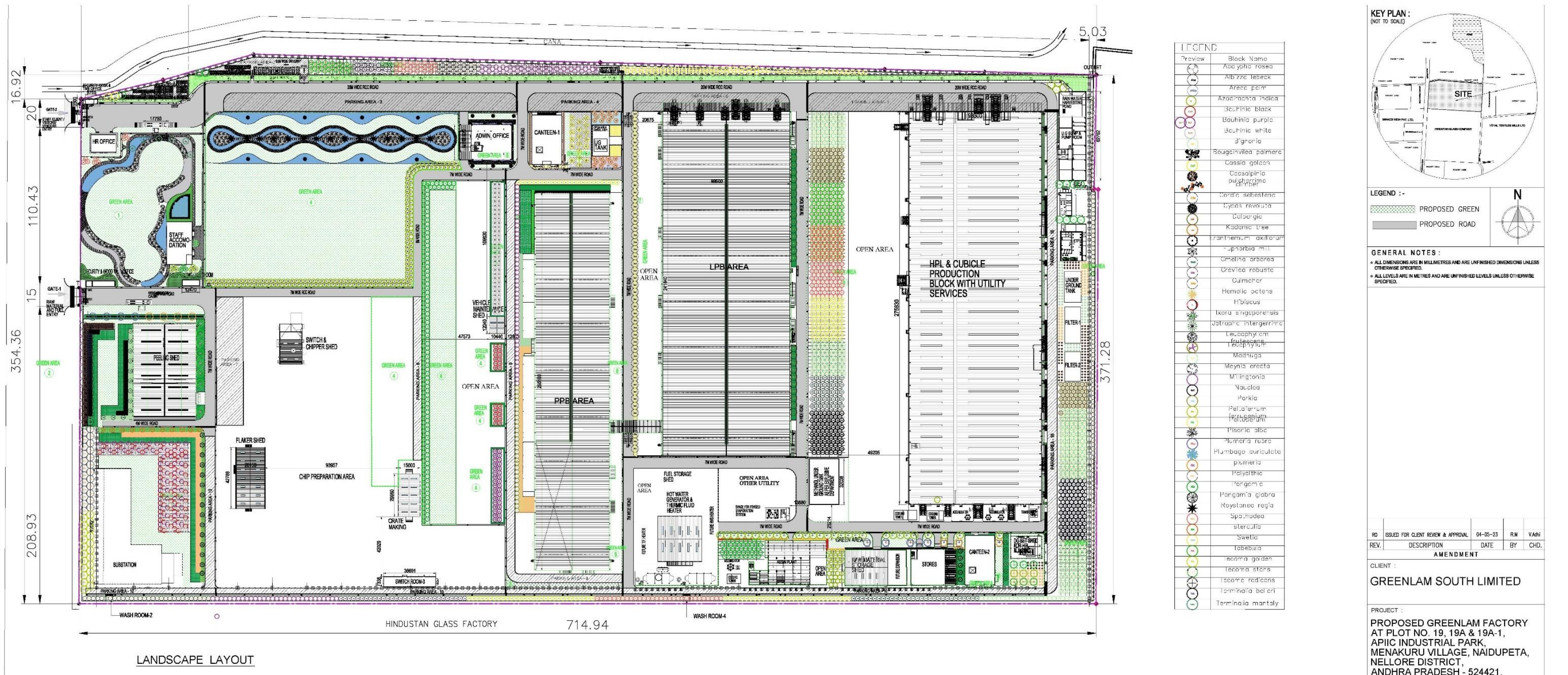
2.11 Greenbelt Development

Out of the total project site of 2,69,086 Sq.m, 80,814 Sq.m (30.03 %) will be developed as Landscape / greenbelt area with 30,003 Sq.m as lawn. The planning of greenbelt is in the preliminary stage and finalizing a capable agency to develop it as per CPCB guidelines. As per the available information, around 50,811 plants shall be grown in greenbelt. Another 48 avenue tree and shrub

[35] GSL has undertaken Membership with Coastal Waste Management Project (Unit-2) for management of hazardous waste and is valid until 29.03.2024. As understood, coastal waste management (unit 2), a division of Mumbai waste management, (a subsidiary of Re-Sustainability limited) is responsible for hazardous waste transportation and disposal.

species shall be added in block plantations after all civil works are over and landscaping is done. Preliminary Landscape and Greenbelt Layout Plan has been presented as Figure 2-8.

Figure 2-8: Preliminary Landscape and Greenbelt Layout Plan



Landscape -Area- (sq.m) Components Wise Details

Sino	Location	Area (Sq.m)	Lawn	Trees Shrubs & Ground Covers: Total Plantation	Trees Shrubs & Ground Covers: Exotic Hybrid Flower plants	Trees Shrubs & Ground Covers: Native/drought species	Sprinkler Irrigation	Drip Irrigation
1	L1	8415	4868	3547	3547		8415	
2	L2	4136	1514	2622	603	2019	1514	2622
3	L3	15687	1854	13833		13833	1854	13833
4	L4	24686	17713	6973	4310	2663	17713	6973
5	L5	6995	2481	4514		4514		6995
6	L6	528	240	288	288		528	
7	L7	2674	138	2536		2536	138	2536
8	L8	2379		2379		2379		2379
9	L9	7850		7850		7850		7850
10	L10	4073	1195	2878	14	2864	1195	2878
11	L11	3391		3391		3391		3391
Landscape Area		80814	30003	50811		42049	31357	49457
Plot Area		269086						
FAR		30.03%	37.13%			52.03%	38.80%	61.20%

Source: GSL

2.12 Resource Efficiency

GSL is yet to develop resource efficiency and conservation plan however the Company intends to promote sustainable use of resources including water, material and energy. Main factory buildings, admin office and canteen are proposed to be constructed as per IGBC guidelines and the facility intends to obtain green building certificate from IGBC post completion. Some of the main IGBC requirements includes site selection & planning (compliance with local regulations), water conservation, energy conservation, material conservation, indoor environmental quality & occupational health. The project has implemented the following measures (but not limited to)

Water Conservation

- Use of Low water fixtures
- Rain water harvesting
- Reuse of treated water

Energy Conservation

- Use of CFC Free air conditioners
- Use of HCFC Free/Low Impact HCFC Equipment
- Energy-efficient LED lights.
- Use of Daylight inside the premises with the help of windows and Skylight.
- Provision of Improved Fresh Ventilation as well as provision of HVAC along with spaces for both mechanical ventilation & air conditioned spaces
- All wood waste produced in the process will be burnt on site (used as boiler fuel) to meet process heat (and power) demands.

Material Conservation

- 50-75% Waste reduction by reusing/recycling and salvaging the >75% of the construction waste,
- Usage of materials with recycled content, such as use of cement blocks with fly ash composition of 68% and AAC blocks with 68% and 75% fly ash composition
- Material Re-use

2.13 Fire Fighting and Explosion Protection System

Firefighting system, spark detection and explosion protection system will be provided for the integrated manufacturing facility as well as for various project components as presented below:

2.13.1 Fire Fighting System for the Integrated Manufacturing Facility

It is proposed to equip the entire plant with fire hydrant system with main pumping station, booster pump and diesel pump to ensure required pressure and flow in entire fire hydrant ring. The facility is proposed to be equipped with fire hydrants, water monitors, nozzles and hose reels. Fire alarm system and mobile fire hydrant pumps as per AP fire department regulations are also proposed to be installed.

Also, various type of fire extinguishers as per requirement of AP state Fire department regulations are proposed to be installed. Main production buildings will have temperature monitors. Fire Fighting system within the facility will comprise of

- Fire Hydrant Pump House equipped with 3 Pumps such as Jokey Pump, Main Pump and DG Pump
- Fire hydrant ring around all buildings
- Fire Extinguishers at prominent places
- Head detectors with alarms
- Manual call points wherever required
- Fire Exit Doors

2.13.2 Spark Detection and extinguishment system for Particle Board (PB) Facility

Spark detection and extinguishing systems are planned with all the particle board equipment to ensure safety of the equipment, plant and personnel. This system is completely automatic and SCADA based with real time monitoring technology.

Facility is proposed to be equipped with high efficiency spark sensors, automatic extinguishers, flow monitors and pressurized water system connected through PLC to detect and suppress sparks online without stopping the plant.

Object extinguishing system is also proposed to be installed in addition to the spark detection system. This system will have pressurized water piping routed through along with spark detection system with pipes of various sizing and flow to ensure sufficient water to put into the objects where there is a chance of fire if in case of any malfunction in spark detection system.

2.13.3 Explosion Protection system for PB facility

The entire Particle board plant is designed based on ATEX norms (a European standard to avoid explosion in the plant) which is a next level to spark detection, firefighting and object extinguishing system.

Explosion protection will take signals from various spark sensors, temperature monitors and isolation gates to avoid propagation of fire to other equipment in case of any malfunction in spark detection and extinguishing system. This will also ensure that explosion takes place where there is no machine/equipment and personnel. This system will be controlled and guided by various rupture disks and rupture sensors.

All equipment related to explosion protection zones are proposed to be connected through a PLC system for controlling and monitoring.

Potential explosions are detected by means of the appropriate sensors and the extinguishing tanks are actuated within a few milliseconds if an explosion is signaled in the detection area. The positioning of the sensors, the extinguishing quantity and the position of the extinguishing tanks are dimensioned in the way that the effective concentration of the extinguishing agent can be produced.

The explosion flame is put out and thereby an explosion and the propagation and increase of the flame are suppressed.

2.14 Parking

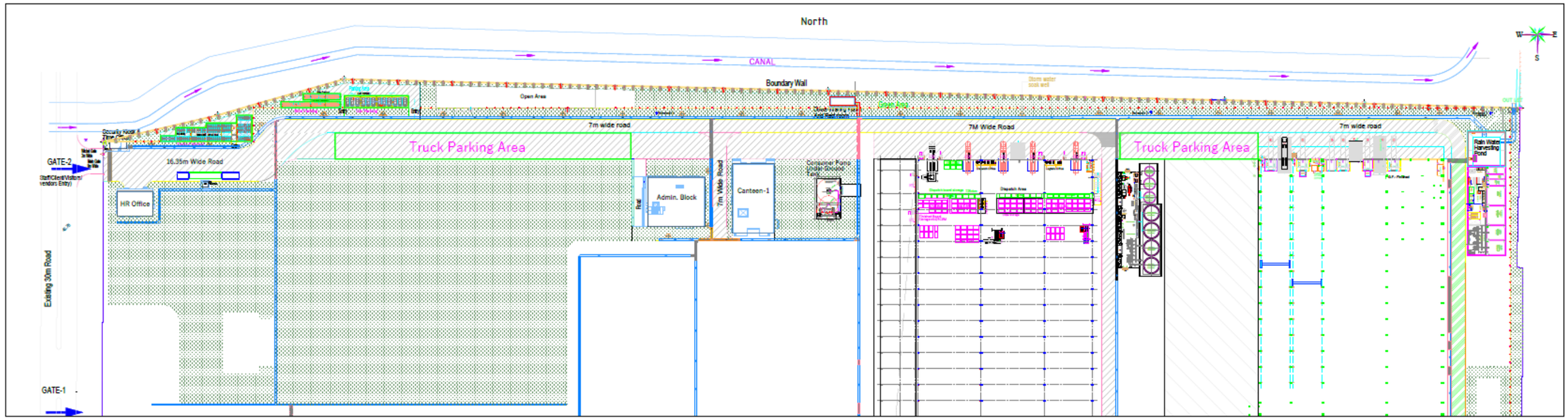
Manufacturing facility will have parking space for cars, two wheelers and trucks. Details of planned parking and layout plan showing parking area is as presented below. The proposed parking area complies with the requirement of Andhra Pradesh Industrial Infrastructure Corporation (APIIC), Building permission with the parking area details have been submitted and approved by APIIC.

Table 2-19: Details of planned Parking within the facility

Parking Type	Details	No. of vehicles	Required as per Andhra Pradesh Industrial Infrastructure Corporation	Proposed for the project
Visitor Car Parking	Car parking	12-20	668.52 sq.m	3480.63 sq.m
	Cycle parking	75-100		
	Two-wheeler parking	45-60		
Other Parking	Truck parking	40-50	--	17971.75 sq.m
Total Parking	--	--	7353.71 sq.m	21453.23 sq.m

Source: GSL and APIIC Building Permission

Figure 2-9: Layout Plan showing Parking Facility



2.15 Land Requirement & Procurement

Total land for the integrated plant is 26.90 ha (66.49 acres). Out of 26.90 ha (66.49 acres), about 0.46 ha (1.13 acres) is required for resin plant. The resin plant is located within the proposed project land premises. The proposed plant is located on Plot No. 19A-1(UDL) (land admeasuring to an extent of 16.49 acres/66,736.00 sq.m and Plot No. 19 & 19A(UDL) (land admeasuring to an extent of 50.00 acres/2,02,350.0 sq.m in Industrial Park, Naidupeta, SPSR Nellore district. The overall land break- up of proposed integrated plant and the resin plant is given below:

Table 2-20: Land Break up of Integrated Plant

Sr.No.	Details	Area in sqm
Total Integrated Plant		
1	Open Area	28,376
2	Road & Parking	43,240
3	Total Green Area -33% of the total plot area	88,770
4	Total Build up area ground floor	1,08,633
Total Area		**2,69,019 (26.90 ha)**
Resin Plant		
5	Methanol storage open area (Underground tank)	290
6	Raw material storage shed	1,456
7	Resin plant	1,206
8	Resin storage & raw material storage tanks area open area	1,238
9	Cooling tower open area	430
Total Area		**4,620 (0.46 Ha)**

Source: Greenlam Report

2.16 Contractors

As per the site visit it was observed that the construction of the project was already started. Reportedly 11 contractors were engaged for the project. As informed during the site visit nearly 570 subcontracted workers were deployed at site. Details of the contractors and manpower are given in ***Table 2-21*** below:

Table 2-21: List of Contractors

Sr.No.	Name of Contractor	Scope/ Nature of Work	Man Power
1	Suroj Buildcon Pvt. Ltd.	Phase-1 Civil	300
2	Dalapathi Constructions	Phase-2 Civil	170
3	Pennar Industries Ltd.	Phase-1 PEB Building	13
4	Zamil Steel Buildings India Pvt. Ltd	Phase-2 PEB Building	10
5	Unique MEP Projects Pvt. Ltd	Fire Hydrant System and Plumbing Works	30
6	Techmet Engineers	Project Mechanical Works & Equipment Installation Works	50
7	Thermal Associates	Project Mechanical Works	12
8	Deep Enterprises	Greenlam Fabrication Works	9
9	PC Chandra Reddy	Electrical Sub Station Work	6

Sr.No.	Name of Contractor	Scope/ Nature of Work	Man Power
10	Forbesvyncke Private Limited	Hot Water Generator, Thermic Fluid Heater Erection and Installation	13
11	Orbittal Electromech Engineering Projects Pvt. Ltd.	Electrical Work	30

Source: Greenlam Report

2.17 Analysis of Alternatives

2.17.1 Site for Manufacturing Facility

Prior to finalising the land, GSL had considered 5 land options at various locations. The following factors were considered while finalising the land for Project:

- Presence of Land in Industrial area
- Presence of other Red Category industry in the Identified Industrial Area
- Tentative duration for obtaining the EC
- Availability of raw materials, utilities like water, fuel, electricity, etc.;
- No Resettlement and Rehabilitation
- Absence of any national park or wildlife habitats within 10 km radial distance from project site
- Vicinity to Ports and Airports for easy transportation and access.
- Source of manpower from nearby villages and surrounding town/city
- Absence of irrigation canal or drainage channel within the selected area
- Presence of adequate water and waste water treatment options in the vicinity

Details for the land options analysed prior to finalization of land have been presented below:

Sr.No.	Locations of Site Considered	Aspects considered
1	Manufacturing Plant at Inagaluru and Resin Plant at Naidupet	• Two separate land parcels • Daily Logistic for transportation of resin • Inagalurru site-The land identified was a non-industrial land. Duration of 5-6 months required to convert this land into notified Industrial area after acquiring few DKT lands. • Source of water is in the area is purely bore wells and rain fall when compared with Naidupeta • Cheaper Inagalaru land cost when compared to Naidupet • Naidupet- APIIC may allot this land since we are moving EC and red category products to Naidupet • Absence of any foreseen restriction, as both plants will be orange category /Green category plant (need to discuss with PCB) and Naidupet is fully developed industrial park and many such industries are already established. • Presence of Formaldehyde plant in a close vicinity and hence advantageous logistics options • Easy accessibility Ports/airports in Chennai and Bangalore • Sourcing of Raw material will be easy
2	Naidupet Industrial park (Current project location)	• Full-fledged Industrial park with all amenities, hence no disturbance to the nearby villagers/ neighbouring places and little or no grievances due to project operations • Project in designated industrial area. Also, no forest are present in 5 km radius • Absence of community or residential area in the immediate vicinity • EC not yet obtained for this particular land. • Minimum 5-6 months to get EC since this industrial park already obtained EC and hence will not take 8-11 months' time like other non EC obtained lands • Future issues will not be there for both plants since main plant will be orange category /Green category plant (in discussion with PCB) and resin unit is red category and EC obtained already. • Land cost will be expensive @ 55-62 Lakhs/acre. • Better admin control • Project execution will be faster since approach road, water and power available • Raw material will not be any issue.

Sr.No.	Locations of Site Considered	Aspects considered
		• Formaldehyde plant is just few 100 mtrs away (Kanoria) and hence logistics point of view is an advantage. • This location is near to Tirupati, Naidupet and Nellore. • Ports/airports/Chennai and Bangalore are good from both locations available and hence handling of ETP is easier (CETP is under construction at Naidupet and GSL can consider Phenol distillate disposal at the same) • Presence of common ETP plant and hence effluent disposal is an advantage. • Raw material procurement is not an issue • Water source is not considered an issue
3	Naidupeta (5 acres) and private land (100 acres)	• Two units at two locations • Forest clause is main concern and will consume more time for suitable land acquisition • Main concern in identifying private lands. • Conversion of private land into industrial land use • Once private land is procured, Project execution will be faster and EC process will take lesser time (approx. 8-11 months since bifurcating into two units) • Land allotment from APIIC will not be an issue since only 5-7 acres land is required in Naidupet • Formaldehyde plant is just few 100 mtrs away (Kanoria) • Ports/airports/Chennai and Bangalore are nearer. • Land cost is less • Not much dependency on APIIC in acquiring land • Raw material will not be an issue
4	All private land	• Land Identification without DKTs or assigned lands, forest distance and suitable location as per GSL requirement will be difficult • Obtaining EC will take minimum of 9-11 months • Project execution will be longer in this case till all land is procured and other formalities completed • FD sourcing will be from nearby Kanoria plant in Naidupeta • No dependency on APIIC for land acquisition. • Raw material will not be an issue since exploring lands in only two districts (Chittoor and Nellore)

2.17.2 Technology

Raw Materials in Resin Manufacturing Technology

Phenol–formaldehyde (PF) resin continues to dominate the resin industry. Its properties such as thermal stability, chemical resistance, fire resistance, and dimensional stability make it a suitable material and been used in the wood industry as adhesives. However, increasing environmental pollution and fossil fuel depletion have driven industries to seek sustainable alternatives to petroleum based raw materials. Therefore, many researchers are shifting their focus towards biomass as a renewable source of carbon-based reagents, and its extensive and accurate use will solve the issues associated with petroleum-based resources.

Greenlam have started to use nature based organic solutions as alternate raw materials. Greenlam is using naturally occurring products such as cashew nut shells in place of synthetic and petroleum products. A waste in cashew processing, these shells are one of the best sources of long-chain phenols[36]. Greenlam has already substituted ~10% of the phenol and modified the resin technology in one of their manufacturing facilities. Currently, Greenlam is substituting about 10% of phenol use in their modified resin technology, subsequently resulting in

- Enhancing the product flexibility and machinability of compact boards
- Reducing the emission of VOCs from the process as well as the final product
- Reducing the handling and storage of hazardous materials in the plant
- Eliminating the need for process washing, enabling zero discharge from the plant, Biomass is currently a viable alternative for phenol production as it is renewable as well as readily available as a waste material, and yields products with lower carbon footprint.

[36] https://www.greenlam.co.in/sustainability/

Phenolic resins have been produced from bioresources and used as adhesives. Wood panels produced from modified PF resin show similar or superior properties compared to those developed from conventional phenolic resin, while also representing an environmentally friendly alternative to traditional PF resin. These natural chemicals can significantly reduce the harmful impacts on the environment and human health.

Along with the use of biomass based phenol, Greenlam products have a Greenguard, Greenguard Gold, Green Label (Singapore), and EN 16516 certification, i.e., products manufactured by Greenlam are compliant to all the expected standards of VOCs, formalin, and other allied chemical constituents' emissions. Also, Greenlam products are non-hazardous and do not fall into the list of 'Deleterious Materials'. Greenlam does not use asbestos, copper chromates, arsenate compounds, lead, or any other heavy metals during production. Along with this, their products do not contain regulated levels of NTP (National Toxicological Program), IARC (International Agency for Research on Cancer), or OSHA Listed Carcinogens. Greenlam is using the best available technology for particle board manufacturing as well as resin production .

Zero Liquid Discharge

At this facility, GSL has adopted a zero liquid discharge process and intends to reuse and treat all the generated waste. The main sources of effluent for the Project will be process, washing, cooling tower, boiler, RO/ DM plant and toilets. Wastewater / effluent generated at site is proposed to be treated and reused on site. The effluent generated from process, washings, cooling tower, RO/DM plant, boiler blow down will be sent to ETP and treated effluent reused for gardening and landscaping. Effluent from phenol formaldehyde resin is proposed to be sent to forced evaporation system. Domestic effluent (sewage) is proposed to be sent to STP and treated sewage will be used on site for secondary purposes including flushing and landscaping.

Digital Platform

GSL is importing manufacturing machineries from EVORIS,DIEFFENBACHER and this facility will also be equipped with their digital platform. Implementation of EVORIS platform will save energy and raw materials with its comprehensive diagnostic capabilities (with Reports App and Anomaly Detection). The reports app detects and informs about unusual consumption of semi-finished products at defined production points and helps to localize and eliminate these inconsistencies. The app also quantifies the energy consumption of the entire plant as well as of individual components and presents anomalies between the production output and the energy consumption. This will allow GSL to locate and shut down less efficient production processes. Anomaly detection also provides information about unnecessarily high energy consumption of machines and parts, which can be targeted and countermeasures implementation can be undertaken. EVORIS apps also predict quality and detect anomalies use artificial intelligence (AI) and will help GSL to optimize board quality while simultaneously lowering production costs, avoiding rejects and reducing the use of wood, glue and other expensive raw materials.

Responsible Forestry

The establishment of the Greenlam project in the region will lead to an increased demand for wood within the landscape. This demand will be met by the existing agroforestry practitioners and farmers, who will transform the current land use. Greenlam will adopt the following measures to ensure responsible forestry in the supply chain catchment area:

- Alongside planting industry-friendly trees such as Eucalyptus, Greenlam will actively encourage the cultivation of native trees to cater to local requirements for fodder, food, and timber at the village and mandal levels.
- Fallow lands, previously used for agriculture but now unused due to soil degradation, limited irrigation, and disinterest in farming, will be promoted and supported for agroforestry plantation.
- Farmers will be incentivized and provided technical assistance to rejuvenate their unproductive lands and utilize them for agroforestry purposes.
- Agricultural lands yielding non-food crops like Tobacco will also be targeted for conversion into agroforestry plantations, contributing to sustainable land use practices.

3 Applicable Legislative, Regulatory and Administrative Regime

This section highlights the environmental and social regulations applicable to the Project. At the outset, it should be emphasized that this administrative framework focuses on:

- Applicable local, national and international environmental and social legislations
- IFC Performance Standards, 2012
- WBG General Environment Health and Safety Guidelines
- WBG EHS Guidelines for Board and Particle Based Products
- WBG EHS Guidelines for Forest Harvesting Operations (as applicable for plantations)
- IFC / EBRD Guidance on Worker Accommodation
- Other applicable laws and regulations pertaining to environment, health, safety, social, land acquisition and resettlement, and labour in India, including country obligations under relevant international treaties such as the UN Declaration on the Rights of Indigenous Peoples, and International Covenant on Economic, Cultural and Social Rights

3.1 Permitting Status of the Project

As per EIA Notification 2006 and its amendments, the captive resin manufacturing unit falls under Item No.5 (f), i.e. Manufacturing of Synthetic organic chemicals industry (dyes & dye intermediates; bulk). Hence, the project requires Environmental Clearance (EC) from the Ministry of Environment Forest and Climate Change (MoEF&CC) or the State Environmental Impact Assessment Authority (SEIAA), Whereas the manufacturing of particle board and high pressure laminates does not require EC. EC via EC identification number EC22B021AP157099 under category B1 has been obtained for the captive resin manufacturing plant, and it also categorises the manufacturing of particle board and high pressure laminates as non EC products.

As per CPCB notification dated March 07, 2016, manufacturing of synthetic organic chemicals industry (dyes & dye intermediates; bulk) is categorized under red category and the facility will be required to obtain the Consent to Establish & Operate. Permissible limits for Ambient Air Quality, Water Quality, Noise Limits have been laid down by CPCB under EP Act, 1986 which requires to be complied with.

GSL has obtained Consent for Establishment (CFE) under section 25 of the Water (Pollution and Prevention) Act, 1974 and under Section 21 of Air (Prevention and Control of Pollution) Act 1981, dated 3rd February 2022 via order No 278/APPCB/CFE/RO-NLR/HO/2022. The CFE is valid for a duration of 7 years.

Post completion of construction works, Consent to Operate to be obtained prior to start of operation phase.

3.2 National Administrative Requirements

In India, the national level laws are formulated by Ministry of Environment Forests and Climate Change (MoEFCC) and state governments are required to consider these regulations as base level for implementation. The State Pollution Control Boards (SPCBs) are responsible for securing compliance under the Environmental Protection Act, 1986, the umbrella legislation regulating environmental issues in the country. A brief description of the relevant enforcement agencies both at central level and state level with respect to the institutional framework is described in Table 3-1 below:

Table 3-1: Relevant Enforcement Agencies

Sr.No.	Agency	Function
Central Level		
1.	Ministry of Environment Forests and Climate Change (MoEFCC)	The Ministry of Environment and Forests (MoEFCC), Government of India is responsible for the environment management at Union of India level. The specific functions of MoEFCC are as follows: • Environmental policy planning; • Effective implementation of legislation; • Issuing guidelines under EP Act for environment protection; • Monitoring and control of pollution through Central Pollution Control Board and State Pollution Control Boards; • Environmental clearance for industrial and development projects covered under EIA Notification; • Monitoring of compliance conditions stipulated in Environmental clearance through its regional offices; • Promotion of environmental education, training and awareness; • Forest conservation, development, and wildlife protection; and

Sr.No.	Agency	Function
		• Protection of Coastal areas. MoEFCC is responsible for the implementation and enforcement of the Environment Protection Act, 1986, and Rules issued under the Act, including the EIA notification. Under sections 3 and 5 of the EP Act, 1986, it retains enormous powers to issue directions in the interests of environment protection.
2.	Central Pollution Control Board	The Central Pollution Control Board (CPCB) has been constituted for the control of water, air and noise pollution, land degradation and hazardous material and waste management. The specific functions of CPCB are as follows: • Prevent pollution of streams and wells; • Advise the Central Government on matters concerning prevention, control and abatement of water and air pollution; • Co-ordinate the activities of SPCB's and provide them with technical and research assistance; • Establish and keep under review quality standards for surface and groundwater and for air quality; • Planning and execution of national programme for the prevention, control and abatement of pollution through the Water and Air Acts.
3.	Central Ground Water Authority	The Central Ground Water Authority (CGWA) was constituted in 1997 to regulate, control and manage groundwater development in the country, under the EP Act 1986. One of the main functions of CGWA is to regulate indiscriminate boring and withdrawal of groundwater and to issue necessary regulatory directions with a view to preserve and protect the groundwater. CGWA has declared certain areas of India as "notified areas" from the point of over-development of resource, or from groundwater quality point of view, or for registration of groundwater abstraction structures. In these so "notified areas" further extraction is regulated in order to prevent the depletion of groundwater levels and deterioration of its quality.
4.	The National Green Tribunal (NGT)	National Green tribunal was constituted in 2010 for effective and expeditious disposal of cases relating to environmental protection and conservation of forests and other natural resources including enforcement of any legal right relating to environment and giving relief and compensation for damages to persons and property and for matters connected therewith or incidental thereto. It is a specialized body equipped with the necessary expertise to handle environmental disputes involving multi-disciplinary issues. The tribunal will have jurisdiction over all civil cases relating to implementation of the following regulations: • The Water Act, 1974; • The Water Cess Act, 1977; • The Forest Conservation Act, 1980; • The Air Act, 1981; • The Environment Protection Act, 1986; • The Public Liability Insurance Act, 1991; and • The Biological Diversity Act, 2002.
5.	Petroleum and Explosives Safety Organization (PESO)	The PESO is under, Ministry of Commerce and Industry, Department of Industrial Policy & Promotion, Government of India. The Chief Controller of explosives is responsible to deal with provisions of: • The Explosive Act 1884 and Rules, 1983; • The Petroleum Act 1934 and the Rules 2002; • The Static and Mobile pressure vessels {Unfired} Rules, 1981 and amendment 2000, 2004; • Gas Cylinder Rules, 2004; and • Manufacture, Storage and Import of Hazardous Chemical Rules, 1989 and amendment, 2000
State Level		
6.	Andhra Pradesh Pollution Control Board	Andhra Pradesh Pollution Control Board has been playing a pioneering role in the field of environment protection. The Board works relentlessly in efficient implementation of environmental policies, laws, regulations, and develops frameworks to manage both wastes and natural resources of the State. APPCB has a state-wide presence with its Head Office at Vijayawada, and 3 Zonal and 13 Regional Offices covering the entire state.

Sr.No.	Agency	Function
		The Board is a statutory organization entrusted to implement Environmental Laws and rules within the state of Andhra Pradesh, India. The Board was constituted as State Board for Prevention and Control of Water Pollution, in 1976, under the Water (Prevention and Control of Pollution) Act. 1974, but was later rechristened as A.P. Pollution Control Board, subsequent to the enactment of the Air (Prevention and Control of Pollution) Act, 1981.
7.	Board of Revenue, Andhra Pradesh	The Chief Commissioner of Land Administration (CCLA) is the chief controlling authority for the revenue administration consisting of Revenue, Survey, Settlement & Land Records and Urban Land Ceiling Departments. CCLA exercises statutory functions and general superintendence over all the functionaries of Revenue Department. In the case of Survey, Settlement & Land Records and Urban Land Ceiling Departments, CCLA has a supervisory and statutory role. The Commissioner SSLR and the Special Officer and competent authority , urban land ceiling report to CCLA&SPL CS. CCLA is the link between the Government and the Revenue administration and also monitors and guides the District Collectors and advises the Government in all the policy matters.
8.	Gram Panchayats	The local Panchayats are empowered with management of local resources like forests, groundwater, common land and infrastructure like roads, buildings etc.
9.	Labour Department, Government of Andhra Pradesh	The Department of Labour is responsible for formulation, implementation, and enforcement of the labour laws in the Andhra Pradesh State. It also undertakes prevention and settlement of industrial disputes, industrial safety, health and promotes welfare of workers in the undertakings falling within the sphere of the state.
10.	Private Security Agency, Andhra Pradesh	It's a state government body, with aim to provide licenses to the private security agencies under the Private Security Agencies (Regulations) Act, 2015. Per the Act, no person shall carry on or commence the business of private security agency, unless he/she holds a license under the Act.
11.	Directorate Industrial Safety and Health Department (DISH) and Labour Department	The Directorate Industrial Safety and Health Department enforces the provisions of Factories Act 1948 and State Factories Rules and the rules made there under to ensure the safety health and welfare of the workers. It also plays a significant role in regularizing working hours, and working conditions and reducing the accident and dangerous occurrences in the factories, redressal of the grievances of the workers in respect of Safety Health and Welfare through a set of policies and programs developed by both the Central and State Government. Some of the functions of DISH are • Eliminating inequality and discrimination in the work place; • Enhancing occupational health and safety awareness and compliance in the workplace; • Workforce and community participation, to employers, employees, workplaces, communities, businesses and unions; and • Providing policy advice and analysis to government on labour and employment related matters.
12.	Andhra Pradesh State Disaster Response and Fire Services Department	The Andhra Pradesh State Disaster Response and Fire Services Department is the agency responsible for fire protection and disaster management in the Indian state of Andhra Pradesh. The department issues No Objection Certificates for buildings that adhere to fire safety norms. The department also has the right to penalize violators of fire safety norms.
13.	Government of Andhra Pradesh, Water Resource Department	The Department is a multi-disciplinary organization with hydrogeology, geophysics, hydrology, chemical quality, hydrometeorology, agronomy specialists. The main objective of the department is scientific development, monitoring, estimation and management of groundwater resources in the State. The department has been declared as the nodal agency for all ground water related activities in the State.
14.	A.P. Wood Based Industries (Establishment and Regulation) Rules, 2018	As the industry is using round log / timber as raw material collected from the surrounding agroforestry plantation, a registration of the industry is required in the state forest department.

3.3 Applicable National Environmental and Social Acts and Rules

Table 3-2 below summarizes the key regulations that are relevant to the manufacturing facility across its lifecycle. This should be used to update/develop a comprehensive legal register for the facility that can be regularly monitored for compliance as well as updated to reflect changes/non-applicability of regulations, policies, and standards.

Table 3-2: Applicability of key E&S regulations in the different phases of Project lifecycle

Sr. No.	Applicable Regulation/Permit	Pre-Construction	Construction	Operation	Responsible Authority	Applicability to the Project/ Status
Environment Protection						
1.	EIA Notification (2006) and its amendments	✓	✓	✓	State Level Impact Assessment Authority, Andhra Pradesh	As per EIA Notification 2006 and its amendments, the resin manufacturing process of the project falls under Item No.5 (f), i.e. Manufacturing of Synthetic organic chemicals industry (dyes & dye intermediates; bulk). Hence, the project requires Environmental Clearance (EC) from the Ministry of Environment Forest and Climate Change (MoEF&CC) or the State Environmental Impact Assessment Authority (SEIAA), Whereas the manufacturing of particle board and high pressure laminates does not require EC. EC via EC identification number EC22B021AP157099 under category B1 has been obtained for the captive resin manufacturing plant, and it also categorises the manufacturing of particle board and high pressure laminates as non EC products.
2.	Environment Protection Act, 1986 and as amended. The Air (Prevention and Control of Pollution) Act, 1981. The Water (Prevention and Control of Pollution) Act, 1974	×	✓	✓	Andhra Pradesh Pollution Control Board (APPCB); Ministry of Environment, Forest & Climate Change (MoEFCC); Central Pollution Control Board (CPCB)	As per CPCB notification dated March 07, 2016, manufacturing of synthetic organic chemicals industry (dyes & dye intermediates; bulk) is categorized under red category and the project will be required to obtain the Consent To Establish & Operate. Permissible limits for Ambient Air Quality, Water Quality, Noise Limits have been laid down by CPCB under EP Act, 1986 which requires to be complied with. GSL has obtained Consent for Establishment (CFE) under section 25 of the Water (Pollution and Prevention) Act, 1974 and under Section 21 of Air (Prevention and Control of Pollution) Act 1981, on 3rd February 2022 via order No 278/APPCB/CFE/RO-NLR/HO/2022. The CFE is valid for a duration of 7 years. Consent to Operate to be obtained prior to start of operation phase.
3.	The Noise (Regulation & Control) Rules, 2000 and as amended up to 2010 Ambient Noise Standards	×	✓	✓	APPCB CPCB	As per the Noise Pollution (Regulation and Control) Rules 2010, every operating facility is required to take all possible steps to meet the ambient noise level standards prescribed in the Rules. The rules prescribe maximum permissible values of day and nighttime noise levels for zones A, B, C and D representing industrial, commercial, residential and silence zone respectively. The same categorization and area code are being followed by EHS guidelines of IFC and MoEFCC vide gazette notification dated 14th February 2000. The manufacturing facility is falling within designated industrial area and the following noise limits are to be referred.

Area Code	Category of Area	Day Time limits in dB(A)Leq	Night-time limits in dB(A)Leq
A	Industrial Area	75	70

4.	Solid Waste Management Rules 2016 as amended	×	✓	✓	APPCB/ local municipal body	Per the waste management rules, the solid waste (biodegradable and non-biodegradable) needs to be disposed properly through authorized vendors as per Rules.
5.	Construction and Demolition Waste Management Rules 2016	×	✓	✓	Local authority	Construction waste generated at the facility need to be disposed of as per the requirements of the Construction and Demolition Waste Management Rules 2016.
6.	Manufacture, Storage and Import of Hazardous Chemicals (MSIHC) Rules, 1989 and as amended	×	✓	✓	APPCB	Rules will be applicable during construction and operation phases, as hazardous chemicals as per Schedule 1, 2 and 3 of the rules will be stored at site and should satisfy the criteria laid down in the Rules. Hazardous Chemicals that will be stored during the operation phase include: Phenol, Formaldehyde (37%), Methanol, Caustic Soda, Melamine, Urea, Liquid Ammonia and Formic Acid. As per the Rules, occupier of the industrial unit is responsible for identification of the major accident hazards, take steps to prevent major accidents and provide to the persons working on the site with the information, training and equipment including antidotes necessary to ensure their safety. All the major accidents to be notified, shall prepare and keep up to date on site emergency response plan.
7.	Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 as amended till date	×	✓	✓	APPCB	Hazardous waste estimated to be generated from the integrated manufacturing facility includes organic residue, salts, spent solvents waste oils, used oils, waste effluent, empty drums, etc., therefore the integrated manufacturing facility attracts the provisions for obtaining a hazardous waste authorization as per Hazardous and other Wastes (Management and Transboundary movement) Rules, 2016 and its amendments thereof. Handling of hazardous waste including collection, storage, transportation, and disposal/ recycling as well as documentation needs to be maintained as per the requirements of Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016. Hazardous waste Authorization for the project shall be obtained prior to operation phase.
8.	Plastic Waste Management Rules 2016	×	✓	✓	APPCB	The manufacturing facility must comply with the Plastic Waste Management Rules. As per the rules, if the project generates plastic waste, then the same must either be sent to nearby cement kiln for co-processing or disposed of through authorised recyclers. The project also has to make sure that the plastic used in the project is greater than 50 microns.
9.	Bio-Medical Waste Management Amendment Rules, 2018	×	✓	✓	APPCB	Bio-medical waste generated at site will attract provisions of Bio-Medical Waste Management Rules, 2016. Biomedical waste generated to be disposed of through authorized agency.

10.	Ground water extraction permission will be required if the project plans to abstract groundwater for fulfilling water demand.	×	✓	✓	APPCB	The manufacturing facility has installed borewell within the facility. As understood, permission of installation of four (04) new borewells has been received from government of Andhra Pradesh, Ground Water and Water Audit Department via letter no 1168/Hg-II/2018 dated 31st August 2021 and the manufacturing facility is withdrawing the ground water during the construction phase as well. As per the approval received, GSL is permitted to pump out 220 KLD of Groundwater from four (4) newly recommended bore wells with I0 hours of pumping per day against the requirement of 275 KLD duly following the terms and conditions as mentioned in the report. As per Central Groundwater Authority (CGWA), Ministry of Jal Shakti, Notification dated 24 September 2020[37], industries will have to obtain authorization from CGWA before abstraction and use of groundwater. As per CGWB, Nellore District, Naidupeta Mandal (where manufacturing facility is located) falls is an area marked as "critical" in terms of groundwater development, whereas as per the Ground water assessment report developed by Andhra Pradesh Ground water and water audit department for the GSL site, Menakuru village(facility location village) is categorised as Over-Exploited. Furthermore, as per CGWA notification dated 24 September 2020, all industries drawing ground water in safe, semi-critical and critical assessment units shall be required to pay ground water abstraction charges as applicable as per Tables 5.2A and 5.3A of the said notification. Where as in Over-exploited assessment units, No Objection Certificate shall not be granted for ground water abstraction to any new industry except those falling in the category of Micro, Small and Medium Enterprises (MSME). Since the CGWA NOC is majorly provided considering the mandal/tehsil categorization (which have been referred as assessment units in the CGWA Notification, 2020) and since the mandal falls in Critical category, ground water withdrawal by GSL has been permitted, however considering the ground water of the project village which is categorised as "over-exploited", The NOC has been given on conditional basis, with the condition being construction of artificial recharge structures.
Fire & Life Safety						
11.	AP Fire Service Act, 1999 as amended till date and	×	✓	✓	Fire Services Department, Andhra Pradesh	Manufacturing facility is required to obtain Provisional Fire NOC before start of the construction which has already been obtained. GSL has obtained Provisional Fire NOC from Andhra Pradesh State Disaster Response and Fire Services Department for the construction of Non Multi Storied building of GSL via RC No 18105/MSB/SR/NLR/2021SDP dated 23rd February 2022. Provisional Fire NOC prior to construction phase was obtained for Canteen Building 1, Canteen Building-2, Production Block, Resin Plant, Hot water generator and thermic fluid heater, raw material godown, Security Room gate-1, Admin Block, Security Room gate-2, Substation, Fire pump room and UG Sump, HR Office, Store, Staff accommodation and Drivers waiting room. All the conditions in the Provisional NOC are to be complied during construction phase and Final NOC to be obtained before start of operations.
12.	National Building Code of India	×	✓	✓	Andhra Pradesh Municipal Corporation	Fire safety requirements; stipulations regarding materials, structural design and construction (including safety); building and plumbing services; landscape development, etc. as per NBC will have to be followed.
13.	Andhra Pradesh State Disaster Management Policy and guidelines	×	✓	✓	Department of Revenue and Disaster Management	Guidelines of disaster management department to be followed and implemented.
14.	Explosives Act, 1884	×	✓	✓	Chief Controller of Explosives	Approval for obtaining explosive license for storage and used of HSD and Methanol has been obtained GSL has received license in Form XV of the Petroleum rules 2002 for the installation of storage of Petroleum Class A products via letter no A/P/SH/AP/15/1553 (P551273) dated 22nd February 2022. The license has been granted by Jt. Chief controller of Explosives, petroleum and explosive safety organization (PESO), Ministry of commerce and Industry, Government of India, on presence of the following documents Site Layout, application in Form IX, License fee, Safety and Test Certificate required under rule 130 and 126 of the Petroleum Rules, 2002 (enclosed) issued by Competent person, No objection certificate issued under Rule 144 of the Petroleum Rules, 2002 as per prescribed proforma by the District Authority through Licensing System for District Authority (LSDA) module only together with a copy of drawings/plans endorsed with his sign and seal. GSL is also required to follow the requirement/provision of " Solvent, Raffinate and Slop (Acquisition, Sale, Storage & Prevention of use in Automobiles)" Order 2000 notified by Government of India, Ministry of Petroleum and Natural Gas vide G.S.R. 519(E) dated 05/06/2000.
Social						
15.	Contract Labour (Regulation & Abolition) Central Act 1970 and Rules, 1971	×	✓	✓	Labour Department	The CLRA Act applies to all establishments where 20 or more workers are employed as contract workers or were employed anytime during the last 12 months. Hence, the CLRA Act would become applicable once 20 or more workers are employed as contract workers on any day in an establishment during the preceding 12 months. As informed during site visit, CLRA license has been obtained.
16.	Minimum Wages Act 1948	×	✓	✓	Labour Department	The Minimum Wages Act, 1948 is a central legislation aimed at statutory fixation of minimum rates of wages in the employments where sweated labour is prevalent with possibility for exploitation of unorganized labour

[37] Central Groundwater Authority (CGWA), Ministry of Jal Shakti ((Department Of Water Resources, River Development and Ganga Rejuvenation), Notification dated 24 September 2020. Link: http://jalshakti-dowr.gov.in/sites/default/files/CGWA_GWExtraction_Notification_24-09-2020.pdf

	• Equal Remuneration Act 1976 • The Payment of Wages Act, 1936, amended in 2005 and 2017 • Maternity Benefit Act, 1961 & • The Maternity Benefit (Amendment) Act, 2017 • The E.P.F. and Miscellaneous Provisions act, 1952 • Payment of Bonus Act, 1965 and rules and subsequent amendment • Payment of Gratuity Act, 1972 • ESI Act, 1948 (Employees State Insurance Act, 1948) • Workmen's Compensation Act, 1923	×	✓	✓	Labour Department	The compliance of these Acts are mandated by Indian labour laws and these acts are meant to ensure the welfare and protection of labour against exploitation of the workers working in the institutional/ commercial setup.
17.	Child Labour (Prohibition and Regulation) Act, 1986 and subsequent amendments	×	✓	✓	Labour Department	An Act to prohibit the engagement of children in certain employments and to regulate the conditions of work of children in certain other employments
18.	The Bonded Labour System (Abolition) Act 1976;	×	✓	✓	Labour Department	An Act to provide for the abolition of bonded labour system with a view of preventing the economic and physical exploitation of the weaker sections of the people and for matters connected therewith or incidental thereto
19.	Inter-state Migrant Workmen Act 1979.	×	✓	✓	Labour Department	An Act to regulate the employment of inter-State migrant workmen and to provide for their conditions of service and for matters connected therewith
20.	The building and other Construction Workers Act, 1996	×	✓	×	Labour Department	An Act to regulate the employment and conditions of service of building and other construction workers and to provide for their safety, health and welfare measures and for other matters connected therewith or incidental thereto
21.	Factories Act, 1948	×	×	✓	Factories Inspector from Labour Department	It applies to factories covered under the Factories Act, 1948. The industries in which ten (10) or more than ten workers are employed on any day of the preceding twelve months and are engaged in manufacturing process being carried out with the aid of power or twenty or more than twenty workers are employed in manufacturing process being carried out without the aid of power, are covered under the provisions of this Act.
22.	Motor Vehicles Act 1989	✓	✓	✓	Transport Department	The Motor Vehicles Act regulates almost all aspects of road transport vehicles. It has provisions for traffic regulations, vehicle insurance, registration of motor vehicles, controlling permits and penalties
Ecology						
23.	Wildlife Protection Act, 1972, 2002 and Rules, 2003 and as amended	✓	✓	✓	Wildlife Warden, State Forest Department	If any protected/ endangered flora or fauna (as listed in Schedules of WP Act, 1972) are found in the project area, the proponent should implement conservation measures for their protection.
24.	A.P. Wood Based Industries (Establishment and Regulation) Rules, 2018	✓	✓	✓	State Forest Department	As the industry is using round log / timber as raw material collected from the surrounding agroforestry plantation, a registration of the industry is required in the forest department. As per the regulation, it is necessary to provide details about the machinery type (in this scenario, a wood chipper) and its quantity to the divisional forest department. Greenlam has already completed the registration process and shared the registration certificate dated 21.12.2020 [Registration number: 0307202036] with us.

3.4 Applicable National and International Ambient Air and Ambient Noise Standards

3.4.1 National Ambient Air Quality Standards (NAAQS)

National Ambient Air Quality Standards (NAAQS), as notified under Environment (Protection) Rules 1986 and revised through Environment (Protection) Seventh Amendment Rules, 2009 has been presented in Table 3-3.

Table 3-3: NAAQS Air Quality Standards

Pollutant	Time Weighted Avg.	Concentration in Ambient Air	
		Industrial, Residential, Rural & Other Areas	Ecologically Sensitive Areas (notified by Central Government)
Sulphur dioxide (SO_2) $\mu g/m^3$	Annual Average*	50	20
	24 Hours**	80	80
Oxides of Nitrogen (NO_x) $\mu g/m^3$	Annual Average*	40	30
	24 Hours**	80	80
Particulate Matter (PM 10) $\mu g/m^3$	Annual Average*	60	60
	24 Hours**	100	100
Particulate Matter (PM 2.5) $\mu g/m^3$	Annual Average*	40	40
	24 Hours**	60	60
Ozone (O_3) $\mu g/m^3$	8 Hours**	100	100
	1 Hour**	180	180
Lead (Pb) $\mu g/m^3$	Annual Average*	0.50	0.50
	24 Hours**	1.0	1.0
Carbon monoxide (CO) mg/m^3	8 Hours**	02	02
	1 Hour**	04	04
Ammonia (NH_3) $\mu g/m^3$	Annual*	100	100
	24 Hours**	400	400
Benzene (C_6H_6) $\mu g/m^3$	Annual*	05	05
Benzo(α)Pyrene- particulate phase ng/m^3	Annual*	01	01
Arsenic (As) ng/m^3	Annual*	06	06
Nickel (Ni) ng/m^3	Annual*	20	20

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

** 24 hourly/8 hourly/1 hourly monitored values, as applicable shall be complied with 98% of the time in a year. 2% of the time, it may exceed but not on two consecutive days of monitoring.

3.4.2 IFC/WB Ambient Air Quality Standards

According to the IFC EHS guidelines, the ambient quality standards are referred to the ambient air quality levels established and published through national legislative and regulatory processes, and ambient quality guidelines refer to ambient quality levels primarily developed through clinical, toxicological, and epidemiological evidence (such as those published by the World Health Organization). The ambient air quality as per IFC EHS guidelines has been presented in Table 3-4.

Table 3-4: IFC/WB Ambient Air Quality Standards

Pollutant	Averaging Period	Guideline Value in µg/m^3
Sulphur Dioxide	24-hour	125 (Interim target-1)
		50 (Interim target-2)
		20 (guideline)
	10 minute	500 (guideline
Nitrogen Oxide	1 year	40 (guideline)
	1 hour	200 (guideline)
Particulate Matter 10	1 year	70 (Interim target-1)
		50 (Interim target-2)
		30 (Interim target-3)
		20 (guideline)
	24 hour	150 (Interim target-1)
		100 (Interim target-2)
		75 (Interim target-3)
		50 (guideline)
Particulate Matter 2.5	1 year	35 (Interim target-1)
		25 (Interim target-2)
		15 (Interim target-3)
		10 (guideline)
	24 hour	75 (Interim target-1)
		50 (Interim target-2)
		37.5 (Interim target-3)
		25 (guideline)
Ozone	8-hour daily	160 (Interim target-1)

Pollutant	Averaging Period	Guideline Value in µg/m3
	Maximum	100 (guideline)

Interim target means Interim targets are provided in recognition of the need for a staged approach to achieving the recommended guidelines.

3.4.3 Ambient Noise standards as per MOEFCC

Noise standards specified by the MoEFCC vide gazette notification dated 14th February, February 2000 based on the A weighted equivalent noise level (Leq) are as presented in Table 3-5.

Table 3-5: Ambient Noise Standards as per MOEFCC

Area Code	Category of Area	Limits in dB(A) Leq	
		Day time*	Night Time
A	Industrial Area	75	70

Note:*Day time is from 6 am to 10 pm, Night time is10.00 pm to 6.00 am;**Silence zone is an area comprising not less than 100 meters around premises of hospitals, educational institutions, courts, religious places or any other area which is declared as such by the competent authority. Use of vehicle horns, loud speakers and bursting of crackers are banned in these zones.

3.4.4 IFC/WB Ambient Noise Standards

As per the IFC/WB, General EHS Guidelines on noise management, noise impacts should not exceed the levels presented in Table 3-6 or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

Table 3-6: IFC/WB Ambient Noise Standards

Receptor	One Hour Leq (dBA)	
	Daytime 07:00 - 22:00	Night time 22:00 - 07:00
Industrial, commercial	70	70

Since the manufacturing facility will be set up in designated industrial area, the noise limits of industrial area will be adhered to.

3.4.5 Emission Standards for Boilers

MOEFCC Standards: The following emission standards have come into force dated 16th May 2023. As per Environment (Protection) Amendment Rules, 2023, the following emission standards are to be adhered to for the boiler with steam generating capacity of 8TPH. These standards are for industrial boilers using coal or lignite, pet coke, bagasse or agro-fuels, and Furnace Oil or Light Diesel Oil or Low Sulphur Heavy Stock, boilers of bagasse or agro-fuels based power plants, and also for Thermic Fluid Heater (TFH) and Hot Air Generator (HAG) on equivalent fuel consumption basis.

IFC/WB Guidelines: IFC/WB EHS guidelines values for small combustion facilities emissions ((3MWth – 50MWth) have bene considered as the project falls in the mentioned category. Also, Industry specific Air Emission guidelines for Board and Particle Based Products have also been referred in the table below.

Table 3-7: Emission Standards

MOEFCC Emission Standards			
Boiler (Steam generation capacity, ton/hour)	**Parameters**	**Type of industrial boiler (fuel-wise) and Standards**	
		Agro based fuels/bagasse	Other fuels
Less than 2	Particulate Matter (PM) Emission (mg/Nm3)	**500**	**500**
2 to less than 10		**250**	**150**
10 and above		**250**	**100**
IFC/WB Air Emission guideline for Board and Particle Based Products[38]			
Particulate Matter (**mg/Nm3)**	• 20 (MDF) • 20 (Wood Dryers) • 50 (Other Sources)		
Condensable VOCs mg/Nm3 (as carbon)	130		
Formaldehyde (**mg/Nm3)**	• 20 (Wood Dryers) • 50 (Other Sources)		
Air Emission guideline for small combustion facilities[39] with solid fuel as per IFC WB EHS guideline			
Particulate Matter (mg/Nm3)	• 20 (MDF) • 20 (Wood Dryers) • 50 (Other Sources)		
Sulphur Dioxide (SO2)	• 2000 mg/m3		
Nitrogen Oxides (NOx)	• 650 mg/m3		

3.4.6 General Discharge Standards as per MOEFCC

Table 3-8: General Discharge Standards

S. N	Parameter	Standards		
		Inland surface water	Public sewers	Land for Irrigation
1	Suspended solids mg/l, max.	100	600	200
2	Particle size of suspended solids	Shall 850 micron IS sieve	-	-
3	PH value	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
4	Temperature	Shall not exceed 50 C above the receiving water temperature	-	-
5	Oil and grease, mg/l max,	10	20	10
6	Total residual chlorine, mg/l max	1.0	-	-
7	Ammonical nitrogen (as N), mg/l max.	50	50	-
8	Total Kjeldahl nitrogen (as N); mg/l max	100	-	-
9	Free ammonia (as NH3), mg/l max	5.0	-	-
10	Biological oxygen demand (3 days at 270	30	350	100

[38] https://documents1.worldbank.org/curated/en/693331489584857393/pdf/113494-WP-ENGLISH-Board-and-PBP-PUBLIC.pdf
[39] Small combustion processes are systems designed to deliver electrical or mechanical power, steam, heat, or any combination of these, regardless of the fuel type, with a total, rated heat input capacity of between three Megawatt thermal (MWth) and 50 MWth.

S. N	Parameter	Standards		
		Inland surface water	Public sewers	Land for Irrigation
	C), mg/l max			
11	Chemical oxygen demand, mg/l max	250	-	-
12	Arsenic (as As) mg/l, max	0.2	0.2	0.2
13	Mercury (As Hg) mg/l max.	0.01	0.01	-
14	Lead (as Pb) mg/l, max	0.1	1.0	-
15	Cadmium (as Cd) mg/l, max	2.0	1.0	-
16	Hexavalent chromium (as Cr +6) mg/1 max	0.1	2.0	-
17	Total chromium (as Cr) mg/1 max	2.0	2.0	-
18	Copper (as Cu) mg/1, max	3.0	3.0	-
19	Zinc (as Zn)	5.0	15	-
20	Selenium (as Se)	0.05	0.05	-
21	Nickel (as Ni) mg/1,max	3.0	3.0	-
22	Cyanide (as CN) mg/1,max	0.2	2.0	0.2
23	Fluoride (as F) mg/1,max	2.0	15	-
24	Dissolved phosphates (as P) mg/1,max	5.0	-	-
25	Sulphide (as S) mg/1,max	2.0	-	-
26	Phenolic compounds (as C6H5OH) mg/1,max	1.0	5.0	-
27	Radioactive materials: (a) Alpha emitters micro curie mg/1,max (b) Beta emitters micro curie mg/1	10-7 10-6	10-7 10-6	10-8 10--7
28	Bio-assay test	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent
29	Manganese	2 mg/1	2 mg/1	-
30	Iron (as Fe)	3mg/1	3mg/1	-
31	Vanadium (as V)	0.2 mg/1	0.2 mg/1	-
32	Nitrate Nitrogen	10 mg/1	-	-

Source: as per G.S.R 422 (E) dated 19.05.1993 and G.S.R 801 (E) dated 31.12.1993 issued under the provisions of E (P) Act 1986.

3.4.7 Treated Sanitary Sewage Standards as per IFC/WB EHS Guidelines

Table 3-9: Treated Sanitary Sewage Standards

S. N	Pollutant	Unit	Guideline Value
1	PH value		6 – 9

S. N	Pollutant	Unit	Guideline Value
2	Biological oxygen demand (3 days at 27^0 C), mg/l max	mg/l	30
3	Chemical oxygen demand, mg/l max	mg/l	125
4	Total Nitrogen	mg/l	10
5	Total phosphorus	mg/l	2
6	Oil and grease	mg/l	10
7	Total suspended solids	mg/l	50
8	Total coliform bacteria	MPN[40] / 100 ml	400

3.4.8 Treated Effluent Guideline as per EHS guidelines for Board and Particle based products

Table 3-10: Treated Effluent Guidelines for Board and Particle Board Products

S. N	Pollutant	Unit	Guideline Value
1	PH value	-	6 – 9
2	Biological oxygen demand$_5$	mg/l	50
3	Chemical oxygen demand, mg/l max	mg/l	150
4	Total suspended solids	mg/l	50
5	Formaldehyde	mg/l	10
6	Temperature[41]	^{0}C	<3

3.4.9 Emission Limits for New Diesel Engines (up to 800 KW) for Generator Sets

Emission standards for diesel engines (engine rating more than 0.8 MW (800 KW)) for power plant, generator set application and other requirements is as follows:

[40] Most Probable Number

[41] At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

Parameter		Area Category	Total engine rating of the plant (includes existing as well as new generator sets)	Generator sets commissioning date		
				Before 1.7.2003	Between 1.7.2003 and 1.7.2005	On or after 1. 7. 2005
NOx (as NO_2) (AT 15% O_2) , dry basis, in ppmv		A	Upto 75 MW	1100	970	710
		B	Upto 150 MW			
		A	More then 75 MW	1100	710	360
		B	More then 150 MW			
NMHC (as C)(at 15% O_2), mg/Nm^3		Both A and B		150	100	
PM (at 15% O_2), mg/Nm^3	Diesel Fuels-HSD & LDO	Both A and B		75	75	
	Furnace Oils-LSHS & FO	Both A and B		150	100	
CO (at 15% O_2), mg/Nm^3		Both A and B		150	150	
Sulphur Content in fuel		A		< 2%		
		B		< 4%		
Fuel specification		For A only	Up to 5MW	Only Diesel fuels (HSD, LDO) shall be used.		
Stack height (for generator sets commissioned after 1.7.2003)		Stack height shall be maximum of the following, in meter: (i) 14 $Q^{0.3}$, Q= Total SO_2 emission from the plant in kg/hr. (ii) Minimum 6 m. above the building where generator set is installed. (iii) 30 m.				

3.4.10 Other Relevant International Guidelines and Standards

3.4.10.1 IFC Performance Standards

Table 3-11: Applicability of IFC Performance Standards to the Project

Sr. No.	IFC Performance Standards	Applicability/ Compliance/Details
1.	PS 1: Assessment and Management of Environmental and Social Risks and Impacts	**Applicable** The Project will have impacts on environment, health, safety and social aspects throughout its lifecycle and will need to be managed and monitored through the implementation of policies and procedures in compliance with IFC PS 1 and the reference framework.
2.	PS 2: Labour and Working Conditions	**Applicable** The construction and operation phase for the Project will include employment of labour for varying activities. These staff and workers shall be governed by the HR policy, minimum wage regulation etc. that fall within the purview of IFC PS 2.
3.	PS 3: Resource Efficiency & Pollution Prevention	**Applicable** Air emissions and pollution discharge is anticipated from the Project during the construction and operation phase. Use of water in project activities (during both construction and operation phase), impact on drainage, wastewater discharge (both construction and operation phase), generation and disposal of waste including hazardous waste, generation and disposal of ash, air emissions, etc. do fall within the purview of PS 3.
4.	PS 4: Community Health, Safety & Security	**Applicable** PS 4 is applicable to the project as the Project would have limited impact on the health and safety of the communities located adjacent to it during both construction and operational phase.
5.	PS 5: Land Acquisition & Involuntary Resettlement	**Not Applicable** PS-5 requires project proponents to anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use. As per the available information, the integrated manufacturing facility is being developed within the Industrial Estate and the land for the facility has already been procured. Since, the land procurement does not involve involuntary resettlement therefore the applicability of the PS 5 is scoped out.

Sr. No.	IFC Performance Standards	Applicability/ Compliance/Details
6.	PS 6: Biodiversity Conservation and Living Natural Resources	Applicable The manufacturing unit is being established in the dedicated industrial area; but the raw material will be sourced from the different locations of Tirupati, Nellore, & Chittoor districts. The industry will increase the demand for wood in the catchment area; which may cause land use change, and ultimately habitat loss and/or modification. There may be also a risk of illegal logging of trees from the nearby forest areas.
7.	PS 7: Indigenous People	Not Applicable As the manufacturing unit is in the A.P State Govt. owned Industrial state and there is no direct potential adverse impact on the Schedule Tribes (Indigenous People) therefore PS-7 is not getting triggered.
8.	PS 8: Cultural Heritage	Not Applicable As the manufacturing unit is located in the industrial park, as well as there are no archeologically protected monuments within the close vicinity of the project and project does not affect any intangible cultural heritage therefore PS-8 is not getting triggered.

3.4.10.2 World Bank Group Environmental, Health and Safety (EHS Guidelines)

These General EHS Guidelines are designed to be used together with the relevant Industry Sector EHS Guidelines which provide guidance to users on EHS issues in specific industry sectors. The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them. The applicability of the EHS Guidelines should be tailored to the hazards and risks established for each project on the basis of the results of an environmental assessment in which site-specific variables, such as host country context, assimilative capacity of the environment, and other project factors, are taken into account.

3.4.10.3 WBG EHS Guidelines for Board and Particle Based Products

The EHS guidelines contain the performance levels and measures that are generally considered to be achievable in crop production areas by existing technology at reasonable costs. Application of the EHS guidelines to existing farming systems may involve the establishment of site-specific targets, with an appropriate timetable for achieving them. The EHS Guidelines for Board and Particle-based Products apply to the manufacture of board and particle-based products such as particleboard, oriented strand board (OSB), medium density fiberboard (MDF), plywood and glued and laminated products.

3.4.10.4 WBG EHS Guidelines for Forest Harvesting Operations (as applicable for plantations)

The EHS Guidelines for Forest Harvesting Operations include information relevant to the management of both plantation and natural forests, in temperate, boreal and tropical zones. The Guidelines are applicable to plantation activities being undertaken for the integrated manufacturing facility. The establishment of plantation forests and subsequent timber harvesting activities involves the replacement of the existing vegetation cover with native and/or non-native species, resulting in the potential loss of habitat diversity and a corresponding loss of wildlife and plant species.

4 Environmental and Social Baseline Conditions

This section describes the existing environmental and social sensitivities and baseline conditions of the study area (as described below for manufacturing facility). The sensitivities include the relevant components of the physical, biological and socio-economic environment. The purpose of describing the environmental and social sensitivities of the study area is to:

- To describe the environmental characteristics of the Project site and surrounding areas to identify key resources and receptors that will be affected by the Project;
- To determine if any nearby communities or structures will be affected by the Project establishment; and
- To understand the significance of the different habitats within the study area and its importance for sustaining species of conservation importance, in terms of providing habitat contiguity to the surrounding region and dependency of surrounding communities.

This section also presents water availability and quality baseline conditions as well as social and ecological baseline conditions for the supply chain (catchment area) as well.

4.1 Study Area

The study area of the Project has been identified considering the extent of Project impact in terms of air quality, noise, water resources, human settlement, cultural heritage sites, location of labour sites, location of the access roads and considering the actual land area which has been procured for the Project and its utilities footprints. Study area also includes area planned for wood sourcing and plantation for the manufacturing facility.

The study area of the project comprises of the following areas:

- Integrated Manufacturing Facility/ Unit: The study area has been identified as 5 km radius from the boundary of the manufacturing unit for the baseline data generation as presented in Figure 4-1.
- Supply Chain Catchment Area: For the catchment area, the baseline data (focused on available secondary information as well as stakeholder consultation) was generated for a potential supply chain catchment area as shown in Figure 4-2

Figure 4-1: Study Area Map (Manufacturing Facility/Unit)

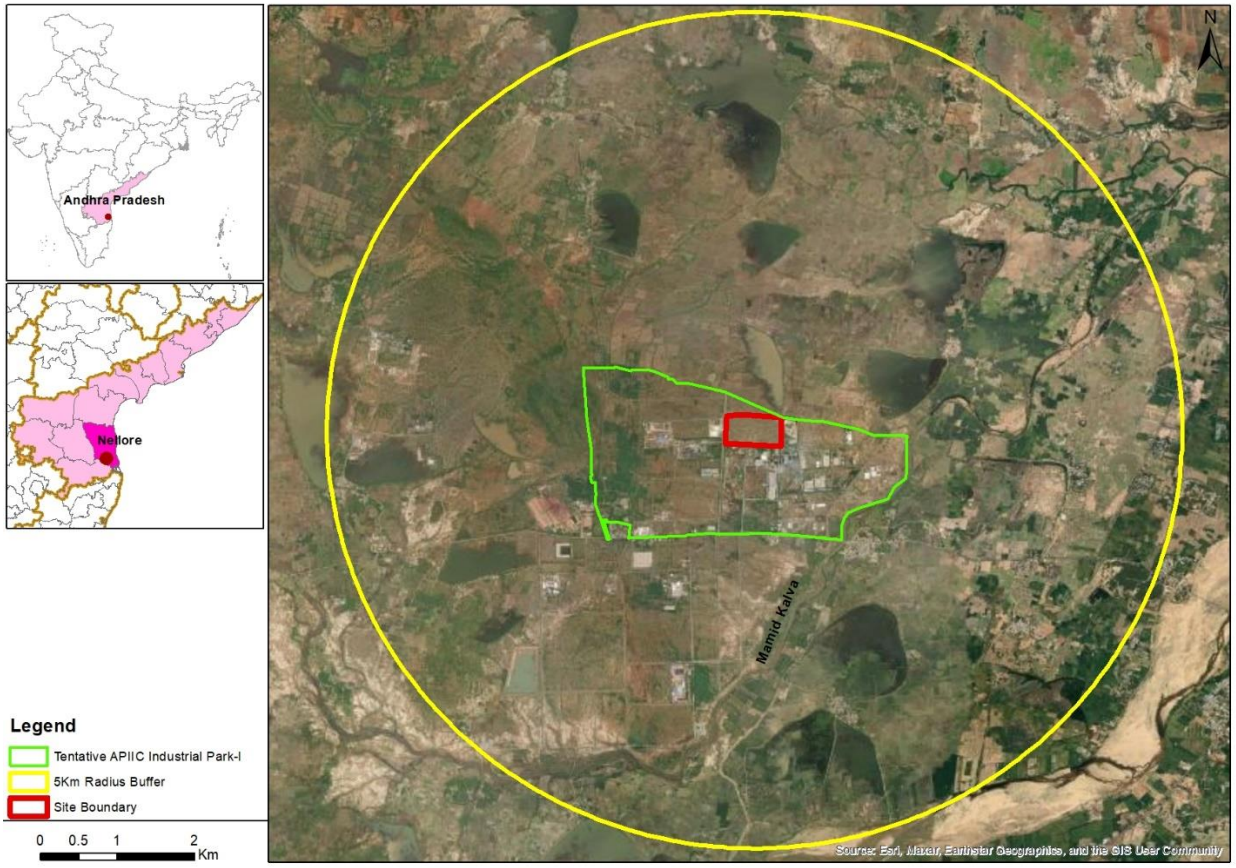
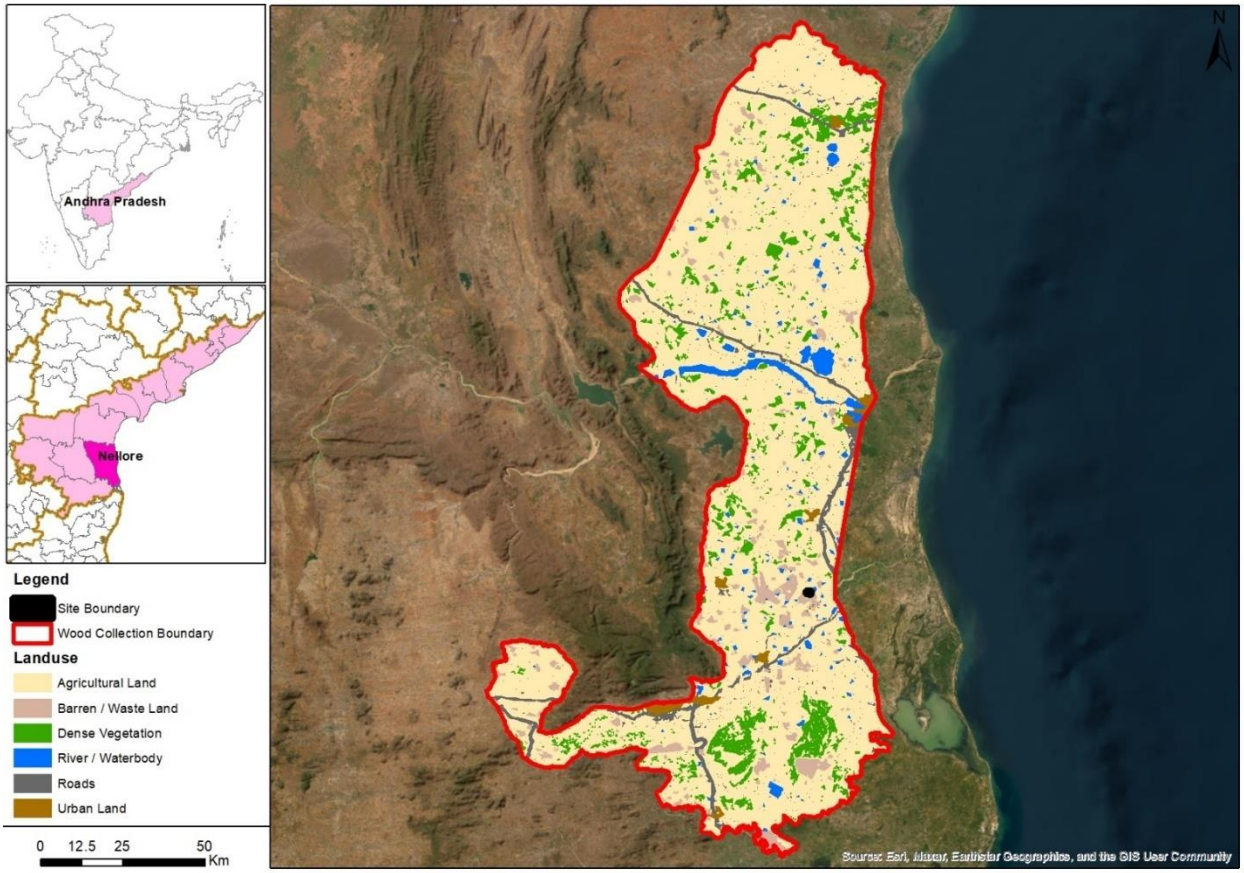


Figure 4-2: Boundary of Potential Supply Chain Catchment Area



4.1.1 Project Footprint Area

The Project footprint is the area that may reasonably be expected to be physically touched by Project activities across all phases. The project footprint includes land used for setting up the manufacturing plant, site office, access road, storage of material and equipment. Labour camps setup in the vicinity of the manufacturing site have also been covered.

4.1.2 Project Area of Influence (AoI)

The effects of the Project and Project activities on a particular resource or receptor will have spatial (distance) and temporal (time) dimensions, the scale of which is dependent on a number of factors, including:

- Nature of the activity
- Specific resource or receptor
- Sensitivity of that resource or receptor
- Whether the impact is direct or indirect (e.g., secondary effect)

The Project's AoI refers to the Project footprint area as well as area covering all components associated with the project in its immediate vicinity. This includes the footprint of the associated project components, such as access road as well as the immediate surroundings that will see increased movement of vehicles, personnel, land-use change and catchment area for wood procurement and souring. Most of the impacts will occur within the project footprint area as identified above. However, certain impacts can be further reaching the catchment area in terms of wood procurement and sourcing.

The AoI considered for the Project with respect to the environmental, social, and ecological resources was based on the following reach of impacts:

- Ecological Parameters:
  - *Manufacturing Unit*: Based on identified sensitivity during desk-based review and previous experiences, the study area for ecological assessment of the area around the Manufacturing Unit was demarcated as,
    - ***Core Area:*** Boundary of the proposed project, and
    - ***Buffer Area:*** 5 km radius from the project boundary.
  - *Supply Chain Catchment Area: for the catchment area, a boundary was conceptualized based on the discussion with Client representative at site, potential wood aggregator and tentative areas identified by Greenlam for wood collection as well as for the promotion of plantation.*

- Environmental Parameters: The area of up to 5 km radius from the boundary of the manufacturing facility has been demarcated as study area or Area of Influence for the Project by considering the extent of impact in terms of air quality, noise, water resources, human settlement, location of the access roads besides considering the actual land area which will be used for the facility. For the purpose of environmental baseline assessment,
  - Core (0 - 500m from manufacturing facility) and
  - Buffer zones (beyond 500m – 5km of boundary of the manufacturing facility).
- *Supply Chain Catchment Area*: for the catchment area, water availability, quality and quantity has been assessed.

- Social and Cultural: The study area for the social assessment comprises of the area identified for the Project as well as villages which might be impacted directly or indirectly by the Project. The key terms used for sub-categorisation of the study area are:
  - ***Core: Project village:*** Villages falling under the 2 km radius from the Project boundary
  - ***Buffer: Project's Area of Influence (AoI):*** Villages falling under the 5 km radius from the Project boundary including the project village
  - ***Project's study area:*** Study are including the Project villages and the village falling under the Project's AoI.

4.2 Primary Environmental Baseline Monitoring

Primary environmental baseline monitoring was conducted within 5 km radius of the manufacturing facility by a National Accreditation Board for Testing and Calibration Laboratories (NABL) under the supervision of Independent E&S Advisor to

understand the baseline conditions of the manufacturing facility's study area. Monitoring locations considered has been presented in Table 4-1. Map showing monitoring locations has been presented in Figure 4-3.

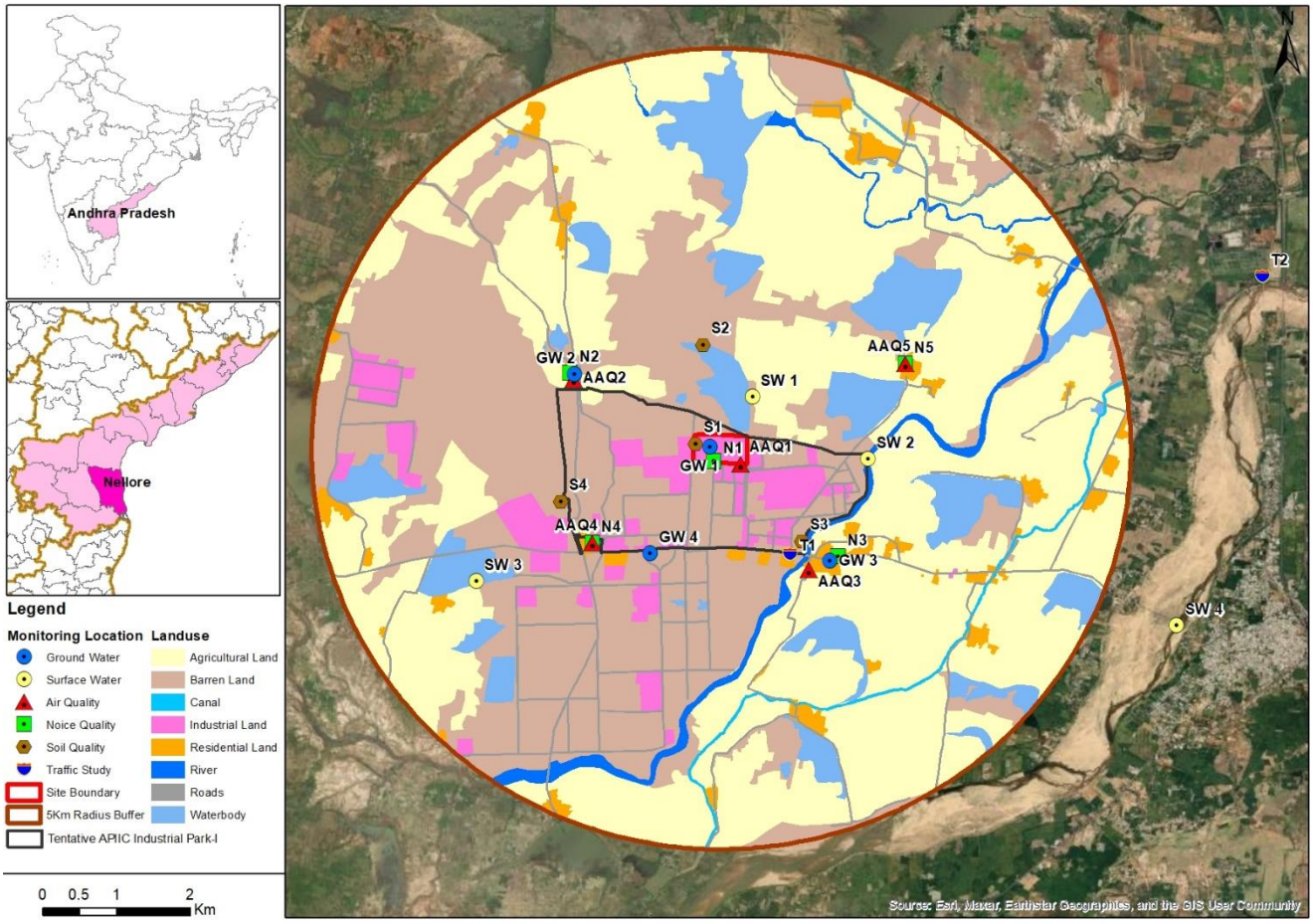
Table 4-1: Environment Monitoring Locations

Parameter	Location Code	Name of the Location	Coordinates	Distance and Direction and Rationale	Location Criteria
Ground Water	GW 1	Borewell, Greenlam Plant	13°55'49.51"N, 79°49'39.64"E	Inside the Greenlam Manufacturing Facility Boundary within the project site	Physical, chemical and biological parameters as per IS 10500:2012 drinking water standards were assessed for the collected samples Once during the monitoring period
	GW 2	Handpump, Jayampa Road	13°56'21.36"N, 79°48'40.18"E	3.8Km aerial distance in north west direction at a nearest residential village settlement which is upstream considering the ground water flow in the study area which is primarily east to west	
	GW 3	Handpump, Munakur	13°54'59.35"N, 79°50'32.28"E	2.1Km aerial distance towards southeast at a nearest residential village settlement in downstream considering the ground water flow in the study area which is primarily east to west	
	GW 4	Handpump, K.Palam	13°55'2.78"N, 79°49'13.41"E	1.7 Km aerial distance towards southwest at a nearest village settlement with at almost similar contour that of project site	
Surface Water	SW 1	Seasonal Pond, Monavali	13°56'11.63"N, 79°49'58.30"E	100 m aerial distance towards northeast (Seasonal in nature, As discussed with local community, water is used for agricultural activities present)	Once during the monitoring period
	SW 2	Minor River, near Munakur	13°55'44.20"N, 79°50'49.20"E	2 km aerial distance towards east (Seasonal minor river of Swarnamukhi river, water used for drinking/agricultural/industrial and other activities)	
	SW 3	Pond, K.Palam,	13°54'50.68"N, 79°47'57.02"E	3.7 Km aerial distance towards southwest (village pond, used for drinking and domestic activities as well as agricultural purposes)	
	SW 4	Swarnamukhi River	13°54'31.17"N, 79°53'4.64"E	6.5 Km aerial distance towards southeast at (Perineal river, water used for all type of activities, major source of water)	
Soil	S1	Greenlam Plant	13°55'50.85"N, 79°49'33.37"E	Inside the Greenlam Manufacturing Facility Boundary	Sample were assessed for parameters such as pH, Conductivity , Moisture Content, Texture, Particle Sizes, Sand Silt, Clay, Bulk Density, Chemical Characteristics, Organic Content, Chlorides as Cl, Sulphates as So4, Total Nitrogen as N, heavy metals, total petroleum hydrocarbons Once during the monitoring period
	S2	Jayampa Road	13°56'34.31"N, 79°49'36.80"E	1.5 km aerial distance towards north at a scrub land	
	S3	Munakur	13°55'8.16"N, 79°50'20.23"E	1.7 km aerial distance towards southeast at the nearest village settlement in this direction	
	S4	K. Palam	13°55'25.63"N, 79°48'34.33"E	2.2 km aerial distance towards southwest at the nearest village settlement in this direction	
Ambient Air	AAQ1	Greenlam Office	13°55'42.08"N, 79°49'53.01"E	Inside the Greenlam Manufacturing Facility Boundary	Twice a week for 4 weeks from the nearest residential receptors covering all directions within 3 km radius of the manufacturing facility
	AAQ2	Residential Settlement	13°56'19.03"N, 79°48'39.93"E	2.2 km aerial distance towards northwest Village Settlement (Cross Wind) of Garudagunta Agraharam	

Parameter	Location Code	Name of the Location	Coordinates	Distance and Direction and Rationale	Location Criteria
	AAQ3	Menkuru	13°54'55.61"N, 79°50'23.13"E	2 km aerial distance towards South East[42] (Upwind Direction) Also the residential settlements of Menakuru Village	
	AAQ4	K. Palam	13°55'7.27"N, 79°48'47.95"E	2.2 km aerial distance towards southwest (Down wind Direction) and also residential settlements of Konetirajupalem village/settlement are present	
	AAQ5	Manavalli Village	13°56'25.95"N, 79°51'05.60"E	2.7 km aerial distance towards northeast (Cross Wind) at a residential village settlement of Manavali	
Ambient Noise	N1	Greenlam Office Building	13°55'43.08"N, 79°49'41.45"E	Inside the Greenlam Manufacturing Facility Boundary	Once for 48 hours from the nearest residential receptors covering all directions in the 3km radius of the manufacturing facility and Manufacturing Facility (Greenlam Office Building) as per MoEFCC guidelines Leq, Noise Levels in dB(A), day and night for 48 hour, once at the selected locations.
	N2	Residential Settlement	13°56'21.86"N, 79°48'38.31"E	2.2 km aerial distance towards northwest	
	N3	Menakura Village	13°55'01.56"N, 79°50'36.07"E	2.2 km aerial distance towards southeast	
	N4	Konetirajupalem Village	13°55'7.27"N, 79°48'47.95"E	2.2 km aerial distance towards southwest	
	N5	Menakura Village	13°56'25.85"N, 79°51'05.56"E	2.7 km aerial distance towards northeast	
Traffic	T1	Ayyapa Reedy, Palam (Up and Down)	13°55'2.55"N, 79°50'15.03"E	1.8 Km aerial towards southeast, access road to the industrial area leading directly to project site	Access Road being used during construction and operation phase
	T2	Menakura (Up and Down)	13°57'4.44"N, 79°53'42.45"E	7.6 km aerial distance towards northeast at SH-74. This road specifically leads towards industrial area from NH-16. This road is also used by all the villagers in an around the area	

[42] Since monitoring will be undertaken during the months of March-April, South-East is the predominant upwind direction in the area.

Figure 4-3: Monitoring Location Map



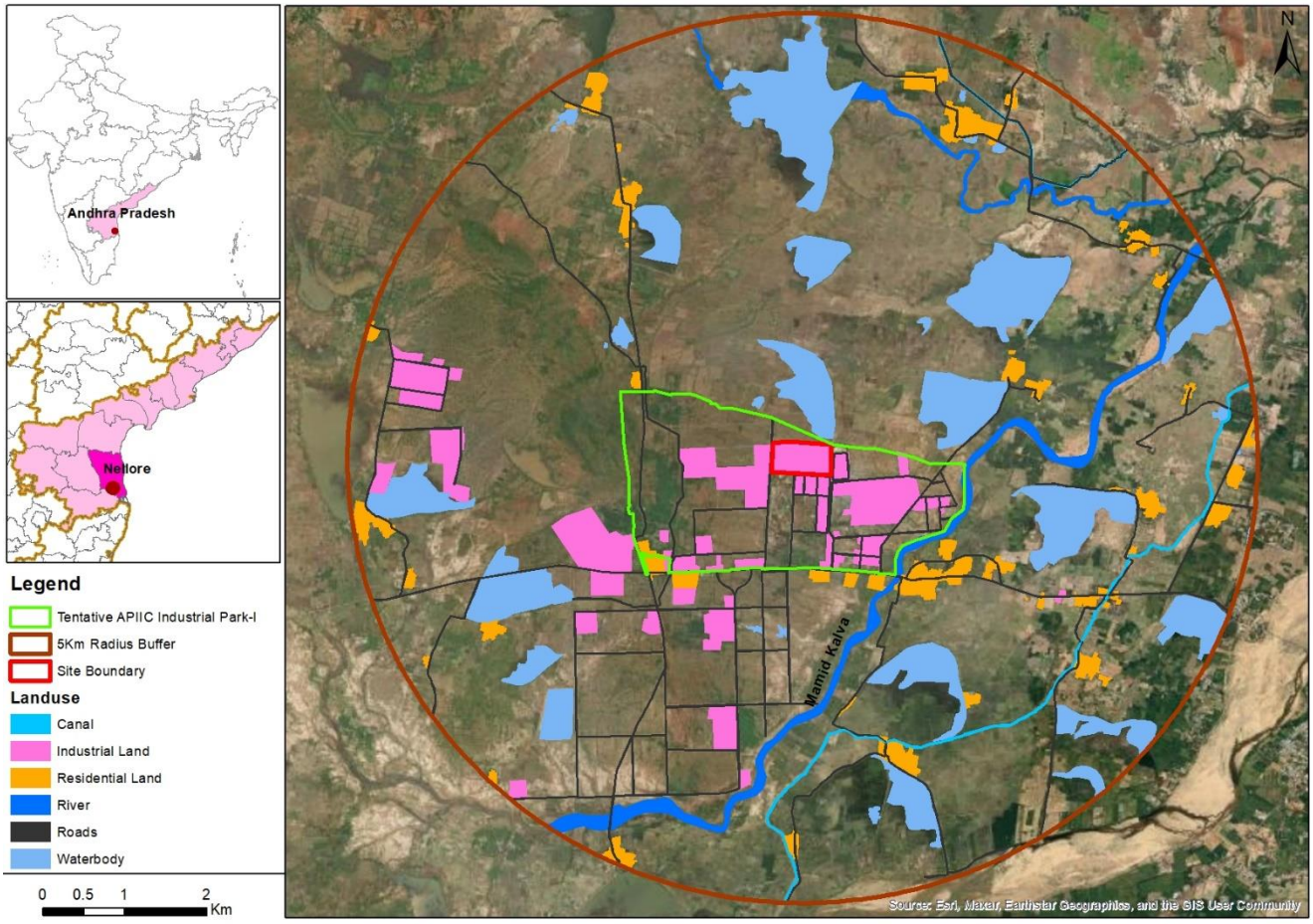
4.3 Physical Environmental Sensitivities

4.3.1 Physical Features

The physical features map of the 5 km radius of the manufacturing facility is showcased in Figure 4-4. The map displays the following features:

- Industrial Area
- Residential settlements
- Water bodies
- Rivers
- Road network

Figure 4-4: Physical Feature Map for 5 km radius of manufacturing facility



4.3.2 Climatology & Meteorology

As per the information provided by CGWB in the groundwater brochure for Nellore district[43] (2013), the climate of the manufacturing facility district is moderate and characterized by sub-tropical climate. The district experiences moderate heat in summer and cold in winter due to its sub-tropical location. The mean daily maximum temperature in the district is about 38°C in May and the mean daily minimum temperature is about 20°C in December/ January. Temperature in the district begins to rise from the middle of February till May. With the onset of southwest monsoon in June, the temperature decreases to about 20°C and is largely uniform during the monsoon period. The relative humidity ranges from 60 to 80% in the mornings, whereas in the evenings it varies from about 45 to more than 70%.

The annual normal rainfall of the district is 1084 mm. The contribution of south-west monsoon is far less than the contribution of NE monsoon rainfall. About 70% of the annual rainfall is contributed by the NE monsoon. In general the amount of rainfall increases from west to east about 900 to 1300 mm in the district.

4.3.3 Land Use

According to the "Ground Water Brochure" for Nellore District (2013) by Central Ground Water Board, the landuse breakup for Nellore district has been represented in Table 4-2.

[43] Newly formed district, "Tirupati" is the project district for the manufacturing plant. Tirupati District came into existence on 4th April 2022. Tirupati district comprise of 4 revenue divisions i.e., Gudur, Sullurupeta, Srikalahasti and Tirupati and 34 Tehsils (also known as "mandals" in the state of Andhra Pradesh). The revenue divisions Gudur & Sullurupeta were initially part of Nellore district and Srikalahasti & Tirupati revenue divisions were part of Chittoor District. Due to the recent formation of Tirupati district, no official government reports are found for the same. Thus, for the purpose of this report, reference for the aforementioned revenue divisions and tehsils has been taken from the official data of their previous districts There has been no change in geographical boundary for any of the tehsils that have been moved into Tirupati district, therefore the data present in the secondary domain from their original district can be considered. S

Table 4-2: Land use breakup of the district

Sr.No.	Land Use Category	Area (Ha)	Percentage
1	Forest Area	2,62,787	35.69
2	Net Area Sown	3,76,388	51.13
3	Cultivable Waste	96,956	13.18
	Total	**7,36,131**	**100.00**

Source: Ground Water Brochure" for Nellore District (2013) by Central Ground Water Board

According to the google earth imagery dated 6/22/2022, the current land use of the identified land for the integrated manufacturing facility was observed to be non-agricultural with presence of shrubs within the land parcel and operational and under construction industries in the vicinity. As observed during site visit, currently the site is under construction, and construction activities have been initiated for Phase 1 as well as Phase 2.

Table 4-3: Land use breakup of the 5 km radius of the Manufacturing Facility

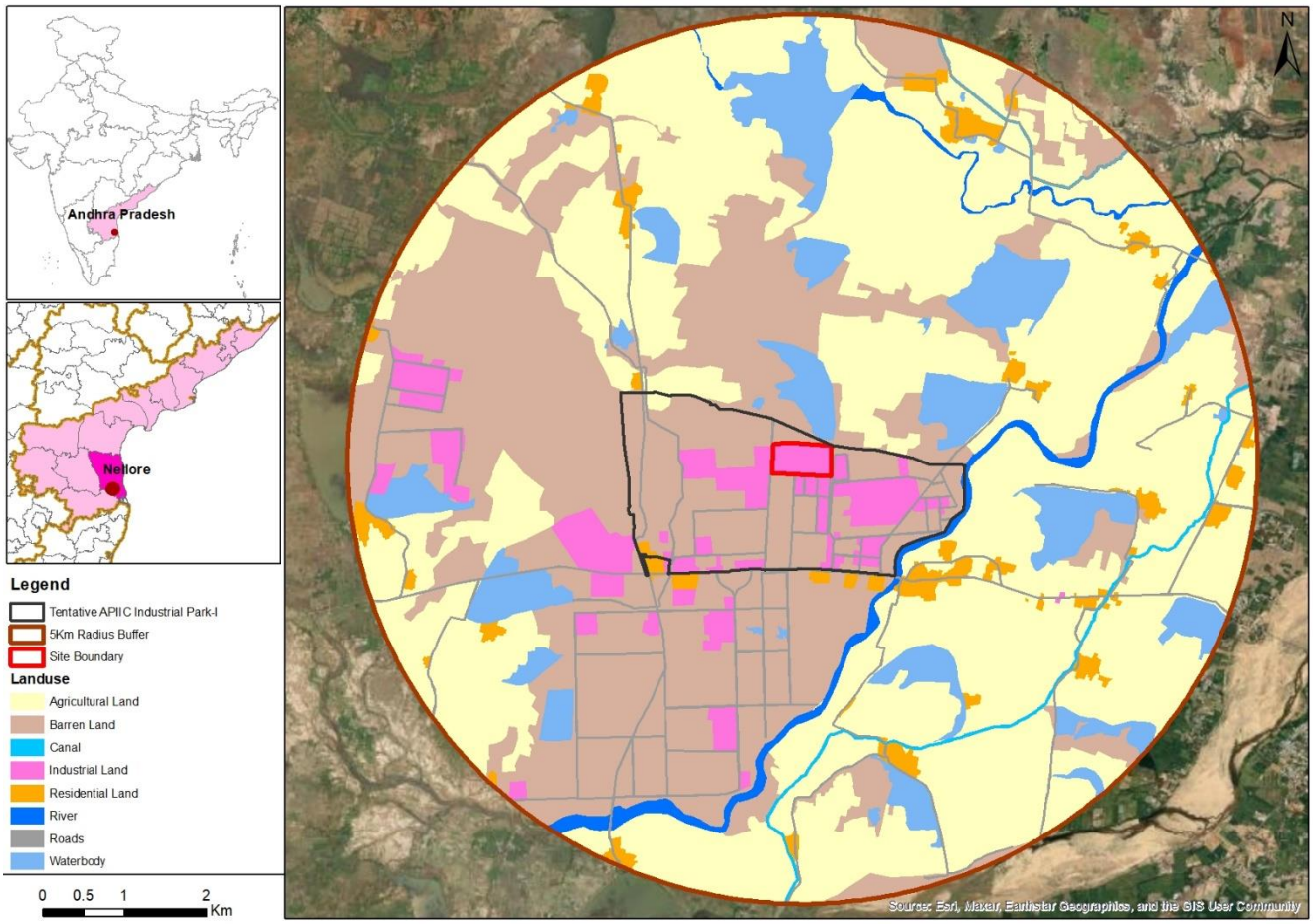
Sr.No.	Land Use Category	Area (Sq km)	Percentage
1.	Agricultural Land	42.80	47.61
2.	Residential Land	2.00	2.22
3.	Industrial Land	3.50	3.89
4.	Barren Land	29.44	32.75
5.	Canal	0.66	0.74
6.	Waterbody	8.00	8.90
7.	River	1.51	1.68
8.	Roads	1.99	2.22
	Total Area (Sqkm)	**89.90**	100.00

Source: ArcGIS imagery Mapping

The Figure 4-5 shows the land use pattern of 5 km radius of the manufacturing facility. As per Table 4-3, it is observed that the 5 km land area within 5 km is dominated by agricultural land (47.61 %) followed by barren land (32.75%). There are settlements located within 5 km radius of the facility area which accounts for 2.22 % of the total land within the 5 km radius of the facility study area where as industrial land forms 3.89 % of the study area for manufacturing facility and the APIIC Industrial area forms the 7% of the demarcated study area (i.e. ~6.40sq. km).

As understood from the figure below, the APIIC-1 industrial area comprises of 65% barren/Open land followed by 26% of developed area (industries), 7.25% of roads and 0.41% of residential area.

Figure 4-5: Land Use Pattern of the Study Area – 5 km radius of the Manufacturing Facility



Source: ArcGIS imagery Mapping, developed by Independent E&S Advisor

4.3.4 Topography & Drainage

Based on Google Earth Imagery dated 06.02.2022, the topography of the manufacturing facility was observed to be almost flat with minor slope with elevation ranging from 38 m to 45 m above mean sea level. The elevation gradually increases from north to south. Since the site is almost flat with minor slope, adequate levelling will be required during construction phase of the project.

The Pennar is the major river which drain in the middle of the district. The other important rivers flowing in the district are Swarnamukhi, Manneru and Upputeru. All the rivers are non-perennial, flowing in the eastern direction and joins the Bay of Bengal. The general drainage pattern is dendritic to sub dendritic. The drainage density varies from less than 1 to 3 km/km^2. Pulicat lake is located in the south eastern part of the district. Pulicat Lake is the second largest lagoon of India and boasts of a rich biodiversity. The lake is drained by three larger inflows (Swarnamukhi, Arani and Kalangi) and many minor inflows. It is connected with an estuary mouth with a width of 200 meters. Owing to its proximity to the sea, it has turned into a salt-water lagoon.

SRTM[44] Digital Elevation Model (DEM) having a 30 m resolution was used for detailed mapping of the watershed or catchment within which the Site is located. Based on the DEM, key topographic features in the study area such as topographic highs and lows and natural drainage network in the area. Digital Elevation Model (DEM) was developed for the Site based on USGS ASTER GDEM data set, LANDSAT, Google Earth Imagery available and the Site visit.

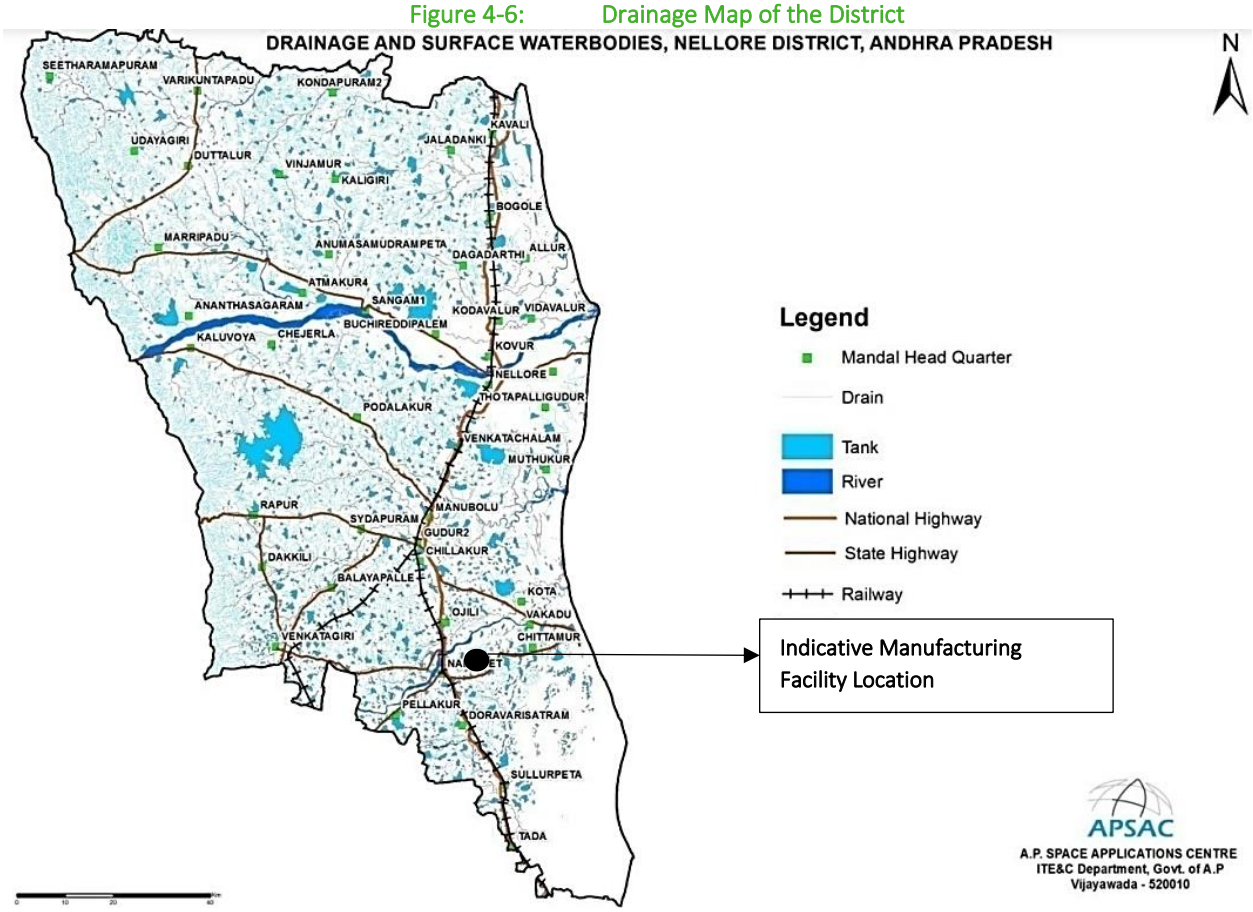
The block-wise statistics, i.e., the maximum and minimum elevation, are analyzed using the Cartosat-1 version 3 satellite imagery. The topographical and the contour map have been presented in Source: Department of Mines and Geology Government of Andhra Pradesh District Survey Report SPS Nellore District

[44] https://earthexplorer.usgs.gov/

Figure 4-7 and Figure 4-8, the elevation for the manufacturing site is ranging between -32m to 45 m above mean sea level and the site has minor slope. This representation helps to understand the spatial variation of elevation in the area.

Additionally, The Figure 4-9 represents the drainage pattern of the 5 km radius of the manufacturing facility, a drainage line from the watershed[45] is present within the manufacturing facility. As observed during site visit, a drainage channel is passing adjacent to the project boundary along with a natural pond in the north of the manufacturing site.

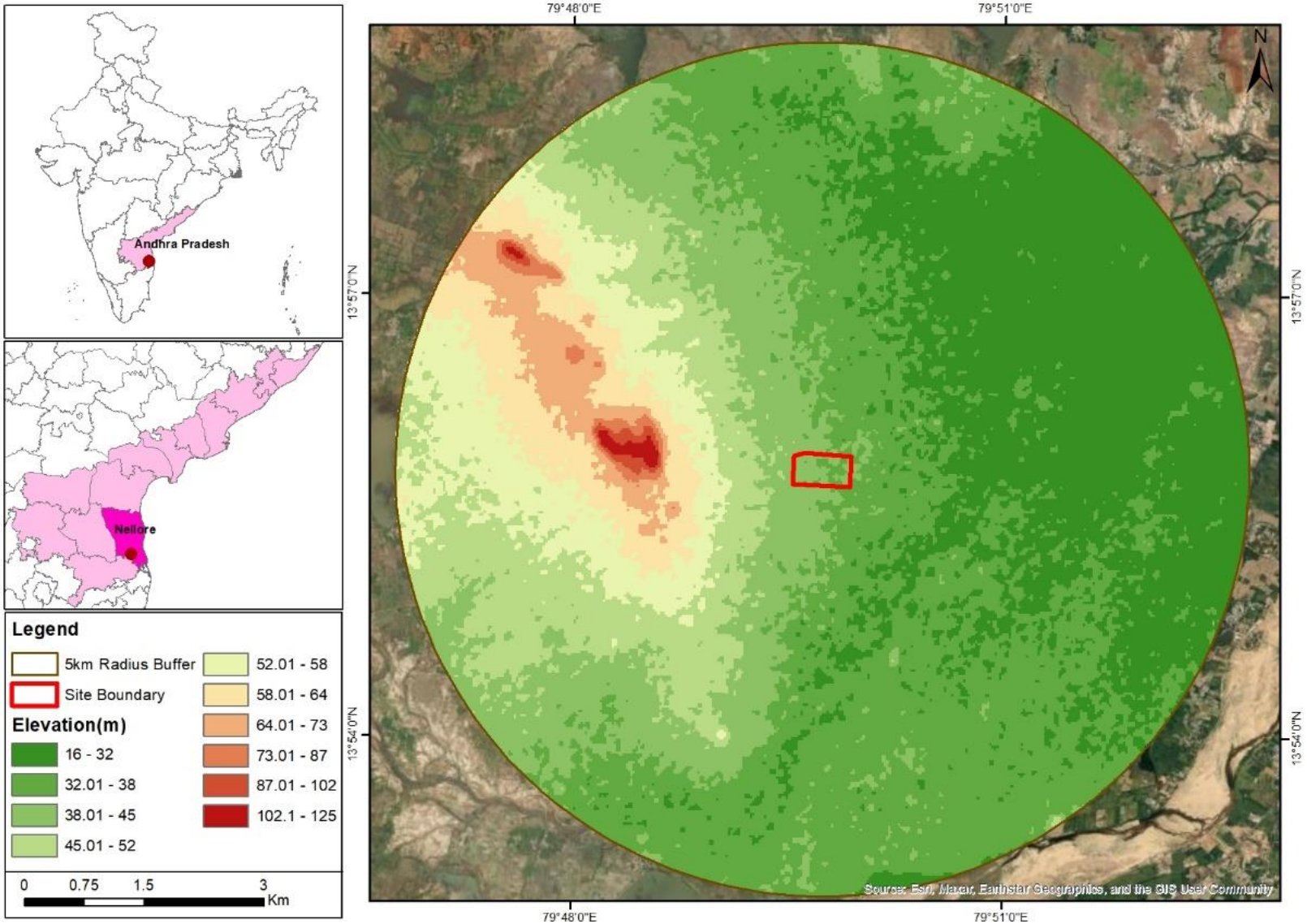
Figure 4-6: Drainage Map of the District



Source: Department of Mines and Geology Government of Andhra Pradesh District Survey Report SPS Nellore District

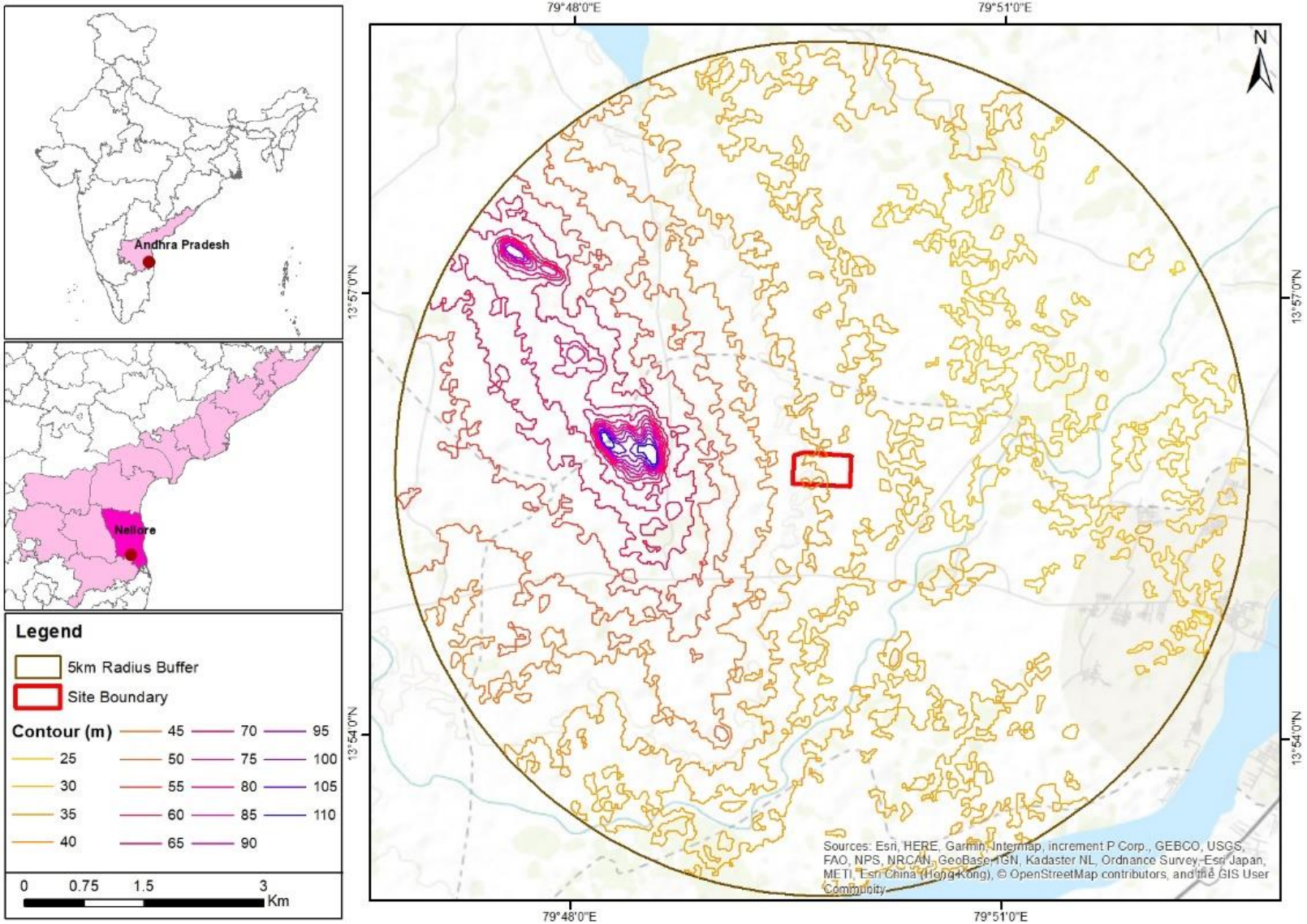
[45] A watershed is an area of land that feeds all the water running under it and draining off of it into a body of water. It combines with other watersheds to form a network of rivers and streams that progressively drain into larger water areas.Topography determines the watershed boundaries, and ridges enclosing an area and the water bodies therein determine the boundary of a watershed. Although water may be extracted from a point source, the quantity and quality of the water is contributed by the extent and characteristics of the watershed. Hence, a watershed level approach is used to develop a better understanding of the source water and various aspects of it.

Figure 4-7: Topographical Map of 5 km radius of the Manufacturing Facility



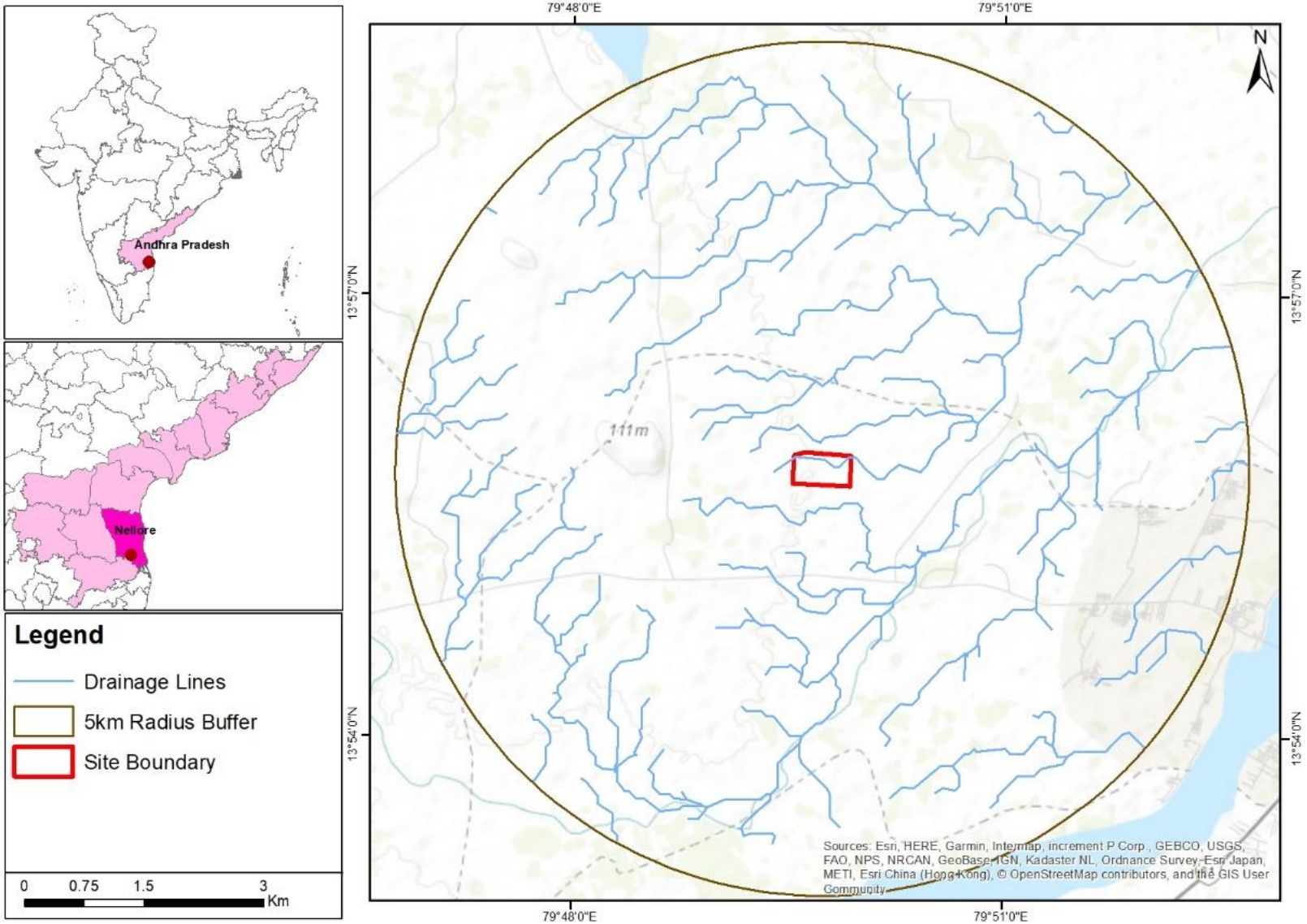
Source: ArcGIS imagery Mapping, developed by Independent E&S Advisor

Figure 4-8: Contour Map of the 5 km radius of the Manufacturing Facility



Source: ArcGIS imagery Mapping, developed by Independent E&S Advisor

Figure 4-9: Map showing Drainage Pattern 5 km radius of the Manufacturing Facility

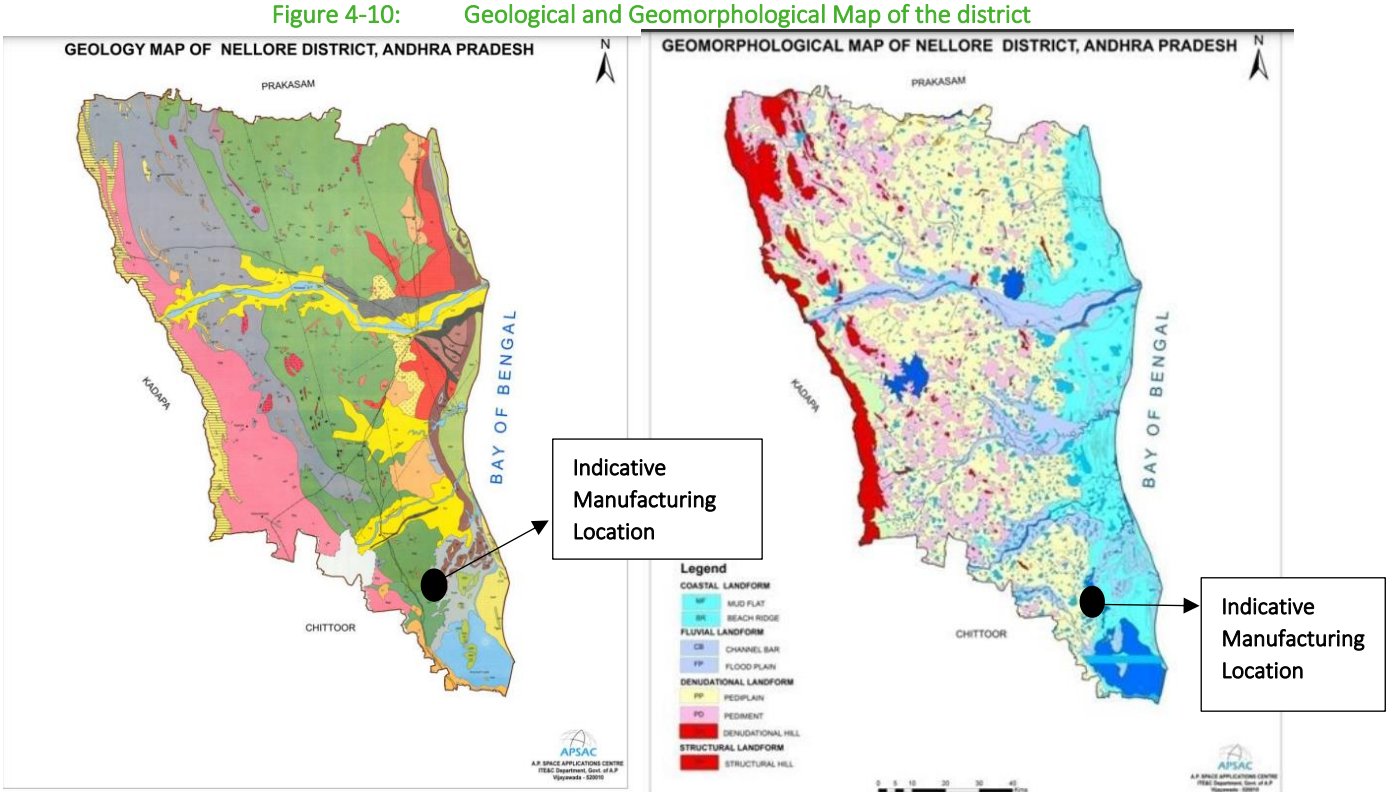


Source: ArcGIS imagery Mapping, developed by Independent E&S Advisor

4.3.5 Geology and Geomorphology

Geomorphologically the district can be broadly divided into 3 distinct units, viz., western hills, central pediplains and eastern deltaic & coastal plains. The higher relief is represented by hill ranges of Eastern Ghats, in the western border of the district. These hills are locally known as Veligonda hills, run in a northwesterly direction with a highest elevation of 1,105 m above mean sea level (amsl) at Penchalakonda. The pediplain area i.e., in the central part of the district extends in a north - south direction. The general altitude of this physiographic unit varies from 36 to 170 m amsl with isolated hillocks. The master slope of the area is from west to east towards the Bay of Bengal. The deltaic and coastal plain extends from north to south along the eastern margin of the district all along the coast. Pennar and Swarnamukhi rivers are the major contributors to the formation of the deltaic plains. The sandy coastal plain extends upto a distance of 5 to 6 km from seacoast. The southernmost fringe of the coastal plain is occupied by Pulicat lake.

Figure 4-10: Geological and Geomorphological Map of the district



Source: Department of Mines and Geology Government of Andhra Pradesh District Survey Report SPS Nellore District

4.3.6 Water Resources- Manufacturing site

4.3.6.1 Ground water

According to the groundwater information for SPS Nellore district[46] by CGWB 2013, the district comprises of variety of rocks that constitute the aquifers. The aquifer in the manufacturing facility is represented by river Alluvium. The river alluvium occurs all along the banks of major rivers and the deltaic areas formed by Pennar and Swarnamukhi rivers. The Pennar and Swarnamukhi deltas cover an area of 1470 Km^2 and 415 Km^2 respectively. The thickness of alluvium increases from west to east, it ranges from few meters to 150 m and 60 m in Pennar and Swarnamukhi delta areas respectively and is followed by sand stones. The manufacturing facility is located in the Swarnamukhi Delta, where fresh water is generally limited to a depth of 15m.

[46] Newly formed district, "Tirupati" is the project district for the integrated manufacturing facility. Tirupati District came into existence on 4th April 2022. Tirupati district comprise of 4 revenue divisions i.e., Gudur, Sullurupeta, Srikalahasti and Tirupati and 34 Tehsils (also known as "mandals" in the state of Andhra Pradesh). The revenue divisions Gudur & Sullurupeta were initially part of Nellore district and Srikalahasti & Tirupati revenue divisions were part of Chittoor District. Due to the recent formation of Tirupati district, no official government reports are found for the same. Thus, for the purpose of this report, reference for the aforementioned revenue divisions and tehsils has been taken from the official data of their previous districts There has been no change in geographical boundary for any of the tehsils that have been moved into Tirupati district, therefore the data present in the secondary domain from their original district will be considered

As per Department of Water Resources, River Development and Ganga Rejuvenation, CGWA[47] and block wise ground water resource assessment 2020[48], the mandal of Naidupeta in which manufacturing facility is located has been categorized as "Critical" in terms of groundwater development with stage of ground water as 92.36%. Also, the village in which the project area falls has been categorized as "Over-Exploited". Refer Table 3-2 on the applicability of the NOC from CGWA and its status.

Depth to water level: According to the CGWB Dynamic Ground Water Resources of India 2020, the depth to water level in the district ranges from 5 to 20 m below ground level (mbgl) and <2 to 10 mbgl during pre-monsoon and post-monsoon, respectively. The depth to water level during pre-monsoon and post-monsoon in Naidupet mandal ranges between 2 to 10 mbgl and 2 to 20 mbgl, respectively.

4.3.6.1.1 Primary Ground water quality assessment

As part of the ESIA, groundwater quality assessment was conducted to understand the groundwater quality in the study area of the manufacturing facility. Four samples of groundwater were collected within 5 km radius of the facility and the samples were analyzed against IS 10500:2012 drinking water standards adopted by Bureau of Indian Standards (BIS). The locations of primary groundwater samples have been presented in Table 4-1 and Map showing monitoring locations has been presented in Figure 4-3, the results of the assessment has been presented in ***Table 4-4.***

Figure 4-11: Groundwater sampling conducted within 5 km radius of the manufacturing facility

GW 1 Location

GW 2 Location

GW 3 Location

GW 4 Location

[47] https://cgwa-noc.gov.in/Sub/Report/AreaType/AreaType.aspx
[48] http://cgwb.gov.in/GW-Assessment/2021-08-02-GWRA-2020-BLOCKWISE%20MASTERSHEET.pdf

Table 4-4: Groundwater Quality in the study area of manufacturing facility

Sr. No.	Parameters	Unit	Groundwater Samples' Code				Desirable Limit as per 10500:2012	Permissible Limit as per 10500:2012
			GW 1	GW 2	GW 3	GW 4		
					Physical Parameters			
1.	Colour	Hazen	<5.0	<5.0	<5.0	<5.0	5	15
2.	Odour	None	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3.	pH	None	6.90	6.80	6.10	6.20	6.5-8.5	No Relaxation
4.	Turbidity	N.T.U	<1.0	<1.0	<1.0	<1.0	1	5
5.	Total Dissolved Solids	mg/l	1168	812	926	964	500	2000
					General Parameters			
6.	Aluminium (Al)	mg/l	<0.01	<0.01	<0.01	<0.01	0.03	0.2
7.	Ammonia (as total ammonia N)	mg/l	<0.1	<0.1	3.1	<0.1	0.5	0.5
8.	Anionic Detergent (as MBAS)	mg/l	<0.02	<0.02	<0.02	<0.02	0.2	1
9.	Boron(B)	mg/l	<0.5	<0.5	<0.5	<0.5	0.5	1
10.	Calcium (Ca)	mg/l	4.9	52	73	33	75	200
11.	Chloramines (as Cl2)	mg/l	<0.3	<0.3	<0.3	<0.3	4	No Relaxation
12.	Chloride	mg/l	135	182	190	107	250	1000
13.	Copper (Cu)	mg/l	<0.02	<0.02	<0.02	<0.02	0.05	1.5
14.	Fluoride as F	mg/l	2.8	0.88	0.44	0.90	1	1.5
15.	Residual Free Chlorine (RFC)	mg/l	<0.1	<0.1	<0.1	<0.1	0.2	1
16.	Iron (Fe)	mg/l	<0.05	<0.05	0.30	0.15	0.3	No Relaxation
17.	Magnesium (Mg)	mg/l	8.8	132	43	73	30	100
18.	Manganese (Mn)	mg/l	<0.02	<0.02	<0.02	<0.02	0.1	0.3
19.	Mineral Oil	mg/l	<0.01	<0.01	<0.01	<0.01	1	No Relaxation
20.	Nitrate	mg/l	<0.5	25	20	34	45	45
21.	Phenolic Compound	mg/l	<0.001	<0.001	<0.001	<0.001	0.001	0.002

Sr. No.	Parameters	Unit	Groundwater Samples' Code				Desirable Limit as per 10500:2012	Permissible Limit as per 10500:2012
			GW 1	GW 2	GW 3	GW 4		
22.	Selenium (Se)	mg/l	<0.005	<0.005	<0.005	<0.005	0.01	No Relaxation
23.	Silver (as Ag)	mg/l	<0.005	<0.005	<0.005	<0.005	0.1	No Relaxation
24.	Sulphate (as SO4)	mg/l	168	48	75	87	200	400
25.	Hydrogen Sulphide (as H2S)	mg/l	<0.01	<0.01	<0.01	<0.01	0.05	No Relaxation
26.	Total Alkalinity	mg/l	690	469	461	604	200	600
27.	Total Hardness (as CaCo3)	mg/l	49	681	363	388	200	600
28.	Zinc (Zn)	mg/l	<0.02	<0.02	<0.02	<0.02	5	15
					Toxic Substances			
29.	Cadmium (Cd)	mg/l	<0.001	<0.001	<0.001	<0.001	0.003	0.003
30.	Cyanide (CN)	mg/l	<0.02	<0.02	<0.02	<0.02	0.05	0.05
31.	Lead (Pb)	mg/l	<0.005	<0.005	<0.005	<0.005	0.01	0.01
32.	Mercury (Hg)	mg/l	<0.001	<0.001	<0.001	<0.001	0.001	0.001
33.	Molybdenum (as Mo)	mg/l	<0.05	<0.05	<0.05	<0.05	0.07	No Relaxation
34.	Nickel (as Ni)	mg/l	<0.02	<0.02	<0.02	<0.02	0.02	No Relaxation
35.	Polychlorinated biphenyls (as PCB)	mg/l	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	No Relaxation
36.	Polynuclear Aromatic Hydrocarbons (as PAH)	mg/l	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	No Relaxation
37.	Arsenic (As)	mg/l	<0.005	<0.005	<0.005	<0.005	0.01	0.05
38.	Total Chromium (Cr)	mg/l	<0.01	<0.01	<0.01	<0.01	0.05	0.05
39.	Bromoform	mg/l	<0.05	<0.05	<0.05	<0.05	0.1	No Relaxation
40.	Dibromochloromethane	mg/l	<0.05	<0.05	<0.05	<0.05	0.1	No Relaxation
41.	Bromodichloromethane	mg/l	<0.05	<0.05	<0.05	<0.05	0.06	No Relaxation
42.	Chloroform	mg/l	<0.05	<0.05	<0.05	<0.05	0.2	No Relaxation
					Pesticides Residues			
43.	Alchor	µg/l	<0.02	<0.02	<0.02	<0.02	20	20

Sr. No.	Parameters	Unit	Groundwater Samples' Code				Desirable Limit as per 10500:2012	Permissible Limit as per 10500:2012
			GW 1	GW 2	GW 3	GW 4		
44.	Atrazine	µg/l	<0.02	<0.02	<0.02	<0.02	2	2
45.	Aldrin	µg/l	<0.01	<0.01	<0.01	<0.01	0.03	0.03
46.	Dieldrin	µg/l	<0.01	<0.01	<0.01	<0.01	0.03	0.03
47.	α-HCH	µg/l	<0.01	<0.01	<0.01	<0.01	0.01	0.01
48.	β-HCH	µg/l	<0.01	<0.01	<0.01	<0.01	0.04	0.04
49.	Butachlore	µg/l	<0.02	<0.02	<0.02	<0.02	125	125
50.	Chlorpyrifos	µg/l	<0.02	<0.02	<0.02	<0.02	30	30
51.	δ-HCH	µg/l	<0.01	<0.01	<0.01	<0.01	2	2
52.	2,4 Dichlorophenoxyacetic acid	µg/l	<0.01	<0.01	<0.01	<0.01	30	30
53.	o,p DDT	µg/l	<0.01	<0.01	<0.01	<0.01	1	1
54.	p,p DDT	µg/l	<0.01	<0.01	<0.01	<0.01	1	1
55.	o,p DDE	µg/l	<0.01	<0.01	<0.01	<0.01	1	1
56.	p,p DDE	µg/l	<0.01	<0.01	<0.01	<0.01	1	1
57.	o,p DDD	µg/l	<0.01	<0.01	<0.01	<0.01	1	1
58.	p,p DDD	µg/l	<0.01	<0.01	<0.01	<0.01	1	1
59.	Endosulphan sulphate	µg/l	<0.01	<0.01	<0.01	<0.01	0.4	0.4
60.	Alpha-Endosulfan	µg/l	<0.01	<0.01	<0.01	<0.01	0.4	0.4
61.	Beta-Endosulfan	µg/l	<0.01	<0.01	<0.01	<0.01	0.4	0.4
62.	Ethion	µg/l	<0.02	<0.02	<0.02	<0.02	3	3
63.	y-HCH (Lindane)	µg/l	<0.01	<0.01	<0.01	<0.01	2	2
64.	Iso Protron	µg/l	<0.02	<0.02	<0.02	<0.02	9	9
65.	Malathion	µg/l	<0.02	<0.02	<0.02	<0.02	190	190
66.	Methyl Parathion	µg/l	<0.02	<0.02	<0.02	<0.02	0.3	0.3
67.	Monocrotphos	µg/l	<0.02	<0.02	<0.02	<0.02	1	1
68.	Phorate	µg/l	<0.02	<0.02	<0.02	<0.02	2	2

Sr. No.	Parameters	Unit	Groundwater Samples' Code				Desirable Limit as per 10500:2012	Permissible Limit as per 10500:2012
			GW 1	GW 2	GW 3	GW 4		
			Bacteriological Parameters					
69.	E. Coli	MPN/100 ml	Detected	Detected	Detected	Not Detected	Absent	Absent
70.	Total Coliform	MPN/100 ml	Detected	Detected	Detected	Not Detected	Absent	Absent

Exceeding Desirable Limit

Exceeding Permissible Limit

Analysis of Groundwater Quality Results

Based on the results presented in Table 4-4, it is observed that all the parameters (as per IS 10500:2012) for the four groundwater samples are within the desirable and permissible limit except for the following.

- Total Dissolved Solid: The TDS in the groundwater samples GW 1, GW 2, GW 3, and GW 4 are 1168 mg/l, 812 mg/l, 926 mg/l, and 964 mg/l which was observed to be exceeding the desirable limit of 500 mg/l whereas all the samples were within permissible limit of 2000- mg/l. This may be attributed to the fact that the groundwater samples were collected from an area characterized by agricultural land, therefore, mixing of soil contaminants (such as Iron, magnesium) with groundwater through leaching and increase in evaporation due to irrigation activities can lead to high TDS.
- pH: The pH value of the samples GW 3 and GW 4 was observed to be within both desirable and Permissible limit, However, the samples of GW 1 (6.90) and GW 2 (6.80) was found to be exceeding the desirable limit of 6.5-8.5.
- Ammonia: The level of ammonia in samples GW 1, GW 2, and GW 4 was observed to be within the desirable and Permissible limit of 0.5 mg/l. However, the sample GW 3 was found to be 3.1 mg/l which is exceeding the desirable as well as permissible limit of 0.5 mg/l.
- Fluoride: The concentration of fluoride in GW 1 was observed to be 2.8 mg/l which is exceeding the desirable limit of 1mg/ l and permissible limit of 1.5 mg/l whereas the water samples of GW 2, GW 3 and GW 4 was observed to be within desirable and permissible limit. The exceedance in GW-1 can be attributed to the weathering and leaching of fluoride bearing minerals from rocks and minerals deep into the ground causing high content of fluoride in groundwater. Also, the fluorotic variation in the district is due to many factors such as sources of water, the geological formation of the area, the amount of rain fall and the quantity of water lost by evaporation. The parameters e.g., pH, alkalinity, calcium, magnesium and chloride which are enhancing fluoride toxicity[49].
- Magnesium: The level of magnesium in the sample GW 3 and GW 4 was observed to be 43 and 73 mg/l respectively which exceeded the desirable limit of 30 mg/l but were well within the permissible limit of 100 mg/l, sample GW 2 (132 mg/l) was exceeding the desirable as well as the permissible limit of 100 mg/l, whereas GW-1 was well within both the standards. The exceedance of the desirable limit may be attributed to the high content of TDS in groundwater.
- Total Alkalinity: The total alkalinity in GW 2 and GW 3 was observed to be 469 mg/l and 461 mg/l respectively which exceeded the desirable limit of 200 mg/l, however, it was within permissible limit of 600 mg/l. And the water sample GW 1 and GW 4 was observed to be 690 mg/l and 604 mg/l respectively which is exceeding both the desirable and permissible limit of 200 mg/l and 600 mg/l respectively.
- Total Hardness: The total hardness in GW 3 and GW 4 was observed to be 363 mg/l and 388 mg/l which exceeded the desirable limit of 200 mg/l, however, the sample was recorded to be within permissible limit of 600 mg/l. And the water sample GW 2 was observed to be 681 mg/l which is exceeding the desirable and permissible limit. But, however the sample GW1 was observed to be within both the desirable and permissible limit. Total hardness of water is correlated to the presence of bivalent metallic ions viz. calcium and magnesium. Since the samples have higher concentration of calcium and magnesium, therefore, there is high concentration of total hardness in the sample. According to CGWB 2019-2020 report, high hardness may cause precipitation of calcium carbonate and encrustation on water supply distribution systems. Long term consumption of extremely hard water might lead to an increased incidence of urolithiasis, anencephaly, parental mortality and cardio-vascular disorders.
- E.coli and Total Coliform Bacteria: The sample was observed to be detected with total coliform bacteria and E.coli indicating disease-causing organisms (water borne pathogens) within the water.

4.3.6.2 Surface Water Quality Assessment

As part of the ESIA, surface water quality assessment was conducted by a National Accreditation Board for Testing and Calibration Laboratories (NABL) accredited lab in March 2023 to understand the surface water quality in the study area. Four sample of surface water was collected from nearby pond and river within 5 km radius of the manufacturing facility for analysis.

The locations of surface water samples have been presented in Environmental Monitoring Locations Table 4-1 and Map showing monitoring locations has been presented in Figure 4-3, the results of the assessment has been presented in ***Table 4-5***

[49] https://rasayanjournal.co.in/vol-4/issue-2/41.pdf

Figure 4-12: Surface water sampling in study area of manufacturing facility

SW 1 Location

SW 2 Location

SW 3 Location

SW 4 Location

Table 4-5: Results of Surface Water Monitoring in Study Area

S. No	Parameters	Unit	Surface Water Sample- 1	Surface Water Sample- 2	Surface Water Sample- 3	Surface Water Sample- 4	Permissible Limit as per IS 2296 Inland surface Water class C	Method
1.	Colour	Hazen	<5.0	<5.0	<5.0	<5.0	300 Max	APHA (23rd Edition) 2120B : 2017
2.	pH	None	7.40	7.40	7.20	7.40	6.5-8.5	APHA (23rd Edition) 4500-H-B : 2017
3.	Turbidity	N.T.U	1.0	<1.0	<1.0	1.0	-	APHA (23rd Edition) 2130B : 2017
4.	Total Dissolved Solids	mg/l	412	514	404	590	1500 max	APHA (23rd Edition) 2540 C : 2017_(O)
5.	Chloride	mg/l	95	170	95	127	600 Max	APHA (23rd Edition) 4500-Cl B : 2017
6.	Copper(Cu)	mg/l	<0.02	<0.02	<0.02	<0.02	1.5 Max	APHA (23rd Edition) 3120B 2017(ICP OES)
7.	Fluoride as F	mg/l	0.70	0.82	0.73	0.58	1.5 Max	APHA (23rd Edition) 4500-F C/D, 2017_(O)
8.	Iron (Fe)	mg/l	0.15	0.07	0.11	0.41	50 max	APHA (23rd Edition) 3500 Fe B, : 2017
9.	Nitrate	mg/l	8.7	<0.5	0.7	<0.5	50 Max	APHA (23rd Edition) 4500-NO3- E: 2017
10.	Phenolic Compound	mg/l	<0.001	<0.001	<0.001	<0.001	0.005	APHA (23rd Edition) 5530C : 2017
11.	Sulphate (as SO4)	mg/l	47	39	43	39	400 Max	APHA (23rd Edition) 4500-SO42- E : 2017
12.	Zinc (Zn)	mg/l	<0.02	<0.02	<0.02	<0.02	15 Max	APHA (23rd Edition) 3120B 2017
13.	Cadmium (Cd)	mg/l	<0.001	<0.001	<0.001	<0.001	0.01 Max	APHA (23rd Edition) 3120B 2017
14.	Lead (Pb)	mg/l	<0.005	<0.005	<0.005	<0.005	0.1 Max	APHA (23rd Edition) 3120 B 2017
15.	Total Coliform	/100ml	Not Detected	Not Detected	Detected	Detected	5000 max	APHA 23rd Edition 9221 B

Source: NABL Accredited Lab

Analysis of Surface Water Quality Monitoring

Based on the results presented in Table 4-5 it is observed that all the assessed parameters are within the permissible limits as per IS 2296 (Inland Surface water) for all the four surface water samples.

4.3.7 Water Availability - Supply Chain (catchment area)

4.3.7.1 Ground Water Availability

The catchment area for the project is located in 10 revenue divisions falling under 3 districts of Andhra Pradesh. Stage of ground water extraction (from 2013 to 2020), groundwater categorization (from 2013 to 2020), based on the available secondary information is presented in ***Table 4-6*** below.

As observed from ***Table 4-6***, the water categorization has improved for Tirupati Rural from Over-exploited to critical since 2013 whereas the ground water categorization has degraded for Gudur, Naidupeta and Nagari Revenue Divisions from 2013 to 2020, also allocated ground water availability for irrigation has been added based on the secondary data available[50]. The positive and negative changes (***Figure 4-13***) in the ground water categorization reflects changes in Annual Extractable Ground Water Resource, Total Current Annual Ground Water Extraction (utilization) and the percentage of utilization with respect to annual extractable resources (stage of Ground Water Extraction).

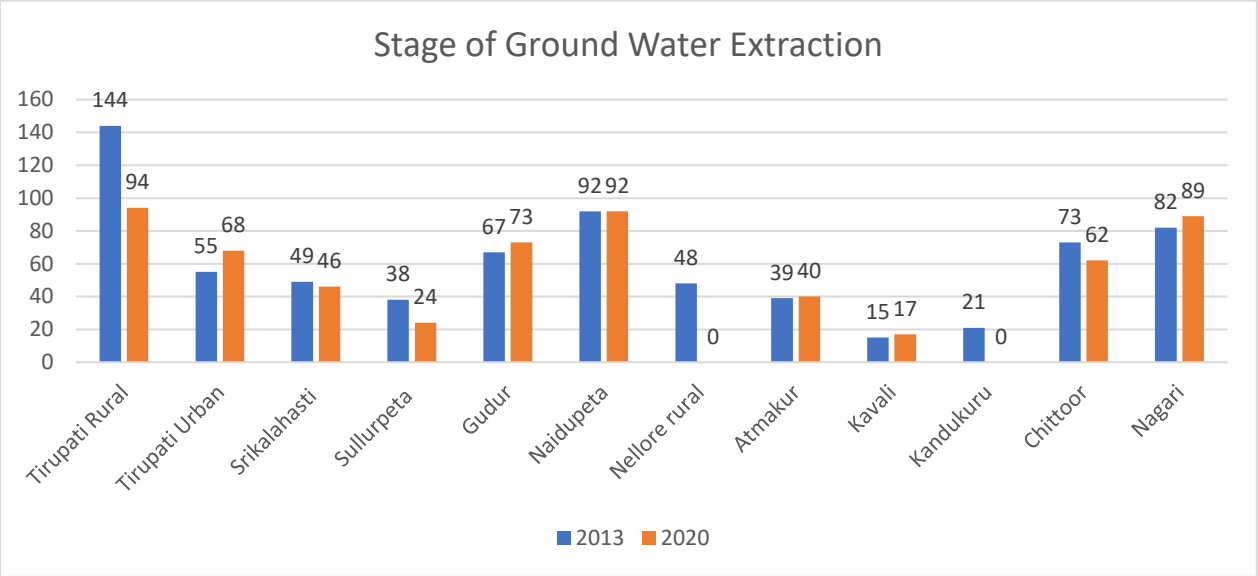
Table 4-6: Ground Resource Assessment – Catchment Area

S.No	Revenue Divisions	Stage of Groundwater Extraction (%)			Groundwater Categorization			Net Annual Ground Water Availability (ham)	Existing gross ground water draft for all uses (ham)	Provision for domestic and industrial requirement supply to (ham)	Net ground water availability for future irrigation development (ham)
		2013	2017	2020	2013	2017	2020			2020	
Tirupati District											
1.	Tirupati Rural	144	NA	94	Over-Exploited	Over-Exploited	Critical	1321	1900	412	1900
2.	Tirupati Urban	55	NA	68	Safe	Safe	Safe	2556	1408	1299	1408
3.	Srikalahasti	49	NA	46	Safe	Safe	Safe	5291	2616	608	2616
4.	Sullurpeta	38	NA	24	Safe	Safe	Safe	2993	1130	181	1130
5.	Gudur	67	NA	73	Safe	Safe	Semi-Critical	2493	1658	164	1658
6.	Naidupeta	92	83.35	92	Safe	Semi-Critical	Critical	657	3365	289	3365
SRI POTTI SRIRAMULU NELLORE (SPS NELLORE) DISTRICT											
7.	Nellore rural	48	NA	NA	Safe	Safe	Safe	9468	4565	1767	3900
8.	Atmakur	39	NA	40	Safe	Safe	Safe	4089	1602	138	2452
9.	Kavali	15	NA	17	Safe	Safe	Safe	5507	813	495	4467
10.	Kandukuru	21	NA	NA	Safe	Safe	Safe	2185	453	276	1493
Nellore District											
11.	Chittoor	73	NA	62	Semi-Critical	Semi-Critical	Safe	2405	1746	585	535
12.	Nagari	82	NA	89	Safe	Safe	Semi-Critical	435	1661	653	1008

Source: Tehsil specific CGWB Reports for 2013, 2017 and 2020

[50] The availability of ground water for future irrigation is same for the 2013, 2017 and 2020 repost as available.

Figure 4-13 Stage of Ground water Extraction



Source: Tehsil specific CGWB Reports for 2013 and 2020

4.3.7.2 Surface Water Resource

As per Andhra Pradesh Water Resources Information and Management System (APWRIMS), agriculture is the primary user of water. Other sectors for water consumption includes industries and households. Details of surface water sources, water use pattern and trend is presented in the ***Table 4-7*** below. Refer ***Section 6.7*** for details on water usage for agroforestry in teg catchment area.

Table 4-7: Surface Water Resources - Catchment Area

Revenue Division	Surface Water Sources	Water Use Patterns	Water Use Trends
District Nellore			
Nellore	Pennar River, tanks and ponds	Agriculture is the primary user of water, accounting for approximately 85% of the total water use. Other major sectors that use water include industries and households.	The demand for water has been increasing steadily over the years due to population growth, urbanization, and expansion of agriculture and industries.
Atmakur	Pennar River, Kandaleru Reservoir and ponds	Agriculture is the primary user of water, accounting for approximately 90% of the total water use. Other major sectors that use water include industries and households.	
Kavali	Pennar River, tanks and ponds	Agriculture is the primary user of water, accounting for approximately 80% of the total water use. Other major sectors that use water include industries and households.	
Kandakur	Pennar River, tanks and ponds	Agriculture is the primary user of water, accounting for approximately 85% of the total water use. Other major sectors that use water include industries and households.	
Tirupati District			
Tirupati	Swarnamukhi River, Kalyani Dam, Papagni River and ponds	Agriculture is the primary user of water, accounting for approximately 60% of the	The demand for water has been increasing steadily over the years due to population growth,

Revenue Division	Surface Water Sources	Water Use Patterns	Water Use Trends
		total water use. Other major sectors that use water include industries and households.	urbanization, and expansion of agriculture and industries.
Srikalahasti	Swarnamukhi River, Kalyani Dam, and ponds	Agriculture is the primary user of water, accounting for approximately 80% of the total water use. Other major sectors that use water include industries and households.	
Sullurpeta	Pulicat Lake, Buckingham Canal and ponds	Agriculture is the primary user of water, accounting for approximately 70% of the total water use. Other major sectors that use water include industries and households.	
Gudur	Pennar River, Pulicat Lake and ponds	Agriculture is the primary user of water, accounting for approximately 75% of the total water use. Other major sectors that use water include industries and households.	
Chittoor District			
Chittoor	Kalyani Dam, Palar River and ponds	Agriculture is the primary user of water, accounting for approximately 75% of the total water use. Other major sectors that use water include industries and households.	The demand for water has been increasing steadily over the years due to population growth, urbanization, and expansion of agriculture and industries.
Nagari	Kandaleru Reservoir, Bahuda River and ponds	Agriculture is the primary user of water, accounting for approximately 85% of the total water use. Other major sectors that use water include industries and households.	

Source: APWRIMS, Department of Water Resources, Government of Andhra Pradesh

4.3.7.3 Water Availability Assessment

Water availability at the supply chain (catchment area) of project has been evaluated using the online water risk assessment tool Aqueduct Water Risk Atlas developed by World Resource Institute (WRI)[51]. Three (03) parameters were considered to evaluate water availability which consists of parameters such as Baseline Water Stress (BWS); Water Depletion (WD), Seasonal Variability (SV. As presented in ***Table 4-8***, most of the area's lie in the High risk with extremely high water stress, low to medium interannual variability. Detailed assessment under these parameters are described in the sections below.

Table 4-8 Water Availability Assessment in Supply Chain Catchment Area

Location	Major basin	Minor basin	Water Stress	Interannual Variability	Seasonal Variability	Groundwater Table Decline	Drought Risk
Kandakur	Pennar	Mannera	Extremely High (>80%)	Low - Medium (0.25-0.50)	Low (<0.33)	Insignificant Trend	High (0.8-1.0)
Kavali	Pennar	Mannera	Extremely High (>80%)	Low - Medium (0.25-0.50)	Low (<0.33)	Insignificant Trend	High (0.8-1.0)

[51] Hofste, R., S. Kuzma, S. Walker, E.H. Sutanudjaja, et. al. 2019. "Aqueduct 3.0: Updated Decision Relevant Global Water Risk Indicators." Technical Note. Washington, DC: World Resources Institute. Available online at: https://www.wri.org/publication/aqueduct-30

Location	Major basin	Minor basin	Water Stress	Interannual Variability	Seasonal Variability	Groundwater Table Decline	Drought Risk
Nellore	Pennar	Delta	High (40-80%)	Low - Medium (0.25-0.50)	Low - Medium (0.33-0.66)	Insignificant Trend	High (0.8-1.0)
Ongolu	Pennar	North Coast	Extremely High (>80%)	Low - Medium (0.25-0.50)	Low (<0.33)	Insignificant Trend	High (0.8-1.0)
Sollurpeta	India East Coast	India East Coast	Extremely High (>80%)	Low - Medium (0.25-0.50)	Low - Medium (0.33-0.66)	Insignificant Trend	High (0.8-1.0)
Srikalahasty	India East Coast	India East Coast	Extremely High (>80%)	Low - Medium (0.25-0.50)	Low - Medium (0.33-0.66)	Insignificant Trend	High (0.8-1.0)
Tirupati	India East Coast	India East Coast	Extremely High (>80%)	Low - Medium (0.25-0.50)	Low - Medium (0.33-0.66)	Insignificant Trend	High (0.8-1.0)
Gudur	India East Coast	India East Coast	Extremely High (>80%)	Low - Medium (0.25-0.50)	Low - Medium (0.33-0.66)	Insignificant Trend	High (0.8-1.0)
Atmakur	Krishna	Peddavagu / Dindi	Extremely High (>80%)	Extremely High (>1.00)	Medium - High (0.66-1.00)	Insignificant Trend	Medium - High (0.6-0.8)
Nagari	India East Coast	India East Coast	Extremely High (>80%)	Low - Medium (0.25-0.50)	Low - Medium (0.33-0.66)	Insignificant Trend	High (0.8-1.0)
Chittor	India East Coast	Palar	Extremely High (>80%)	Medium - High (0.50-0.75)	Low - Medium (0.33-0.66)	Insignificant Trend	High (0.8-1.0)

Source: Aqueduct Water Risk Atlas developed by World Resource Institute

4.3.7.3.1 Baseline Water Stress

BWS Maps contained information for the world, and also captures baseline water stress for the manufacturing facility and supply chain. This map was developed based on BWS at the watershed- level for different regions of the world. Baseline water stress measures the ratio of total water withdrawals to available renewable surface and groundwater supplies. Water withdrawals include domestic, industrial, irrigation, and livestock consumptive and non-consumptive uses. Available renewable water supplies include the impact of upstream consumptive water users and large dams on downstream water availability. Higher values indicate more competition among users.

As per the BWS Map, the Project (manufacturing facility and supply chain) falls in the region of ***Extremely High*** risk of water stress except for Nellore and Atmakur revenue division which falls in High to Extremely High and Medium to High risk of water stress, respectively. Also as projected for 2040, the project will fall in ***Extremely High*** risk area of water stress except for Kandakur and Sullurpeta which falls in high to extremely high risk of water stress. BWS map is presented Figure 4-14 below.

4.3.7.3.2 Water Depletion

Water depletion measures the ratio of total water consumption to available renewable water supplies. Total water consumption includes domestic, industrial, irrigation, and livestock consumptive uses. Available renewable water supplies include the impact of upstream consumptive water users and large dams on downstream water availability. Higher values indicate larger impact on the local water supply and decreased water availability for downstream users. Baseline water depletion is similar to baseline water stress; however, instead of looking at total water withdrawal (consumptive plus non-consumptive), baseline water depletion is calculated using consumptive withdrawal only.

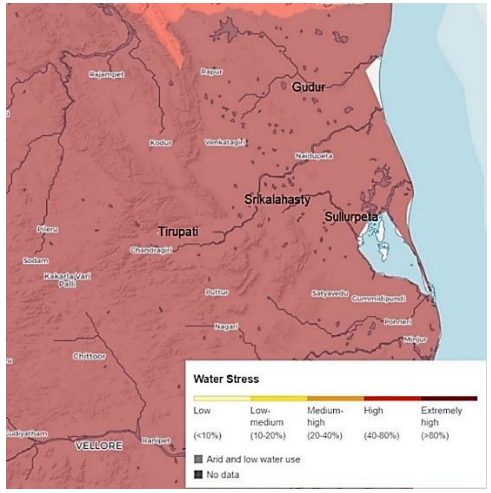
As per the Water Depletion Map, the Project (manufacturing facility and supply chain) falls in the region varying from low to medium to high risk of water depletion. WD map is presented in Figure 4-15 below.

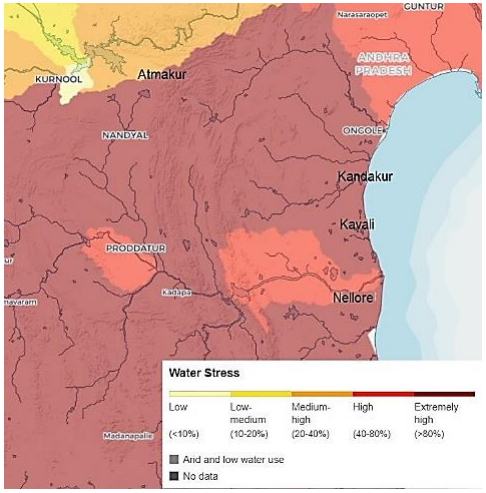
4.3.7.3.3 Seasonal Variability

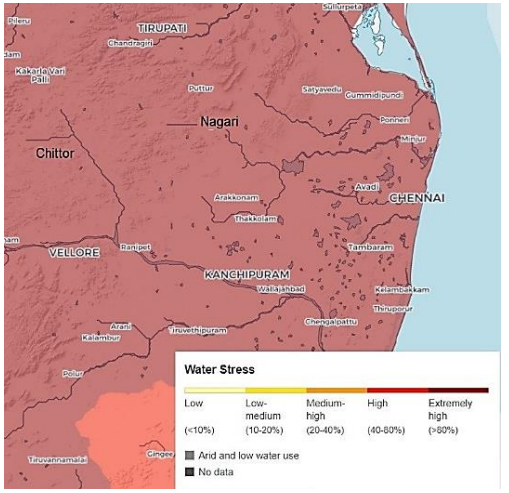
Seasonal variability measures the average within-year variability of available water supply, including both renewable surface and groundwater supplies. Higher values indicate wider variations of available supply within a year. Seasonal variability map for the Project is as presented in Figure 4-16 below. The Project site fall in the region of low to medium. Hence, the water risk from seasonal variability was estimated to be low to medium. As predicted in 2040, the area has been categorised as high to extremely high indicating shortage of water supply over the years.

Figure 4-14: Baseline Water Stress Map (Current scenario and 2040 scenario)

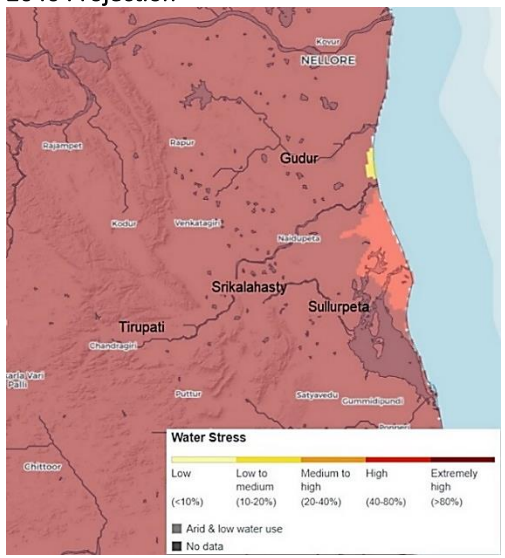
Current Scenario

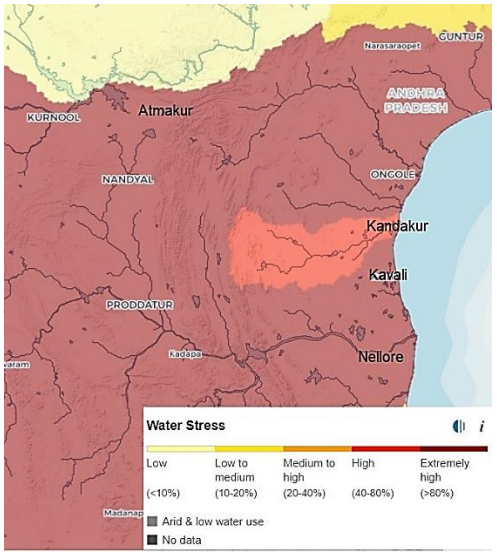






2040 Projection





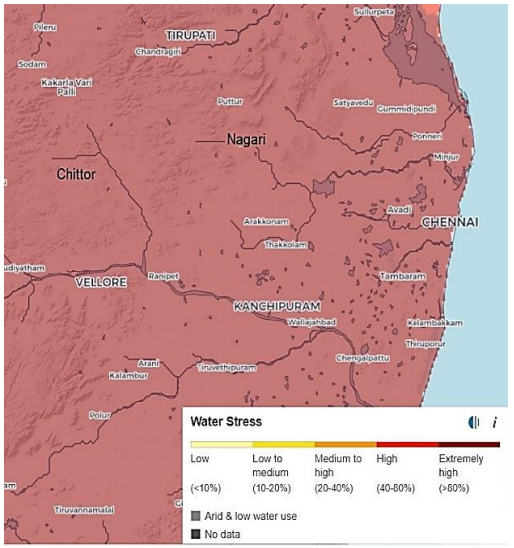


Figure 4-15: Water Depletion – Current Scenario

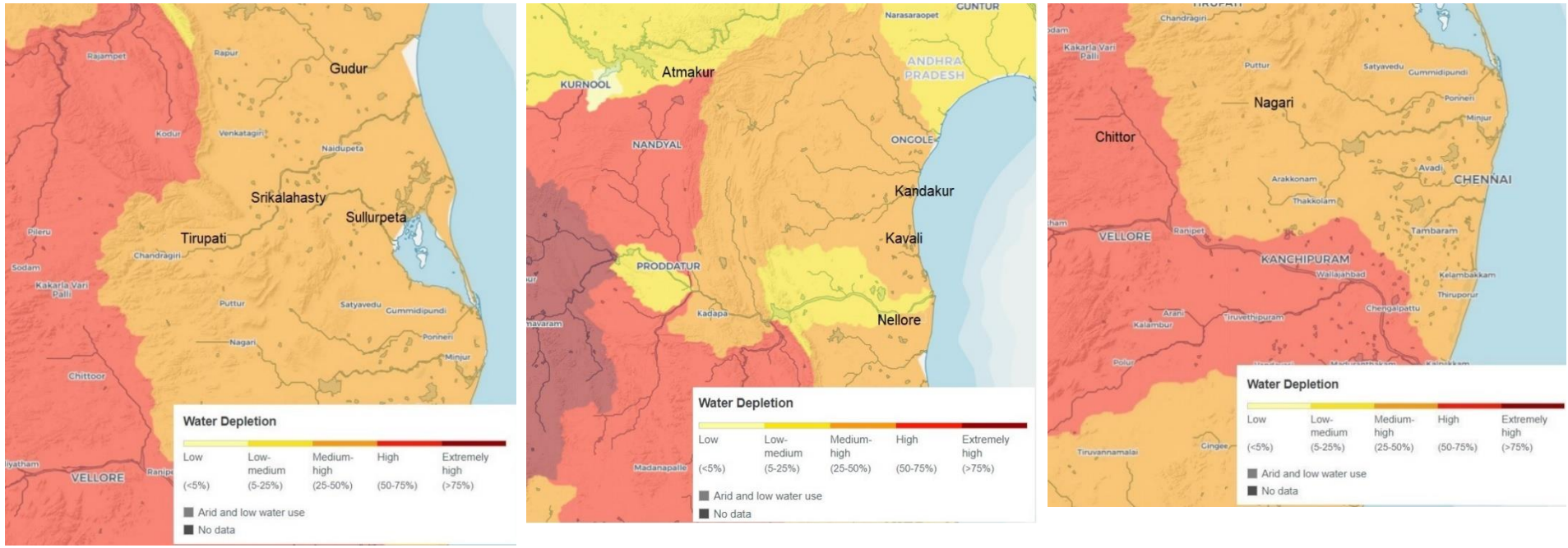
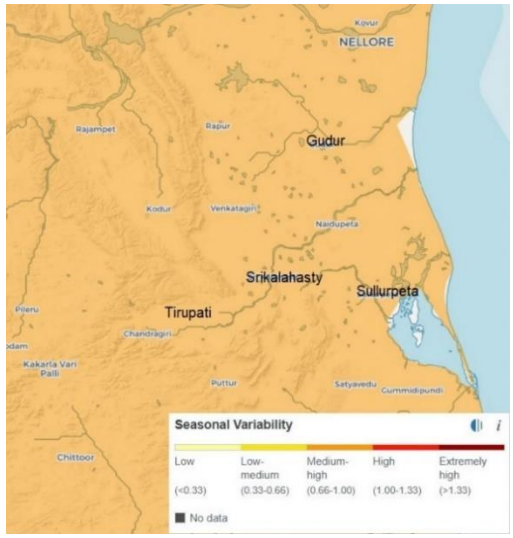
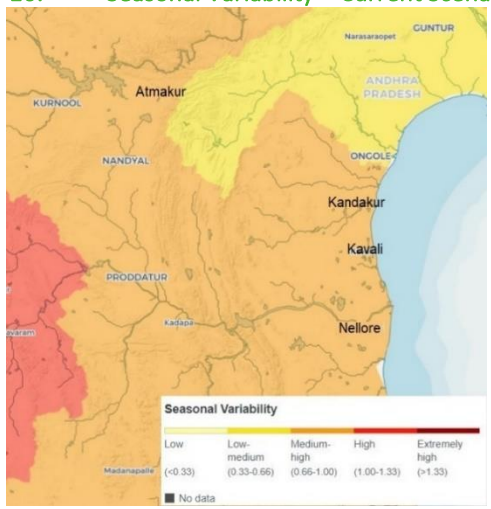
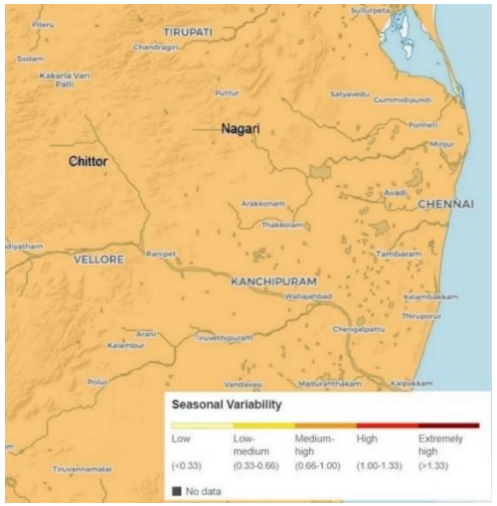


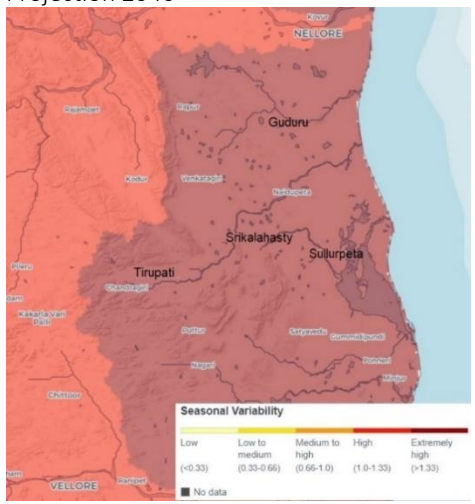
Figure 4-16: Seasonal Variability – Current Scenario and Projection 2040

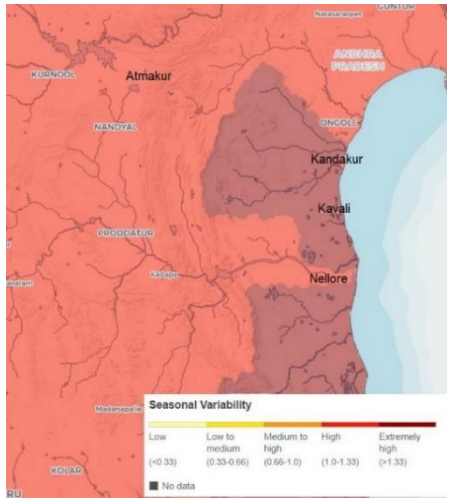


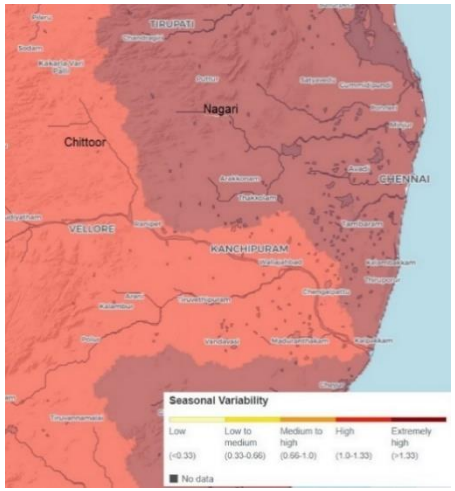




Projection 2040







4.3.7.4 Site Observation on Available Water Resource

Based on the consultations during site visit, it was understood that the dependence on water for irrigation farming and domestic use was ground water like borewell, open well and river water like Telugu Ganga Canal, Swarnamugi river, Galeru Nagari canal, Somasila canal water. Also, the groundwater quality was observed to be good for most of the villages except few villages like Tripuranthaka Puramkota, Yedlurupadu in Chittoor and Nellore district respectively. The depth of ground water was also observed to be between 60 to 400 feet which was mentioned as sufficient water level for irrigation purposes and domestic uses. Details for the information obtained during the site visit has been mentioned in Table 4-9.

Table 4-9: Details of Water Resource as per Stakeholder Consultation

S.No	District	Village	Water Availability	Water Quality	Depth of GW Level
1.	SPS Nellore	Menakuru	Groundwater (borewell)	Groundwater quality is good	Depth of ground water level is 150 feet
2.	Chittoor	Nagari	Borewell in each farmer's land	Groundwater quality is good	Depth of borewell is 150 – 300 feet
3.	Chittoor	Tripuranthaka Puramkota	Borewell and open well in agriculture field and Galeru Nagari canal water For every 2 acres, there is 1 borewell	TDS and salt content in the water level is quite high.	Depth of borewell is 50 feet.
4.	Tirupati	Sullurpeta	Telugu ganga river and Open well	-	Depth of borewell: 150 to 250 feet
5.	Tirupati	Arimenupadu	Telugu Ganga Canal, Rainfall and borewell Swarnamugi river flows25 km from the village Drip irrigation is followed in some areas and mainly flood irrigation is followed	Groundwater Quality is good	Depth of ground water level is 150 to 400 feet.
6.	Tirupati	Rachapalem	Telugu Ganga Canal, and Borewell water	Groundwater Quality is good	Depth of groundwater is 150 feet
7.	Nellore	Muttukuru	Somasila reservoir water, Groundwater	Groundwater Quality is good	Depth of Groundwater is 60 to 70 feet - borewell
8.	Nellore	Ravullakollu	Groundwater and Somasila Reservoir water and it is rainfed area	Groundwater Quality is good	Depth of Ground Water level is 150 to 200 feet
9.	Nellore	Yedlurupadu	Somasila canal water and Groundwater (very few borewells)	Salty Groundwater	Depth of groundwater is 150 feet

4.3.7.5 Water usage by Eucalyptus Plantation

The water intake by any plant species is a function of myriad natural factors woven together through complex interactions of cause and effects. Some of these factors that influence the water intake by trees, inter alia include:

- Environmental factors: The amount of rainfall, temperature, humidity, and wind speed can affect the water intake of trees. For example, trees may transpire less during periods of high humidity or low temperature. The water intake is also linked with evapotranspiration of the tree, which is again a function of season, weather, climate, terrain, sunlight etc.
- Edaphic Factors: The topography, depth of hard pan, soil resistance to roots, type of soil, its depth, structure, texture, water-holding capacity and constituents can influence the availability of water to tree roots.
- Tree Anatomy & Physiology: The water intake is not a constant rate of charge. It varies widely across species, age classes, size, cell wall anatomy, plant physiology and physiological activity of the tree can affect its water intake. For example, younger trees or trees with active growth may have higher water requirements than older, more established trees.
- Management & package of practices: Irrigation, pruning, fertilization, and other management practices can affect the water intake of trees.

Besides above, there are multiple factors due to which accurate prediction/calculation of water consumption for trees raised under a widespread plantation program is not feasible such as

- Variability: Trees are highly variable in their water use through their life cycle. This variability can depend on several factors, as listed above. Predicting water consumption accurately would require accurate knowledge of these factors and their complex interactions.
- Site-specificity: The water requirements of trees are highly dependent on the specific location, climate, and soil conditions. Therefore, water consumption projections for one location may not be applicable to another.
- Complexity: The physiological processes that govern water intake by trees are complex and involve interactions between multiple environmental and plant factors. As a result, modelling tree water consumption can be challenging and often requires simplifying assumptions that lead to wrong results.

Thus, accurately projecting the water consumption of trees can be challenging due to the many interacting factors that influence it, as well as the site-specificity and complexity of the physiological processes involved. There are several studies claiming that the Eucalyptus is not a water intensive species, while few other supports its water intensive nature. Thus, it's become the most controversial tree species among environment related scientist and socio economists due to the dilemma of its environmental effect and tree product benefits. Some of those examples have been provided below,

Mr. Francis, H. Raj, N.C.M. Rajan, K. Rajagopal and H.N. Mathur, belonging to the prestigious Forest Research Institute, Dehradun, in their article titled 'Some Hydrological Investigations on Blue Gum at Osmund (Nilgiris)' (1980):

- Eucalyptus (Blue Gum) is not a water intensive species and does not drain waterlogged areas, as indicated by plantations raised in such areas in UP
- Eucalyptus does not play any significant role in depletion of water table and the criticism is not based on scientific facts
- Study did not reveal any adverse effect of blue gum on the hydrological cycles in the Nilgiris
- Local ground water and soil moisture regime and water quality in Nilgiris have not been upset adversely due to blue gum planting

Dr. Dinesh Kumar, a well-known scientist at the Indian Agricultural Research Institute, New Delhi, in his paper titled 'Place of Eucalyptus in Indian Agroforestry Systems' in book on 'Eucalypts in India- Past, Present and Future' (1986) states that:

- Eucalyptus is a xerophytic species, i.e. plant adapted to life in a dry or physiologically dry habitat by means of mechanism to prevent water loss and as such has low rates of transpiration
- Further, in the low water availability areas, eucalyptus has ability to close up its leaves in such a way that it's evaporation transpiration process is dramatically reduced
- It may be noted that when it does not rain and the other trees turn yellow and parched, the eucalyptus stays green not because it has enormous reserves of water which is hoarded, but because it shuts off the stomas, and does not allow the water to escape through them
- In other words, eucalyptus does not lose as much water by way of transpiration as other trees

One of the most authoritative study on Eucalyptus is by J. Davidson, published by FAO (1985), titled "Setting aside the idea that Eucalyptus are always bad" stated that:

- Species of Eucalyptus planted in India, '*Eucalyptus tereticornis*' has a root depth of 3m, therefore uses rainfed soil moisture from the upper soil profile

- Most Eucalyptus root systems are more specifically adapted to using rainfed soil moisture from the upper soil profile, rather than from the groundwater table at considerable depth
- Eucalyptus plantation in study area, supports more luxuriant undergrowth and had a greater species diversity than the same in sal plantation

Report published by Mr. Vinayakrao Patil, an eminent forest scientist, titled 'Local Communities and Eucalyptus - An Experience in India' (1995) mentions:

- Co-operative agro forestry, and specially eucalyptus plantations, can be used as an effective medium to fight the battle against environmental degradation. By meeting the needs of the people for small timber and domestic energy locally, pressure on national forests will be relieved considerably
- The Report further goes on to 'dispel the myths and misconceptions about eucalyptus' and states among other things that
    a. Eucalyptus does not compete for ground water and other nutrients with crops in its vicinity
    b. Eucalyptus does not need plenty of water and does not drain away subsoil water
    c. Eucalyptus does not cause degradation of land and does not hamper soil fertility

Calder et al. (1997)[52] in their study, "Eucalyptus water use greater than rainfall input - A possible explanation from southern India" reports:

- The roots of Eucalyptus can extend to more than 7.4 m.
- The deep root system can use ground water and contribute to the decrease of water level.

Bewket and Sterk (2005)[53] also highlighted in their research that Eucalyptus cultivation and land degradation in the highlands of Ethiopia distinctly contribute to a reduction in stream flow, particularly during drier seasons, compared to various other types of land use changes.

Chanie et al. (2013)[54] additionally documented farmers' perceptions, wherein they attributed the drying up of springs in highland areas to Eucalyptus cultivation.

Lane et al. (2004)[55] and Ren et al. (2019)[56] reached the conclusion in their separate studies conducted in China, that Eucalyptus plantations would not significantly impact water resources or water security.

As per National Green Tribunal (NGT) in its order dated 20th July, 2015 in Original Application No.9 of 2014, in para31 stated that based on studies conducted in different countries, growing of eucalyptus, one of the major farm forestry species, has no adverse environmental impact nor is it disastrous for water table, as it consumes less water per Kg of total biomass generated vs many tree and agricultural crops, as presented in table below.

S.No.	Plant	Water use (Litres/Kg of total biomass)
1.	Cotton/Coffee/ Bananas	3200
2.	Pongomia	2600
3.	Sunflower	2400
4.	Field pea	2000
5.	Paddy Rice	2000
6.	Horse bean	1714
7.	Cow Pea	1667
8.	Conifers(T)	1538

[52] Calder I.R., Rosier P.T.W., Prasanna K.T. & Parameswarappa S. (1997) Eucalyptus water use greater than rainfall input - A possible explanation from southern India. *Hydrology and Earth System Sciences*, 1(2): 249-256.
[53] Bewket W. & Sterk G. (2005) Dynamics in landcover and its effect on stream flow in the Chemoga watershed, Blue Nile basin Ethiopia. *Hydrological Processes*, 19(2): 445-458.
[54] Chanie T. et al. (2013) Eco-hydrologicalimpacts of Eucalyptus in the semi humidEthiopian highlands: The Lake Tana Plain. *Journal of Hydrology and Hydromechanics*, 61(1): 21-29.
[55] Lane P.N.J., Morris J., Ningnan Z., Guangyi Z., Guoyi Z., & Daping X. (2004) Water balance of tropical eucalypt plantations in south-eastern China. *Agr. Forest Meteorol.*, 124: 253-267.
[56] Ren S., White D.A., Xiang D., Short T.M., Xiao W., Chen J., Deng Z., & Yang Z. (2019) Simple model of evapotranspiration by Eucalyptus plantations for data poor areas and tested using water balance data from a small catchment in Guangxi, China. *Aust. Forest*., 82: 66-79.

S.No.	Plant	Water use (Litres/Kg of total biomass)
9.	Dalbergia(T)	1483
10.	Soybean	1430
11.	Acacia	1323
12.	Syzygium	1017
13.	Potato	1000
14.	Sorghum	1000
15.	Albizia(T)	967
16.	**Eucalyptus (T)**	**785**
17.	Finger Millet	592

Source: National Green Tribunal (NGT) in its order dated 20th July, 2015 in Original Application No.9 of 2014, in para31

Considering the above, water consumption is calculated to be:

- Eucalyptus Wood Yields assumed at peak from Plantations for Greenlam is 300,000 Tons (300 million Kgs)
- Water Uptake by Trees grown under Plantation Program @785 Litres/Kg of Wood will be 235,500 million Litres (235.5 billion Litres)

Based on our analysis, the perception that Eucalyptus consumes more water compared to alternative crops appears deeply ingrained, although it lacks a solid scientific basis. The reputation of Eucalyptus having significantly higher water consumption might arise from the robust initial growth of Eucalyptus trees and the multitude of studies conducted on young plantation stands[57].

[57] White D.A., et al. (2022) Is the reputation of Eucalyptus plantations for using more water than Pinus plantations justified? *Hydrol. Earth Syst. Sci.*, 26: 5357–5371.

4.3.8 Soil Type

The predominant soils in the district are red loam, black cotton, lateritic sandy and alluvial soils. Red loam soils cover an area of more than 70% of the district except in the deltaic area. The black cotton soils constitute about 10% of the district and it is found in the southern part in isolated patches of Pennar river. Red lateritic soil occurs all along the eastern side of the district. The alluvial soil occurs along the Pennar and Swarnamukhi rivers, and also in the due north of the Pennar along the eastern margin of the district.

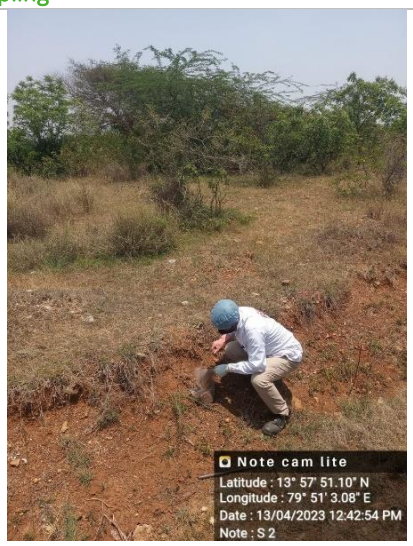
Red loam soils are suitable for *Eucalyptus* spp. for such kind of soil type, but *Leucaena leucocephala* can also grow here. ***Refer section 4.6*** for details on the type of species and plantation in the supply chain area.

4.3.8.1 Soil Quality Assessment

Soil samples were collected from the study area (5 km of the boundary of the manufacturing facility) from four (4) locations during the study period. The locations of soil samples have been presented in **Table 4-1** and Map showing monitoring locations has been presented in **Figure 4-3**, the results of the assessment has been presented in ***Table 4-10***.

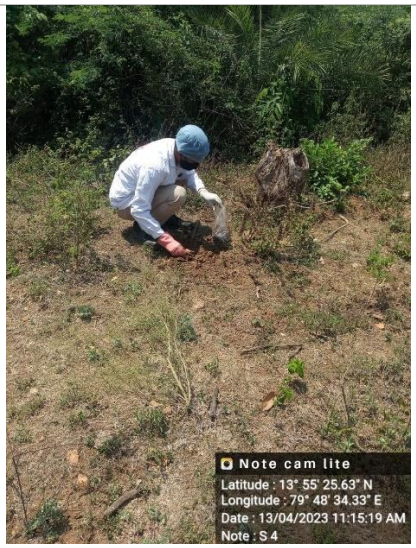
Figure 4-17: Soil Sampling

S 1 Location



S 2 Location

S 3 Location



S 4 Location

Table 4-10: Physico Chemical Properties of the Soil Samples

S.No	Parameter	Units	S1	S2	S3	S4
1.	pH value	None	8.93	8.05	8.30	6.92
2.	Chloride (as Cl)	mg/kg	80	60	40	30
3.	Sulphate (as So4)	mg/kg	<15	<15	<15	<15
4.	Bulk Density	g/cc	1.25	1.40	1.42	1.48
5.	Available Nitrogen (as N)	mg/kg	129	241	101	140
6.	Sand	%	46	51	65	87
7.	Silt	%	28	30	24	7.0
8.	Texture	None	Loam	Loam	Sandy Loam	Sand
9.	Clay	%	26	19	11	6
10.	Available Potassium (as K)	mg/kg	60	73	25	45
11.	Total Nitrogen (as N)	mg/kg	493	991	375	185
12.	Organic Matter	%	0.92	1.2	0.61	0.18
13.	Sodium Adsorption Ration (as SAR)	None	0.35	0.03	0.02	0.04
14.	Available Phosphorus (as P)	mg/kg	<3.0	<3.0	<3.0	42
15.	Cation Exchange Capacity	meq/100 gm	39	51	65	5.2
16.	Total Petroleum Hydrocarbon (as TPH)	mg/kg	<1.0	<1.0	<1.0	<1.0
17.	Electrical conductivity	micro S/cm	362	197	164	57
18.	Salinity	None	0.21	0.11	0.09	0.04
19.	Moisture	%	28	25	22	19
20.	Particle Size Distribution	%	Sand:46%Silt:28%Clay:26%	Sand:51%Silt:30%Clay:19%	Sand:65%Silt:24% Clay:11%	Sand:87%Silt:7%Clay:6%
21.	Heavy metals	None	102	49	72	21
22.	Trace Metals	mg/kg	884	566	875	114

Source: Monitoring conducted by NABL accredited lab in April 2023.

4.3.8.2 Analysis of Soil Quality Monitoring

Table 4-11: Soil Classification Standards

S.No.	Soil Test Parameters	Classification
1	pH	<4.5 Extremely acidic 4.51-5.00 Very strongly acidic 5.00-5.50 slightly acidic 5.51-6.0 moderately acidic 6.01-6.50 slightly acidic 6.51-7.30 Neutral 7.31-7.80 slightly alkaline 7.81-8.50 moderately alkaline 8.51-9.0 strongly alkaline 9.01 very strongly alkaline
2	Salinity Electrical Conductivity (mmhos/cm)	Up to 1.00 Average 1.01-2.00 harmful to germination

S.No.	Soil Test Parameters	Classification
	(1 ppm = 640 mhos/cm)	2.01-3.00 harmful to crops (sensitive to salts)
3	Organic Carbon	Up to 0.2: very less 0.21-0.4: less 0.41-0.5 medium, 0.51-0.8: on an average sufficient 0.81-1.00: sufficient >1.0 more than sufficient
4	Nitrogen (kg/ha)	Up to 50 very less 51-100 less 101-150 good 151-300 Better >300 sufficient
5	Phosphorus (kg/ha)	Up to 15 very less 16-30 less 31-50 medium, 51-65 on an average sufficient 66-80 sufficient >80 more than sufficient
6	Potash (kg/ha)	0-120 very less 120-180 less 181-240 medium 241-300 average 301-360 better >360 more than sufficient

Source: Handbook of agriculture, Indian Council of Agricultural Research, New Delhi, India

The analysis of the soil quality assessment has been provided below.

- pH: The pH value of the soil samples were found to be 8.93 (S1), 8.05 (S2), 8.30 (S3) and 6.92 (S4). As per the standard soil classification, the samples S2 and S3 are moderately alkaline in nature and Sample S1 was strongly alkaline in nature whereas the sample S4 was neutral.
- Texture: The texture of the soil samples S1 and S2 was found to be loamy in nature and sample S3 was Sandy loam and S4 sample was Sandy in nature.
- Nitrogen: Total Nitrogen in the soil samples of S1, S3 & S4 were between 185 to 991mg/kg. The nitrogen content in the soil sample 2 is more than 500 mg/kg which indicates excess quantity of nitrogen in the soil. Values of soil nitrogen supply can be classed into five descriptive categories from "Very Less" to "Sufficient". The higher the value for soil nitrogen supply the more likely it is that the microorganisms in a soil will convert more organic nitrogen into mineral nitrogen for plant uptake. In sandy soils, the best balance is achieved by a "Moderate" soil nitrogen supply (25 – 50 mg-N/kg soil). In contrast, in loam and clay soils "High" soil nitrogen supply is most suitable (50 – 75 and 75 – 125 mg-N/kg soil respectively).
- *Phosphorous:* The levels of phosphorous in soil samples is <3.0 for S1, S2 and S3mg/kg respectively, which is less than 15 and indicated a deficient soil whereas the sample S4 was 42 mg/kg which is medium deficient soil.
- Electrical Conductivity (EC): EC is used to estimate the soluble salt concentration in soil and is commonly used as a measure of salinity. The electrical conductivity of S1, S2, S3 and S4 was found to be 362 µs/cm, 197 µs/cm, 164 µs/cm and 57 µs/cm respectively, i.e. all the values are less than 1 mmhos/cm. This indicates average salinity concentration or conductivity in the soil which is good for plant generation and will not affect germination stage.
- Metals: Iron, copper and zinc are important soil micronutrients considered essential for the normal growth of plants. Deficiencies of micronutrient drastically affect plant growth and metabolism. Presence of heavy metals was observed in the soil samples as (S1) 102, (S2) 49, (S3) 72 and (S4) 21. Similarly, the trace metals were also observed to be present in the soil samples as 884 (S1), 566 (S2), 875 (S3) and 114 (S4).

4.3.9 Ambient Air Quality Assessment

Manual ambient air quality stations have been setup in various cities across India under National Ambient Air Quality Monitoring Program (NAMP). The nearest ambient air quality station setup to the manufacturing facility is Tirupati city with 4 Ambient Air Quality Monitoring stations present in south west direction at an aerial distance of ~ 55km and the second nearest ambient air quality stations are setup in Nellore with 4 Ambient Air Quality Monitoring stations present in north east direction at an aerial distance of ~ 57km. Annual Average for the pollutant concentration in ambient air at the two cities has been presented in ***Table 4-12***

Table 4-12: Annual Average for Air Quality data for 2019[58]

Area	Annual average concentration of SO_2 (µg/m³)	Annual average concentration of NO_2 (µg/m³)	Annual average concentration of PM 10 (µg/m³)	Annual average concentration of PM 2.5 (µg/m³)
Tirupati	5	15	53	27
Nellore	5	19	38	32

Of the two, only Nellore is categorized as non-attainment cities as per the National Ambient Air Quality Status. Non-attainment cities are those that have fallen short of the National Ambient Air Quality Standards (NAAQS) for over five years, i.e. the cities whose air quality did not meet the national ambient air quality standards in 2014-2018.

Ambient Air Quality monitoring was undertaken from 1st December 2020 to February 2021 at 9 locations falling within 8 km from the integrated manufacturing facility during pre-construction phase as part of the EIA report. As per the EIA report, the sampling duration for PM10, PM2.5, SO2 and NO2 was 24 hourly continuous samples and CO and O3 were sampled for 8 hours continuously thrice a day, remaining parameters were assessed for 24hours. Review of the EIA report indicates that all the monitored AAQ parameters were within the prescribed limits as per the National Ambient Air Quality Monitoring Standards.

Table 4-13: Ambient Air Quality Monitoring results as per Project EIA report

Area	Avg SO_2	Avg NO_2	Avg PM 10	Avg PM 2.5	Avg CO	Avg O_3	Ammonia (max)	Benzene (max)	B(a)P (max)	As (max)	VOC (max)	Pb (max)	Ni (max)	HBr (max)	H2S (max)	HCl (max)	HF (max)	Chlorine (max)
Plant site	13.0	13.0	46.4	24.7	201	5.8	<20.0	<1.0	<0.1	<0.001	<0.01	<0.1	<0.001	<0.002	<1	<0.001	<0.002	<145
Karaballavolu	14.0	16.2	46.5	21.4	228	7.4	<20.0	<1.0	<0.1	<0.001	<0.01	<0.1	<0.001	<0.002	<1	<0.001	<0.002	<145
Nemallapudi	13.4	13.9	36.3	21.5	193	5.6	<20.0	<1.0	<0.1	<0.001	<0.01	<0.1	<0.001	<0.002	<1	<0.001	<0.002	<145
Manavali	13.0	13.2	42.3	24.9	221	5.6	<20.0	<1.0	<0.1	<0.001	<0.01	<0.1	<0.001	<0.002	<1	<0.001	<0.002	<145
Naidupeta	14.2	16.2	50.1	24.0	219	10.1	<20.0	<1.0	<0.1	<0.001	<0.01	<0.1	<0.001	<0.002	<1	<0.001	<0.002	<145
Chavali	14.8	16.4	47.2	20.9	229	3.9	<20.0	<1.0	<0.1	<0.001	<0.01	<0.1	<0.001	<0.002	<1	<0.001	<0.002	<145
Dwarakapuram	13.0	14.4	43.3	16.0	205	4.8	<20.0	<1.0	<0.1	<0.001	<0.01	<0.1	<0.001	<0.002	<1	<0.001	<0.002	<145
Attivaram	11.6	13.5	42.7	18.8	212	4.8	<20.0	<1.0	<0.1	<0.001	<0.01	<0.1	<0.001	<0.002	<1	<0.001	<0.002	<145
Kundam	13.6	15.5	47.7	16.8	214	6.8	<20.0	<1.0	<0.1	<0.001	<0.01	<0.1	<0.001	<0.002	<1	<0.001	<0.002	<145
NAAQS Standard[59]	**80**	**80**	**100**	**60**	**2000**	**100**	**400**	**5**	**1**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**

Source: EIA Report

All the values are in µg/m3, except for B(a)P which will be ng/m3

4.3.9.1 Ambient Air Quality – Primary Monitoring

The existing Ambient Air Quality (AAQ) of the 5 km radius of the manufacturing facility was monitored at five (05) locations, twice a week for 24 hours for 4 weeks at each location from April 2023 to May 2023. The monitoring parameters included:

- PM10 (particulate matter of particle size less than 10 micrometre);
- PM2.5 (particulate matter of particle size less than 2.5 micrometre);

[58] https://cpcb.nic.in/upload/NAAQS_2019.pdf
[59] https://cpcb.nic.in/upload/NAAQS_2019.pdf

- Sulphur Dioxide (SO2);
- Nitrogen Dioxide (NOx); and
- Carbon Monoxide (CO).

The sampling and analysis of AAQ parameters was carried out as per the procedures detailed in ***Table 4-14***. The locations of samples have been presented in mentioned in Table 4-1 and Map showing monitoring locations has been presented in Figure 4-3. AAQ monitoring results are presented in Table 4-15.

Table 4-14: Details of Methods and Detection Limits for different Air Quality Parameters

Sr.No.	Parameter	Range / Detection Limit
1	Particulate Matter (size less than 10 µm or PM10	IS-5182 (Part -23):2006 & CPCB Guidelines Volume 1 (2012-2013)
2	Particulate Matter (size less than 2.5 µm or PM2.5	CPCB Guidelines Volume 1 (2012-2013)
3	Sulphur Dioxide (SO2)	IS-5182 (Part-II):2001
4	Nitrogen Oxide (NOx)	IS-5182 (Part-VI):2006
5	Carbon Monoxide (CO)	CO Analyser

Selection of Sampling Locations

Selection of AAQ monitoring locations is based on the following considerations:

- Meteorological conditions of the area based on information of IMD;
- Topography of the study area; and
- Location of sensitive receptors such as settlements

Figure 4-18: Ambient Air Quality Monitoring

AAQ 1 Location

AAQ 2 Location

AAQ 3 Location

AAQ 4 Location

AAQ 5 Location

Table 4-15: Results of Ambient Air Quality Monitoring

Parameter	Unit	Observed Concentration	AAQ1	AAQ2	AAQ3	AAQ4	AA5
PM10	µg/m³	Minimum	75.0	73.9	68.7	62.5	68.3
		Maximum	98.1	97.1	81.3	82.7	78.1
		Average	86.3	85.9	75.6	71.6	72.3
		98 Percentile	97.46	96.76	81.19	81.79	77.79
		NAAQS Standard (24 hrs)			**100.00**		
		IFC/WB Ambient Air Quality Standards (24 hrs)	• 150 (Interim target-1) • 100 (Interim target-2) • 75 (Interim target-3) • 50 (IFC EHS guideline)				
PM2.5	µg/m³	Minimum	42.3	42.3	38.2	36.8	36.3
		Maximum	54.5	52.6	47.4	44	45.9
		Average	48.7	47.7	41.8	39.8	40.6
		98 Percentile	54.14	52.39	47.09	43.93	45.58
		NAAQS Standard (24 hrs)			**60.00**		
		IFC/WB Ambient Air Quality Standards (24 hrs)	• 75 (Interim target-1) • 50 (Interim target-2) • 37.5 (Interim target-3) • 25 (IFC EHS guideline)				
SO_2	µg/m³	Minimum	8.1	7.9	7.1	6.5	6.8
		Maximum	12.1	12.3	9.4	9.8	8.3
		Average	10.0	10.0	8.4	7.9	7.6
		98 Percentile	11.99	12.15	9.37	9.59	8.26
		NAAQS Standard (24 hrs)			**80.00**		
		IFC/WB Ambient Air Quality Standards (24 hrs)	• 125 (Interim target-1) • 50 (Interim target-2) • 20 (IFC EHS guideline)				
NO_2	µg/m³	Minimum	25.4	24.8	22.7	19.5	20.4
		Maximum	34.7	36.1	25.9	24.8	24.9
		Average	29.2	29.6	24.6	23.1	23.5
		98 Percentile	34.42	35.79	26.27	24.79	25.07
		NAAQS Standard (24 hrs)			**80.00**		
		IFC/WB Ambient Air Quality Standards (24 hrs)	• 1 year: 40 (IFC EHS guideline) • 1 hour: 200 (IFC EHS guideline)				
CO	mg/m³	Minimum	0.50	0.52	0.38	0.32	0.34
		Maximum	0.72	0.82	0.58	0.56	0.52
		Average	0.59	0.60	0.51	0.46	0.44
		98 Percentile	0.71	0.80	0.58	0.56	0.52
		NAAQS Standard (8 hrs)			**2.00**		
		IFC/WB Ambient Air Quality Standards (24 hrs)			**--**		

Source: Survey conducted by NABL accredited lab in April 2023

4.3.9.2 Analysis of Ambient Air Quality Monitoring

As per the above results, all the parameters were found to be within NAAQS CPCB limit. The values for monitoring results were within IFC EHS guideline values for SO2, CO and NO2, However, the values for PM10 and PM2.5 were exceeding the Interim target 3 and EHS guidelines. Considering the exceedance in the IFC values, the air shed can be considered as degraded for PM10 and PM2.5.

4.3.10 Noise Quality Assessment

4.3.10.1 Ambient Noise Quality

Noise Level was recorded at five (05) locations once during the monitoring season. Noise levels were recorded with the help of a digital noise level meter for 48 hours and the noise quality is reported as Leq day during daytime and Leq night during night-time for each of the locations. Daytime is considered from 0600 to 2200 hours and night from 2200 to 0600 hours. The locations of ambient noise samples have been presented in Table 4-1 and Map showing monitoring locations has been presented in ***Figure 4-3*** Figure 4-3., the results of the assessment has been presented in ***Table 4-16.*** Table 4-16

Figure 4-19: Noise Level Monitoring

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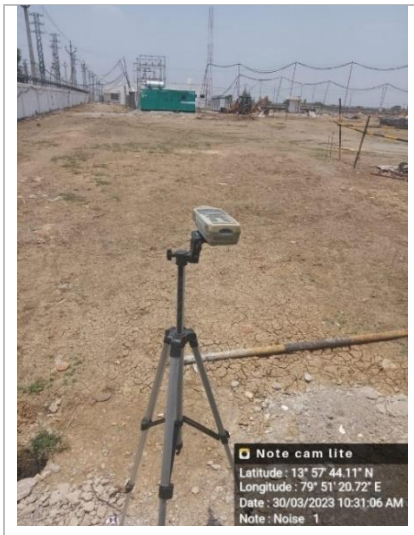
<tr><td> 
</td><td> 
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<tr><td>N 1 Location</td><td>N 2 Location</td><td>N 3 Location</td></tr>
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<tr><td>N 4 Location</td><td colspan="2">N 5 Location</td></tr>
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Table 4-16: Results of Ambient Noise Quality Monitoring

S.No.	Sampling ID	Average dB(a)	Day			Night		
			L max	L min	Average[60] dB(a)	L max	L min	Average[61] dB(a)
1.	N1	38.6	46.55	37.5	41.9	39.6	35.75	35.6
2.	N2	37	42.7	34.45	39.4	40.95	33.65	34.1
3.	N3	41.5	51.5	41.1	46	46.1	31.75	40.05
4.	N4	39.4	47.75	39.45	42.95	39.15	31.85	34.85
5.	N5	41.1	50.75	40.3	46	45.3	34.35	40.05
Industrial Area Leq dB(A) Limit As per CPCB (Environment Protection Rules, 1986)			-	-	**75**	-	-	**70**
Residential Area Leq dB(A) Limit As per CPCB (Environment Protection Rules, 1986)			-	-	**55**	-	-	**45**
Limit as per EHS guidelines of IFC, residential, institutional and educational area (Leq hourly)			-	-	**55**	-	-	**45**
Limit as per EHS guidelines of IFC, Industrial, commercial			-	-	**75**	-	-	**70**

Source: Monitoring conducted by NABL accredited lab in March and April 2023.

4.3.10.2 Analysis of Noise Quality Monitoring

It is observed that, as per the above results, the Leq Day and Leq Night of all the samples were found to be within the CPCB limits for industrial as well as residential area as well as IFC EHS guidelines.

4.3.11 Traffic Density

The traffic characteristics were monitored at the access road to the manufacturing facility in the month of April 2023. The locations of traffic sampling have been presented in **Table 4-1** and Map showing monitoring locations has been presented in **Figure 4-3.**, the results of the assessment has been presented in ***Table 4-17***

Figure 4-20: Traffic Level Monitoring

T 1 Up Location

T 1 Down Location

[60] Hourly values for 32 hours were considered for day time (Hourly values for 48 hours were monitored, including day and night)
[61] Hourly values for 16 hours were considered for day time (Hourly values for 48 hours were monitored, including day and night)

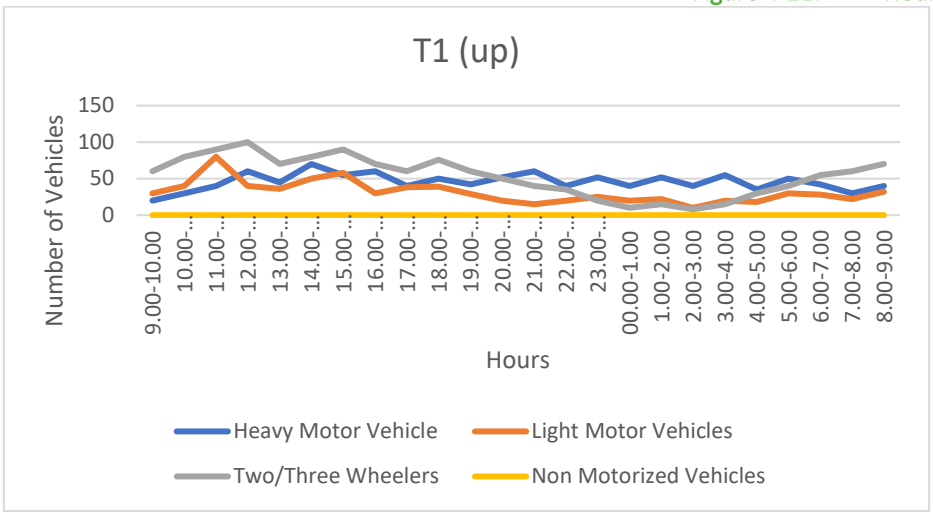
	
T 2 Up Location	T 2 Down Location

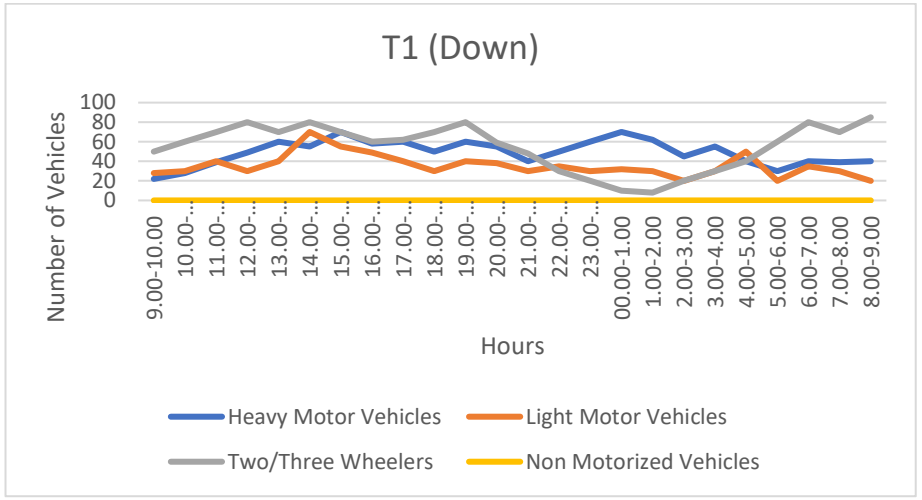
Table 4-17: Existing Traffic Volume Count

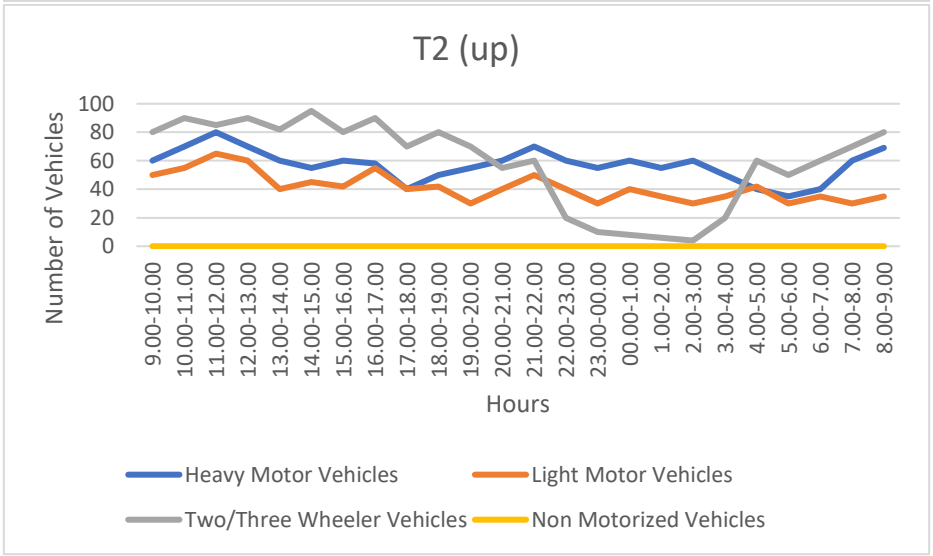
S.No.	Motorised Vehicles		Non-Motorised Vehicles		Total Vehicles
	Heavy Motor Vehicles (Truck, Bus, Dumper, Tanker, Trailer)	Light Motor Vehicles (Car, Jeep, Van, Metador, Tractor, Tempo)	Two/Three Wheelers (Scooter, M. Cycle, Auto, Moped)	Bicycle, Tricycle	
T1 (Up and Down)					
1.	1008	752	1284	Nil	3044
2.	1177	852	1759	Nil	3788
T2 (Up and Down)					
3.	1372	996	1415	Nil	3783
4.	1222	897	1366	Nil	3485

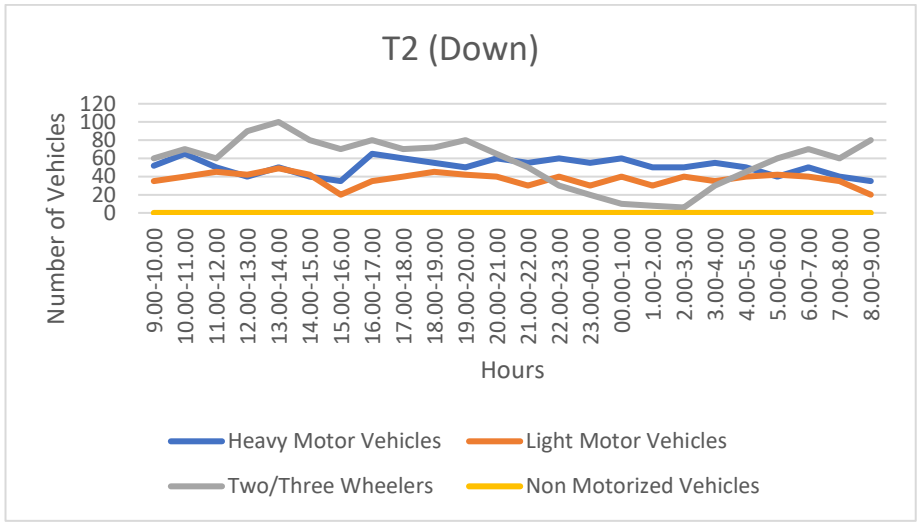
Source: Monitoring conducted by NABL accredited lab in April 2023.

Figure 4-21: Hourly Road Traffic Scenario









4.3.11.1 Analysis

Based on the traffic survey data presented in ***Table 4-17*** and Hourly Road Traffic Scenario presented in ***Figure 4-21,*** it is observed that T2 Menakuru road is busier than T1 Ayyapa Reedy, Palam with daily traffic accounting for 7268 vehicles. The hourly traffic scenario depicted that the majority of traffic in the two roads is due to movement of motorized Two/Three Wheelers (Scooter, M. Cycle, Auto, Moped) travelling up and down the roads followed by heavy Motor Vehicles comprising of Truck, Bus, Dumper, Tanker, Trailer for T1 and for T2. Two wheelers constitute maximum percentage on both the roads and in total as well which constitutes approximately 44% and 38% vehicles for T1 and T2 respectively. Number of heavy vehicles is the least on both the roads, which constitute of only 32% and 36% for T1 and T2 respectively.

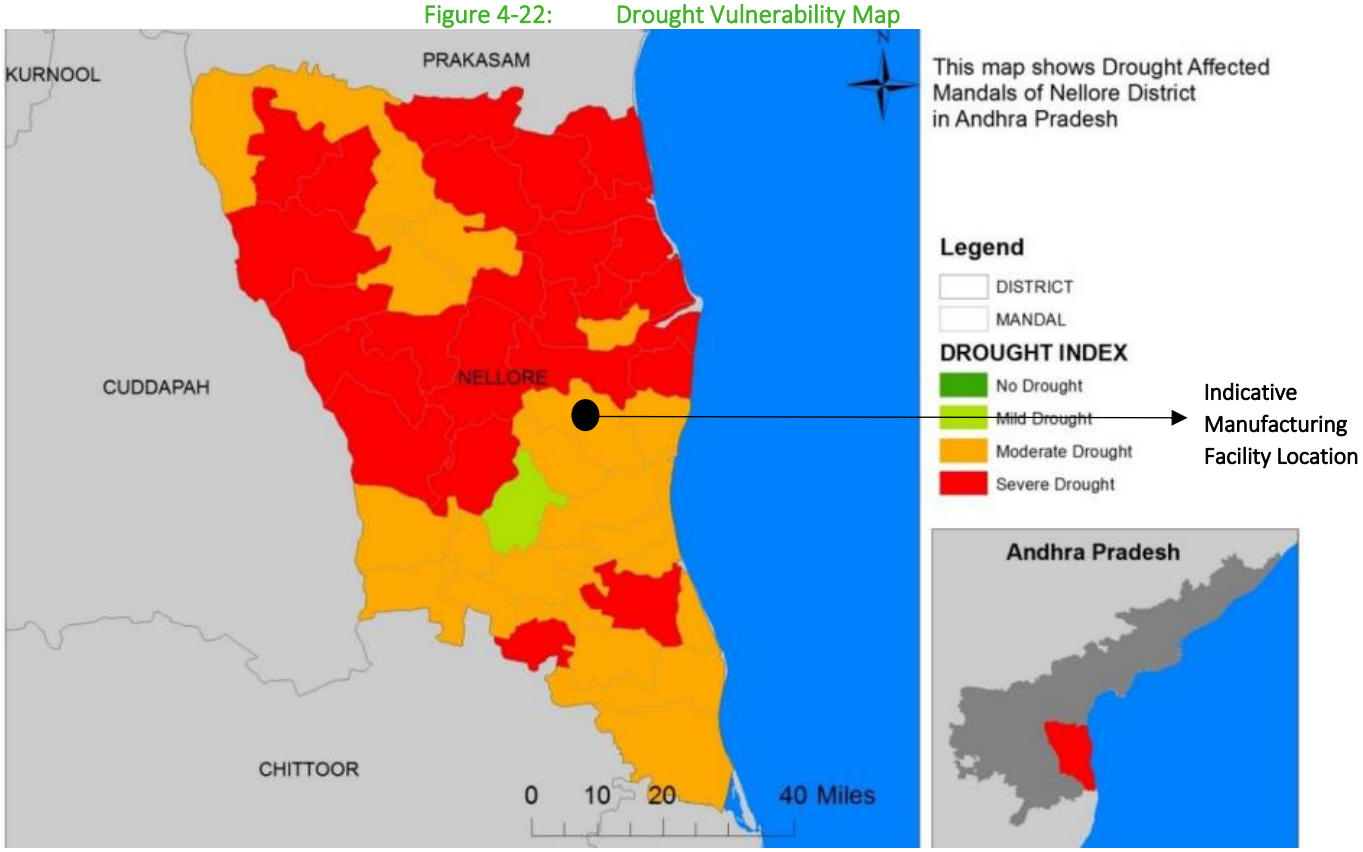
4.3.12 Natural Hazards

The Building Materials & Technology Promotion Council (BMTPC), Government of India, has published hazard maps of Andhra Pradesh. According to the District Disaster Management Plan; drought, floods, wind and earthquake are the main natural hazards that can cause damage to life and property in the district.

- Drought: As per the District Disaster Management Plan[62], Nellore is prone to droughts. As per the "Memorandum on Drought in AP 2014", out of 46 blocks of the district, 21 blocks experienced moderate drought and 25 blocks experienced severe drought. Naidupeta (manufacturing facility location) falls under "moderate droughts" as presented in Figure 4-22.
- Winds: As per the Wind and Cyclone Hazard Map of India, the integrated manufacturing facility is located in an area that falls under Very High Damage Risk Zone – B (Vb = 50m/s) as presented in ***Figure 4-23***.
- Cyclone: As per District Disaster Management Plan[63],the integrated manufacturing facility is located in an area that experiences high wind velocities Vb= 50 m/s and the zone is classified as very high damage risk zone-B for cyclones, presented in ***Figure 4-24***. The facility is located in a Naidupet mandal situated in a coastal district of Nellore (currently in Tirupati district) in Andhra Pradesh which is frequently subjected to cyclones and storm surge.
- Floods: The manufacturing facility falls in an area which is prone to flooding incidents. According to the Vulnerability Atlas of India (3rd version, 2019)[64] for Andhra Pradesh, the mandal in which manufacturing facility is located has a probable maximum surge height of 4.5m as presented in ***Figure 4-25.***
- Earthquake: According to the Hazard Map of India, integrated manufacturing facility is located in an area that falls under Zone III which is categorized as Moderate Risk Zone as presented in ***Figure 4-26.***

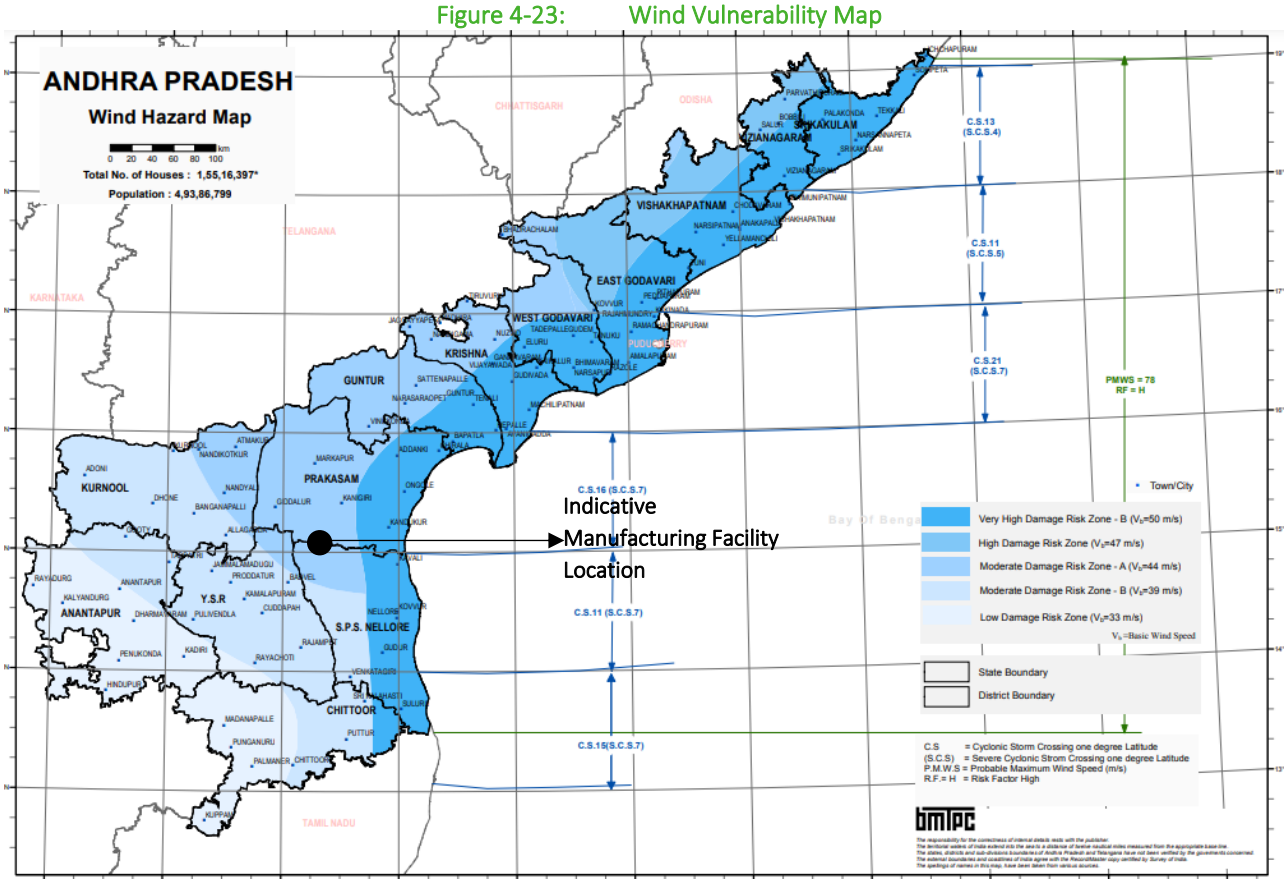
[62] https://apsdma.ap.gov.in/dmplans_files/district_dmplans/Nellore-DDMP-Volume%20I%20Genral%20Plan%20and%20HVCA%20Report.pdf
[63] https://apsdma.ap.gov.in/dmplans_files/district_dmplans/Nellore-DDMP-Volume%20I%20Genral%20Plan%20and%20HVCA%20Report.pdf
[64] https://vai.bmtpc.org/AP.html

Figure 4-22: Drought Vulnerability Map



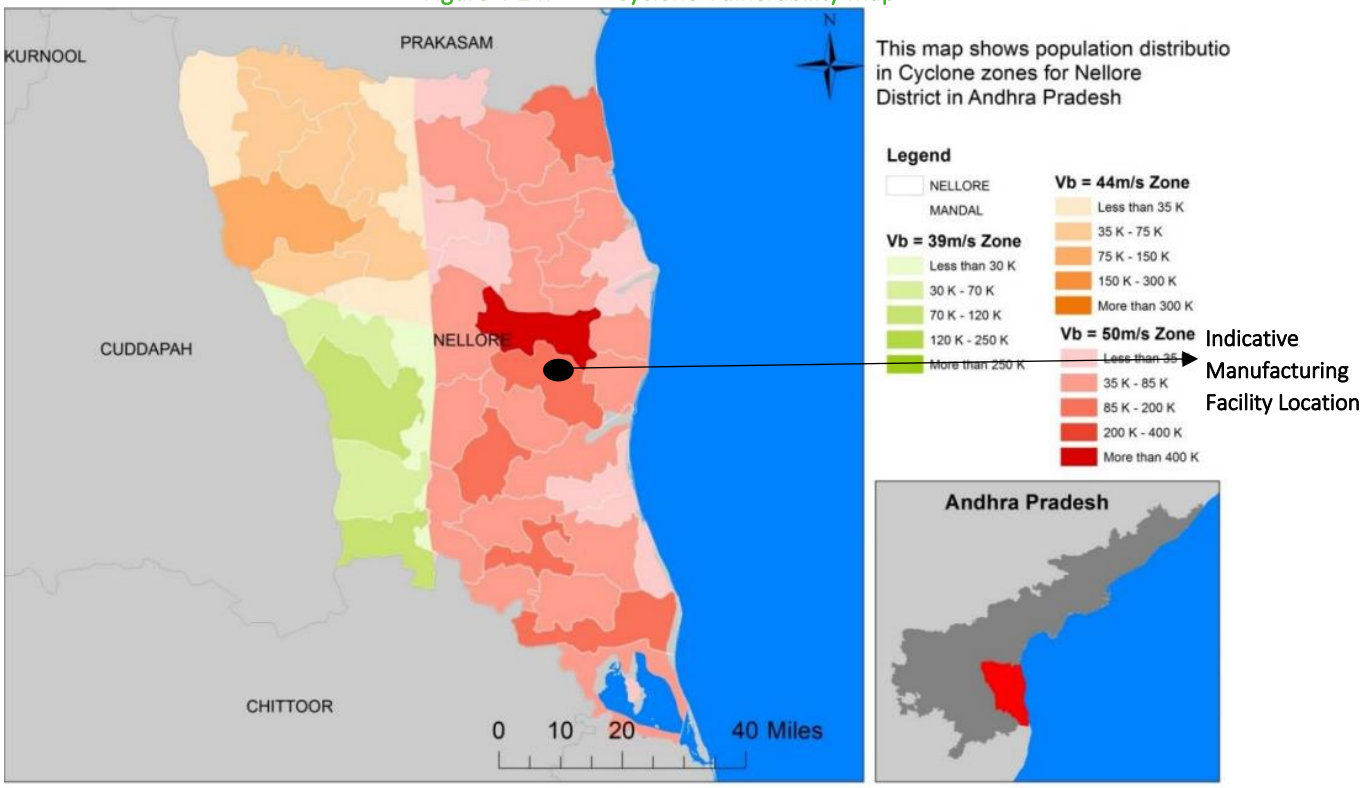
Source: District Disaster Management Plan of Nellore District

Figure 4-23: Wind Vulnerability Map



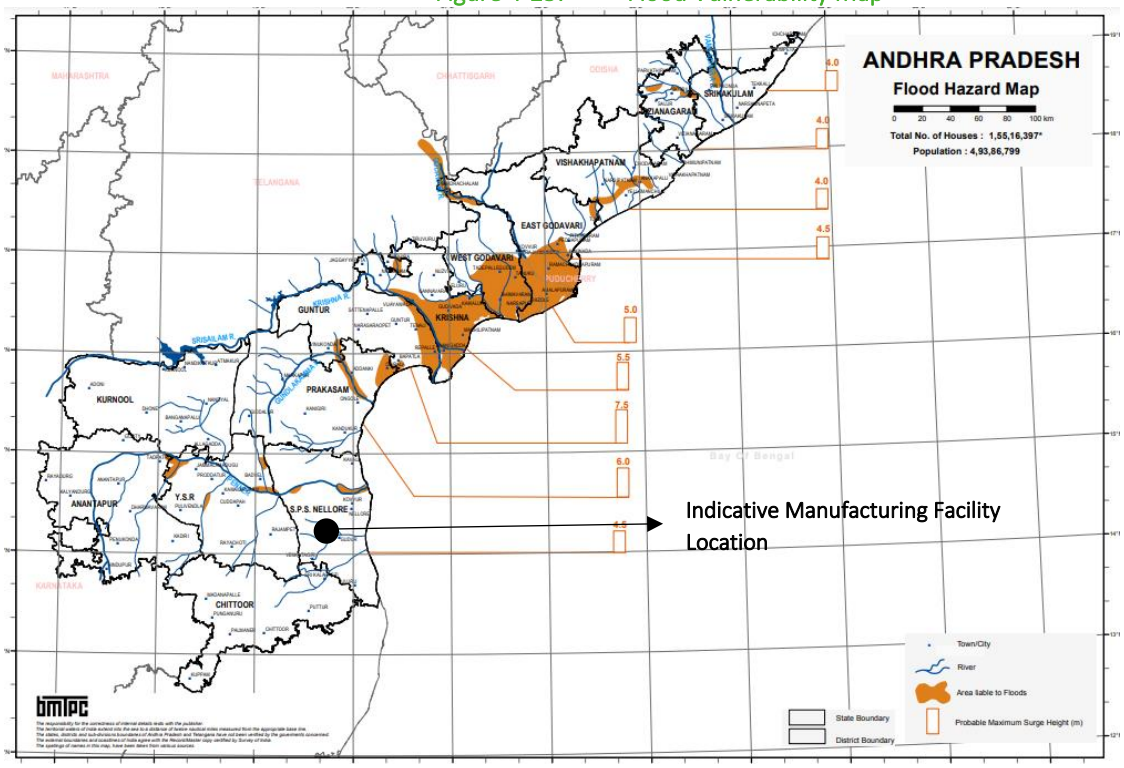
Source: The Building Materials & Technology Promotion Council (BMTPC)

Figure 4-24: Cyclone Vulnerability Map



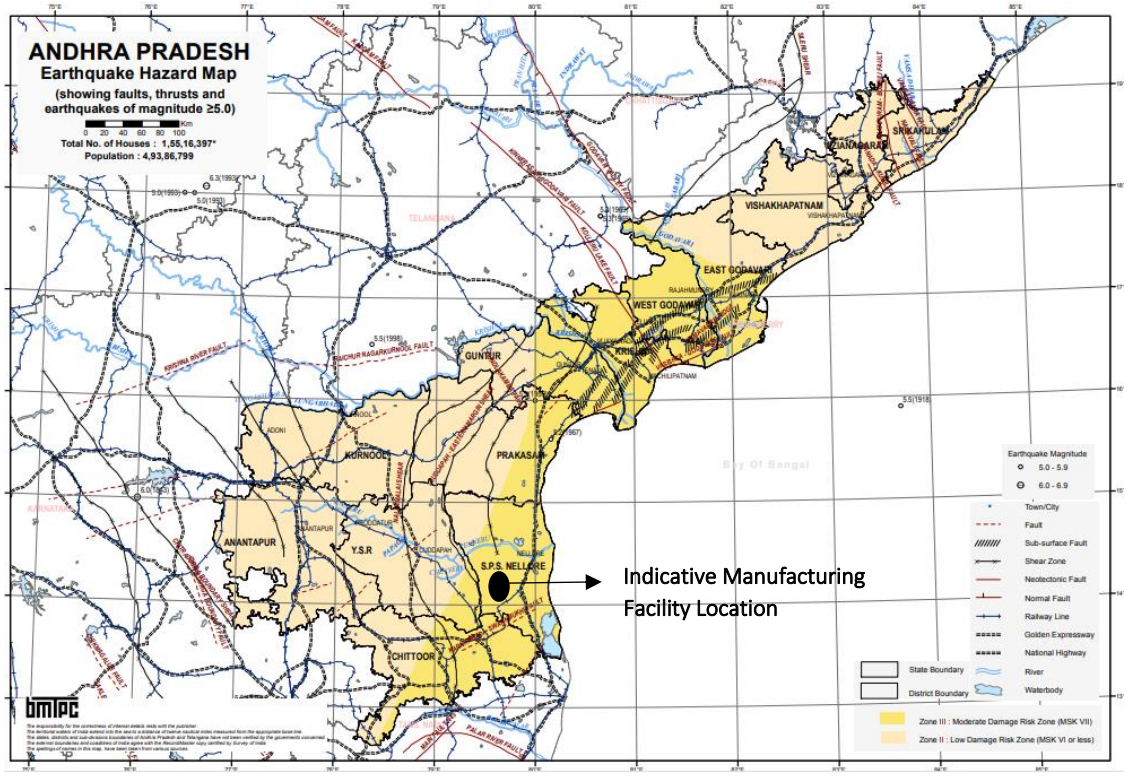
Source: District Disaster Management Plan of Nellore District

Figure 4-25: Flood Vulnerability Map



Source: The Building Materials & Technology Promotion Council (BMTPC)

Figure 4-26: Earthquake Vulnerability Map



Source: The Building Materials & Technology Promotion Council (BMTPC)

4.4 Socio-economic Baseline

4.4.1 Approach

For the purpose of establishing the social baseline for the project and undertaking the social impact assessment of the project, a participatory approach has been adopted. Through this approach an attempt was made to integrate the local understanding and perspective into the impact assessment process and identification of the mitigation measures. The purpose of such an approach was to allow for:

- The triangulation of the information available from secondary sources through the information made available by the local community, both qualitative and quantitative
- Formulation of the socio-economic baseline on the basis of a combination of primary and secondary qualitative and quantitative data
- An understanding to be developed of the local community's perception of the project and its activities and the possible impacts from the same and the desirable mitigation measures

4.4.2 Study Area

The social baseline for the integrated manufacturing facility was prepared by considering 5 Km radius from the boundary. Based on the project impacts the study area was divided into core and buffer zones respectively. The area falling under 2 KM distance range from the facility was considered as core zone while area coming under additional 3 Km from core area was considered as buffer. Further In order to understand the socio-economic profile of the communities /stakeholder involved in wood plantation business (supply chain) the data from four districts that is Tirupati, Nellore, Prakasham[65] and Chittoor was collected and analyzed. Primary data was collected from the 11 selected sample villages and secondary data

[65] Due to the formation of Tirupati districts (4th April 2022) the Mandals of then Nellore and Paraksham also districts were reorganized. Therefore Mandals namely Kandukuru Lingasamudram Gudluru Ulavapadu and Voletivaripalem was earlier part of prakasham district were now included in Nellore Districts. As the census 2011 data includes the information of these mandals under prakasham district therefore for the social baseline district prakasham is considered.

was for all the 87 mandals respectively. The detailed social baseline was generated using both primary and secondary data sources.[66]

4.4.3 Primary data/information collection/site consultations

As part of the baseline data collection process, consultations were undertaken with the local stakeholders identified for the Project the ***Table 4-18*** provides a list of consultation undertaken as part of the site visit.

Table 4-18: List of Stakeholder Consulted

Sr. No.	Stakeholder Details	Objective of the consultation	Remarks
1	Discussion with the Project management team	Key Discussion points: • Status of the project plant construction • Project overview and team organization structure • Timeline of the project • Key issues (if any) faced during the land procurement • General perception of the local community about the project • Stakeholder engagement/ Grievance management	At this planning phase of the project, the project team has identified following key stakeholders for the Project: • Farmers and Tree growers • Wood Aggregator • Wood Transporter • Plantation worker • Nursery Owners • Nearby local community • Project affected persons
2	Consultation with Community • Project location's adjacent community including SEZ in the area • Sample community in catchment area includes 1st mile transport route from village to collection centre.	Consultation on: • Socio economic status of the village • Major occupation in the villages • Demographic Profile • Social stratification • Land use pattern • Literacy profile • Livelihood profile • Social and physical infrastructure • Social Issues • Feedback related to the proposed project	

Source: Site Visit – March 2023

As part of these consultation an attempt has been made to develop an understanding of the stakeholder groups' key concerns and expectations from the Project, the stakeholder groups' perception of the project and to triangulate the secondary information available on the area.

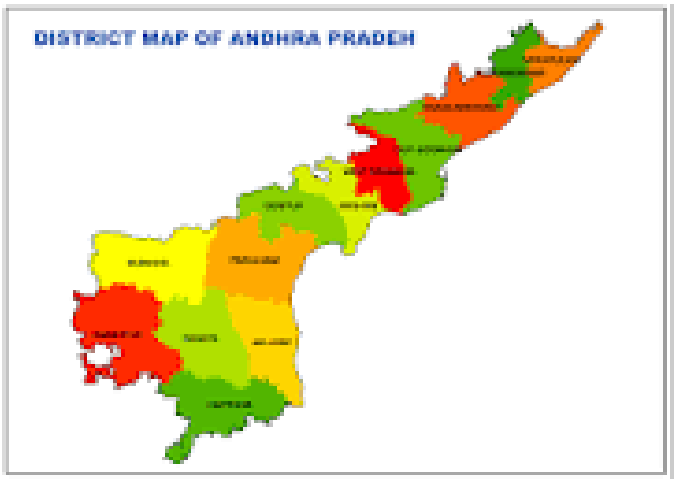
4.4.3.1 Review of Secondary Information

For establishing the social baseline for the study area, a review of the secondary information available in the public domain was undertaken. The list of secondary sources of information used is as follows:

- District Statistical Handbook
- Primary Census Abstract Data of India, 2011
- Village Directory Census Data of India, 2011

[66] As per the Greenlam's wood procurement strategy the wood both for raw material and fuel will be procured form the 87 mandal falling within district Tirupati, Nellore and Chittor respectively.

The proposed project falls under Andhra Pradesh state. The snapshots of the project affected state and districts are given in the subsequent sections below

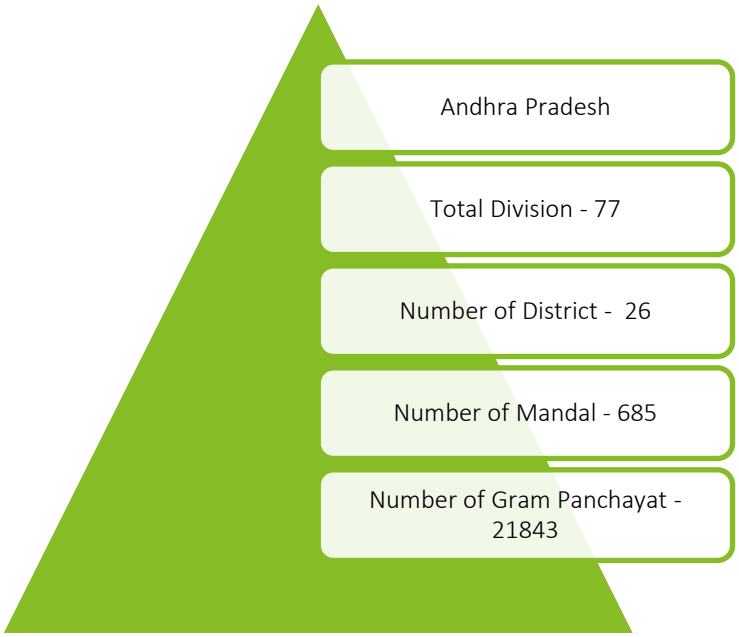


4.4.3.2 State Profile: Andhra Pradesh

Andhra Pradesh covers an area of 1,60,205[67] square kilometers (61,855.49 sq. mile) or 4.87 per cent of the total geographical area of India. Andhra Pradesh is bordered by Telangana to the north-west, Chhattisgarh to the north, Odisha to the north-east, Tamil Nadu to the south, Karnataka to the west and the Bay of Bengal to the east. It has the second longest coastline in India after Gujarat.

As per the review of available secondary sources state government data, the state of Andhra Pradesh has 26 district, 77 Revenue Division, 685 Mandal and 21843 Panchayats.

Figure 4-27: Administrative Structure of Andhra Pradesh



Source: Wikipedia and Govt. of AP website

The state comprises of a population of 8,45,80,777 individuals, which is pre-dominantly living in rural area, forming 66.63% of the state's total population. The sex ratio in the state is 993, which is significantly higher than that of India which stands at 943 females per 1000 males.

The literacy rate of Andhra Pradesh is nearly 67.02 per cent which is lower than that of the country, at 74.04 per cent. The male literacy rate is relatively higher in the state, at 74.88 per cent and female literacy rate is 59.15 per cent are also lower than the national literacy rate of 82.14 % and 65.46%, respectively.

Table 4-19: Demographic Profile of Andhra Pradesh

Attributes	Number	% of India
Area (sq. km)	1,60,205	4.87
Total population	8,45,80,777	6.98
Males	42,442,146	6.80
Females	42,138,631	7.17

[67] https://web.archive.org/web/20191221132152/https://www.ap.gov.in/?page_id=30

Attributes	Number	% of India
Sex ratio	993	
Percentage of rural Population	66.63	
Percentage of urban population	33.37	
Percentage of SC population	16.41	
Percentage of ST population	7	
Total literacy rate	67.02	
Male Literacy rate	74.88	
Female Literacy Rate	59.15	

Source: Primary Census Abstract data of India, 2011

4.4.3.3 District Profile: Sri Potti Sriramulu Nellore

Per the census 2011, SPS Nellore had a population of 29,63,557 of which male and female were 14,92,974 and 14,70,583 respectively. In 2001 census, SPS Nellore had a population of 26,68,564 of which males were 13,44,935 and remaining 13,23,629 were females. In 2001, Nellore district population constituted 3.50 per cent of total Andhra Pradesh population. In 2011 census, this figure remained constant, at 3.50 per cent.

There was an increase of 11.05 per cent in the total population in 2011 compared to population as per 2001. In the previous census of India 2001, Nellore district recorded increase of 11.6 per cent to it population compared to 1991.

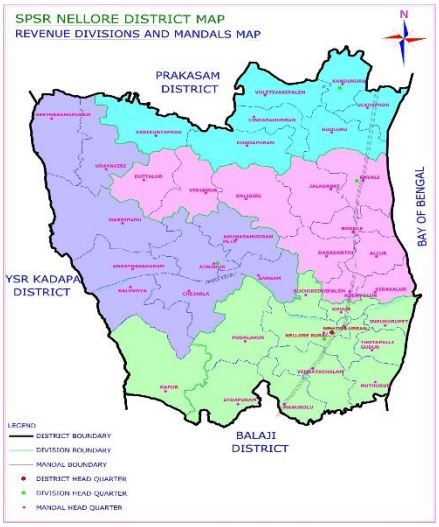


Table 4-20: District Profile of Nellore

Variables	SPS Nellore District
Area (sq. km)	13,076
Total Population	29,63,557
Males	14,92,974
Female	14,70,583
Population Growth (percentage)[68]	28.94
Sex Ratio[69]	985
Child Sex Ratio (0-6 age)	939
Population density[70] (sq. km)	227
Total Child Population (0-6 Age)	3,04,309
Male Population (0-6 Age)	1,56,907
Female Population (0-6 Age)	1,47,402
Total Literacy Rate[71] (percent)	68.90
Male Literacy Rate (percentage)	75.74
Female Literacy Rate (percentage)	61.99

Source: District Census Handbook, 2011[72]

[68] Population Growth from year 2001 to 2011
[69] It is the number of females per 1000 males.
[70] Population Density is a measurement of population per square kilometer
[71] It denotes ability to write a letter in any language. Literacy status assessment made for population 7 years and over.
[72] https://cdn.s3waas.gov.in/s39c82c7143c102b71c593d98d96093fde/uploads/2019/08/2019080553.pdf

SPS Nellore District Density

Per the census 2011, the density of the district for 2011 is 227 people per sq. km. In 200173, the district density was at 204 people per sq. km.

SPS Nellore Literacy Rate

Average literacy rate of the district in 2011 was 69.80 compared to 65.1 of 2001. The male and female literacy in 2011 were 75.74 and 61.99, respectively. For 2001 census, the literacy rate stood at 73.7 and 56.4 in the district. Number of male and female literates in the district were 10,11,922 and 8,20,267 respectively.

SPS Nellore Sex Ratio

With regards to sex ratio in SPS Nellore, it stood at 985 per 1000 male compared to 2001 census figure of 984. The average national sex ratio in India is 940 as per the census 2011 directorate.

SPS Nellore Child Population

In census enumeration, data regarding child under 0-6 age were also collected for all districts including SPS Nellore. There were total 3,04,309 children under the age of 0-6 against 3,28,412 of 2001 census. Of total 3,04,309 children in 2011, male and female were 1,56,907 and 1,47,402 respectively. Child sex ratio as per census 2011 was 939, compared to 954 of census 2001. In 2011, children under 0-6 formed 10.26 per cent of the district compared to 12.30 per cent of 2001.

SPS Nellore district urban/rural

Out of the total SPS Nellore population for 2011 census, 28.94 per cent lives in urban regions of the district. In total 8,57,630 people lives in urban areas of which males are 4,32,164 and female are 4,25,466. Sex ratio in urban region of the district is 984 as per 2011 census data. Similarly, child sex ratio in SPS Nellore district was 939 in 2011 census. Child population (0-6) in urban region was 80,228 of which males and females were 41,351 and 38,877. The urban child population figure of the district is 26.36% of district total child population. Average literacy rate in the district as per census 2011 is 68.90% of which males and female are 75.74% and 61.99% literates respectively. In actual number of 6,34,570 people are literate in urban region of which males and females are 3,38,976 and 2,95,594 respectively.

A per 2011 census, 71.06% of population of the district lives in rural areas of villages. The total SPS Nellore district population living in the rural areas is 21,05,92 of which males and females are 10,60,810 and 10,45,117 respectively. In rural areas of the district, sex ratio is 985 females per 1000 males. Child sex ratio of SPS Nellore district is 939 girls per 1000 boys. Child population in the age 0-6 is 2,24,081 in rural areas of which males were 1,15,556 and females were 1,08,525. The rural child population figure of the district is 73.64% of district total child population. Average literacy rate in the district as per census 2011 is 68.90% of which males and female are 75.74% and 61.99% literates respectively. In actual number of 11,97,619 people are literate in urban region of which males and females are 6,72,946 and 5,24,67 respectively.

[73] https://censusindia.gov.in/nada/index.php/catalog/27685

4.4.3.4 District Profile: Prakasam[74]

Per the census 2011, Prakasam had a population of 33,97,448 of which male and female were 17,14,764 and 16,82,684 respectively. In 2001 census, Prakasam had a population of 30,59,423 of which males were 15,52,332 and remaining 15,07,091 were females. In 2001, Prakasam district population constituted 4.01 per cent of total Andhra Pradesh population. In 2011 census, this figure remained constant, at 4.01 per cent.

There was an increase of 11.05 per cent in the total population in 2011 compared to population as per 2001. In the previous census of India 2001[75], Prakasam district recorded increase of 10.9 per cent to it population compared to 1991.

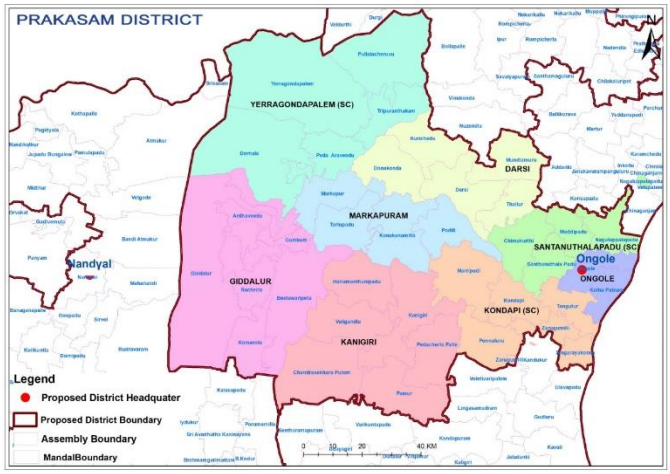


Table 4-21: District Profile of Praksham

Variables	Prakasam District
Area (sq. km)	17,626
Total Population	33,97,448
Males	17,14,764
Female	16,82,684
Population Growth (percentage)[76]	11.05
Sex Ratio[77]	981
Child Sex Ratio (0-6 age)	932
Population density[78] (sq. km)	193
Total Child Population (0-6 Age)	3,78,261
Male Population (0-6 Age)	1,95,753
Female Population (0-6 Age)	1,82,508
Total Literacy Rate[79] (percent)	63.08
Male Literacy Rate (percentage)	72.92
Female Literacy Rate (percentage)	53.11

Source: District Census Handbook, 2011[80]

Prakasam District Density

Per the census 2011, the density of the district for 2011 is 193 people per sq. km. In 2001, the district density was at 174 people per sq. km.

Prakasam Literacy Rate

[74] The Prakasham district was included in the social baseline (otherwise there 3 districts in the project area covering 87 mandal) because of the reason that during census 2011 Mandal Kandukuru Lingasamudram Gudluru Ulavapadu Voletivaripalem were the part of Parkasham district and now due to recent reorganization these mandal were included in Nellore district.

[75] http://lsi.gov.in:8081/jspui/bitstream/123456789/2981/1/38001_2001_PRA.pdf
[76] Population Growth from year 2001 to 2011
[77] It is the number of females per 1000 males.
[78] Population Density is a measurement of population per square kilometer
[79] It denotes ability to write a letter in any language. Literacy status assessment made for population 7 years and over.
[80] https://censusindia.gov.in/nada/index.php/catalog/127

Average literacy rate of the district in 2011 were 63.08 compared to 57.4 of 2001. The male and female literacy in 2011 were 72.92 and 53.11, respectively. For 2001 census, the literacy rate stood at 69.4 and 45.1 for males and females respectively in the district. Number of male and female literates in the district were 11,07,686 and 7,96,749 respectively.

Prakasam Sex Ratio

With regards to sex ratio in Prakasam, it stood at 981 per 1000 male compared to 2001 census figure of 971. The average national sex ration in India is 940 as per the census 2011 directorate.

Prakasam Child Population

There were total 3,78,261 children under the age of 0-6 against 92,433 of 2001 census. Of total 3,78,261 children in 2011, male and female were 1,95,753 and 1,82,508 respectively. Child sex ratio as per census 2011 was 932, compared to 975 of census 2001. In 2011, children under 0-6 formed 11.13 per cent of the district compared to 14.18 per cent of 2001.

Prakasam district urban/rural

Out of the total Prakasam population for 2011 census, 19.56 per cent lives in urban regions of the district. In total 6,64,582 people lives in urban areas of which males are 3,32,123 and female are 3,32,459. Sex ratio in urban region of the district is 1001 as per 2011 census data. Similarly, child sex ratio in Prakasam district was 932 in 2011 census. Child population (0-6) in urban region was 67,187 of which males and females were 34,547 and 32,640. The urban child population figure of the district is 17.76% of district total child population. Average literacy rate in the district as per census 2011 is 63.08% of which males and female are 72.92% and 53.11% literates respectively. In actual number of 4,68,522 people are literate in urban region of which males and females are 2,55,098 and 2,13,424 respectively.

A per 2011 census, 80.44% of population of the district lives in rural areas of villages. The total Prakasam district population living in the rural areas is 27,32,866 of which males and females are 13,82,641 and 13,50,225 respectively. In rural areas of the district, sex ratio is 977 females per 1000 males. Child sex ratio of Prakasam district is 932 girls per 1000 boys. Child population in the age 0-6 is 3,11,074 in rural areas of which males were 1,61,206 and females were 1,49,868. The rural child population figure of the district is 82.24% of district total child population. Average literacy rate in the district as per census 2011 is 68.90% of which males and female are 75.74% and 61.99% literates respectively. In actual 14,35,91 number of people are literate in rural region of which males and females are 8,52,588 and 5,83,325 respectively.

4.4.3.5 District Profile: Chittoor

Per the census 2011, Chittoor had a population of 41,74,064 of which male and female were 20,90,204 and 20,83,860 respectively. In 2001[81] census, Chittoor had a population of 37,45,875 of which males were 18,89,690 and remaining 18,56,785 were females. In 2001, Chittoor district population constituted 4.91 per cent of total Andhra Pradesh population. In 2011 census, this figure increased to 4.93 per cent.

There was an increase of 11.76 per cent in the total population in 2011 compared to population as per 2001. In the previous census of India 2001, Chittoor district recorded increase of 14.9 per cent to its population compared to 1991.

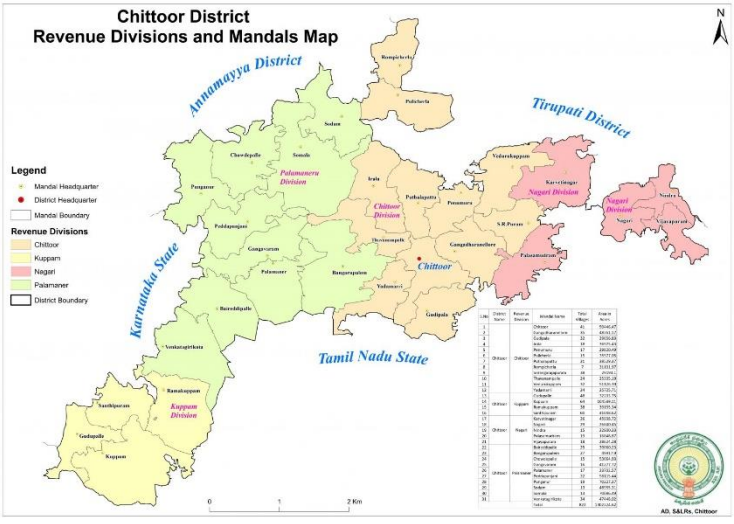


Table 4-22: District Profile of Chittoor

Variables	Chittoor District
Area (sq. km)	15,152
Total Population	41,74,064

[81] https://censusindia.gov.in/nada/index.php/catalog/27671/download/30840/DH_28_2001_CHI.pdf

Variables	Chittoor District
Males	20,90,204
Female	20,83,860
Population Growth (percentage)[82]	11.76
Sex Ratio[83]	997
Child Sex Ratio (0-6 age)	930
Population density[84] (sq. km)	275
Total Child Population (0-6 Age)	4,44,572
Male Population (0-6 Age)	2,30,283
Female Population (0-6 Age)	2,14,289
Total Literacy Rate[85] (percent)	71.53
Male Literacy Rate (percentage)	79.83
Female Literacy Rate (percentage)	63.28

Source: District Census Handbook, 2011[86]

Chittoor District Density

Per the census 2011, the density of the district for 2011 is 275 people per sq. km. In 2001, the district density was at 247 people per sq. km.

Chittoor Literacy Rate

Average literacy rate of the district in 2011 were 71.53 compared to 66.8 of 2001. The male and female literacy in 2011 were 79.83 and 63.28, respectively. For 2001 census, the literacy rate stood at 77.6 and 55.8 for males and females respectively in the district. Total literate in the district were 26,67,878 of which male and female were 14,84,794 and 11,83,084 respectively.

Chittoor Sex Ratio

With regards to sex ratio in Chittoor, it stood at 997 per 1000 male compared to 2001 census figure of 982. The average national sex ratio in India is 940 as per the census 2011 directorate.

Chittoor Child Population

There were total 4,44,572 children under the age of 0-6 against 4,85,584 of 2001 census. Of total 4,44,572 children in 2011, male and female were 2,30,283 and 2,14,289 respectively. Child sex ratio as per census 2011 was 930, compared to 954 of census 2001. In 2011, children under 0-6 formed 10.65 per cent of the district compared to 12.96 per cent of 2001.

Chittoor district urban/rural

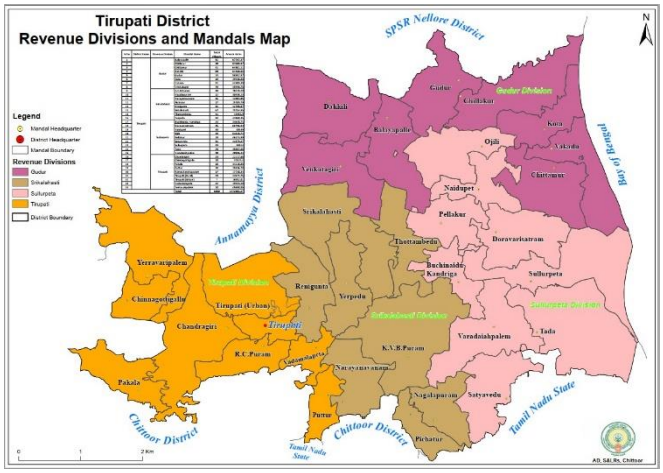
Out of the total Chittoor population for 2011 census, 29.50 per cent lives in urban regions of the district. In total 12,31,386 people lives in urban areas of which males are 6,16,152 and female are 6,15,234. Sex ratio in urban region of the district is 999 as per 2011 census data. Similarly, child sex ratio in Chittoor district was 930 in 2011 census. Child population (0-6) in urban region was 1,24,378 of which males and females were 64,588 and 59,790, respectively. The urban child population figure of the district is 27.9% of district total child population. Average literacy rate in the district as per census 2011 is 71.53% of which males and female are 79.83% and 63.28% literates respectively. In actual number of 9,10,662 people are literate in urban region of which males and females are 4,86,043 and 4,24,619 respectively.

[82] Population Growth from year 2001 to 2011
[83] It is the number of females per 1000 males.
[84] Population Density is a measurement of population per square kilometer
[85] It denotes ability to write a letter in any language. Literacy status assessment made for population 7 years and over.
[86] https://censusindia.gov.in/nada/index.php/catalog/117

A per 2011 census, 70.5% of population of the district lives in rural areas of villages. The total Chittoor district population living in the rural areas is 29,42,678 of which males and females are 14,74,052 and 14,68,626 respectively. In rural areas of the district, sex ratio is 996 females per 1000 males. Child sex ratio of Chittoor district is 925 girls per 1000 boys. Child population in the age 0-6 is 3,20,194 in rural areas of which males were 1,65,69 and females were 1,54,499. The rural child population figure of the district is 72.1% of district total child population. Average literacy rate in the district as per census 2011 is 71.53% of which males and female are 79.83% and 63.28% literates respectively. In actual 17,57,216 number of people are literate in rural region of which males and females are 9,98,751 and 7,58,465 respectively.

4.4.3.6 District Profile: Tirupati

Tirupati district came into existence on 4 April 2022 with Gudur, Sullurupeta revenue divisions from Nellore districts and Tirupati revenue division from Chittoor district. Srikalahasti revenue division was newly created for the districts. however, it is be noted that mandal boundaries remained as it is, and certain Mandals were simply incorporated into the new Tirupati district from other surrounding districts. Thus, the District Census Handbook does not exist for Tirupati; the same will come into existence once the Census is conducted. Thus, data has been derived from official government website for Tirupati district. This includes certain derivations from census 2011 in accordance to Mandals incorporated.



Per the census 2011, Tirupati has a population of 41,74,064 of which male and female were 20,90,204 and 20,83,860 respectively.

There was an increase of 11.3 per cent in the total population in 2011 compared to population as per 2001. In the previous census of India 2001, Tirupati district recorded increase of 14.86 per cent to it population compared to 1991.

Table 4-23: District Profile of Tirupati

Variables	Tirupati District
Area (sq. km)	9174[87]
Total Population	41,74,064
Males	20,90,204
Female	20,83,860
Population Growth (percentage)[88]	11.3
Sex Ratio[89]	997
Child Sex Ratio (0-6 age)	930
Population density[90] (sq. km)	275
Total Child Population (0-6 Age)	4,44,572
Male Population (0-6 Age)	2,30,283
Female Population (0-6 Age)	2,14,289
Total Literacy Rate[91] (percent)	71.53
Male Literacy Rate (percentage)	79.83
Female Literacy Rate (percentage)	63.28

[87] https://tirupati.ap.gov.in/demography/
[88] Population Growth from year 2001 to 2011
[89] It is the number of females per 1000 males.
[90] Population Density is a measurement of population per square kilometer
[91] It denotes ability to write a letter in any language. Literacy status assessment made for population 7 years and over.

Source: District Census Handbook, 2011[92]

Tirupati District Density

Per the census 2011, the density of the district for 2011 is 275 people per sq. km. In 2001, the district density was at 247 people per sq. km.

Tirupati Literacy Rate

Average literacy rate of the district in 2011 was 71.53. The male and female literacy in 2011 were 79.83 and 63.28, respectively. Total literate in the district were 26,67,878 of which male and female were 14,84,794 and 11,83,084 respectively.

Tirupati Sex Ratio

With regards to sex ratio in Tirupati, it stood at 997 per 1000 male compared to 2001 census figure of 982. The average national sex ratio in India is 940 as per the census 2011 directorate.

Tirupati Child Population

There were total 4,44,572 children under the age of 0-6. Of total 4,44,572 children in 2011, male and female were 2,30,283 and 2,14,289 respectively. Child sex ratio as per census 2011 was 930. In 2011, children under 0-6 formed 10.65 per cent of the district.

4.4.3.7 Mandal Demographic Profile

Greenlam has developed a detailed wood procurement strategy for their wood procurement and based on the strategy it was understood that there are existing wood growing clusters in the project districts. In order to have better understanding of the areas under supply chain data from these 89[93] Mandal that falling under 4 districts, namely Chittoor, Tirupati, Prakasam and Sri Potti Sriramulu Nellore was collected. Thus, for the purpose of this report, the socio economic and demographic profile of these Mandals has been presented in *Section 4.4.3.8.2*.

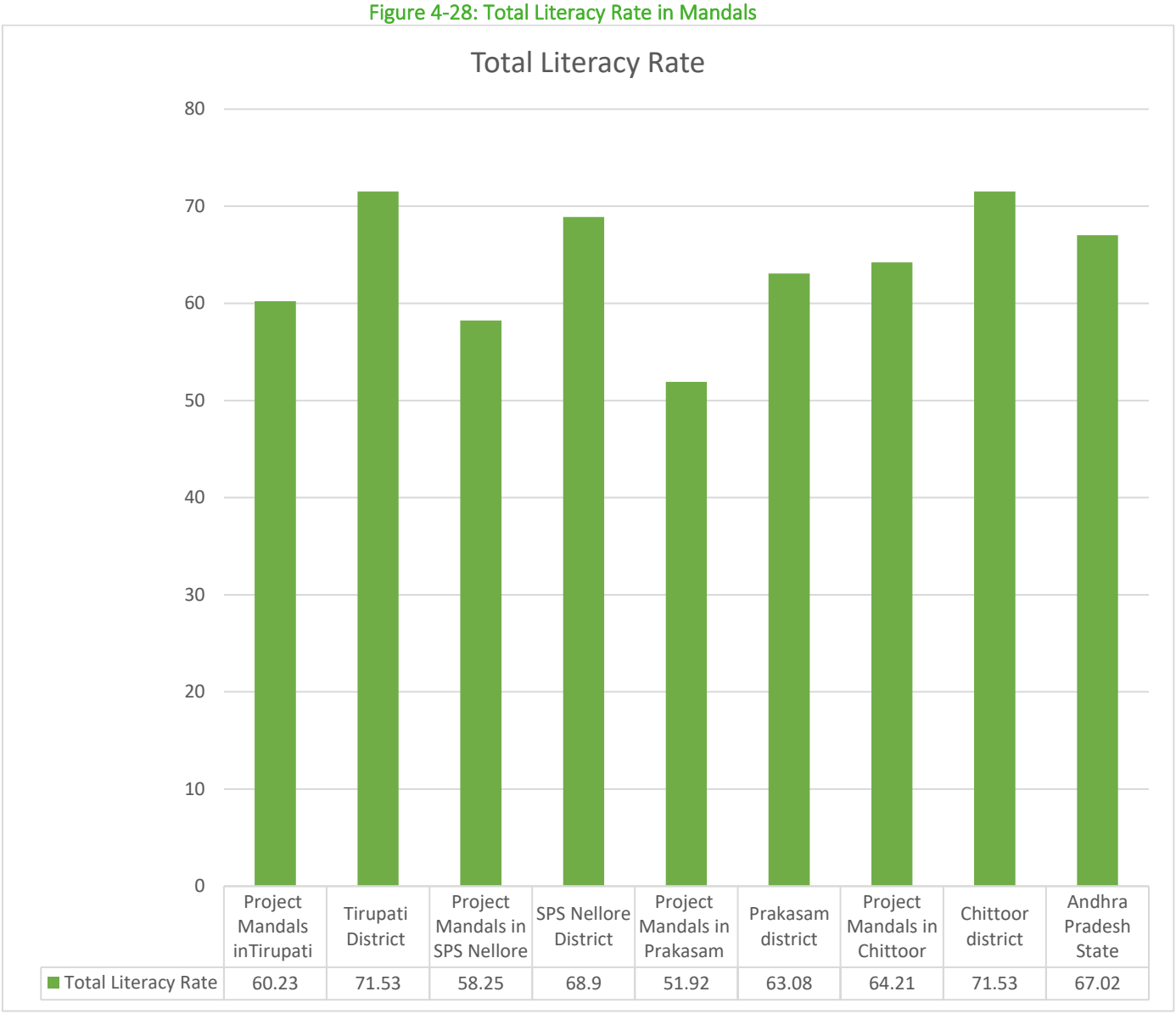
The project mandals in total have 14,49,206 households and 56,10.663 individuals. Thus, the average household size inclusive of all project mandals is 3.87 individuals.

The total literacy rate of Andhra Pradesh state is 67.02%, while that of SPS Nellore district is 68.90%, of Prakasam district is 63.08%, Chittoor district is 71.53% and that of Tirupati district is 71.53%. The total mandals considered for the preparation of this baseline sum up to a total of 89 mandals. Out of these 89 total mandals, 34 lie in Tirupati district, 33 lie in SPS Nellore district, 5 are a part of Prakasam district and remaining 17 are a part of Chittoor district. A comparison of the total literacy rate of the mandals falling within project consideration for each district and the total literacy rate for the entire district against the Andhra Pradesh state literacy rate has been provided in ***Figure 4-28.***

[92] https://cdn.s3waas.gov.in/s3ca8155f4d27f205953f9d3d7974bdd70/uploads/2022/03/2022032871.pdf

[93] Considering the wider coverage as some of the stakeholder might be living in urban areas therefore data of Tirupati and Nellore urban was included in for the social baseline which makes total 89 mandal although as per wood procurement strategy there will 87 Mandal from where wood will be procured.

Figure 4-28: Total Literacy Rate in Mandals



Source: Census 2011

According to the given figure, it can be concluded that the highest literacy rates amongst project mandals of different states can be noticed in Project Mandals of Chittoor district, that has a total literacy rate of 64.21%. On the other hand, the lowest total literacy rate amongst all district wise project mandals can be noticed in Project Mandals in Prakasam with a total literacy rate of 51.92%.

Additionally, it can be inferred from the given figure that the average total literacy rate of all district specific project mandals is always lower than the total literacy rate of the entire district.

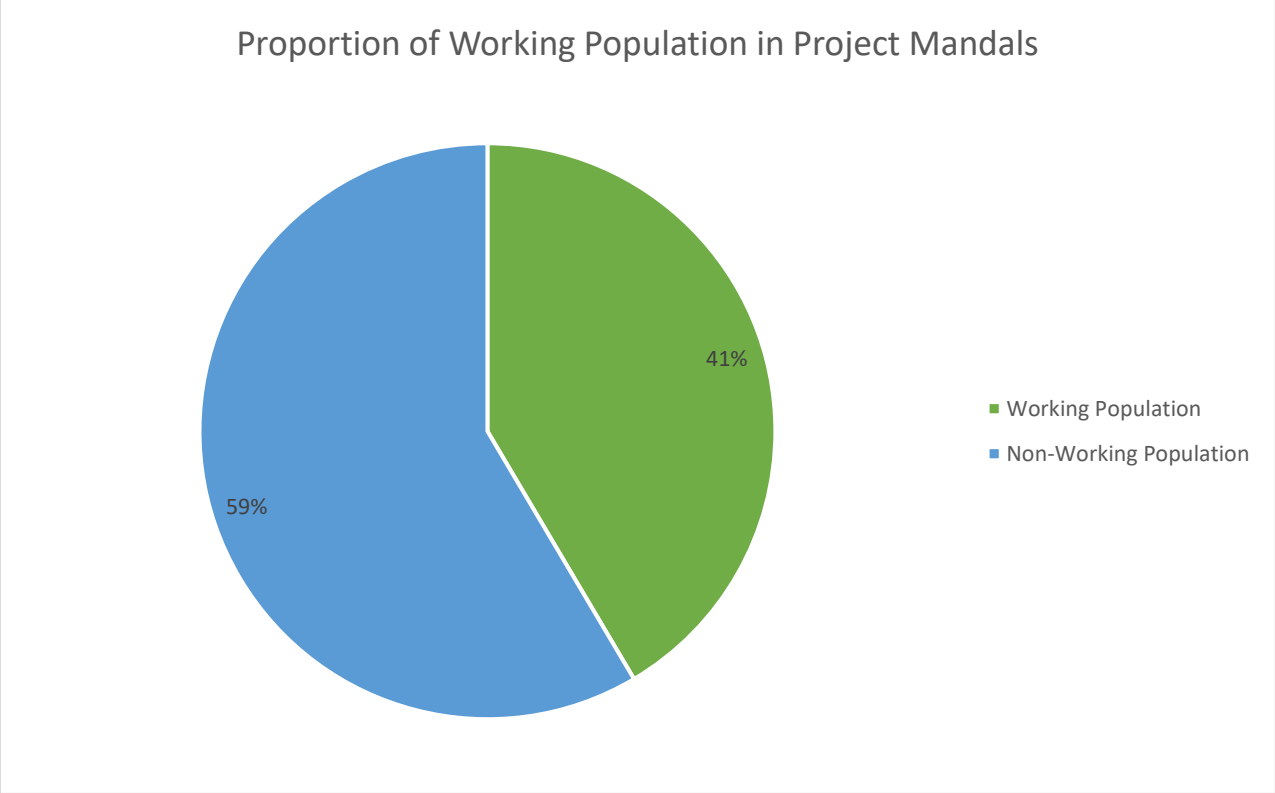
Out of all the mandals, Voletivaripalem, a mandal of the Prakasam district has the lowest literacy rate with only 47.93% of its population being literate. On the contrary, Tirupati Urban, a mandal of the Tirupati district has the highest literacy rate, with 77.175 of its population being literate.

4.4.3.7.1 Mandal Occupational Profile

The Mandal wise, occupational profile has been presented in ***Figure 4-29.*** The project mandals combined have a total working population equating to 41% of the total population. This shows that majority of the individuals 959%) are non-working and may engage in other activities. On exclusion of children and other dependents, the reason for a high rate of non-working population can be charted out to the employment crisis amongst skilled individuals that Andhra Pradesh as a state is facing. However, a low working population percentage is not directly proportionate to the unemployability rates,

certain factors such as higher education amongst youth must also be considered. The proportion of working population to non-working population in project affected mandals can be seen in ***Figure 4-29***.

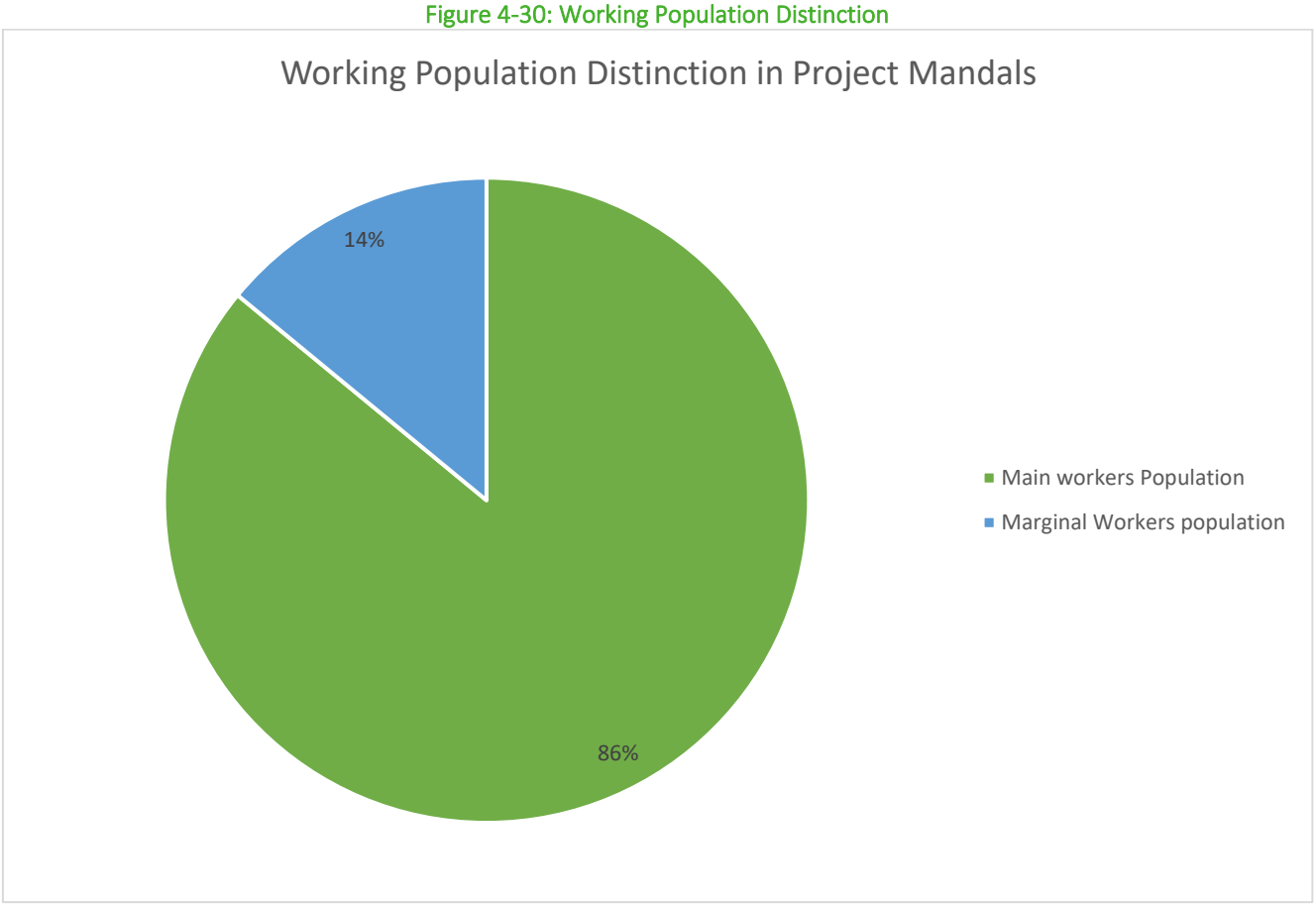
Figure 4-29: Proportion of Working Population in Project Mandals



Source: Census 2011

Additionally, the working population can be divided into "Main Workers" and Marginal Workers". Those workers who work for the major part of a year (i.e. 6 months or more) are termed as Main Workers. Those workers who do not work for the major part of a year (i.e. less than 6 months) are termed as Marginal Workers. 63.8% of the total working population is male, while 36.2% is female. Additionally As can be ascertained from ***Figure 4-30,*** the working population consists of 14% of marginal workers, while the remaining majority of 86% constitutes the main workers population.

Figure 4-30: Working Population Distinction



Source: Census 2011

4.4.3.8 Mandal Physical Infrastructure: Water Supply and Sanitation

According to data found in Census 2011, most mandals falling under Chittoor District depend on multiple sources of water for domestic as well as agricultural use. These sources primarily include Tubewells, boreholes, and Untreated Tap Water. These water facilities are available in most Mandals. To a limited extent, locals also depend on Canals and Tanks to fulfil their water requirements.

In Sri Potti Sriramulu Nellore District, majority of the water requirements are met via treated tap water, untreated tap water, boreholes, canals and tubewells. These water facilities are available in most mandals, according to Census 2011. To a limited extent, locals also depend on Tanks to fulfil their water requirements.

Similarly, in the Prakasam district, most of the water requirements for the Mandals falling in this district are met via treated tap water and handpumps. Additionally, residents also rely on untreated tap water, borewells, canals and covered wells. However, the dependence on latter is limited.

4.4.3.8.1 Study Area

The socio-economic profile of the study area is presented in the subsequent subsections. The profile of the study area is primarily based on the secondary data from census 2011 and primary data was gathered through stakeholder consultations and focused group discussions.

4.4.3.8.2 Demographic Profile: Study Area

Village Menakuru is located in core zone close to the manufacturing facility. Menakuru village has a total population of 2412 individuals and 656 households. The Buffer Zone for Manufacturing site includes 1 village of Manavali. In comparison to Menakuru village, Manavali has a higher sex ratio at 1002 females per 1000 males. But has a smaller population at 875 individuals and 268 households. Manavali has no Scheduled tribe population, while Menakuru has a ST population equivalent to 13.02% of its total population. Additionally, female literacy as well as overall literacy rates are higher in Menakuru village (at 52.48% and 61.77% respectively) in comparison to female and overall literacy rate for Manavali village (at 50.68% and 58.05% respectively).

In the Plantation Area (Supply Chain i.e. Study Area 2), Muttukuru village has the highest population, with 14,333 individuals and 305 households. The village with least population is Ravullakollu, with a total population of 367 individuals and 94 households. The average household size overall for study area 2 is 3.79 persons per household. Additionally, 3 villages have a positive sex ratio with Rachapalem reflecting the highest sex ratio at 1117 females per 1000 males, followed by Muttukuru at 1073 females per 1000 males and Tripuranthakapuram Kota with a sex ratio of 1010. Ravullakollu has the lowest sex ratio (962) . The average Scheduled Caste Population in plantation area is 27.53% of total population, i.e. 19,811 individuals. The female literacy rate is highest in Muttukuru village (56.86%) and lowest in Tripuranthakapuram Kota (44.99%). Moreover, the highest overall literacy rate is in Padiri village (61.44%) and lowest in Tripuranthakapuram Kota (52.57%). Demographic data for both the Study Areas is presented in the following ***Table 4-24***. Detailed demographic profile for the study area is present in *Section 4.4.3.7*.

Table 4-24: Demographic Profile of Study Area

Villages	No. of HH	Population	Average HH Size	Sex Ratio	% SC	% ST	% Lit	% F Lit
Study Area 1 (Manufacturing Site) Total	**924**	**3287**	**365.63958**	**970**	**39.19**	**6.51**	**59.91**	**51.58**
Study Area 2 Total	**5198**	**19811**	**3.792**	**1027.8**	**27.538**	**8.832**	**58.57**	**51.706**

Source: Census 2011

(*Note: The data for village Arimenupade, S.G. Palli, Chowdaripalem, Yedlurupadu could not be found in the Census 2011, and thus has not been considered for calculation purposes.)*

4.4.3.8.3 Land Ownership and Use: Study Area

The ownership and use of land in the study area, is based on the census 2011. The area has an agrarian economy and hence the dependence on land as a resource is high. The table for the land utilization reiterates the heavy dependence of people on agriculture, making it one of the primary sources of their livelihood.

At the household level, land holding is arguably the most valuable asset for rural communities which serve as an important means for livelihood and source of income. It also serves as an insurance to help tide over financially difficult situations. Details of land used is presented in ***Table 4-25***. Detailed land use break up has been provided in ***Section 4.3.3.***

Table 4-25: Land use breaks up in the study area

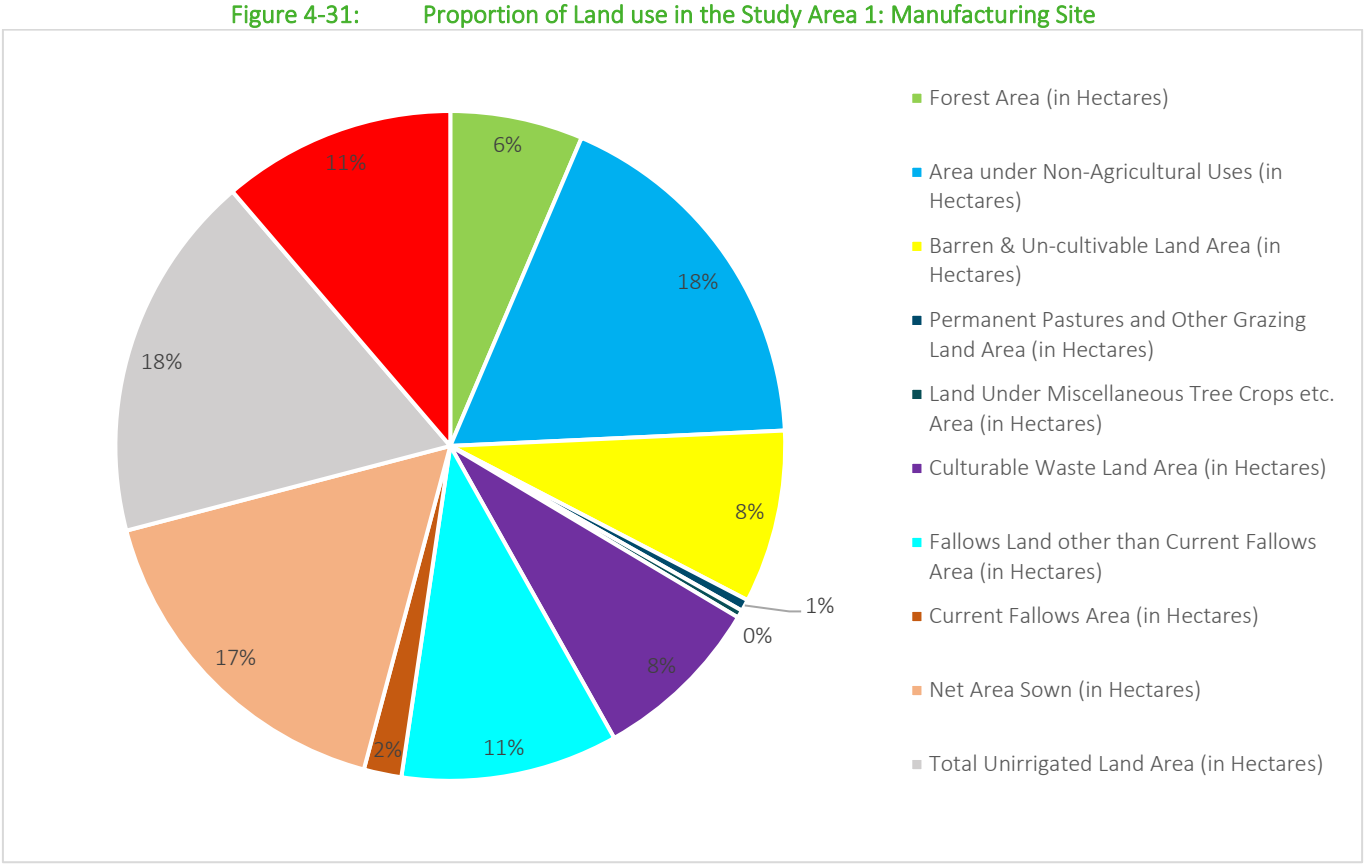
Villages	Total Geographical Area (in Hectares)	Forest Area (in Hectares)	Area under Non-Agricultural Uses (in Hectares)	Barren & Un-cultivable Land Area (in Hectares)	Permanent Pastures and Other Grazing Land Area (in Hectares)	Land Under Miscellaneous Tree Crops etc. Area (in Hectares)	Culturable Waste Land Area (in Hectares)	Fallows Land other than Current Fallows Area (in Hectares)	Current Fallows Area (in Hectares)	Net Area Sown (in Hectares)	Total Unirrigated Land Area (in Hectares)	Area Irrigated by Source (in Hectares)
Study Area 1 Total	1770	160	445.58	208.37	14.14	9.29	207.2	261.48	45.38	418.56	444.17	281.25
Study Area 2 Total	5108	847.61	740.57	688.49	167.12	54.61	129.03	409.24	386.2	1685.13	1440.93	1039.64

Source: Census 2011

Table 4-25 denotes that out of total land present in Study Area 1 (Manufacturing Site), a large portion of the land is utilized for Non-Agricultural use; approximately 18% of the total land is used under "Area under Non-Agricultural Uses". The least usage of land is for "Land Under Miscellaneous Tree Crops etc.", with a proportion of 0.52% of total land. Similarly, 444.17 hectares of land is unirrigated, while 281.25 hectares is irrigated by Source. There is also considerable forest area, with 160 hectares, (6% of total land) of coverage.

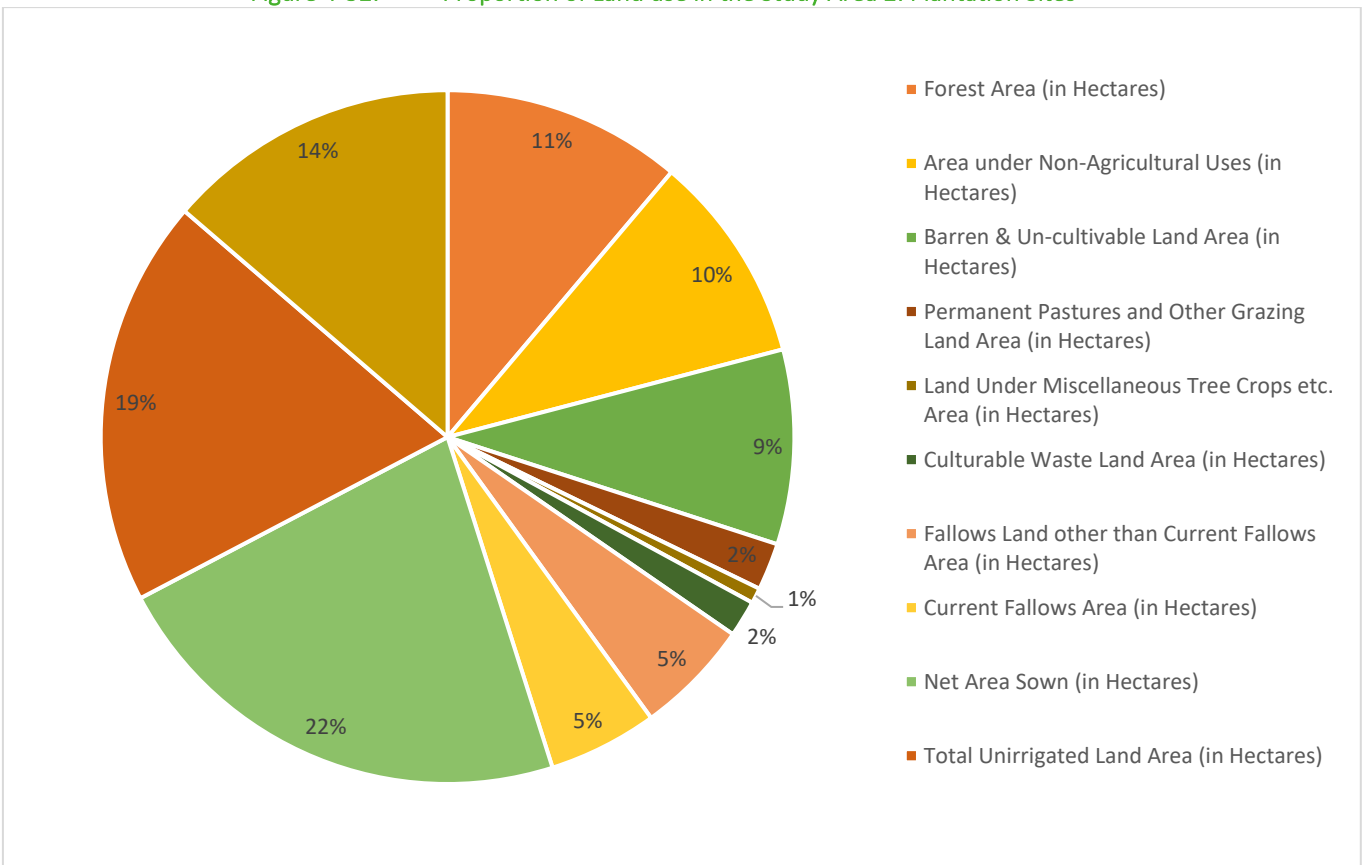
Similarly, out of total geographical area of 5108 hectares in Plantation Sites, largest proportion of land is used under "Net Area Sown" using 22% of total area (1685.13 hectares). The Forest Area coverage occupies 11% of total area, with 847.61 hectares. Area Under Non-Agricultural Use covers a total of 740.57 hectares. According to total geographical area, Tripuranthakapuram Kota (TP Kota) village is the largest amongst all falling in Study Area 2. However, Muttukuru village has the largest net area sown, with 648.71 hectares out of 1183 hectares. Overall in the study area, 1440.93 hectares is total unirrigated land area, while 1039.64 hectares is irrigated by source. Details of land use is presented in ***Figure 4-31*** & ***Figure 4-32.***

Figure 4-31: Proportion of Land use in the Study Area 1: Manufacturing Site



Source: Census 2011

Figure 4-32: Proportion of Land use in the Study Area 2: Plantation Sites



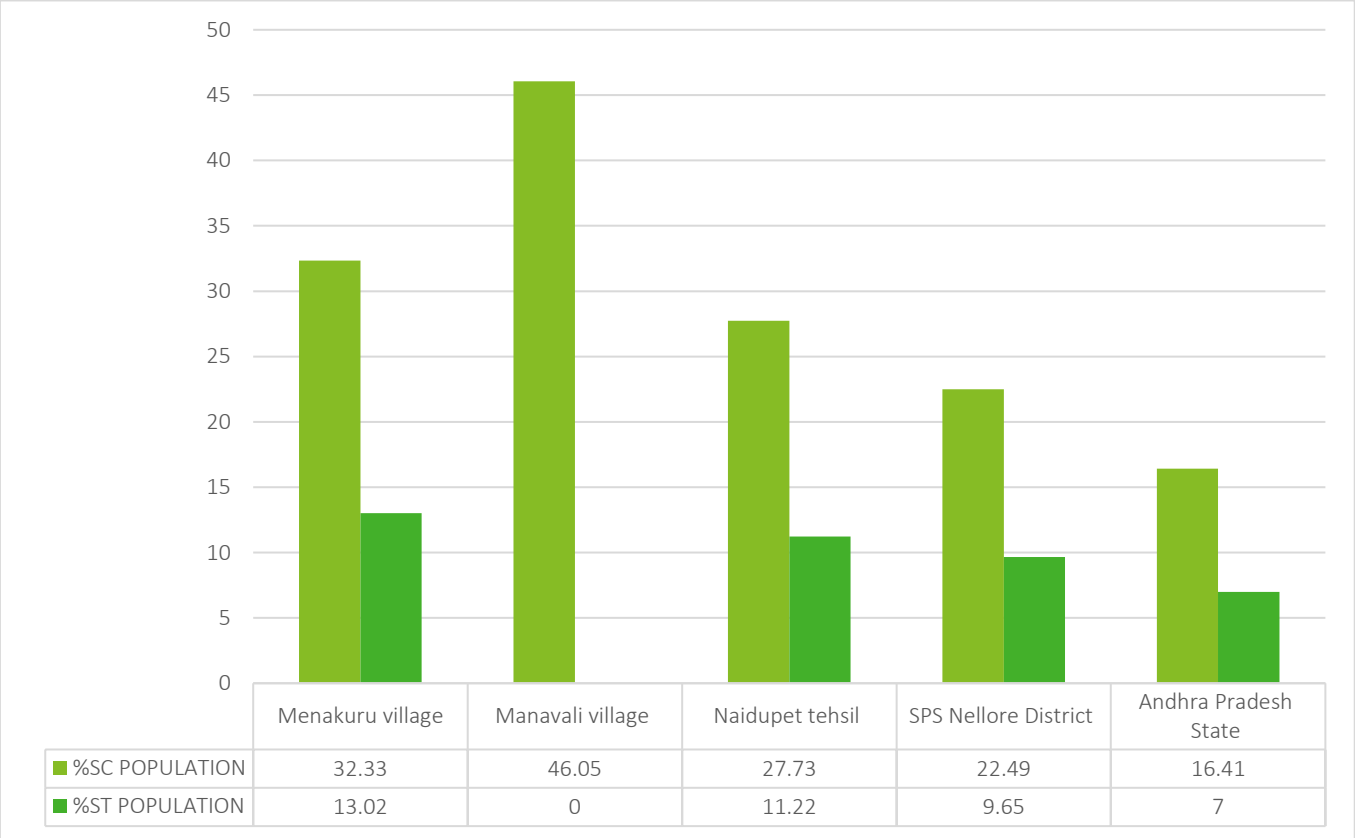
Source: Census 2011

4.4.3.8.4 Social Stratification: Study Area

The proportion of SC and ST population in the study area is higher than the national and state % which is 16.6% and 8.6%, respectively for India and 16.4% and 5.6% respectively for Andhra Pradesh.

As observed, SC population is considerably higher than the proportion of ST population, with SC population being at 32.33% and ST population being at 13.02% in Menakuru village and SC population being 46.05% and ST population being 0% in Manavali village. A similar pattern is observed in the Mandal, district and state as well. The SC population in Naidupet Mandal is 27.73% and ST population is 11.22%. The proportion of SC and ST population decreases as we move to larger areas, i.e. from village to Mandal to district to state. The lowest proportion of SC population is in Andhra Pradesh state, at 16.41% of its total population belonging to SC community, and 7% of its total population belongs to ST community. The national SC population equates to 16.6% and the ST population is 8.6% according to Census 2011.This is The below ***Figure 4-33*** & ***Figure 4-34*** presents the graphic representation of population of SC/STs in the study areas.

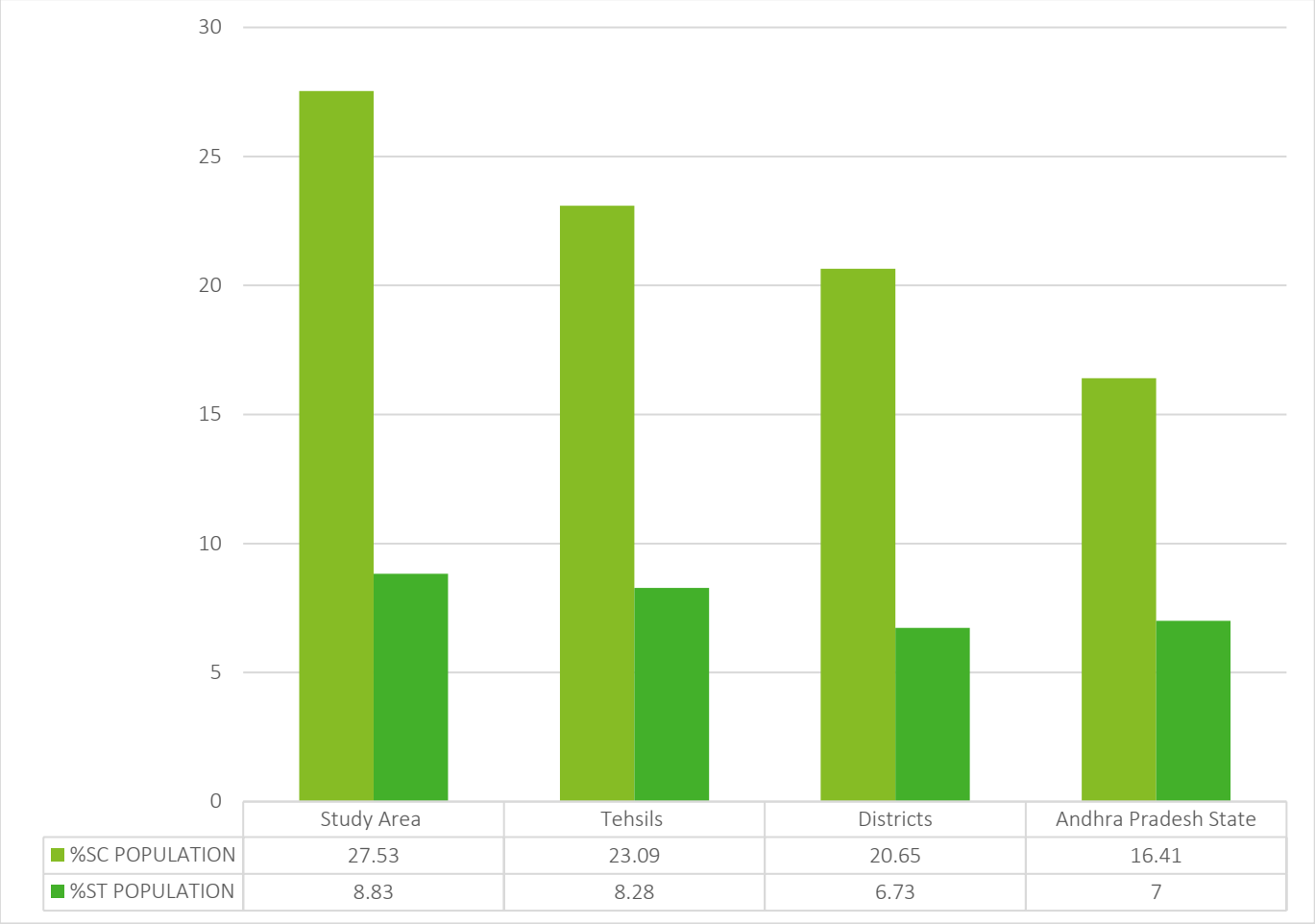
Figure 4-33: Proportion of Scheduled Caste and Scheduled Tribe Population in Study Area villages, Mandal, District and State: Study Area 1



	Menakuru village	Manavali village	Naidupet tehsil	SPS Nellore District	Andhra Pradesh State
%SC POPULATION	32.33	46.05	27.73	22.49	16.41
%ST POPULATION	13.02	0	11.22	9.65	7

Source: Census 2011

Figure 4-34: Proportion of Scheduled Caste and Scheduled Tribe Population in Study Area, Mandal, Districts and State: Study Area 2



Source: Census 2011

4.4.3.8.5 Physical Infrastructure: Study Area

According to Central Ground Water Board report for Chittoor District, January 2017, the rivers flowing in the district are non-perennial in nature of which river Ponnai flows towards south-east along the prominent NW-SE fault and joins river Palar in Tamil Nadu. Swarnamukhi is another important river originates in Eastern Ghats and flows in NE direction before flowing into Nellore district. Other important rivers are river Bahuda, river Pincha, river Kushastali, river Kalyani, river Bheema, river Araniyar and river Pedderu etc.

Similarly, according to Central Ground Water Board report for SPS Nellore District, 2013, The Pennar is the major river which drain in the middle of the district. The other important rivers flowing in the district are Swarnamukhi, Manneru and Upputeru. All the rivers are non-perennial, flowing in the eastern direction and joins the Bay of Bengal. The district is served with both surface and ground water irrigation sources. Major and medium irrigation projects exist in the district. The total net area irrigated is 264971 ha (2012) by means of all sources of irrigation available in the district. The district has one major (Pennar River Canal System) and five medium (Telugu Ganga, Somasila, Kanpur canal, Gandipalem project and Swarnamukhi Barrage) irrigation projects. The area irrigated through canals and tanks is 96889 ha and 70783 ha respectively, and irrigation through lift and other sources is 5124 ha. 92175 ha area is irrigated through tube wells and dug wells. Sources of water for study area are given below ***Table 4-26***.

Table 4-26: Water Sources in Study Area

village	Treated Tap water	Untreated Tap Water	Covered Well	Uncovered Well	Hand Pump	Tubewell/ Borewell	Spring	River /Canal	Tank/Pond/ Lake
Study Area 1 Total	2	0	0	0	2	1	0	0	0
Study Area 2 Total	**2**	**3**	**1**	**1**	**4**	**1**	**0**	**0**	**0**

Source: Census 2011

4.4.3.8.6 Occupational Profile: Study Area

Census data 2011 indicates that in Study Area 1 as well as Study Area 2, more women are involved in the non-working population and more men are involved in the working population, inclusive of main workers and marginal workers. Based on the discussion carried out during the site visit it was understood most of the person close to the manufacturing plant are occupied in nonagricultural work however agriculture is also carried out but the significant portion of income of the family is coming from other sources as well which includes service, business, labour and rents etc. whereas in the plantation areas community are generally engaged in agriculture and reportedly agriculture and allied activities contribute significant portion of their family income. Detailed occupation profile is given in *Table 4-27*.

Table 4-27: Occupational Profile of Study Area

VILLAGE	WORKING POPULATION			MAIN WORKERS POPULATION			MARGINAL WORKERS POPULATION			NON-WORKING POPULATION		
	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE
Study Area 1 Total	**1665**	**1004**	**661**	**1109**	**720**	**389**	**556**	**284**	**272**	**1622**	**677**	**945**
Study Area 2 Total	**8219**	**5558**	**2661**	**6689**	**4915**	**1774**	**1530**	**643**	887	**11592**	**4070**	**7522**

Source: Census 2011

4.4.3.8.7 Livelihood & Agriculture

As per the discussion carried out with the farmers it was understood that mostly the community is engaged in varied agriculture practices. In most of the project villages where there is a good water availability, farmers cultivate crops like sugarcane, lemon, mangoes , and tobacco as cash crops. Whereas where there is less water availability crop cultivation is carried out for subsistence mostly and lintels, chickpeas and other crops which are less water intensive were grown. However most of the farmers in the region were finding agriculture getting more and more difficult due to shortage of labor and the cost inputs are going up as compared to the returns from the traditional farming. Therefore farmers are looking for options which can provide better returns to their investment and does not require regular inputs.

It was understood that communities in the region are engaged in wood plantation since long time and are well experienced and aware of up and downs of the plantation business.

As informed, most of the land where plantation is done are generally barren, either does not have proper water supply or soil is not fit for cultivation of other crops. Therefore, plantation is generally done on less fertile land and fertile land is used for crop cultivation. Most of the consulted farmers adopt mix farming model which includes crop cultivation which provides food security whereas plantation provides income in the long run. However most of the big farmers or the people who are having big land holdings are finding difficult to carry agriculture due to labor cost and hence have shifted to plantations which provides income as well as land is secured from opportunistic encroachments.

It was also noted that farmers in the region are dynamic in terms of agriculture practices. They keep changing their agriculture practices with changing trends. As informed during the consultations especially in village Ravullakollu historically they were engaged in the wood plantation however due to economic losses in the plantation business they uprooted the plantation in 2018-19 and shifted to Tobacco. Therefore from the consultations it can be concluded that most of the farmers in the region are progressive and based on the demand they easily adjust to the changing trends. In the same meeting farmers expressed that they are still open to carry out plantation but on conditions of purchase agreements.

4.4.3.8.8 Education Infrastructure

The primary schools in the study area are privately operated, and for higher studies including different types of colleges students have go beyond 10 km radius of the study area.

Plantation Area (Supply Chain) - it was reported that all the villages are having the basic education infrastructure within the villages both private pre-primary schools and government primary schools were operational in the selected villages. Government middle school and government secondary school are either within the village or close to the villages however to avail higher education, students are required to commute to the nearest district or Mandal towns.

4.4.3.8.9 Health Facilities and Health Seeking Behavior

In Study Area 1 (Manufacturing Site) - only Primary Health Sub Centre, Veterinary Hospital, Mobile Health Clinic and non-government medicine shop is available to the public. Similar pattern can be observed in the supply chain / plantation area in terms of healthcare infrastructure availability. Sparsely distributed only Primary Health Sub Centre, Veterinary Hospital, Mobile Health Clinic, non-government medicine shop is available. Major health infrastructure is available either at Mandal or district level respectively.

4.5 Ecological Baseline

4.5.1 Objectives

The survey was conducted with the following objectives,

- Identification of internationally and/or nationally recognized areas of high biodiversity value e.g., Protected Areas (PAs), Key Biodiversity Areas (KBAs) / Important Bird and Biodiversity Areas (IBAs), Alliance for Zero Extinction (AZE) sites, etc.
- Identification of different habitats [natural, modified, and critical (if any)] falling within core and buffer zones.
- Documentation of floral and faunal [specifically herpetofauna (reptiles + amphibians), birds, and mammals] species based on direct sightings, calls, pugmarks (if any), etc.
- Trace out of any endangered or protected or restricted range floral species. Identification of any threatened (as per IUCN Red List), scheduled (as per Wildlife (Protection) Act, 1972), endemic or restricted-range and migratory or congregatory faunal species (as defined in IFC PS 6) from the study area.
- Identification of wildlife migratory corridors, avian migratory routes, and other important areas for ecological reasons such as breeding, nesting, foraging, resting, etc.
- Identification of potential critical habitat triggers (species) within the catchment areas.

4.5.2 Ecological Baseline - Methods

To understand the existing ecological conditions in the study area, an ecological baseline was prepared. This base line was prepared with the help of information gathered under, i. Literature Review and ii. Field Data Collection.

4.5.2.1 Literature Review

A literature review was performed to screen out the presence of internationally and/or nationally recognized areas of high biodiversity value e.g., Protected Areas (PAs), Alliance for Zero Extinction (AZE) sites, etc.; habitat of IUCN Threatened and Restricted-range species; Key Biodiversity Areas (KBAs), which include Important Bird and Biodiversity Areas (IBAs) in and around the project location. A list of floral and faunal species was also prepared along with their conservation status (as per IUCN) and their status in the list of scheduled species [as per Wildlife (Protection) Act, 1972] utilizing collected secondary data during literature review (focusing on eBird, and iNaturalist). The dominant habitats in and around the project location was also identified with the help of google earth imagery and other available secondary data. The recognized (internationally and/or nationally) wildlife migratory corridors, and avian migratory routes were also identified with the available information.

4.5.2.2 Establishment of Ecologically Appropriate Area of Analysis (EAAA)

As per the guidance note 59 of IFC PS6, it is important to identify the Ecologically Appropriate Area of Analysis (EAAA) specifically in the case of Critical Habitat Screening and Assessment. As per the GN 59, the boundaries of this area taking into account the distribution of species and/or ecosystems. These boundaries may include catchments, large rivers, or geological features.

The operation of the project will not have any adverse effects on the protected areas surrounding the designated Supply Chain Catchment Area. The collection of wood will be confined to the regions utilized by agroforestry plantations and their immediate vicinity. While non-protected forest areas with dense vegetation exist within the Supply Chain Catchment Area, no wood harvesting will occur in these areas. This decision aligns with consultations held with the client, local agroforestry farmers, potential wood aggregators, and Forest Development Corporation officials. Post-collection, the wood will be transported to the manufacturing unit via roads, which will not cross any protected area. Consequently, given the project's nature and operational activities, the Ecologically Appropriate Area of Analysis (EAAA) has been estimated same as the extent of the Supply Chain Catchment Area (*Figure 4-36*).

4.5.2.3 Field Data Collection

A field survey was conducted to determine the existing ecological conditions (habitats, flora and fauna) within the study area. This baseline facilitates an adequate assessment of the project's impacts upon ecology as well as it helps the development of appropriate mitigation measures. Habitats, which may support good biodiversity i.e., forest patches, scrubs, water bodies, etc. will be focused during the survey.

4.5.2.3.1 Habitat Survey

Different habitats (natural, modified) available within the study area identified by the desktop review were verified through site visit. Data regarding the type and quality of habitat with reference to flora and fauna supported were collected.

4.5.2.3.2 Floral Survey

The floral diversity of the study area was recorded by visual observation during the site visit and identified using published manuals. The information (Scientific publications) dealing with the floristic diversity of the related area available in the public domain were also considered in the survey.

4.5.2.3.3 Faunal Survey

- Faunal species (specifically reptiles, birds, and mammals) from the study areas were recorded based on direct sightings, indirect evidence such as dung, droppings, scats, pugmarks, scratch signs, burrows, nests, etc.;
- Consultations with local communities were carried out by displaying photographs of species anticipated in the area to confirm whether there have been any recent sightings. The photographs of the species were typically obtained from the authentic sources [94,95];
- Identification and classification of any species recognized as Threatened (in accordance with International Union for the Conservation of Nature [IUCN] Red List Online Version 2022-2) and according to the schedules of the Wildlife (Protection) Act, 1972; and
- Identification of areas which are important or sensitive for ecological reasons including their breeding, nesting, foraging, resting, overwintering areas including wildlife migratory corridors/avian migratory routes.

4.5.3 Ecological Baseline - Results

4.5.3.1 Habitat Survey

In the literature review, different habitats within the study area, were identified with the help of google earth satellite imagery. These habitats were verified during the reconnaissance survey in site visit.

Manufacturing Unit

As per the google earth satellite imagery and primary site survey, the study area consists of natural habitats (open scrub & water bodies), and modified habitats (agricultural land including plantation). The distribution of identified habitats within the study area can be seen in ***Figure 4-35.*** Photographs of these habitats have been presented in ***Figure 4-37***.

Supply Chain Catchment Area

As per the google earth satellite imagery and primary site survey, the supply chain catchment area consists of natural habitats (Dense Vegetation / forest, open scrub, & water bodies), and modified habitats (agricultural land including plantations). The distribution of identified habitats within the study area can be seen in ***Figure 4-36***. Photographs of these habitats have been presented in ***Figure 4-37***.

The supply chain catchment area covered by different natural and modified habitats and has been listed in ***Table 4-28.*** Among the natural habitats, Dense Vegetation / forest is the dominating one with 6.10% of all land cover; followed by Open scrub (3.45%), and Water bodies & River (2.15%). On the other hand, Agricultural land (including plantations) is the dominating modified habitat with 85.75% of total land cover.

A recommendation has been made to categorize all forest patches within the Supply Chain Catchment Area (***Figure 4-36***) as exclusion zones, thereby prohibiting the procurement of wood from these designated areas.

Table 4-28: Area covered by different habitats in the study area

Natural Habitats	Area covered		Modified Habitats	Area covered	
	Ha	%		Ha	%
Dense Vegetation / forest	807.76	6.10	Agricultural land including plantations	11348.71	85.75

[94] Grewal, B., Sen, S., Singh, S., Devasar, N. & Bhatia G. (2016) A Pictorial Field Guide to Birds of India, Pakistan, Nepal, Bhutan, Sri Lanka and Bangladesh. Om Books International, Noida, Uttar Pradesh, India.

[95] Menon, V. (2014) Indian Mammals: A Field Guide. Hachette, India

Natural Habitats	Area covered	
	Ha	%
Open scrub	456.41	3.45
Water bodies & River	284.93	2.15

Modified Habitats	Area covered	
	Ha	%
Roads	210.20	1.59
Urban Land	126.68	0.96

Figure 4-35: Distribution of habitats in the study area (Manufacturing Unit)

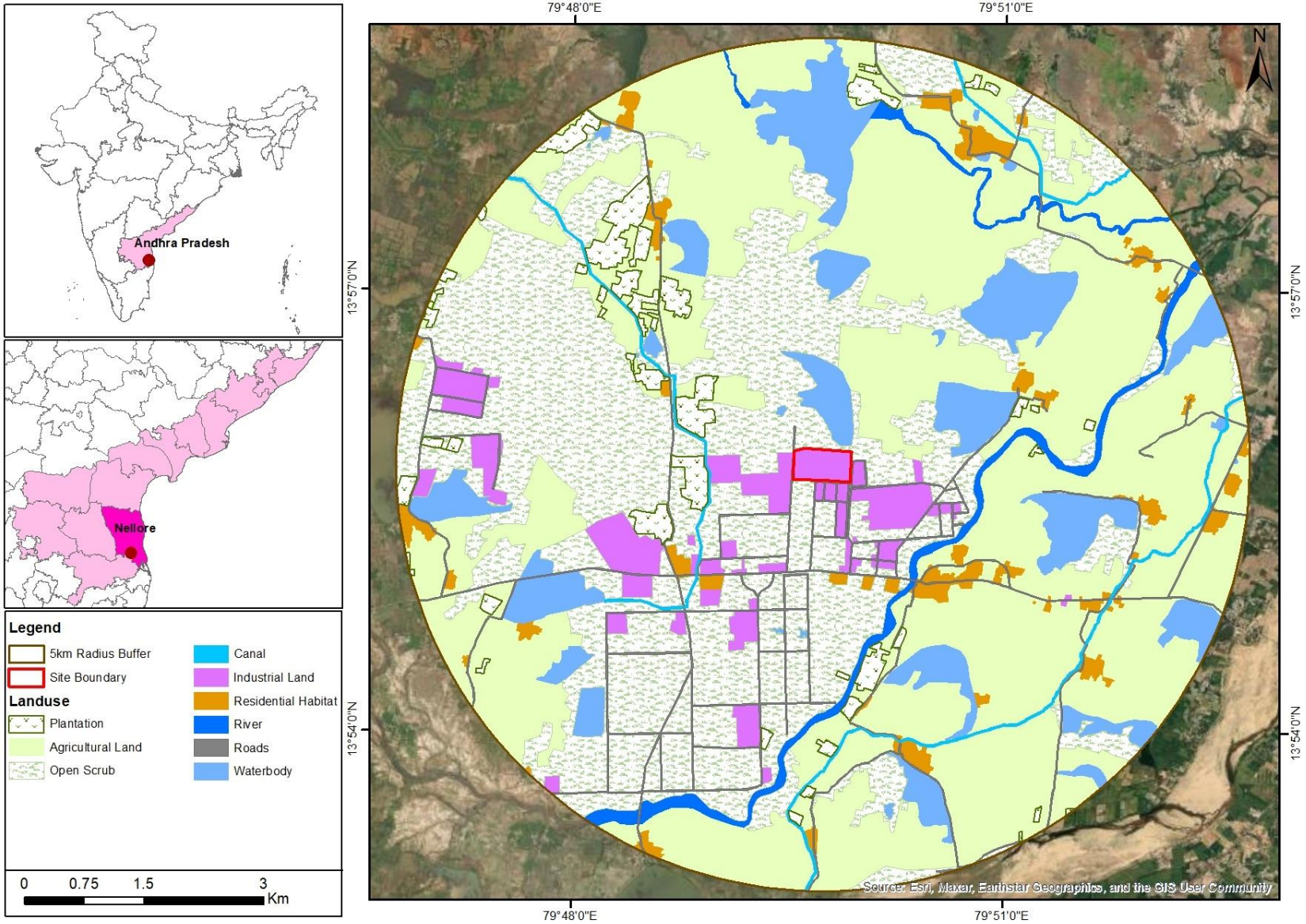


Figure 4-36: Distribution of habitats in the study area / EAAA (Supply Chain Catchment Area)

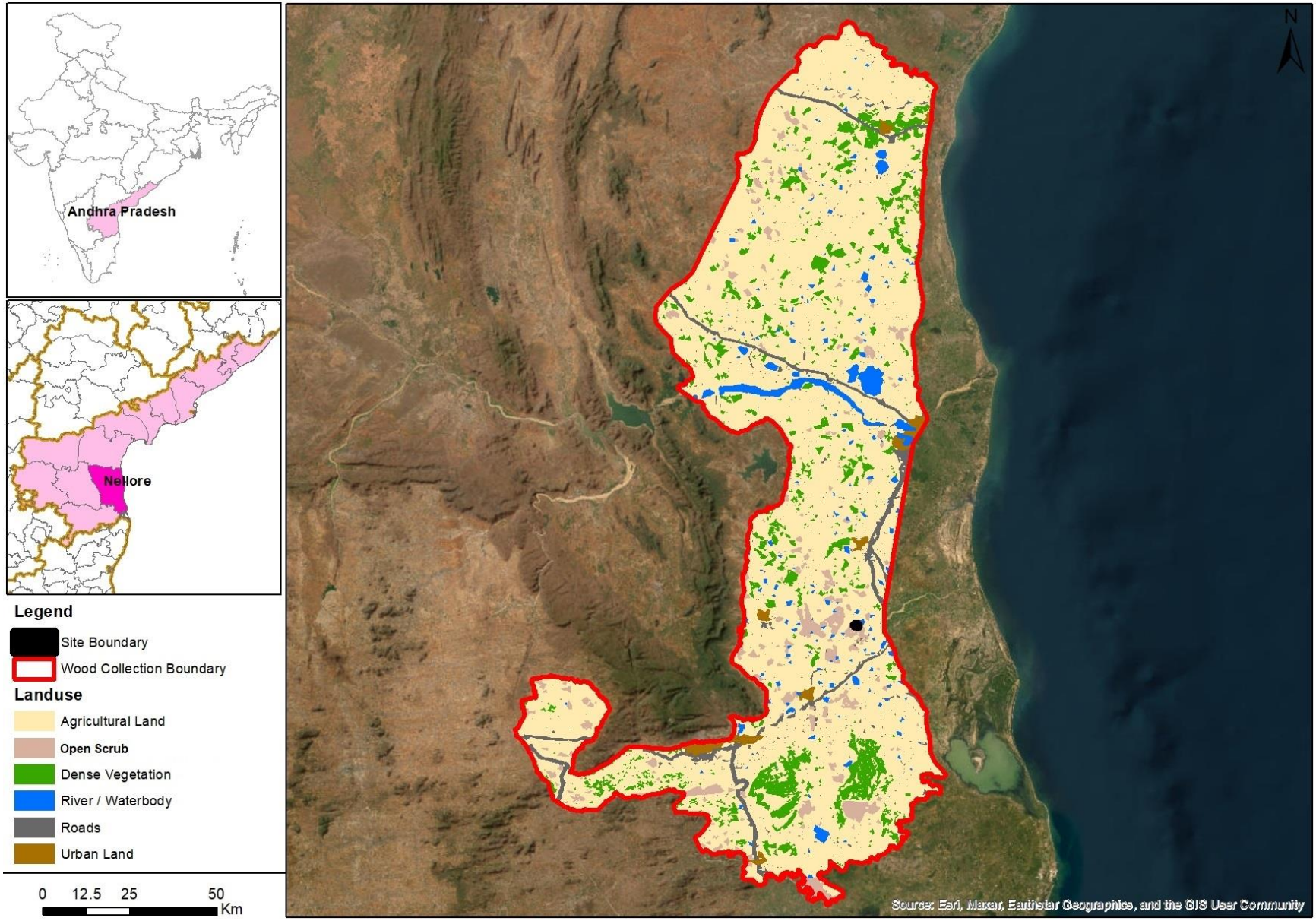
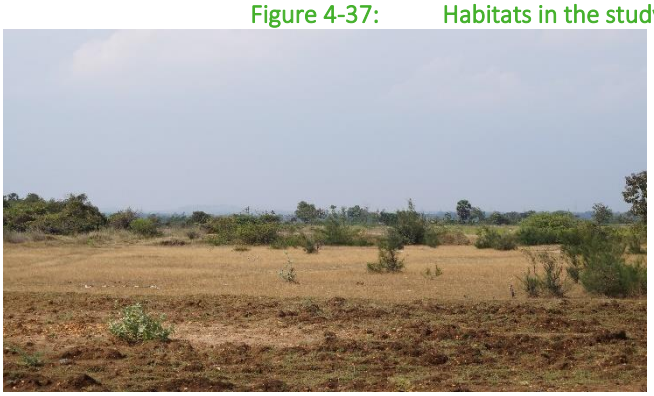


Figure 4-37: Habitats in the study area (Manufacturing Unit & Catchment Area)


Open Scrub


Water Body


Agricultural Land


Plantation

4.5.3.2 Literature Review - eBird Database

Manufacturing Unit

The historical data regarding the presence of birds in the region was extracted from the eBird Database[96]. The major objective to extract this information was to see the incidence of migratory birds, vultures, raptors, and IUCN Threatened birds in the region (50 km buffer from the manufacturing unit). As per the eBird Database, at least 313 avifaunal species including 109 migratory birds were reported from the region. The data indicates the presence of one Critically Endangered [White-Rumped Vulture (*Gyps bengalensis*)]; one Endangered [Great Knot (*Calidris tenuirostris*)]; six Vulnerable [Common Pochard (*Aythya ferina*), Greater Spotted Eagle (*Clanga clanga*), Indian Spotted Eagle (*Clanga hastata*), River Tern (*Sterna aurantia*), Tawny Eagle (*Aquila rapax*), & Yellow-throated Bulbul (*Pycnonotus xantholaemus*)]; and 28 Schedule I [Black Baza, Black Eagle, Black Kite, Black-winged Kite, Bonelli's Eagle, Booted Eagle, Brahminy Kite, Changeable Hawk-Eagle, Crested Goshawk, Crested Serpent-Eagle, Eurasian Buzzard, Eurasian Spoonbill, Fulvous Whistling-duck, Greater Spotted Eagle, Indian Grey Hornbill, Indian Peafowl, Montagu's Harrier, Oriental Honey-buzzard, Osprey, Pallid Harrier, Peregrine Falcon, Red-necked Falcon, Rufous-bellied Eagle, Shikra, Short-toed Snake-Eagle, Tawny Eagle, Western Marsh-Harrier, & White-eyed Buzzard] from the region (***Table 4-29***). This secondary information also reports one vulture and thirty-one raptor species from the region (***Table 4-30***).

The only Critically Endangered - White-Rumped Vulture (*Gyps bengalensis*) was last time reported from the Pulicat Bird Sanctuary in Jan. 2016, and after that no record is available in the region for the species[97]. As per the available secondary records, the presence of migratory Great Knot (*Calidris tenuirostris*) - Endangered is restricted along the coasts. The nearest records for this Endangered species are available from the Pulicat Bird Sanctuary (about 23 km from the manufacturing unit)[98]. Grey-fronted Green-pigeon (*Treron affinis*) - Endemic to Eastern Ghats was also reported from the region, specifically from the forests of Sri Venkateshwara National Park (near Tirupati) and Guindy National Park, Chennai[99]. Thus, due to the absence of recent records

[96] https://ebird.org/barchart?byr=2001&eyr=2023&bmo=1&emo=12&r=L5435997,L5424106,L6425561,L14354303,L10891558,L6873924,L12270884,L3167817,L1076318,L14354309,L10068233,L10278697,L14354258

[97] https://ebird.org/map/whrvul1?bmo=1&emo=12&byr=2001&eyr=2023&env.minX=79.467&env.minY=13.659&env.maxX=80.111&env.maxY=14.314&gp=true

[98] https://ebird.org/map/grekno?bmo=1&emo=12&byr=2001&eyr=2023&env.minX=79.467&env.minY=13.659&env.maxX=80.111&env.maxY=14.314&gp=true

[99] https://ebird.org/map/pomgrp2?bmo=1&emo=12&byr=2001&eyr=2023&env.minX=79.467&env.minY=13.659&env.maxX=80.111&env.maxY=14.314&gp=true

(White-Rumped Vulture) and suitable habitat (Great Knot & Grey-fronted Green-pigeon), the presence of the above-mentioned species in the study area is very unlikely.

Table 4-29: Birds reported from the region (Manufacturing Unit)

Sr.No.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
1	Ashy Drongo	*Dicrurus leucophaeus*	M	Least Concern	Schedule IV
2	Ashy Prinia	*Prinia socialis*	R	Least Concern	Schedule IV
3	Ashy Woodswallow	*Artamus fuscus*	R	Least Concern	Not Listed
4	Ashy-crowned Sparrow-lark	*Eremopterix griseus*	R	Least Concern	Schedule IV
5	Asian Brown Flycatcher	*Muscicapa dauurica*	M	Least Concern	Schedule IV
6	Asian Dowitcher	*Limnodromus semipalmatus*	M	Near Threatened	Schedule IV
7	Asian Green Bee-eater	*Merops orientalis*	R	Least Concern	Schedule IV
8	Asian Koel	*Eudynamys scolopaceus*	R	Least Concern	Schedule IV
9	Asian Openbill	*Anastomus oscitans*	R	Least Concern	Schedule IV
10	Asian Palm-swift	*Cypsiurus balasiensis*	R	Least Concern	Schedule IV
11	Baillon's Crake	*Zapornia pusilla*	M	Least Concern	Schedule IV
12	Bar-headed Goose	*Anser indicus*	M	Least Concern	Schedule IV
13	Barn Owl	*Tyto alba*	R	Least Concern	Schedule IV
14	Barn Swallow	*Hirundo rustica*	M	Least Concern	Not Listed
15	Barred Buttonquail	*Turnix suscitator*	R	Least Concern	Schedule IV
16	Baya Weaver	*Ploceus philippinus*	R	Least Concern	Schedule IV
17	Bay-backed Shrike	*Lanius vittatus*	R	Least Concern	Not Listed
18	Black Baza	*Aviceda leuphotes*	M	Least Concern	Schedule I
19	Black Bittern	*Ixobrychus flavicollis*	R	Least Concern	Schedule IV
20	Black Drongo	*Dicrurus macrocercus*	R	Least Concern	Schedule IV
21	Black Eagle	*Ictinaetus malaiensis*	R	Least Concern	Schedule I
22	Black Kite	*Milvus migrans*	R	Least Concern	Schedule I
23	Black Redstart	*Phoenicurus ochruros*	M	Least Concern	Schedule IV
24	Black-breasted Weaver	*Ploceus benghalensis*	R	Least Concern	Schedule IV
25	Black-crowned Night-heron	*Nycticorax*	R	Least Concern	Schedule IV
26	Black-headed Cuckooshrike	*Lalage melanoptera*	R	Least Concern	Schedule IV
27	Black-headed Gull	*Chroicocephalus ridibundus*	M	Least Concern	Schedule IV
28	Black-headed Ibis	*Threskiornis melanocephalus*	R	Near Threatened	Schedule IV
29	Black-hooded Oriole	*Oriolus xanthornus*	R	Least Concern	Schedule IV
30	Black-naped Monarch	*Hypothymis azurea*	R	Least Concern	Schedule IV
31	Black-naped Oriole	*Oriolus chinensis*	R	Least Concern	Schedule IV
32	Black-rumped Flameback	*Dinopium benghalense*	R	Least Concern	Schedule IV
33	Black-tailed Godwit	*Limosa*	M	Near Threatened	Schedule IV
34	Black-winged Kite	*Elanus caeruleus*	R	Least Concern	Schedule I
35	Black-winged Stilt	*Himantopus*	R	Least Concern	Schedule IV
36	Blue-capped Rock-thrush	*Monticola cinclorhyncha*	M	Least Concern	Schedule IV

Sr.No.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
37	Blue-faced Malkoha	*Phaenicophaeus viridirostris*	R	Least Concern	Schedule IV
38	Blue-tailed Bee-eater	*Merops philippinus*	M	Least Concern	Schedule IV
39	Blue-throated Blue-flycatcher	*Cyornis rubeculoides*	M	Least Concern	Schedule IV
40	Blyth's Pipit	*Anthus godlewskii*	M	Least Concern	Schedule IV
41	Blyth's Reed Warbler	*Acrocephalus dumetorum*	M	Least Concern	Schedule IV
42	Bonelli's Eagle	*Aquila fasciata*	R	Least Concern	Schedule I
43	Booted Eagle	*Hieraaetus pennatus*	M	Least Concern	Schedule I
44	Booted Warbler	*Iduna caligata*	M	Least Concern	Schedule IV
45	Brahminy Kite	*Haliastur indus*	R	Least Concern	Schedule I
46	Brahminy Starling	*Sturnia pagodarum*	R	Least Concern	Schedule IV
47	Bridled Tern	*Onychoprion anaethetus*	M	Least Concern	Schedule IV
48	Broad-billed Sandpiper	*Calidris falcinellus*	M	Least Concern	Schedule IV
49	Bronze-winged Jacana	*Metopidius indicus*	R	Least Concern	Schedule IV
50	Brown Shrike	*Lanius cristatus*	M	Least Concern	Not Listed
51	Brown-backed Needletail	*Hirundapus giganteus*	R	Least Concern	Not Listed
52	Brown-breasted Flycatcher	*Muscicapa muttui*	M	Least Concern	Schedule IV
53	Brown-capped Pygmy Woodpecker	*Picoides nanus*	R	Least Concern	Schedule IV
54	Brown-headed Barbet	*Psilopogon zeylanicus*	R	Least Concern	Schedule IV
55	Brown-headed Gull	*Larus brunnicephalus*	M	Least Concern	Schedule IV
56	Caspian Tern	*Hydroprogne caspia*	M	Least Concern	Schedule IV
57	Cattle Egret	*Bubulcus ibis*	R	Least Concern	Schedule IV
58	Changeable Hawk-Eagle	*Nisaetus cirrhatus*	R	Least Concern	Schedule I
59	Chestnut-bellied Sandgrouse	*Pterocles exustus*	R	Least Concern	Schedule IV
60	Chestnut-headed Bee-eater	*Merops leschenaulti*	R	Least Concern	Not Listed
61	Chestnut-tailed Starling	*Sturnia malabarica*	M	Least Concern	Schedule IV
62	Cinnamon Bittern	*Ixobrychus cinnamomeus*	R	Least Concern	Schedule IV
63	Citrine Wagtail	*Motacilla citreola*	M	Least Concern	Schedule IV
64	Clamorous Reed Warbler	*Acrocephalus stentoreus*	R	Least Concern	Schedule IV
65	Common Babbler	*Argya caudata*	R	Least Concern	Schedule IV
66	Common Coot	*Fulica atra*	M	Least Concern	Schedule IV
67	Common Cuckoo	*Cuculus canorus*	R	Least Concern	Schedule IV
68	Common Grasshopper-Warbler	*Locustella naevia*	M	Least Concern	Schedule IV
69	Common Greenshank	*Tringa nebularia*	M	Least Concern	Schedule IV
70	Common Gull-billed Tern	*Gelochelidon nilotica*	M	Least Concern	Schedule IV
71	Common Hawk-cuckoo	*Hierococcyx varius*	R	Least Concern	Schedule IV
72	Common Hoopoe	*Upupa epops*	R	Least Concern	Not Listed
73	Common Iora	*Aegithina tiphia*	R	Least Concern	Schedule IV
74	Common Kestrel	*Falco tinnunculus*	M	Least Concern	Schedule IV
75	Common Kingfisher	*Alcedo atthis*	R	Least Concern	Schedule IV

Sr.No.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
76	Common Moorhen	*Gallinula chloropus*	R	Least Concern	Schedule IV
77	Common Myna	*Acridotheres tristis*	R	Least Concern	Schedule IV
78	Common Pochard	*Aythya ferina*	M	Vulnerable	Schedule IV
79	Common Redshank	*Tringa totanus*	M	Least Concern	Schedule IV
80	Common Rosefinch	*Carpodacus erythrinus*	M	Least Concern	Schedule IV
81	Common Sandpiper	*Actitis hypoleucos*	M	Least Concern	Schedule IV
82	Common Snipe	*Gallinago*	M	Least Concern	Schedule IV
83	Common Tailorbird	*Orthotomus sutorius*	R	Least Concern	Schedule IV
84	Common Teal	*Anas crecca*	M	Least Concern	Schedule IV
85	Common Tern	*Sterna hirundo*	M	Least Concern	Schedule IV
86	Common Woodshrike	*Tephrodornis pondicerianus*	R	Least Concern	Schedule IV
87	Coppersmith Barbet	*Psilopogon haemacephalus*	R	Least Concern	Schedule IV
88	Cotton Pygmy-Goose	*Nettapus coromandelianus*	R	Least Concern	Schedule IV
89	Crested Goshawk	*Accipiter trivirgatus*	R	Least Concern	Schedule I
90	Crested Serpent-Eagle	*Spilornis cheela*	M	Least Concern	Schedule I
91	Crested Treeswift	*Hemiprocne coronata*	R	Least Concern	Not Listed
92	Curlew Sandpiper	*Calidris ferruginea*	M	Near Threatened	Schedule IV
93	Dunlin	*Calidris alpina*	M	Least Concern	Schedule IV
94	Dusky Crag-Martin	*Ptyonoprogne concolor*	R	Least Concern	Not Listed
95	Eurasian Buzzard	*Buteo*	M	Least Concern	Schedule I
96	Eurasian Collared-Dove	*Streptopelia decaocto*	R	Least Concern	Schedule IV
97	Eurasian Curlew	*Numenius arquata*	M	Near Threatened	Schedule IV
98	Eurasian Oystercatcher	*Haematopus ostralegus*	M	Near Threatened	Schedule IV
99	Eurasian Spoonbill	*Platalea leucorodia*	R	Least Concern	Schedule I
100	Eurasian Wigeon	*Mareca penelope*	M	Least Concern	Schedule IV
101	Forest Wagtail	*Dendronanthus indicus*	M	Least Concern	Schedule IV
102	Fork-tailed Drongo-Cuckoo	*Surniculus dicruroides*	R	Least Concern	Not Listed
103	Fulvous Whistling-duck	*Dendrocygna bicolor*	R	Least Concern	Schedule I
104	Gadwall	*Mareca strepera*	M	Least Concern	Schedule IV
105	Garganey	*Spatula querquedula*	M	Least Concern	Schedule IV
106	Glossy Ibis	*Plegadis falcinellus*	M	Least Concern	Schedule IV
107	Golden-fronted Leafbird	*Chloropsis aurifrons*	R	Least Concern	Schedule IV
108	Great Cormorant	*Phalacrocorax carbo*	R	Least Concern	Schedule IV
109	Great Crested Tern	*Thalasseus bergii*	R	Least Concern	Not Listed
110	Great Egret	*Ardea alba*	R	Least Concern	Schedule IV
111	Great Knot	*Calidris tenuirostris*	M	Endangered	Schedule IV
112	Great Tit	*Parus major*	R	Least Concern	Schedule IV
113	Great White Pelican	*Pelecanus onocrotalus*	R	Least Concern	Schedule IV
114	Greater Coucal	*Centropus sinensis*	R	Least Concern	Schedule IV

Sr.No.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
115	Greater Flameback	*Chrysocolaptes guttacristatus*	R	Least Concern	Schedule IV
116	Greater Flamingo	*Phoenicopterus roseus*	M	Least Concern	Schedule IV
117	Greater Painted-snipe	*Rostratula benghalensis*	R	Least Concern	Not Listed
118	Greater Racket-tailed Drongo	*Dicrurus paradiseus*	R	Least Concern	Schedule IV
119	Greater Sand-Plover	*Charadrius leschenaultii*	M	Least Concern	Schedule IV
120	Greater Spotted Eagle	*Clanga*	M	Vulnerable	Schedule I
121	Green Imperial-Pigeon	*Ducula aenea*	R	Near Threatened	Schedule IV
122	Green Sandpiper	*Tringa ochropus*	M	Least Concern	Schedule IV
123	Green Warbler	*Phylloscopus nitidus*	M	Least Concern	Schedule IV
124	Greenish Warbler	*Phylloscopus trochiloides*	M	Least Concern	Schedule IV
125	Grey Francolin	*Francolinus pondicerianus*	R	Least Concern	Schedule IV
126	Grey Heron	*Ardea cinerea*	R	Least Concern	Schedule IV
127	Grey Junglefowl	*Gallus sonneratii*	R	Least Concern	Schedule IV
128	Grey Plover	*Pluvialis squatarola*	M	Least Concern	Schedule IV
129	Grey Wagtail	*Motacilla cinerea*	M	Least Concern	Schedule IV
130	Grey-bellied Cuckoo	*Cacomantis passerinus*	R	Least Concern	Schedule IV
131	Grey-breasted Prinia	*Prinia hodgsonii*	R	Least Concern	Schedule IV
132	Grey-capped Emerald Dove	*Chalcophaps indica*	R	Least Concern	Schedule IV
133	Grey-fronted Green-pigeon	*Treron affinis*	R	Least Concern	Schedule IV
134	Grey-headed Lapwing	*Vanellus cinereus*	M	Least Concern	Schedule IV
135	House Crow	*Corvus splendens*	R	Least Concern	Schedule V
136	House Sparrow	*Passer domesticus*	R	Least Concern	Schedule IV
137	Hume's Leaf-warbler	*Phylloscopus humei*	M	Least Concern	Schedule IV
138	Indian Cormorant	*Phalacrocorax fuscicollis*	R	Least Concern	Schedule IV
139	Indian Courser	*Cursorius coromandelicus*	R	Least Concern	Schedule IV
140	Indian Cuckoo	*Cuculus micropterus*	R	Least Concern	Schedule IV
141	Indian Golden Oriole	*Oriolus kundoo*	R	Least Concern	Schedule IV
142	Indian Grey Hornbill	*Ocyceros birostris*	R	Least Concern	Schedule I
143	Indian Nightjar	*Caprimulgus asiaticus*	R	Least Concern	Schedule IV
144	Indian Paradise-flycatcher	*Terpsiphone paradisi*	R	Least Concern	Schedule IV
145	Indian Peafowl	*Pavo cristatus*	R	Least Concern	Schedule I
146	Indian Pied Starling	*Gracupica contra*	R	Least Concern	Schedule IV
147	Indian Pitta	*Pitta brachyura*	M	Least Concern	Schedule IV
148	Indian Pond Heron	*Ardeola grayii*	R	Least Concern	Schedule IV
149	Indian Robin	*Saxicoloides fulicata*	R	Least Concern	Schedule IV
150	Indian Roller	*Coracias benghalensis*	R	Least Concern	Schedule IV
151	Indian Scimitar-Babbler	*Pomatorhinus horsfieldii*	R	Least Concern	Schedule IV
152	Indian Scops-owl	*Otus bakkamoena*	R	Least Concern	Schedule IV
153	Indian Silverbill	*Euodice malabarica*	R	Least Concern	Schedule IV

Sr.No.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
154	Indian Spot-billed Duck	*Anas poecilorhyncha*	R	Least Concern	Schedule IV
155	Indian Spotted Eagle	*Clanga hastata*	R	Vulnerable	Not Listed
156	Indian Thick-knee	*Burhinus indicus*	R	Least Concern	Not Listed
157	Indian White-eye	*Zosterops palpebrosus*	R	Least Concern	Schedule IV
158	Intermediate Egret	*Ardea intermedia*	R	Least Concern	Schedule IV
159	Jacobin Cuckoo	*Clamator jacobinus*	R	Least Concern	Schedule IV
160	Jerdon's Bushlark	*Mirafra affinis*	R	Least Concern	Not Listed
161	Jerdon's Leafbird	*Chloropsis jerdoni*	R	Least Concern	Not Listed
162	Jerdon's Nightjar	*Caprimulgus atripennis*	R	Least Concern	Schedule IV
163	Jungle Babbler	*Turdoides striatus*	R	Least Concern	Schedule IV
164	Jungle Bush-quail	*Perdicula asiatica*	R	Least Concern	Schedule IV
165	Jungle Myna	*Acridotheres fuscus*	R	Least Concern	Schedule IV
166	Jungle Nightjar	*Caprimulgus indicus*	R	Least Concern	Schedule IV
167	Jungle Owlet	*Glaucidium radiatum*	R	Least Concern	Schedule IV
168	Jungle Prinia	*Prinia sylvatica*	R	Least Concern	Schedule IV
169	Kentish Plover	*Charadrius alexandrinus*	M	Least Concern	Schedule IV
170	Large Cuckooshrike	*Coracina javensis*	R	Least Concern	Not Listed
171	Large Grey Babbler	*Argya malcolmi*	R	Least Concern	Schedule IV
172	Large-billed Crow	*Corvus macrorhynchos*	R	Least Concern	Schedule IV
173	Large-tailed Nightjar	*Caprimulgus macrurus*	R	Least Concern	Schedule IV
174	Laughing Dove	*Streptopelia senegalensis*	R	Least Concern	Schedule IV
175	Lesser Black-backed Gull	*Larus fuscus*	M	Least Concern	Schedule IV
176	Lesser Crested Tern	*Thalasseus bengalensis*	M	Least Concern	Schedule IV
177	Lesser Flamingo	*Phoeniconaias minor*	M	Near Threatened	Schedule IV
178	Lesser Sand-Plover	*Charadrius mongolus*	M	Least Concern	Schedule IV
179	Lesser Whistling-duck	*Dendrocygna javanica*	R	Least Concern	Schedule IV
180	Lesser Whitethroat	*Sylvia curruca*	M	Least Concern	Schedule IV
181	Little Cormorant	*Microcarbo niger*	R	Least Concern	Schedule IV
182	Little Egret	*Egretta garzetta*	R	Least Concern	Schedule IV
183	Little Grebe	*Tachybaptus ruficollis*	R	Least Concern	Schedule IV
184	Little Pratincole	*Glareola lactea*	R	Least Concern	Not Listed
185	Little Ringed Plover	*Charadrius dubius*	R	Least Concern	Schedule IV
186	Little Stint	*Calidris minuta*	M	Least Concern	Schedule IV
187	Little Swift	*Apus affinis*	R	Least Concern	Not Listed
188	Little Tern	*Sternula albifrons*	R	Least Concern	Schedule IV
189	Long-tailed Shrike	*Lanius schach*	R	Least Concern	Not Listed
190	Long-toed Stint	*Calidris subminuta*	M	Least Concern	Schedule IV
191	Loten's Sunbird	*Cinnyris lotenius*	R	Least Concern	Schedule IV
192	Marsh Sandpiper	*Tringa stagnatilis*	M	Least Concern	Schedule IV

Sr.No.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
193	Mongolian Short-toed Lark	*Calandrella dukhunensis*	M	Least Concern	Not Listed
194	Montagu's Harrier	*Circus pygargus*	M	Least Concern	Schedule I
195	Northern Pintail	*Anas acuta*	M	Least Concern	Schedule IV
196	Northern Shoveler	*Spatula clypeata*	M	Least Concern	Schedule IV
197	Orange-headed Thrush	*Geokichla citrina*	M	Least Concern	Schedule IV
198	Oriental Darter	*Anhinga melanogaster*	R	Near Threatened	Schedule IV
199	Oriental Honey-buzzard	*Pernis ptilorhynchus*	R	Least Concern	Schedule I
200	Oriental Magpie-Robin	*Copsychus saularis*	R	Least Concern	Schedule IV
201	Oriental Pratincole	*Glareola maldivarum*	R	Least Concern	Not Listed
202	Oriental Skylark	*Alauda gulgula*	R	Least Concern	Schedule IV
203	Oriental Turtle-Dove	*Streptopelia orientalis*	R	Least Concern	Schedule IV
204	Osprey	*Pandion haliaetus*	M	Least Concern	Schedule I
205	Pacific Golden-Plover	*Pluvialis fulva*	M	Least Concern	Schedule IV
206	Paddyfield Pipit	*Anthus rufulus*	R	Least Concern	Schedule IV
207	Paddyfield Warbler	*Acrocephalus agricola*	M	Least Concern	Schedule IV
208	Painted Spurfowl	*Galloperdix lunulata*	R	Least Concern	Schedule IV
209	Painted Stork	*Mycteria leucocephala*	R	Near Threatened	Schedule IV
210	Pale-billed Flowerpecker	*Dicaeum erythrorhynchos*	R	Least Concern	Schedule IV
211	Pallas's Gull	*Larus ichthyaetus*	M	Least Concern	Schedule IV
212	Pallid Harrier	*Circus macrourus*	M	Near Threatened	Schedule I
213	Peregrine Falcon	*Falco peregrinus*	R	Least Concern	Schedule I
214	Pheasant-tailed Jacana	*Hydrophasianus chirurgus*	R	Least Concern	Schedule IV
215	Pied Avocet	*Recurvirostra avosetta*	M	Least Concern	Schedule IV
216	Pied Bushchat	*Saxicola caprata*	R	Least Concern	Schedule IV
217	Pied Kingfisher	*Ceryle rudis*	R	Least Concern	Schedule IV
218	Pintail Snipe	*Gallinago stenura*	M	Least Concern	Schedule IV
219	Plain Prinia	*Prinia inornata*	R	Least Concern	Schedule IV
220	Plum-headed Parakeet	*Psittacula cyanocephala*	R	Least Concern	Schedule IV
221	Puff-throated Babbler	*Pellorneum ruficeps*	R	Least Concern	Schedule IV
222	Purple Heron	*Ardea purpurea*	R	Least Concern	Schedule IV
223	Purple Sunbird	*Nectarinia asiatica*	R	Least Concern	Schedule IV
224	Purple Swamphen	*Porphyrio*	R	Least Concern	Schedule IV
225	Purple-rumped Sunbird	*Leptocoma zeylonica*	R	Least Concern	Schedule IV
226	Red Avadavat	*Amandava*	R	Least Concern	Schedule IV
227	Red Collared-Dove	*Streptopelia tranquebarica*	R	Least Concern	Schedule IV
228	Red Spurfowl	*Galloperdix spadicea*	R	Least Concern	Schedule IV
229	Red-breasted Flycatcher	*Ficedula parva*	M	Least Concern	Schedule IV
230	Red-crested Pochard	*Netta rufina*	M	Least Concern	Schedule IV
231	Red-naped Ibis	*Pseudibis papillosa*	R	Least Concern	Schedule IV

Sr.No.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
232	Red-necked Falcon	*Falco ruficollis*	M	Least Concern	Schedule I
233	Red-rumped Swallow	*Cecropis daurica*	R	Least Concern	Schedule IV
234	Red-throated Flycatcher	*Ficedula albicilla*	M	Least Concern	Schedule IV
235	Red-vented Bulbul	*Pycnonotus cafer*	R	Least Concern	Schedule IV
236	Red-wattled Lapwing	*Vanellus indicus*	R	Least Concern	Schedule IV
237	Red-whiskered Bulbul	*Pycnonotus jocosus*	R	Least Concern	Schedule IV
238	Richard's Pipit	*Anthus richardi*	M	Least Concern	Schedule IV
239	River Tern	*Sterna aurantia*	R	Vulnerable	Schedule IV
240	Rock Bush-Quail	*Perdicula argoondah*	R	Least Concern	Schedule IV
241	Rock Dove	*Columba livia*	R	Least Concern	Schedule IV
242	Rose-ringed Parakeet	*Psittacula krameri*	R	Least Concern	Schedule IV
243	Rosy Starling	*Pastor roseus*	M	Least Concern	Schedule IV
244	Ruddy Shelduck	*Tadorna ferruginea*	M	Least Concern	Schedule IV
245	Ruddy Turnstone	*Arenaria interpres*	M	Least Concern	Schedule IV
246	Ruddy-breasted Crake	*Zapornia fusca*	R	Least Concern	Schedule IV
247	Ruff	*Calidris pugnax*	M	Least Concern	Schedule IV
248	Rufous Treepie	*Dendrocitta vagabunda*	R	Least Concern	Schedule IV
249	Rufous-bellied Eagle	*Lophotriorchis kienerii*	R	Near Threatened	Schedule I
250	Rufous-tailed Lark	*Ammomanes phoenicura*	R	Least Concern	Schedule IV
251	Sanderling	*Calidris alba*	M	Least Concern	Schedule IV
252	Savanna Nightjar	*Caprimulgus affinis*	R	Least Concern	Schedule IV
253	Scaly-breasted Munia	*Lonchura punctulata*	R	Least Concern	Schedule IV
254	Shikra	*Accipiter badius*	R	Least Concern	Schedule I
255	Short-toed Snake-Eagle	*Circaetus gallicus*	R	Least Concern	Schedule I
256	Siberian Rubythroat	*Calliope*	M	Least Concern	Schedule IV
257	Sirkeer Malkoha	*Taccocua leschenaultii*	R	Least Concern	Schedule IV
258	Slaty-breasted Rail	*Lewinia striata*	R	Least Concern	Schedule IV
259	Slender-billed Gull	*Larus genei*	R	Least Concern	Schedule IV
260	Small Minivet	*Pericrocotus cinnamomeus*	R	Least Concern	Schedule IV
261	Spot-billed Pelican	*Pelecanus phillippensis*	R	Near Threatened	Schedule IV
262	Spotted Dove	*Spilopelia chinensis*	R	Least Concern	Schedule IV
263	Spotted Owlet	*Athene brama*	R	Least Concern	Schedule IV
264	Spotted Redshank	*Tringa erythropus*	M	Least Concern	Schedule IV
265	Streaked Weaver	*Ploceus manyar*	R	Least Concern	Schedule IV
266	Streak-throated Swallow	*Petrochelidon fluvicola*	R	Least Concern	Schedule IV
267	Streak-throated Woodpecker	*Picus xanthopygaeus*	R	Least Concern	Schedule IV
268	Striated Heron	*Butorides striata*	M	Least Concern	Schedule IV
269	Sykes's Warbler	*Iduna rama*	M	Least Concern	Not Listed
270	Tawny Eagle	*Aquila rapax*	R	Vulnerable	Schedule I

Sr.No.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
271	Tawny Pipit	*Anthus campestris*	M	Least Concern	Schedule IV
272	Tawny-bellied Babbler	*Dumetia hyperythra*	R	Least Concern	Schedule IV
273	Temminck's Stint	*Calidris temminckii*	M	Least Concern	Schedule IV
274	Terek Sandpiper	*Xenus cinereus*	M	Least Concern	Schedule IV
275	Thick-billed Flowerpecker	*Dicaeum agile*	R	Least Concern	Schedule IV
276	Tickell's Blue Flycatcher	*Cyornis tickelliae*	R	Least Concern	Schedule IV
277	Tree Pipit	*Anthus trivialis*	M	Least Concern	Schedule IV
278	Tricoloured Munia	*Lonchura malacca*	R	Least Concern	Schedule IV
279	Verditer Flycatcher	*Eumyias thalassinus*	M	Least Concern	Schedule IV
280	Watercock	*Gallicrex cinerea*	R	Least Concern	Schedule IV
281	Western Crowned Leaf-warbler	*Phylloscopus occipitalis*	M	Least Concern	Schedule IV
282	Western Marsh-Harrier	*Circus aeruginosus*	M	Least Concern	Schedule I
283	Western Reef-Egret	*Egretta gularis*	R	Least Concern	Schedule IV
284	Western Yellow Wagtail	*Motacilla flava*	M	Least Concern	Schedule IV
285	Whimbrel	*Numenius phaeopus*	M	Least Concern	Schedule IV
286	Whiskered Tern	*Chlidonias hybrida*	M	Least Concern	Schedule IV
287	White stork	*Ciconia*	M	Least Concern	Schedule IV
288	White Wagtail	*Motacilla alba*	M	Least Concern	Schedule IV
289	White-bellied Drongo	*Dicrurus caerulescens*	R	Least Concern	Schedule IV
290	White-bellied Sea-Eagle	*Haliaeetus leucogaster*	R	Least Concern	Not Listed
291	White-breasted Kingfisher	*Halcyon smyrnensis*	R	Least Concern	Schedule IV
292	White-breasted Waterhen	*Amaurornis phoenicurus*	R	Least Concern	Schedule IV
293	White-browed Bulbul	*Pycnonotus luteolus*	R	Least Concern	Schedule IV
294	White-browed Fantail	*Rhipidura aureola*	R	Least Concern	Schedule IV
295	White-browed Wagtail	*Motacilla maderaspatensis*	R	Least Concern	Schedule IV
296	White-eyed Buzzard	*Butastur teesa*	R	Least Concern	Schedule I
297	White-naped Woodpecker	*Chrysocolaptes festivus*	R	Least Concern	Schedule IV
298	White-rumped Munia	*Lonchura striata*	R	Least Concern	Schedule IV
299	White-rumped Shama	*Kittacincla malabarica*	R	Least Concern	Schedule IV
300	White-rumped Spinetail	*Zoonavena sylvatica*	R	Least Concern	Not Listed
301	White-Rumped Vulture	*Gyps bengalensis*	R	Critically Endangered	Schedule IV
302	White-spotted Fantail	*Rhipidura albogularis*	R	Least Concern	Schedule IV
303	White-Winged Tern	*Chlidonias leucopterus*	M	Least Concern	Schedule IV
304	Wire-tailed Swallow	*Hirundo smithii*	R	Least Concern	Not Listed
305	Wood Sandpiper	*Tringa glareola*	M	Least Concern	Schedule IV
306	Yellow Bittern	*Ixobrychus sinensis*	R	Least Concern	Schedule IV
307	Yellow-billed Babbler	*Turdoides affinis*	R	Least Concern	Schedule IV
308	Yellow-eyed Babbler	*Chrysomma sinense*	R	Least Concern	Schedule IV
309	Yellow-footed Green-Pigeon	*Treron phoenicopterus*	R	Least Concern	Schedule IV

Sr.No.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
310	Yellow-legged Buttonquail	*Turnix tanki*	R	Least Concern	Schedule IV
311	Yellow-throated Bulbul	*Pycnonotus xantholaemus*	R	Vulnerable	Schedule IV
312	Yellow-wattled Lapwing	*Vanellus malabaricus*	R	Least Concern	Schedule IV
313	Zitting Cisticola	*Cisticola juncidis*	R	Least Concern	Schedule IV

Table 4-30: Vulture and Raptors reported from the region (Manufacturing Unit)

Sr.No.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
Vulture					
1	White-Rumped Vulture	*Gyps bengalensis*	R	Critically Endangered	Schedule IV
Raptors					
1	Barn Owl	*Tyto alba*	R	Least Concern	Schedule IV
2	Black Baza	*Aviceda leuphotes*	M	Least Concern	Schedule I
3	Black Eagle	*Ictinaetus malaiensis*	R	Least Concern	Schedule I
4	Black Kite	*Milvus migrans*	R	Least Concern	Schedule I
5	Black-winged Kite	*Elanus caeruleus*	R	Least Concern	Schedule I
6	Bonelli's Eagle	*Aquila fasciata*	R	Least Concern	Schedule I
7	Booted Eagle	*Hieraaetus pennatus*	M	Least Concern	Schedule I
8	Brahminy Kite	*Haliastur indus*	R	Least Concern	Schedule I
9	Changeable Hawk-Eagle	*Nisaetus cirrhatus*	R	Least Concern	Schedule I
10	Common Kestrel	*Falco tinnunculus*	M	Least Concern	Schedule IV
11	Crested Goshawk	*Accipiter trivirgatus*	R	Least Concern	Schedule I
12	Crested Serpent-Eagle	*Spilornis cheela*	M	Least Concern	Schedule I
13	Eurasian Buzzard	*Buteo*	M	Least Concern	Schedule I
14	Greater Spotted Eagle	*Clanga*	M	Vulnerable	Schedule I
15	Indian Scops-owl	*Otus bakkamoena*	R	Least Concern	Schedule IV
16	Indian Spotted Eagle	*Clanga hastata*	R	Vulnerable	Not Listed
17	Jungle Owlet	*Glaucidium radiatum*	R	Least Concern	Schedule IV
18	Montagu's Harrier	*Circus pygargus*	M	Least Concern	Schedule I
19	Oriental Honey-buzzard	*Pernis ptilorhynchus*	R	Least Concern	Schedule I
20	Osprey	*Pandion haliaetus*	M	Least Concern	Schedule I
21	Pallid Harrier	*Circus macrourus*	M	Near Threatened	Schedule I
22	Peregrine Falcon	*Falco peregrinus*	R	Least Concern	Schedule I
23	Red-necked Falcon	*Falco ruficollis*	M	Least Concern	Schedule I
24	Rufous-bellied Eagle	*Lophotriorchis kienerii*	R	Near Threatened	Schedule I
25	Shikra	*Accipiter badius*	R	Least Concern	Schedule I
26	Short-toed Snake-Eagle	*Circaetus gallicus*	R	Least Concern	Schedule I
27	Spotted Owlet	*Athene brama*	R	Least Concern	Schedule IV
28	Tawny Eagle	*Aquila rapax*	R	Vulnerable	Schedule I

Sr.No.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
29	Western Marsh-Harrier	*Circus aeruginosus*	M	Least Concern	Schedule I
30	White-bellied Sea-Eagle	*Haliaeetus leucogaster*	R	Least Concern	Not Listed
31	White-eyed Buzzard	*Butastur teesa*	R	Least Concern	Schedule I

Supply Chain Catchment Area

The historical data regarding the presence of birds in the potential supply chain catchment area for wood collection as well as promotion of plantation, was extracted from the eBird Database[100]. The major objective to extract this information was to see the incidence of migratory birds, vultures, raptors, and IUCN Threatened birds in the catchment area. As per the eBird Database, at least 338 avifaunal species including 122 migratory birds were reported from the region. The data indicates the presence of one Critically Endangered [White-Rumped Vulture (*Gyps bengalensis*)]; one Endangered [Great Knot (*Calidris tenuirostris*)]; six Vulnerable [Common Pochard (*Aythya ferina*), Greater Spotted Eagle (*Clanga clanga*), Indian Spotted Eagle (*Clanga hastata*), River Tern (*Sterna aurantia*), Tawny Eagle (*Aquila rapax*), & Yellow-throated Bulbul (*Pycnonotus xantholaemus*)]; and 29 Schedule I [Black Baza, Black Eagle, Black Kite, Black-winged Kite, Bonelli's Eagle, Booted Eagle, Brahminy Kite, Changeable Hawk-Eagle, Crested Goshawk, Crested Serpent-Eagle, Eurasian Buzzard, Eurasian Sparrowhawk, Eurasian Spoonbill, Fulvous Whistling-duck, Greater Spotted Eagle, Indian Grey Hornbill, Indian Peafowl, Montagu's Harrier, Oriental Honey-buzzard, Osprey, Pallid Harrier, Peregrine Falcon, Red-necked Falcon, Rufous-bellied Eagle, Shikra, Short-toed Snake-Eagle, Tawny Eagle, Western Marsh-Harrier, & White-eyed Buzzard] from the region (***Table 4-31***). This secondary information also reports one vulture and thirty-five raptor species from the region (***Table 4-32***).

The only Critically Endangered - White-Rumped Vulture (*Gyps bengalensis*) was last time reported from the Pulicat Bird Sanctuary in Jan. 2016, and after that no record is available in the region for the species[101]. As per the available secondary records, the presence of migratory Great Knot (*Calidris tenuirostris*) - Endangered is restricted along the coasts. The nearest records for this Endangered species are available from the Pulicat Bird Sanctuary (about 23 km from the manufacturing unit)[102]. Grey-fronted Green-pigeon (*Treron affinis*) - Endemic to Eastern Ghats was also reported from the region, specifically from the forests of Sri Venkateshwara National Park (near Tirupati) and Guindy National Park, Chennai[103]. Thus, due to the absence of recent records (White-Rumped Vulture) and suitable habitat (Great Knot & Grey-fronted Green-pigeon), the presence of the above-mentioned species in the study area is very unlikely.

Table 4-31: Birds reported from the region (Supply Chain Catchment Area)

Sr.No.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
1	African Comb Duck	*Sarkidiornis melanotos*	R	Least Concern	Schedule IV
2	Ashy Drongo	*Dicrurus leucophaeus*	M	Least Concern	Schedule IV
3	Ashy Prinia	*Prinia socialis*	R	Least Concern	Schedule IV
4	Ashy Woodswallow	*Artamus fuscus*	R	Least Concern	Not Listed
5	Ashy-crowned Sparrow-lark	*Eremopterix griseus*	R	Least Concern	Schedule IV
6	Asian Brown Flycatcher	*Muscicapa dauurica*	M	Least Concern	Schedule IV
7	Asian Dowitcher	*Limnodromus semipalmatus*	M	Near Threatened	Schedule IV
8	Asian Green Bee-eater	*Merops orientalis*	R	Least Concern	Schedule IV
9	Asian Koel	*Eudynamys scolopaceus*	R	Least Concern	Schedule IV

[100] https://ebird.org/barchart?byr=2001&eyr=2023&bmo=1&emo=12&r=L3852120,L10692120,L20383898,L5435997,L5424106,L6425561,L14354303,L10134565,L8042657,L14320101,L10891558,L17894576,L10807842,L10068228,L6873924,L12270884,L14091458,L3167817,L1076318,L14354309,L13720473,L11676689,L6720719,L12531875,L10068233,L11539895,L10139618,L967216,L10278697,L10282520,L967219,L5540948,L20501356,L14354258,L14320085

[101] https://ebird.org/map/whrvul1?bmo=1&emo=12&byr=2001&eyr=2023&env.minX=79.467&env.minY=13.659&env.maxX=80.111&env.maxY=14.314&gp=true

[102] https://ebird.org/map/grekno?bmo=1&emo=12&byr=2001&eyr=2023&env.minX=79.467&env.minY=13.659&env.maxX=80.111&env.maxY=14.314&gp=true

[103] https://ebird.org/map/pomgrp2?bmo=1&emo=12&byr=2001&eyr=2023&env.minX=79.467&env.minY=13.659&env.maxX=80.111&env.maxY=14.314&gp=true

Sr.No.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
10	Asian Openbill	*Anastomus oscitans*	R	Least Concern	Schedule IV
11	Asian Palm-swift	*Cypsiurus balasiensis*	R	Least Concern	Schedule IV
12	Baillon's Crake	*Zapornia pusilla*	M	Least Concern	Schedule IV
13	Bar-headed Goose	*Anser indicus*	M	Least Concern	Schedule IV
14	Barn Owl	*Tyto alba*	R	Least Concern	Schedule IV
15	Barn Swallow	*Hirundo rustica*	M	Least Concern	Not Listed
16	Barred Buttonquail	*Turnix suscitator*	R	Least Concern	Schedule IV
17	Baya Weaver	*Ploceus philippinus*	R	Least Concern	Schedule IV
18	Bay-backed Shrike	*Lanius vittatus*	R	Least Concern	Not Listed
19	Black Baza	*Aviceda leuphotes*	M	Least Concern	Schedule I
20	Black Bittern	*Ixobrychus flavicollis*	R	Least Concern	Schedule IV
21	Black Drongo	*Dicrurus macrocercus*	R	Least Concern	Schedule IV
22	Black Eagle	*Ictinaetus malaiensis*	R	Least Concern	Schedule I
23	Black Kite	*Milvus migrans*	R	Least Concern	Schedule I
24	Black Redstart	*Phoenicurus ochruros*	M	Least Concern	Schedule IV
25	Black-breasted Weaver	*Ploceus benghalensis*	R	Least Concern	Schedule IV
26	Black-crowned Night-heron	*Nycticorax*	R	Least Concern	Schedule IV
27	Black-headed Cuckooshrike	*Lalage melanoptera*	R	Least Concern	Schedule IV
28	Black-headed Gull	*Chroicocephalus ridibundus*	M	Least Concern	Schedule IV
29	Black-headed Ibis	*Threskiornis melanocephalus*	R	Near Threatened	Schedule IV
30	Black-hooded Oriole	*Oriolus xanthornus*	R	Least Concern	Schedule IV
31	Black-naped Monarch	*Hypothymis azurea*	R	Least Concern	Schedule IV
32	Black-naped Oriole	*Oriolus chinensis*	R	Least Concern	Schedule IV
33	Black-rumped Flameback	*Dinopium benghalense*	R	Least Concern	Schedule IV
34	Black-tailed Godwit	*Limosa*	M	Near Threatened	Schedule IV
35	Black-winged Kite	*Elanus caeruleus*	R	Least Concern	Schedule I
36	Black-winged Stilt	*Himantopus*	R	Least Concern	Schedule IV
37	Blue Rock-Thrush	*Monticola solitarius*	M	Least Concern	Schedule IV
38	Blue-bearded Bee-eater	*Nyctyornis athertoni*	R	Least Concern	Not Listed
39	Blue-capped Rock-thrush	*Monticola cinclorhyncha*	M	Least Concern	Schedule IV
40	Blue-faced Malkoha	*Phaenicophaeus viridirostris*	R	Least Concern	Schedule IV
41	Blue-tailed Bee-eater	*Merops philippinus*	M	Least Concern	Schedule IV
42	Blue-throated Blue-flycatcher	*Cyornis rubeculoides*	M	Least Concern	Schedule IV
43	Blyth's Pipit	*Anthus godlewskii*	M	Least Concern	Schedule IV
44	Blyth's Reed Warbler	*Acrocephalus dumetorum*	M	Least Concern	Schedule IV
45	Bonelli's Eagle	*Aquila fasciata*	R	Least Concern	Schedule I
46	Booted Eagle	*Hieraaetus pennatus*	M	Least Concern	Schedule I
47	Booted Warbler	*Iduna caligata*	M	Least Concern	Schedule IV
48	Brahminy Kite	*Haliastur indus*	R	Least Concern	Schedule I

Sr.No.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
49	Brahminy Starling	*Sturnia pagodarum*	R	Least Concern	Schedule IV
50	Bridled Tern	*Onychoprion anaethetus*	M	Least Concern	Schedule IV
51	Broad-billed Sandpiper	*Calidris falcinellus*	M	Least Concern	Schedule IV
52	Bronze-winged Jacana	*Metopidius indicus*	R	Least Concern	Schedule IV
53	Brown Fish-Owl	*Ketupa zeylonensis*	R	Least Concern	Schedule IV
54	Brown Shrike	*Lanius cristatus*	M	Least Concern	Not Listed
55	Brown-backed Needletail	*Hirundapus giganteus*	R	Least Concern	Not Listed
56	Brown-breasted Flycatcher	*Muscicapa muttui*	M	Least Concern	Schedule IV
57	Brown-capped Pygmy Woodpecker	*Picoides nanus*	R	Least Concern	Schedule IV
58	Brown-cheeked Fulvetta	*Alcippe poioicephala*	R	Least Concern	Schedule IV
59	Brown-headed Barbet	*Psilopogon zeylanicus*	R	Least Concern	Schedule IV
60	Brown-headed Gull	*Larus brunnicephalus*	M	Least Concern	Schedule IV
61	Caspian Tern	*Hydroprogne caspia*	M	Least Concern	Schedule IV
62	Cattle Egret	*Bubulcus ibis*	R	Least Concern	Schedule IV
63	Changeable Hawk-Eagle	*Nisaetus cirrhatus*	R	Least Concern	Schedule I
64	Chestnut-bellied Sandgrouse	*Pterocles exustus*	R	Least Concern	Schedule IV
65	Chestnut-headed Bee-eater	*Merops leschenaulti*	R	Least Concern	Not Listed
66	Chestnut-shouldered Bush-sparrow	*Gymnoris xanthocollis*	R	Least Concern	Schedule IV
67	Chestnut-tailed Starling	*Sturnia malabarica*	M	Least Concern	Schedule IV
68	Cinnamon Bittern	*Ixobrychus cinnamomeus*	R	Least Concern	Schedule IV
69	Citrine Wagtail	*Motacilla citreola*	M	Least Concern	Schedule IV
70	Clamorous Reed Warbler	*Acrocephalus stentoreus*	R	Least Concern	Schedule IV
71	Common Babbler	*Argya caudata*	R	Least Concern	Schedule IV
72	Common Coot	*Fulica atra*	M	Least Concern	Schedule IV
73	Common Cuckoo	*Cuculus canorus*	R	Least Concern	Schedule IV
74	Common Grasshopper-Warbler	*Locustella naevia*	M	Least Concern	Schedule IV
75	Common Greenshank	*Tringa nebularia*	M	Least Concern	Schedule IV
76	Common Gull-billed Tern	*Gelochelidon nilotica*	M	Least Concern	Schedule IV
77	Common Hawk-cuckoo	*Hierococcyx varius*	R	Least Concern	Schedule IV
78	Common Hoopoe	*Upupa epops*	R	Least Concern	Not Listed
79	Common Iora	*Aegithina tiphia*	R	Least Concern	Schedule IV
80	Common Kestrel	*Falco tinnunculus*	M	Least Concern	Schedule IV
81	Common Kingfisher	*Alcedo atthis*	R	Least Concern	Schedule IV
82	Common Moorhen	*Gallinula chloropus*	R	Least Concern	Schedule IV
83	Common Myna	*Acridotheres tristis*	R	Least Concern	Schedule IV
84	Common Pochard	*Aythya ferina*	M	Vulnerable	Schedule IV
85	Common Redshank	*Tringa totanus*	M	Least Concern	Schedule IV
86	Common Rosefinch	*Carpodacus erythrinus*	M	Least Concern	Schedule IV
87	Common Sandpiper	*Actitis hypoleucos*	M	Least Concern	Schedule IV

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88	Common Snipe	*Gallinago gallinago*	M	Least Concern	Schedule IV
89	Common Tailorbird	*Orthotomus sutorius*	R	Least Concern	Schedule IV
90	Common Teal	*Anas crecca*	M	Least Concern	Schedule IV
91	Common Tern	*Sterna hirundo*	M	Least Concern	Schedule IV
92	Common Woodshrike	*Tephrodornis pondicerianus*	R	Least Concern	Schedule IV
93	Coppersmith Barbet	*Psilopogon haemacephalus*	R	Least Concern	Schedule IV
94	Cotton Pygmy-Goose	*Nettapus coromandelianus*	R	Least Concern	Schedule IV
95	Crested Goshawk	*Accipiter trivirgatus*	R	Least Concern	Schedule I
96	Crested Serpent-Eagle	*Spilornis cheela*	M	Least Concern	Schedule I
97	Crested Treeswift	*Hemiprocne coronata*	R	Least Concern	Not Listed
98	Curlew Sandpiper	*Calidris ferruginea*	M	Near Threatened	Schedule IV
99	Dunlin	*Calidris alpina*	M	Least Concern	Schedule IV
100	Dusky Crag-Martin	*Ptyonoprogne concolor*	R	Least Concern	Not Listed
101	Eurasian Buzzard	*Buteo*	M	Least Concern	Schedule I
102	Eurasian Collared-Dove	*Streptopelia decaocto*	R	Least Concern	Schedule IV
103	Eurasian Curlew	*Numenius arquata*	M	Near Threatened	Schedule IV
104	Eurasian Oystercatcher	*Haematopus ostralegus*	M	Near Threatened	Schedule IV
105	Eurasian Sparrowhawk	*Accipiter nisus*	M	Least Concern	Schedule I
106	Eurasian Spoonbill	*Platalea leucorodia*	R	Least Concern	Schedule I
107	Eurasian Wigeon	*Mareca penelope*	M	Least Concern	Schedule IV
108	Forest Wagtail	*Dendronanthus indicus*	M	Least Concern	Schedule IV
109	Fork-tailed Drongo-Cuckoo	*Surniculus dicruroides*	R	Least Concern	Not Listed
110	Fulvous Whistling-duck	*Dendrocygna bicolor*	R	Least Concern	Schedule I
111	Gadwall	*Mareca strepera*	M	Least Concern	Schedule IV
112	Garganey	*Spatula querquedula*	M	Least Concern	Schedule IV
113	Glossy Ibis	*Plegadis falcinellus*	M	Least Concern	Schedule IV
114	Golden-fronted Leafbird	*Chloropsis aurifrons*	R	Least Concern	Schedule IV
115	Great Cormorant	*Phalacrocorax carbo*	R	Least Concern	Schedule IV
116	Great Crested Tern	*Thalasseus bergii*	R	Least Concern	Not Listed
117	Great Egret	*Ardea alba*	R	Least Concern	Schedule IV
118	Great Grey Shrike	*Lanius excubitor*	R	Least Concern	Not Listed
119	Great Knot	*Calidris tenuirostris*	M	Endangered	Schedule IV
120	Great Tit	*Parus major*	R	Least Concern	Schedule IV
121	Great White Pelican	*Pelecanus onocrotalus*	R	Least Concern	Schedule IV
122	Greater Coucal	*Centropus sinensis*	R	Least Concern	Schedule IV
123	Greater Flameback	*Chrysocolaptes guttacristatus*	R	Least Concern	Schedule IV
124	Greater Flamingo	*Phoenicopterus roseus*	M	Least Concern	Schedule IV
125	Greater Painted-snipe	*Rostratula benghalensis*	R	Least Concern	Not Listed
126	Greater Racket-tailed Drongo	*Dicrurus paradiseus*	R	Least Concern	Schedule IV

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127	Greater Sand-Plover	*Charadrius leschenaultii*	M	Least Concern	Schedule IV
128	Greater Spotted Eagle	*Clanga*	M	Vulnerable	Schedule I
129	Green Imperial-Pigeon	*Ducula aenea*	R	Near Threatened	Schedule IV
130	Green Sandpiper	*Tringa ochropus*	M	Least Concern	Schedule IV
131	Green Warbler	*Phylloscopus nitidus*	M	Least Concern	Schedule IV
132	Greenish Warbler	*Phylloscopus trochiloides*	M	Least Concern	Schedule IV
133	Grey Francolin	*Francolinus pondicerianus*	R	Least Concern	Schedule IV
134	Grey Heron	*Ardea cinerea*	R	Least Concern	Schedule IV
135	Grey Junglefowl	*Gallus sonneratii*	R	Least Concern	Schedule IV
136	Grey Plover	*Pluvialis squatarola*	M	Least Concern	Schedule IV
137	Grey Wagtail	*Motacilla cinerea*	M	Least Concern	Schedule IV
138	Grey-bellied Cuckoo	*Cacomantis passerinus*	R	Least Concern	Schedule IV
139	Grey-breasted Prinia	*Prinia hodgsonii*	R	Least Concern	Schedule IV
140	Grey-capped Emerald Dove	*Chalcophaps indica*	R	Least Concern	Schedule IV
141	Grey-fronted Green-pigeon	*Treron affinis*	R	Least Concern	Schedule IV
142	Grey-headed Lapwing	*Vanellus cinereus*	M	Least Concern	Schedule IV
143	Spangled Drongo	*Dicrurus hottentottus*	M	Least Concern	Schedule IV
144	House Crow	*Corvus splendens*	R	Least Concern	Schedule V
145	House Sparrow	*Passer domesticus*	R	Least Concern	Schedule IV
146	Hume's Leaf-warbler	*Phylloscopus humei*	M	Least Concern	Schedule IV
147	Indian Blue Robin	*Larvivora brunnea*	M	Least Concern	Schedule IV
148	Indian Cormorant	*Phalacrocorax fuscicollis*	R	Least Concern	Schedule IV
149	Indian Courser	*Cursorius coromandelicus*	R	Least Concern	Schedule IV
150	Indian Cuckoo	*Cuculus micropterus*	R	Least Concern	Schedule IV
151	Indian Golden Oriole	*Oriolus kundoo*	R	Least Concern	Schedule IV
152	Indian Grey Hornbill	*Ocyceros birostris*	R	Least Concern	Schedule I
153	Indian Nightjar	*Caprimulgus asiaticus*	R	Least Concern	Schedule IV
154	Indian Paradise-flycatcher	*Terpsiphone paradisi*	R	Least Concern	Schedule IV
155	Indian Peafowl	*Pavo cristatus*	R	Least Concern	Schedule I
156	Indian Pied Starling	*Gracupica contra*	R	Least Concern	Schedule IV
157	Indian Pitta	*Pitta brachyura*	M	Least Concern	Schedule IV
158	Indian Pond Heron	*Ardeola grayii*	R	Least Concern	Schedule IV
159	Indian Robin	*Saxicoloides fulicata*	R	Least Concern	Schedule IV
160	Indian Roller	*Coracias benghalensis*	R	Least Concern	Schedule IV
161	Indian Scimitar-Babbler	*Pomatorhinus horsfieldii*	R	Least Concern	Schedule IV
162	Indian Scops-owl	*Otus bakkamoena*	R	Least Concern	Schedule IV
163	Indian Silverbill	*Euodice malabarica*	R	Least Concern	Schedule IV
164	Indian Spot-billed Duck	*Anas poecilorhyncha*	R	Least Concern	Schedule IV
165	Indian Spotted Eagle	*Clanga hastata*	R	Vulnerable	Not Listed

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166	Indian Thick-knee	*Burhinus indicus*	R	Least Concern	Not Listed
167	Indian White-eye	*Zosterops palpebrosus*	R	Least Concern	Schedule IV
168	Intermediate Egret	*Ardea intermedia*	R	Least Concern	Schedule IV
169	Isabelline Shrike	*Lanius isabellinus*	M	Least Concern	Not Listed
170	Jacobin Cuckoo	*Clamator jacobinus*	R	Least Concern	Schedule IV
171	Jerdon's Bushlark	*Mirafra affinis*	R	Least Concern	Not Listed
172	Jerdon's Leafbird	*Chloropsis jerdoni*	R	Least Concern	Not Listed
173	Jerdon's Nightjar	*Caprimulgus atripennis*	R	Least Concern	Schedule IV
174	Jungle Babbler	*Turdoides striatus*	R	Least Concern	Schedule IV
175	Jungle Bush-quail	*Perdicula asiatica*	R	Least Concern	Schedule IV
176	Jungle Myna	*Acridotheres fuscus*	R	Least Concern	Schedule IV
177	Jungle Nightjar	*Caprimulgus indicus*	R	Least Concern	Schedule IV
178	Jungle Owlet	*Glaucidium radiatum*	R	Least Concern	Schedule IV
179	Jungle Prinia	*Prinia sylvatica*	R	Least Concern	Schedule IV
180	Kentish Plover	*Charadrius alexandrinus*	M	Least Concern	Schedule IV
181	Large Cuckooshrike	*Coracina javensis*	R	Least Concern	Not Listed
182	Large Grey Babbler	*Argya malcolmi*	R	Least Concern	Schedule IV
183	Large-billed Crow	*Corvus macrorhynchos*	R	Least Concern	Schedule IV
184	Large-billed Leaf Warbler	*Phylloscopus magnirostris*	M	Least Concern	Schedule IV
185	Large-tailed Nightjar	*Caprimulgus macrurus*	R	Least Concern	Schedule IV
186	Laughing Dove	*Streptopelia senegalensis*	R	Least Concern	Schedule IV
187	Lesser Black-backed Gull	*Larus fuscus*	M	Least Concern	Schedule IV
188	Lesser Crested Tern	*Thalasseus bengalensis*	M	Least Concern	Schedule IV
189	Lesser Flamingo	*Phoeniconaias minor*	M	Near Threatened	Schedule IV
190	Lesser Sand-Plover	*Charadrius mongolus*	M	Least Concern	Schedule IV
191	Lesser Whistling-duck	*Dendrocygna javanica*	R	Least Concern	Schedule IV
192	Lesser Whitethroat	*Sylvia curruca*	M	Least Concern	Schedule IV
193	Little Cormorant	*Microcarbo niger*	R	Least Concern	Schedule IV
194	Little Egret	*Egretta garzetta*	R	Least Concern	Schedule IV
195	Little Grebe	*Tachybaptus ruficollis*	R	Least Concern	Schedule IV
196	Little Pratincole	*Glareola lactea*	R	Least Concern	Not Listed
197	Little Ringed Plover	*Charadrius dubius*	R	Least Concern	Schedule IV
198	Little Stint	*Calidris minuta*	M	Least Concern	Schedule IV
199	Little Swift	*Apus affinis*	R	Least Concern	Not Listed
200	Little Tern	*Sternula albifrons*	R	Least Concern	Schedule IV
201	Long-tailed Shrike	*Lanius schach*	R	Least Concern	Not Listed
202	Long-toed Stint	*Calidris subminuta*	M	Least Concern	Schedule IV
203	Loten's Sunbird	*Cinnyris lotenius*	R	Least Concern	Schedule IV
204	Marsh Sandpiper	*Tringa stagnatilis*	M	Least Concern	Schedule IV

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205	Mongolian Short-toed Lark	*Calandrella dukhunensis*	M	Least Concern	Not Listed
206	Montagu's Harrier	*Circus pygargus*	M	Least Concern	Schedule I
207	Northern Pintail	*Anas acuta*	M	Least Concern	Schedule IV
208	Northern Shoveler	*Spatula clypeata*	M	Least Concern	Schedule IV
209	Orange-breasted Green-Pigeon	*Treron bicinctus*	R	Least Concern	Schedule IV
210	Orange-headed Thrush	*Geokichla citrina*	M	Least Concern	Schedule IV
211	Oriental Darter	*Anhinga melanogaster*	R	Near Threatened	Schedule IV
212	Oriental Honey-buzzard	*Pernis ptilorhynchus*	R	Least Concern	Schedule I
213	Oriental Magpie-Robin	*Copsychus saularis*	R	Least Concern	Schedule IV
214	Oriental Pratincole	*Glareola maldivarum*	R	Least Concern	Not Listed
215	Oriental Scops-Owl	*Otus sunia*	R	Least Concern	Schedule IV
216	Oriental Skylark	*Alauda gulgula*	R	Least Concern	Schedule IV
217	Oriental Turtle-Dove	*Streptopelia orientalis*	R	Least Concern	Schedule IV
218	Osprey	*Pandion haliaetus*	M	Least Concern	Schedule I
219	Pacific Golden-Plover	*Pluvialis fulva*	M	Least Concern	Schedule IV
220	Paddyfield Pipit	*Anthus rufulus*	R	Least Concern	Schedule IV
221	Paddyfield Warbler	*Acrocephalus agricola*	M	Least Concern	Schedule IV
222	Painted Spurfowl	*Galloperdix lunulata*	R	Least Concern	Schedule IV
223	Painted Stork	*Mycteria leucocephala*	R	Near Threatened	Schedule IV
224	Pale-billed Flowerpecker	*Dicaeum erythrorhynchos*	R	Least Concern	Schedule IV
225	Pallas's Gull	*Larus ichthyaetus*	M	Least Concern	Schedule IV
226	Pallid Harrier	*Circus macrourus*	M	Near Threatened	Schedule I
227	Peregrine Falcon	*Falco peregrinus*	R	Least Concern	Schedule I
228	Pheasant-tailed Jacana	*Hydrophasianus chirurgus*	R	Least Concern	Schedule IV
229	Pied Avocet	*Recurvirostra avosetta*	M	Least Concern	Schedule IV
230	Pied Bushchat	*Saxicola caprata*	R	Least Concern	Schedule IV
231	Pied Kingfisher	*Ceryle rudis*	R	Least Concern	Schedule IV
232	Pied Thrush	*Geokichla wardii*	M	Least Concern	Schedule IV
233	Pintail Snipe	*Gallinago stenura*	M	Least Concern	Schedule IV
234	Plain Prinia	*Prinia inornata*	R	Least Concern	Schedule IV
235	Plum-headed Parakeet	*Psittacula cyanocephala*	R	Least Concern	Schedule IV
236	Puff-throated Babbler	*Pellorneum ruficeps*	R	Least Concern	Schedule IV
237	Purple Heron	*Ardea purpurea*	R	Least Concern	Schedule IV
238	Purple Sunbird	*Nectarinia asiatica*	R	Least Concern	Schedule IV
239	Purple Swamphen	*Porphyrio porphyrio*	R	Least Concern	Schedule IV
240	Purple-rumped Sunbird	*Leptocoma zeylonica*	R	Least Concern	Schedule IV
241	Red Avadavat	*Amandava amandava*	R	Least Concern	Schedule IV
242	Red Collared-Dove	*Streptopelia tranquebarica*	R	Least Concern	Schedule IV
243	Red Spurfowl	*Galloperdix spadicea*	R	Least Concern	Schedule IV

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244	Red-breasted Flycatcher	*Ficedula parva*	M	Least Concern	Schedule IV
245	Red-crested Pochard	*Netta rufina*	M	Least Concern	Schedule IV
246	Red-naped Ibis	*Pseudibis papillosa*	R	Least Concern	Schedule IV
247	Red-necked Falcon	*Falco ruficollis*	M	Least Concern	Schedule I
248	Red-rumped Swallow	*Cecropis daurica*	R	Least Concern	Schedule IV
249	Red-throated Flycatcher	*Ficedula albicilla*	M	Least Concern	Schedule IV
250	Red-vented Bulbul	*Pycnonotus cafer*	R	Least Concern	Schedule IV
251	Red-wattled Lapwing	*Vanellus indicus*	R	Least Concern	Schedule IV
252	Red-whiskered Bulbul	*Pycnonotus jocosus*	R	Least Concern	Schedule IV
253	Richard's Pipit	*Anthus richardi*	M	Least Concern	Schedule IV
254	River Tern	*Sterna aurantia*	R	Vulnerable	Schedule IV
255	Rock Bush-Quail	*Perdicula argoondah*	R	Least Concern	Schedule IV
256	Rock Dove	*Columba livia*	R	Least Concern	Schedule IV
257	Rose-ringed Parakeet	*Psittacula krameri*	R	Least Concern	Schedule IV
258	Rosy Starling	*Pastor roseus*	M	Least Concern	Schedule IV
259	Ruddy Shelduck	*Tadorna ferruginea*	M	Least Concern	Schedule IV
260	Ruddy Turnstone	*Arenaria interpres*	M	Least Concern	Schedule IV
261	Ruddy-breasted Crake	*Zapornia fusca*	R	Least Concern	Schedule IV
262	Ruff	*Calidris pugnax*	M	Least Concern	Schedule IV
263	Rufous Treepie	*Dendrocitta vagabunda*	R	Least Concern	Schedule IV
264	Rufous-bellied Eagle	*Lophotriorchis kienerii*	R	Near Threatened	Schedule I
265	Rufous-tailed Lark	*Ammomanes phoenicura*	R	Least Concern	Schedule IV
266	Rusty-tailed Flycatcher	*Ficedula ruficauda*	M	Least Concern	Schedule IV
267	Sanderling	*Calidris alba*	M	Least Concern	Schedule IV
268	Savanna Nightjar	*Caprimulgus affinis*	R	Least Concern	Schedule IV
269	Scaly-breasted Munia	*Lonchura punctulata*	R	Least Concern	Schedule IV
270	Shikra	*Accipiter badius*	R	Least Concern	Schedule I
271	Short-toed Snake-Eagle	*Circaetus gallicus*	R	Least Concern	Schedule I
272	Siberian Rubythroat	*Calliope*	M	Least Concern	Schedule IV
273	Siberian Stonechat	*Saxicola maurus*	M	Not Listed	Schedule IV
274	Sirkeer Malkoha	*Taccocua leschenaultii*	R	Least Concern	Schedule IV
275	Slaty-breasted Rail	*Lewinia striata*	R	Least Concern	Schedule IV
276	Slender-billed Gull	*Larus genei*	R	Least Concern	Schedule IV
277	Small Minivet	*Pericrocotus cinnamomeus*	R	Least Concern	Schedule IV
278	Spot-bellied Eagle-Owl	*Bubo nipalensis*	R	Least Concern	Schedule IV
279	Spot-billed Pelican	*Pelecanus phillippensis*	R	Near Threatened	Schedule IV
280	Spotted Dove	*Spilopelia chinensis*	R	Least Concern	Schedule IV
281	Spotted Owlet	*Athene brama*	R	Least Concern	Schedule IV
282	Spotted Redshank	*Tringa erythropus*	M	Least Concern	Schedule IV

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283	Streaked Weaver	*Ploceus manyar*	R	Least Concern	Schedule IV
284	Streak-throated Swallow	*Petrochelidon fluvicola*	R	Least Concern	Schedule IV
285	Streak-throated Woodpecker	*Picus xanthopygaeus*	R	Least Concern	Schedule IV
286	Striated Heron	*Butorides striata*	M	Least Concern	Schedule IV
287	Sykes's Warbler	*Iduna rama*	M	Least Concern	Not Listed
288	Tawny Eagle	*Aquila rapax*	R	Vulnerable	Schedule I
289	Tawny Pipit	*Anthus campestris*	M	Least Concern	Schedule IV
290	Tawny-bellied Babbler	*Dumetia hyperythra*	R	Least Concern	Schedule IV
291	Temminck's Stint	*Calidris temminckii*	M	Least Concern	Schedule IV
292	Terek Sandpiper	*Xenus cinereus*	M	Least Concern	Schedule IV
293	Thick-billed Flowerpecker	*Dicaeum agile*	R	Least Concern	Schedule IV
294	Tickell's Blue Flycatcher	*Cyornis tickelliae*	R	Least Concern	Schedule IV
295	Tickell's Thrush	*Turdus unicolor*	M	Least Concern	Schedule IV
296	Tree Pipit	*Anthus trivialis*	M	Least Concern	Schedule IV
297	Tricoloured Munia	*Lonchura malacca*	R	Least Concern	Schedule IV
298	Tufted Duck	*Aythya fuligula*	M	Least Concern	Schedule IV
299	Ultramarine Flycatcher	*Ficedula superciliaris*	M	Least Concern	Schedule IV
300	Verditer Flycatcher	*Eumyias thalassinus*	M	Least Concern	Schedule IV
301	Watercock	*Gallicrex cinerea*	R	Least Concern	Schedule IV
302	Western Crowned Leaf-warbler	*Phylloscopus occipitalis*	M	Least Concern	Schedule IV
303	Western Marsh-Harrier	*Circus aeruginosus*	M	Least Concern	Schedule I
304	Western Reef-Egret	*Egretta gularis*	R	Least Concern	Schedule IV
305	Western Yellow Wagtail	*Motacilla flava*	M	Least Concern	Schedule IV
306	Whimbrel	*Numenius phaeopus*	M	Least Concern	Schedule IV
307	Whiskered Tern	*Chlidonias hybrida*	M	Least Concern	Schedule IV
308	White stork	*Ciconia ciconia*	M	Least Concern	Schedule IV
309	White Wagtail	*Motacilla alba*	M	Least Concern	Schedule IV
310	White-bellied Drongo	*Dicrurus caerulescens*	R	Least Concern	Schedule IV
311	White-bellied Sea-Eagle	*Haliaeetus leucogaster*	R	Least Concern	Not Listed
312	White-breasted Kingfisher	*Halcyon smyrnensis*	R	Least Concern	Schedule IV
313	White-breasted Waterhen	*Amaurornis phoenicurus*	R	Least Concern	Schedule IV
314	White-browed Bulbul	*Pycnonotus luteolus*	R	Least Concern	Schedule IV
315	White-browed Fantail	*Rhipidura aureola*	R	Least Concern	Schedule IV
316	White-browed Wagtail	*Motacilla maderaspatensis*	R	Least Concern	Schedule IV
317	White-eyed Buzzard	*Butastur teesa*	R	Least Concern	Schedule I
318	White-naped Woodpecker	*Chrysocolaptes festivus*	R	Least Concern	Schedule IV
319	White-rumped Munia	*Lonchura striata*	R	Least Concern	Schedule IV
320	White-rumped Shama	*Kittacincla malabarica*	R	Least Concern	Schedule IV
321	White-rumped Spinetail	*Zoonavena sylvatica*	R	Least Concern	Not Listed

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322	White-Rumped Vulture	*Gyps bengalensis*	R	Critically Endangered	Schedule IV
323	White-spotted Fantail	*Rhipidura albogularis*	R	Least Concern	Schedule IV
324	White-tailed Iora	*Marshall's Iora*	R	Least Concern	Schedule IV
325	White-Winged Tern	*Chlidonias leucopterus*	M	Least Concern	Schedule IV
326	Wire-tailed Swallow	*Hirundo smithii*	R	Least Concern	Not Listed
327	Wood Sandpiper	*Tringa glareola*	M	Least Concern	Schedule IV
328	Yellow Bittern	*Ixobrychus sinensis*	R	Least Concern	Schedule IV
329	Yellow-billed Babbler	*Turdoides affinis*	R	Least Concern	Schedule IV
330	Yellow-browed Bulbul	*Acritillas indica*	R	Least Concern	Schedule IV
331	Yellow-browed Warbler	*Phylloscopus inornatus*	M	Least Concern	Schedule IV
332	Yellow-crowned Woodpecker	*Leiopicus mahrattensis*	R	Least Concern	Schedule IV
333	Yellow-eyed Babbler	*Chrysomma sinense*	R	Least Concern	Schedule IV
334	Yellow-footed Green-Pigeon	*Treron phoenicopterus*	R	Least Concern	Schedule IV
335	Yellow-legged Buttonquail	*Turnix tanki*	R	Least Concern	Schedule IV
336	Yellow-throated Bulbul	*Pycnonotus xantholaemus*	R	Vulnerable	Schedule IV
337	Yellow-wattled Lapwing	*Vanellus malabaricus*	R	Least Concern	Schedule IV
338	Zitting Cisticola	*Cisticola juncidis*	R	Least Concern	Schedule IV

Table 4-32: Vulture and Raptors reported from the region (Supply Chain Catchment Area)

Sr.No.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
Vulture					
1	White-Rumped Vulture	*Gyps bengalensis*	R	Critically Endangered	Schedule IV
Raptors					
1	Barn Owl	*Tyto alba*	R	Least Concern	Schedule IV
2	Black Baza	*Aviceda leuphotes*	M	Least Concern	Schedule I
3	Black Eagle	*Ictinaetus malaiensis*	R	Least Concern	Schedule I
4	Black Kite	*Milvus migrans*	R	Least Concern	Schedule I
5	Black-winged Kite	*Elanus caeruleus*	R	Least Concern	Schedule I
6	Bonelli's Eagle	*Aquila fasciata*	R	Least Concern	Schedule I
7	Booted Eagle	*Hieraaetus pennatus*	M	Least Concern	Schedule I
8	Brahminy Kite	*Haliastur indus*	R	Least Concern	Schedule I
9	Brown Fish-Owl	*Ketupa zeylonensis*	R	Least Concern	Schedule IV
10	Changeable Hawk-Eagle	*Nisaetus cirrhatus*	R	Least Concern	Schedule I
11	Common Kestrel	*Falco tinnunculus*	M	Least Concern	Schedule IV
12	Crested Goshawk	*Accipiter trivirgatus*	R	Least Concern	Schedule I
13	Crested Serpent-Eagle	*Spilornis cheela*	M	Least Concern	Schedule I
14	Eurasian Buzzard	*Buteo*	M	Least Concern	Schedule I
15	Eurasian Sparrowhawk	*Accipiter nisus*	M	Least Concern	Schedule I

Sr.No.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
16	Greater Spotted Eagle	*Clanga*	M	Vulnerable	Schedule I
17	Indian Scops-owl	*Otus bakkamoena*	R	Least Concern	Schedule IV
18	Indian Spotted Eagle	*Clanga hastata*	R	Vulnerable	Not Listed
19	Jungle Owlet	*Glaucidium radiatum*	R	Least Concern	Schedule IV
20	Montagu's Harrier	*Circus pygargus*	M	Least Concern	Schedule I
21	Oriental Honey-buzzard	*Pernis ptilorhynchus*	R	Least Concern	Schedule I
22	Oriental Scops-Owl	*Otus sunia*	R	Least Concern	Schedule IV
23	Osprey	*Pandion haliaetus*	M	Least Concern	Schedule I
24	Pallid Harrier	*Circus macrourus*	M	Near Threatened	Schedule I
25	Peregrine Falcon	*Falco peregrinus*	R	Least Concern	Schedule I
26	Red-necked Falcon	*Falco ruficollis*	M	Least Concern	Schedule I
27	Rufous-bellied Eagle	*Lophotriorchis kienerii*	R	Near Threatened	Schedule I
28	Shikra	*Accipiter badius*	R	Least Concern	Schedule I
29	Short-toed Snake-Eagle	*Circaetus gallicus*	R	Least Concern	Schedule I
30	Spot-bellied Eagle-Owl	*Bubo nipalensis*	R	Least Concern	Schedule IV
31	Spotted Owlet	*Athene brama*	R	Least Concern	Schedule IV
32	Tawny Eagle	*Aquila rapax*	R	Vulnerable	Schedule I
33	Western Marsh-Harrier	*Circus aeruginosus*	M	Least Concern	Schedule I
34	White-bellied Sea-Eagle	*Haliaeetus leucogaster*	R	Least Concern	Not Listed
35	White-eyed Buzzard	*Butastur teesa*	R	Least Concern	Schedule I

4.5.3.3 Floral Survey

4.5.3.3.1 Vegetation Profile

Manufacturing Unit

As per the available information, the proposed project (manufacturing unit) is coming on the Deccan Peninsula - Deccan South (6E) Biogeographical Province of India[104]; Eastern Coastal Plains and Island of Andaman and Nicobar, hot subhumid (Transitional zone with coastal and deltaic alluvial soils) Agro-ecological Region[105] and East Coast Plains and Hills Region (XI) Agro-Climatic Region[106]. The vegetation of the area may be defined as Dry Deciduous Scrub (5A-DS1) according to forest classification of Champion and Seth (1968)[107].

Supply Chain Catchment Area

As per the available information, the supply chain catchment area is coming on the Deccan Peninsula - Deccan South (6E) Biogeographical Province of India[108]; Eastern Coastal Plains and Island of Andaman and Nicobar, hot subhumid (Transitional zone with coastal and deltaic alluvial soils) as well as Deccan Plateau, hot semiarid eco-region (Red loamy soils) Agro-ecological Region[109] and East Coast Plains and Hills Region (XI) as well as Southern Plateau and Hills Region (X) Agro-Climatic Region[110]. The vegetation of the area may be defined as Southern Dry Mixed Deciduous Forest (5A-C3) and Dry Deciduous Scrub (5A-DS1) according to forest classification of Champion and Seth (1968)[111].

[104] http://wiienvis.nic.in/database/htmlpages/bioprovincemap.htm

[105] Mandal D.K., Mandal C. and Singh S.K. (2015) Delineating Agro-Ecological Regions. ICAR-NBSSLUP technology, p. 8.

[106] http://apps.iasri.res.in/agridata/19data/chapter1/db2019tb1_2.pdf

[107] Champion H.G. and Seth S.K. (1968) A Revised Survey of Forest Types of India. Govt. of India Press, New Delhi, p. 404.

[108] http://wiienvis.nic.in/database/htmlpages/bioprovincemap.htm

[109] Mandal D.K., Mandal C. and Singh S.K. (2015) Delineating Agro-Ecological Regions. ICAR-NBSSLUP technology, p. 8.

[110] http://apps.iasri.res.in/agridata/19data/chapter1/db2019tb1_2.pdf

[111] Champion H.G. and Seth S.K. (1968) A Revised Survey of Forest Types of India. Govt. of India Press, New Delhi, p. 404.

4.5.3.3.2 Floral Diversity

Manufacturing Unit

The floral diversity present within the study area for manufacturing unit (plant boundary and 5 km buffer) was assessed during the site survey. A total of fifty-eight (58) floral species belonging to thirty (30) families were observed from the 5 km radius of the project area. Fabaceae was the most dominating family in the area with 13 species. One globally Endangered (as per IUCN RedList), *Tectona grandis* L.f. (Teak) has been observed in the study area. In the study area, Teak has been planted for its timber value, while no natural population of Teak was observed during the primary survey. Another IUCN Near Threatened species, *Aegle marmelos* (L.) Corrêa (Wood Apple) was also observed in the study area. A list of encountered floral species with their families and life forms has been given in ***Table 4-33***Table 4-33.

Table 4-33: Floral diversity of the study area (Manufacturing Unit)

Sr.No.	Binomial Scientific Name	Family	Life form	IUCN Red List - Categories
1	*Abutilon indicum* (L.) Sweet	Malvaceae	Herb	Not assessed
2	*Acacia auriculiformis* A.Cunn. ex Benth.	Fabaceae	Tree	Least Concern
3	*Acacia nilotica* (L.) Delile	Fabaceae	Tree	Least Concern
4	*Achyranthes aspera* L.	Amaranthaceae	Herb	Not assessed
5	*Aegle marmelos* (L.) Corrêa	Rutaceae	Tree	Near Threatened
6	*Agave americana* L.	Agavaceae	Herb	Least Concern
7	*Ailanthus excelsa* Roxb.	Simaroubaceae	Tree	Not assessed
8	*Albizia lebbeck* (L.) Benth.	Fabaceae	Tree	Least Concern
9	*Albizia procera* (Roxb.) Benth.	Fabaceae	Tree	Least Concern
10	*Argemone mexicana* L.	Papaveraceae	Herb	Not assessed
11	*Artocarpus heterophyllus* Lam.	Moraceae	Tree	Not assessed
12	*Azadirachta indica* A.Juss.	Meliaceae	Tree	Least Concern
13	*Bauhinia purpurea* L.	Fabaceae	Tree	Least Concern
14	*Borassus flabellifer* L.	Arecaceae	Tree	Not assessed
15	*Calotropis gigantea* (L.) Dryand.	Apocynaceae	Tree	Not assessed
16	*Cassia fistula* L.	Fabaceae	Tree	Least Concern
17	*Casuarina equisetifolia* L.	Casuarinaceae	Tree	Least Concern
18	*Cissus quadrangularis* L.	Vitaceae	Straggling Shrub	Not assessed
19	*Cocos nucifera* L.	Arecaceae	Tree	Not assessed
20	*Croton bonplandianus* Baill.	Euphorbiaceae	Herb	Not assessed
21	*Datura innoxia* Mill.	Solanaceae	Herb	Not assessed
22	*Delonix elata* (L.) Gamble	Fabaceae	Tree	Least Concern
23	*Delonix regia* (Hook.) Raf.	Fabaceae	Tree	Least Concern
24	*Dichanthium annulatum* (Forssk.) Stapf	Poaceae	Grass	Not assessed
25	*Dodonaea viscosa* (L.) Jacq.	Sapindaceae	Shrub	Least Concern
26	*Eucalyptus* sp.	Myrtaceae	Tree	-
27	*Eucalyptus tereticornis* Sm.	Myrtaceae	Tree	Least Concern
28	*Ficus benghalensis* L.	Moraceae	Tree	Not assessed
29	*Ficus hispida* L.f.	Moraceae	Tree	Least Concern
30	*Ficus religiosa* L.	Moraceae	Tree	Least Concern
31	*Ficus virens* Aiton	Moraceae	Tree	Least Concern
32	*Grewia asiatica* L.	Malvaceae	Tree	Least Concern

Sr.No.	Binomial Scientific Name	Family	Life form	IUCN Red List - Categories
33	*Heliotropium indicum* L.	Boraginaceae	Herb	Not assessed
34	*Holoptelea integrifolia* Planch.	Ulmaceae	Tree	Not assessed
35	*Ipomoea carnea* Jacq.	Convolvulaceae	Shrub	Not assessed
36	*Lantana camara* L.	Verbenaceae	Shrub	Not assessed
37	*Leucaena leucocephala* (Lam.) de Wit	Fabaceae	Tree	Not assessed
38	*Madhuca longifolia* (J.Koenig ex L.) J.F.Macbr.	Sapotaceae	Tree	Not assessed
39	*Mangifera indica* L.	Anacardiaceae	Tree	Data Deficient
40	*Millingtonia hortensis* L.f.	Bignoniaceae	Tree	Not assessed
41	*Phoenix acaulis* Roxb.	Arecaceae	Shrub	Not assessed
42	*Phoenix sylvestris* (L.) Roxb.	Arecaceae	Tree	Not assessed
43	*Pongamia pinnata* (L.) Pierre	Fabaceae	Tree	Least Concern
44	*Prosopis juliflora* (Sw.) DC.	Fabaceae	Tree	Not assessed
45	*Ricinus communis* L.	Euphorbiaceae	Small Tree	Not assessed
46	*Sapindus mukorossi* Gaertn.	Sapindaceae	Tree	Least Concern
47	*Schoenoplectus lacustris* (L.) Palla	Cyperaceae	Grass	Least Concern
48	*Semecarpus anacardium* L.f.	Anacardiaceae	Tree	Least Concern
49	*Senna auriculata* (L.) Roxb.	Fabaceae	Shrub	Not assessed
50	*Syzygium cumini* (L.) Skeels	Myrtaceae	Tree	Least Concern
51	*Tamarindus indica* L.	Fabaceae	Tree	Least Concern
52	*Tectona grandis* L.f.	Lamiaceae	Tree	Endangered
53	*Thespesia populnea* (L.) Sol. ex Corrêa	Malvaceae	Tree	Least Concern
54	*Typha domingensis* Pers.	Typhaceae	Herb	Least Concern
55	*Wrightia tinctoria* R.Br.	Apocynaceae	Tree	Not assessed
56	*Xanthium strumarium* L.	Asteraceae	Herb	Not assessed
57	*Ziziphus jujuba* Mill.	Rhamnaceae	Tree	Least Concern
58	*Ziziphus xylopyrus* (Retz.) Willd.	Rhamnaceae	Tree	Not assessed

Supply Chain Catchment Area

The floral diversity present within the supply chain catchment area was assessed during the site survey. A total of eighty-two (82) floral species belonging to thirty-nine (39) families were recorded (observed & reported) from the catchment area. Fabaceae was the most dominating family in the area with 19 species. Five globally Endangered (as per IUCN RedList), *Cycas beddomei* Dyer (Peritha), *Eucalyptus gunnii* Hook.f. (Cider Gum), *Prunus ceylanica* (Wight) Miq. (Ceylon Cherry), *Pterocarpus santalinus* L.f. (Red Sandalwood), *Tectona grandis* L.f. (Teak) have been recorded from the study area. Out of these Endangered species, *Eucalyptus gunnii* (Cider Gum) has been introduced from Australia for plantation because of its timber quality; no natural population was observed / reported from the study area. *Cycas beddomei* (Peritha), *Prunus ceylanica* (Ceylon Cherry), and *Pterocarpus santalinus* (Red Sandalwood) were reported from the forest area specifically from the nearby protected areas, Sri Venkateshwara National Park. *Tectona grandis* (Teak) has been planted for its timber value, while no natural population of Teak was observed during the primary survey in the study area. Seven globally Vulnerable (as per IUCN RedList), *Chloroxylon swietenia* (Roxb.) DC. (Ceylon Satinwood), *Cleistanthus collinus* (Roxb.) Benth. ex Hook.f. (Toxic Gooseberry), *Eucalyptus melliodora* A. Cunn. ex Schauer (Yellow Box), *Gossypium hirsutum* L. (Mexican Cotton), *Santalum album* L. (Sandalwood), *Saraca asoca* (Roxb.) de Wilde (Sita Ashok), *Vanda spathulata* (L.) Spreng (Spoon-Leaf Vanda) have also been recorded from the study area. *Eucalyptus melliodora* (Yellow Box), and *Gossypium hirsutum* (Mexican Cotton) have been introduced from Australia and Central America (Mexico) respectively. While the other Vulnerable species have been reported from the nearby protected forest areas. Three IUCN Near Threatened species, *Aegle marmelos* (L.) Corrêa (Wood Apple), *Conocarpus lancifolius* Engl. (Damas tree), and *Pterocarpus marsupium* Roxb.

(Indian Kino Tree) were also reported from the study area. A list of encountered floral species with their families and life forms has been given in ***Table 4-34***.

Table 4-34: Floral diversity of the study area (Supply Chain Catchment Area)

Sr.No.	Binomial Scientific Name	Family	Life form	IUCN Red List – Categories
1	*Abutilon indicum* (L.) Sweet	Malvaceae	Herb	Not assessed
2	*Acacia auriculiformis* A.Cunn. ex Benth.	Fabaceae	Tree	Least Concern
3	*Acacia nilotica* (L.) Delile	Fabaceae	Tree	Least Concern
4	*Achyranthes aspera* L.	Amaranthaceae	Herb	Not assessed
5	*Aegle marmelos* (L.) Corrêa	Rutaceae	Tree	Near Threatened
6	*Agave americana* L.	Agavaceae	Herb	Least Concern
7	*Ailanthus excelsa* Roxb.	Simaroubaceae	Tree	Not assessed
8	*Albizia lebbeck* (L.) Benth.	Fabaceae	Tree	Least Concern
9	*Albizia procera* (Roxb.) Benth.	Fabaceae	Tree	Least Concern
10	*Argemone 150exicana* L.	Papaveraceae	Herb	Not assessed
11	*Artocarpus heterophyllus* Lam.	Moraceae	Tree	Not assessed
12	*Azadirachta indica* A.Juss.	Meliaceae	Tree	Least Concern
13	*Bauhinia purpurea* L.	Fabaceae	Tree	Least Concern
14	*Borassus flabellifer* L.	Arecaceae	Tree	Not assessed
15	*Calotropis gigantea* (L.) Dryand.	Apocynaceae	Tree	Not assessed
16	*Cassia fistula* L.	Fabaceae	Tree	Least Concern
17	*Casuarina equisetifolia* L.	Casuarinaceae	Tree	Least Concern
18	*Cissus quadrangularis* L.	Vitaceae	Straggling Shrub	Not assessed
19	*Cocos nucifera* L.	Arecaceae	Tree	Not assessed
20	*Croton bonplandianus* Baill.	Euphorbiaceae	Herb	Not assessed
21	*Datura innoxia* Mill.	Solanaceae	Herb	Not assessed
22	*Delonix elata* (L.) Gamble	Fabaceae	Tree	Least Concern
23	*Delonix regia* (Hook.) Raf.	Fabaceae	Tree	Least Concern
24	*Dichanthium annulatum* (Forssk.) Stapf	Poaceae	Grass	Not assessed
25	*Dodonaea viscosa* (L.) Jacq.	Sapindaceae	Shrub	Least Concern
26	*Eucalyptus* sp.	Myrtaceae	Tree	-
27	*Eucalyptus tereticornis* Sm.	Myrtaceae	Tree	Least Concern
28	*Ficus benghalensis* L.	Moraceae	Tree	Not assessed
29	*Ficus hispida* L.f.	Moraceae	Tree	Least Concern
30	*Ficus religiosa* L.	Moraceae	Tree	Least Concern
31	*Ficus virens* Aiton	Moraceae	Tree	Least Concern
32	*Grewia asiatica* L.	Malvaceae	Tree	Least Concern
33	*Heliotropium indicum* L.	Boraginaceae	Herb	Not assessed
34	*Holoptelea integrifolia* Planch.	Ulmaceae	Tree	Not assessed
35	*Ipomoea carnea* Jacq.	Convolvulaceae	Shrub	Not assessed
36	*Lantana camara* L.	Verbenaceae	Shrub	Not assessed
37	*Leucaena leucocephala* (Lam.) de Wit	Fabaceae	Tree	Not assessed

Sr.No.	Binomial Scientific Name	Family	Life form	IUCN Red List – Categories
38	*Madhuca longifolia* (J.Koenig ex L.) J.F.Macbr.	Sapotaceae	Tree	Not assessed
39	*Mangifera indica* L.	Anacardiaceae	Tree	Data Deficient
40	*Millingtonia hortensis* L.f.	Bignoniaceae	Tree	Not assessed
41	*Phoenix acaulis* Roxb.	Arecaceae	Shrub	Not assessed
42	*Phoenix sylvestris* (L.) Roxb.	Arecaceae	Tree	Not assessed
43	*Pongamia pinnata* (L.) Pierre	Fabaceae	Tree	Least Concern
44	*Prosopis juliflora* (Sw.) DC.	Fabaceae	Tree	Not assessed
45	*Ricinus communis* L.	Euphorbiaceae	Small Tree	Not assessed
46	*Sapindus mukorossi* Gaertn.	Sapindaceae	Tree	Least Concern
47	*Schoenoplectus lacustris* (L.) Palla	Cyperaceae	Grass	Least Concern
48	*Semecarpus anacardium* L.f.	Anacardiaceae	Tree	Least Concern
49	*Senna auriculata* (L.) Roxb.	Fabaceae	Shrub	Not assessed
50	*Syzygium cumini* (L.) Skeels	Myrtaceae	Tree	Least Concern
51	*Tamarindus indica* L.	Fabaceae	Tree	Least Concern
52	*Tectona grandis* L.f.	Lamiaceae	Tree	Endangered
53	*Thespesia populnea* (L.) Sol. Ex Corrêa	Malvaceae	Tree	Least Concern
54	*Typha domingensis* Pers.	Typhaceae	Herb	Least Concern
55	*Wrightia tinctoria* R.Br.	Apocynaceae	Tree	Not assessed
56	*Xanthium strumarium* L.	Asteraceae	Herb	Not assessed
57	*Ziziphus jujuba* Mill.	Rhamnaceae	Tree	Least Concern
58	*Ziziphus xylopyrus* (Retz.) Willd.	Rhamnaceae	Tree	Not assessed

4.5.3.4 Faunal Diversity

4.5.3.4.1 Herpetofauna

Manufacturing Unit

As per the literature review[112], local consultation and field survey, twenty-nine (29) herpetofauna (reptiles + amphibians) species were recorded (reported / observed) from the study area. None of the species was categorized under any threatened category of the IUCN Red List (Online Version 2022-2); one Near Threatened species, Red Sand Boa (*Eryx johnii*) was reported from the study area; and two species [Bengal Monitor Lizard (*Varanus bengalensis*), & Indian Rock Python (*Python molurus*)] were listed under the Schedule I category as per the Wildlife (Protection) Act, 1972 (***Table 4-35***).

Table 4-35: Herpetofauna diversity from the study area (Manufacturing Unit)

Sr.No.	Common English Name	Binomial Scientific Name	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules	Reported / Observed
1	Asiatic Water Snake	*Fowlea piscator*	Not assessed	Schedule II	Observed
2	Asian Common Toad	*Duttaphrynus melanostictus*	Least Concern	Not listed	Reported
3	Banded Kukri Snake	*Oligodon arnensis*	Least Concern	Not listed	Reported
4	Barred Wolf Snake	*Lycodon striatus*	Least Concern	Not listed	Reported
5	Bengal Monitor Lizard	*Varanus bengalensis*	Least Concern	Schedule I	Reported
6	Bronze Mabuya	*Eutropis macularia*	Least Concern	Not listed	Reported

112 https://www.inaturalist.org/observations?lat=13.915696751721786&lng=79.82653432883035&place_id=any&radius=31.50479994315241&subview=map&view=species&iconic_taxa=Amphibia,Reptilia

Sr.No.	Common English Name	Binomial Scientific Name	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules	Reported / Observed
7	Buff-striped Keelback	*Amphiesma stolatum*	Not assessed	Schedule IV	Reported
8	Chunam Tree Frog	*Polypedates maculatus*	Least Concern	Not listed	Reported
9	Common Krait	*Bungarus caeruleus*	Not assessed	Schedule IV	Reported
10	Common Skittering Frog	*Euphlyctis cyanophlyctis*	Least Concern	Schedule IV	Observed
11	Common Wolf Snake	*Lycodon aulicus*	Not assessed	Schedule IV	Reported
12	Daudin's Bronzeback	*Dendrelaphis tristis*	Least Concern	Not listed	Reported
13	Eluru Dot Frog	*Uperodon variegatus*	Least Concern	Not listed	Reported
14	Fan Throated Lizard	*Sitana ponticeriana*	Least Concern	Not listed	Reported
15	Flowery Wolf Snake	*Lycodon anamallensis*	Least Concern	Not listed	Reported
16	Golden Skink	*Eutropis carinata*	Least Concern	Not listed	Reported
17	Indian Bullfrog	*Hoplobatrachus tigerinus*	Least Concern	Schedule IV	Reported
18	Indian Chameleon	*Chamaeleo zeylanicus*	Least Concern	Not listed	Reported
19	Indian Cobra	*Naja naja*	Least Concern	Schedule II	Reported
20	Indian Rock Python	*Python molurus*	Not assessed	Schedule I	Reported
21	Jerdon`s Bullfrog	*Hoplobatrachus crassus*	Least Concern	Schedule IV	Reported
22	Olive Keelback Water Snake	*Atretium schistosum*	Least Concern	Schedule II	Reported
23	Oriental Garden Lizard	*Calotes versicolor*	Not assessed	Not listed	Reported
24	Red Sand Boa	*Eryx johnii*	Near Threatened	Schedule IV	Reported
25	Russell's Viper	*Daboia russelii*	Least Concern	Schedule II	Reported
26	Saw-scaled Vipers	*Echis carinatus*	Least Concern	Not listed	Reported
27	Sri Lankan Bullfrog	*Uperodon taprobanicus*	Least Concern	Not listed	Reported
28	Streaked Kukri Snake	*Oligodon taeniolatus*	Least Concern	Not listed	Reported
29	Trinket Snake	*Coelognathus helena*	Least Concern	Not listed	Reported

Supply Chain Catchment Area

As per the literature review[113], local consultation and limited field survey, fifty-six (56) herpetofauna (reptiles + amphibians) species were recorded (reported / observed) from the supply chain catchment area, including one Endangered [Rishi Valley Geckoella (*Cyrtodactylus rishivalleyensis*)]; two Vulnerable [Indian Flapshell Turtle (*Lissemys punctata*), & Indian Star Tortoise (*Geochelone elegans*)]; two Near Threatened [Red Sand Boa (*Eryx johnii*), & Rough-tailed Sand Boa (*Eryx conicus*)] as per IUCN Red List (Online Version 2022-2). Three species, Bengal Monitor Lizard (*Varanus bengalensis*), Indian Flapshell Turtle (*Lissemys punctata*) & Indian Rock Python (*Python molurus*) were listed under the Schedule I category as per the Wildlife (Protection) Act, 1972 (***Table 4-36***). The only reported one Endangered herpetofauna [Rishi Valley Geckoella (*Cyrtodactylus rishivalleyensis*)] was reported from the forest areas; while the two Vulnerable herpetofauna [Indian Flapshell Turtle (*Lissemys punctata*), & Indian Star Tortoise (*Geochelone elegans*)] were confined to the large water bodies.

Table 4-36: Herpetofauna diversity from the study area (Supply Chain Catchment Area)

Sr.No.	Common English Name	Binomial Scientific Name	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules	Reported / Observed
1	Anaimalai Spiny Lizard	*Salea anamallayana*	Least Concern	Not listed	Reported
2	Asian Common Toad	*Duttaphrynus melanostictus*	Least Concern	Not listed	Reported

[113] https://www.inaturalist.org/observations?nelat=15.331648278652699&nelng=80.11599834682087&place_id=any&subview=map&swlat=13.13810503843447&swlng=79.26455791713337&view=species&iconic_taxa=Amphibia,Reptilia

Sr.No.	Common English Name	Binomial Scientific Name	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules	Reported / Observed
3	Asiatic Water Snake	*Fowlea piscator*	Not assessed	Schedule II	Observed
4	Banded Kukri Snake	*Oligodon arnensis*	Least Concern	Not listed	Reported
5	Barred Wolf Snake	*Lycodon striatus*	Least Concern	Not listed	Reported
6	Bengal Monitor Lizard	*Varanus bengalensis*	Least Concern	Schedule I	Reported
7	Blanford's Rock Agama	*Psammophilus blanfordanus*	Least Concern	Not listed	Reported
8	Boulenger's Bronzeback	*Dendrelaphis bifrenalis*	Least Concern	Not listed	Reported
9	Brahminy Blind Snake	*Ramphotyphlops braminus*	Not assessed	Schedule IV	Reported
10	Bronze Mabuya	*Eutropis macularia*	Least Concern	Not listed	Reported
11	Buff-striped Keelback	*Amphiesma stolatum*	Not assessed	Schedule IV	Reported
12	Chunam Tree Frog	*Polypedates maculatus*	Least Concern	Not listed	Reported
13	Common Dotted Garden Skink	*Riopa punctata*	Least Concern	Not listed	Reported
14	Common Indian Cricket Frog	*Minervarya agricola*	Least Concern	Not listed	Reported
15	Common Krait	*Bungarus caeruleus*	Not assessed	Schedule IV	Reported
16	Common Skittering Frog	*Euphlyctis cyanophlyctis*	Least Concern	Schedule IV	Observed
17	Common Wolf Snake	*Lycodon aulicus*	Not assessed	Schedule IV	Reported
18	Daudin's Bronzeback	*Dendrelaphis tristis*	Least Concern	Not listed	Reported
19	Dumeril's Black-headed Snake	*Sibynophis subpunctatus*	Least Concern	Not listed	Reported
20	Eluru Dot Frog	*Uperodon variegatus*	Least Concern	Not listed	Reported
21	Fan Throated Lizard	*Sitana ponticeriana*	Least Concern	Not listed	Reported
22	Flowery Wolf Snake	*Lycodon anamallensis*	Least Concern	Not listed	Reported
23	Golden Skink	*Eutropis carinata*	Least Concern	Not listed	Reported
24	Green Keelback	*Macropisthodon plumbicolor*	Not assessed	Not listed	Reported
25	Guangdong Rice Frog	*Microhyla rubra*	Least Concern	Not listed	Reported
26	Indian Bullfrog	*Hoplobatrachus tigerinus*	Least Concern	Schedule IV	Reported
27	Indian Burrowing Frog	*Sphaerotheca breviceps*	Least Concern	Not listed	Reported
28	Indian Chameleon	*Chamaeleo zeylanicus*	Least Concern	Not listed	Reported
29	Indian Cobra	*Naja*	Least Concern	Schedule II	Reported
30	Indian Five-fingered Frog	*Euphlyctis hexadactyla*	Least Concern	Not listed	Reported
31	Indian Flapshell Turtle	*Lissemys punctata*	Vulnerable	Schedule I	Reported
32	Indian Flying Snake	*Chrysopelea taprobanica*	Least Concern	Not listed	Reported
33	Indian Rock Python	*Python molurus*	Not assessed	Schedule I	Reported
34	Indian Star Tortoise	*Geochelone elegans*	Vulnerable	Not listed	Reported
35	Indian Vine Snake	*Ahaetulla oxyrhynca*	Not assessed	Not listed	Reported
36	Jerdon`s Bullfrog	*Hoplobatrachus crassus*	Least Concern	Schedule IV	Reported
37	Leschenault's Snake-Eye	*Ophisops leschenaultii*	Least Concern	Not listed	Reported
38	Mangalore Burrowing Frog	*Sphaerotheca dobsonii*	Least Concern	Not listed	Reported
39	Marbled Balloon Frog	*Uperodon systoma*	Least Concern	Not listed	Reported
40	Olive Keelback Water Snake	*Atretium schistosum*	Least Concern	Schedule II	Reported
41	Oriental Garden Lizard	*Calotes versicolor*	Not assessed	Not listed	Reported

Sr.No.	Common English Name	Binomial Scientific Name	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules	Reported / Observed
42	Oriental Ratsnake	*Ptyas mucosa*	Not assessed	Schedule II	Reported
43	Ornamented Pygmy Frog	*Microhyla ornata*	Least Concern	Not listed	Reported
44	Paddy Field Frog	*Fejervarya limnocharis*	Least Concern	Not listed	Reported
45	Pond Slider	*Trachemys scripta*	Least Concern	Not listed	Reported
46	Red Sand Boa	*Eryx johnii*	Near Threatened	Schedule IV	Reported
47	Rishi Valley Geckoella	*Cyrtodactylus rishivalleyensis*	Endangered	Not listed	Reported
48	Rough-tailed Sand Boa	*Eryx conicus*	Near Threatened	Not listed	Reported
49	Russell's Viper	*Daboia russelii*	Least Concern	Schedule II	Reported
50	Saw-scaled Vipers	*Echis carinatus*	Least Concern	Not listed	Reported
51	Sharma's Racer	*Platyceps bholanathi*	Data Deficient	Not listed	Reported
52	South Indian Rock Agama	*Psammophilus dorsalis*	Least Concern	Not listed	Reported
53	Sri Lankan Bullfrog	*Uperodon taprobanicus*	Least Concern	Not listed	Reported
54	Streaked Kukri Snake	*Oligodon taeniolatus*	Least Concern	Not listed	Reported
55	Trinket Snake	*Coelognathus helena*	Least Concern	Not listed	Reported
56	Vellore Bridal Snake	*Lycodon nympha*	Least Concern	Not listed	Reported

4.5.3.4.2 Avifauna (Birds)

Manufacturing Unit

During the field survey, 37 avifaunal species were observed from the study area. None of the species was categorized under any threatened category of the IUCN Red List (Online Version 2022-2). Two (02) Schedule I species - Black Kite, & Indian Peafowl were observed from the area as per the Wildlife (Protection) Act, 1972. One Raptors species, Black Kite (*Milvus migrans*) was observed from the study area, while no migratory, and no vulture was observed in the study area (***Table 4-37***).

Table 4-37: Avifaunal diversity observed from the study area (Manufacturing Unit)

Sr.No.	Common English Name	Binomial Scientific Name	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
1	Asian Openbill	*Anastomus oscitans*	R	Least Concern
2	Asian Green Bee-eater	*Merops orientalis*	R	Least Concern
3	Asian Koel	*Eudynamys scolopaceus*	R	Least Concern
4	Baya Weaver	*Ploceus philippinus*	R	Least Concern
5	Black Drongo	*Dicrurus macrocercus*	R	Least Concern
6	Black Kite	*Milvus migrans*	R	Least Concern
7	Black-winged Stilt	*Himantopus himantopus*	R	Least Concern
8	Cattle Egret	*Bubulcus ibis*	R	Least Concern
9	Common Babbler	*Argya caudata*	R	Least Concern
10	Common Hoopoe	*Upupa epops*	R	Least Concern
11	Common Moorhen	*Gallinula chloropus*	R	Least Concern
12	Common Myna	*Acridotheres tristis*	R	Least Concern
13	Grey Francolin	*Francolinus pondicerianus*	R	Least Concern
14	Grey Heron	*Ardea cinerea*	R	Least Concern
15	House Crow	*Corvus splendens*	R	Least Concern

Sr.No.	Common English Name	Binomial Scientific Name	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
16	House Sparrow	*Passer domesticus*	R	Least Concern
17	Indian Cormorant	*Phalacrocorax fuscicollis*	R	Least Concern
18	Indian Peafowl	*Pavo cristatus*	R	Least Concern
19	Indian Pond Heron	*Ardeola grayii*	R	Least Concern
20	Indian Robin	*Saxicoloides fulicata*	R	Least Concern
21	Indian Roller	*Coracias benghalensis*	R	Least Concern
22	Indian Silverbill	*Euodice malabarica*	R	Least Concern
23	Indian Spot-billed Duck	*Anas poecilorhyncha*	R	Least Concern
24	Intermediate Egret	*Ardea intermedia*	R	Least Concern
25	Laughing Dove	*Streptopelia senegalensis*	R	Least Concern
26	Lesser Whistling-duck	*Dendrocygna javanica*	R	Least Concern
27	Little Grebe	*Tachybaptus ruficollis*	R	Least Concern
28	Pied Kingfisher	*Ceryle rudis*	R	Least Concern
29	Purple Heron	*Ardea purpurea*	R	Least Concern
30	Purple Sunbird	*Nectarinia asiatica*	R	Least Concern
31	Red-vented Bulbul	*Pycnonotus cafer*	R	Least Concern
32	Red-wattled Lapwing	*Vanellus indicus*	R	Least Concern
33	Southern Coucal	*Centropus sinensis*	R	Least Concern
34	Tricoloured Munia	*Lonchura malacca*	R	Least Concern
35	White-breasted Kingfisher	*Halcyon smyrnensis*	R	Least Concern
36	White-breasted Waterhen	*Amaurornis phoenicurus*	R	Least Concern
37	White-browed Wagtail	*Motacilla maderaspatensis*	R	Least Concern

Supply Chain Catchment Area

During the field survey, 57 avifaunal species were observed from the supply chain catchment area. None of the species was categorized under any threatened category of the IUCN Red List (Online Version 2022-2), but one Near Threatened, Painted Stork (*Mycteria leucocephala*) was observed in the supply chain catchment area. Six (06) Schedule I species - Black Kite, Black-winged Kite, Brahminy Kite, Indian Peafowl, Shikra, & Short-toed Snake-Eagle were also observed from the area as per the Wildlife (Protection) Act, 1972. One migratory [Common Kestrel (*Falco tinnunculus*)], and 06 Raptors [Black Kite (*Milvus migrans*), Black-winged Kite (*Elanus caeruleus*), Brahminy Kite (*Haliastur indus*), Common Kestrel (*Falco tinnunculus*), Shikra (*Accipiter badius*), & Short-toed Snake-Eagle (*Circaetus gallicus*)] species were also observed in the study area; while no vulture was observed (Table 4-38).

Table 4-38: Avifaunal diversity observed from the study area (Supply Chain Catchment Area)

Sr.No.	Common English Name	Binomial Scientific Name	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
1	Ashy Prinia	*Prinia socialis*	R	Least Concern
2	Ashy-crowned Sparrow-lark	*Eremopterix griseus*	R	Least Concern
3	Asian Green Bee-eater	*Merops orientalis*	R	Least Concern
4	Asian Koel	*Eudynamys scolopaceus*	R	Least Concern
5	Asian Openbill	*Anastomus oscitans*	R	Least Concern
6	Baya Weaver	*Ploceus philippinus*	R	Least Concern

Sr.No.	Common English Name	Binomial Scientific Name	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
7	Bay-backed Shrike	*Lanius vittatus*	R	Least Concern
8	Black Drongo	*Dicrurus macrocercus*	R	Least Concern
9	Black Kite	*Milvus migrans*	R	Least Concern
10	Black-rumped Flameback	*Dinopium benghalense*	R	Least Concern
11	Black-winged Kite	*Elanus caeruleus*	R	Least Concern
12	Black-winged Stilt	*Himantopus*	R	Least Concern
13	Brahminy Kite	*Haliastur indus*	R	Least Concern
14	Bronze-winged Jacana	*Metopidius indicus*	R	Least Concern
15	Cattle Egret	*Bubulcus ibis*	R	Least Concern
16	Common Babbler	*Argya caudata*	R	Least Concern
17	Common Cuckoo	*Cuculus canorus*	R	Least Concern
18	Common Hoopoe	*Upupa epops*	R	Least Concern
19	Common Kestrel	*Falco tinnunculus*	M	Least Concern
20	Common Kingfisher	*Alcedo atthis*	R	Least Concern
21	Common Moorhen	*Gallinula chloropus*	R	Least Concern
22	Common Myna	*Acridotheres tristis*	R	Least Concern
23	Coppersmith Barbet	*Psilopogon haemacephalus*	R	Least Concern
24	Eurasian Collared-Dove	*Streptopelia decaocto*	R	Least Concern
25	Grey Francolin	*Francolinus pondicerianus*	R	Least Concern
26	Grey Heron	*Ardea cinerea*	R	Least Concern
27	House Crow	*Corvus splendens*	R	Least Concern
28	House Sparrow	*Passer domesticus*	R	Least Concern
29	Indian Cormorant	*Phalacrocorax fuscicollis*	R	Least Concern
30	Indian Golden Oriole	*Oriolus kundoo*	R	Least Concern
31	Indian Peafowl	*Pavo cristatus*	R	Least Concern
32	Indian Pond Heron	*Ardeola grayii*	R	Least Concern
33	Indian Robin	*Saxicoloides fulicata*	R	Least Concern
34	Indian Roller	*Coracias benghalensis*	R	Least Concern
35	Indian Silverbill	*Euodice malabarica*	R	Least Concern
36	Indian Spot-billed Duck	*Anas poecilorhyncha*	R	Least Concern
37	Intermediate Egret	*Ardea intermedia*	R	Least Concern
38	Laughing Dove	*Streptopelia senegalensis*	R	Least Concern
39	Lesser Whistling-duck	*Dendrocygna javanica*	R	Least Concern
40	Little Grebe	*Tachybaptus ruficollis*	R	Least Concern
41	Little Ringed Plover	*Charadrius dubius*	R	Least Concern
42	Painted Stork	*Mycteria leucocephala*	R	Near Threatened
43	Pied Kingfisher	*Ceryle rudis*	R	Least Concern
44	Purple Heron	*Ardea purpurea*	R	Least Concern
45	Purple Sunbird	*Nectarinia asiatica*	R	Least Concern

Sr.No.	Common English Name	Binomial Scientific Name	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
46	Purple Swamphen	*Porphyrio*	R	Least Concern
47	Red-vented Bulbul	*Pycnonotus cafer*	R	Least Concern
48	Red-wattled Lapwing	*Vanellus indicus*	R	Least Concern
49	Rock Dove	*Columba livia*	R	Least Concern
50	Rose-ringed Parakeet	*Psittacula krameri*	R	Least Concern
51	Shikra	*Accipiter badius*	R	Least Concern
52	Short-toed Snake-Eagle	*Circaetus gallicus*	R	Least Concern
53	Southern Coucal	*Centropus sinensis*	R	Least Concern
54	Tricoloured Munia	*Lonchura malacca*	R	Least Concern
55	White-breasted Kingfisher	*Halcyon smyrnensis*	R	Least Concern
56	White-breasted Waterhen	*Amaurornis phoenicurus*	R	Least Concern
57	White-browed Wagtail	*Motacilla maderaspatensis*	R	Least Concern

4.5.3.4.3 Mammals

Manufacturing Unit

As per the literature review[114], local consultation and field survey, nine (09) mammals were recorded (reported and observed) from the study area. One Vulnerable as per IUCN Red List (Online Version 2022-2), Bonnet Macaque (*Macaca radiata*) was reported from the study area. None of the recorded species was listed under the Schedule I category as per the Wildlife (Protection) Act, 1972 (Table 4-39).

Table 4-39: Mammals from the study area (Manufacturing Unit)

Sr.No.	Common English Name	Binomial Scientific Name	IUCN Red List - Categories	Wildlife (Protection) Act. 1972 - Schedules	Reported / Observed
1	Bonnet Macaque	*Macaca radiata*	Vulnerable	Schedule II	Observed
2	Brown Rat	*Rattus norvegicus*	Least Concern	Schedule V	Reported
3	Common Palm Squirrel	*Funambulus palmarum*	Least Concern	Schedule IV	Observed
4	Greater Bandicoot-Rat	*Bandicota indica*	Least Concern	Schedule IV	Reported
5	Indian Grey Mongoose	*Herpestes edwardsii*	Least Concern	Schedule II	Observed
6	Indian Hare	*Lepus nigricollis*	Least Concern	Schedule IV	Reported
7	Jungle Cat	*Felis chaus*	Least Concern	Schedule II	Reported
8	Lesser Asiatic Yellow House Bat	*Scotophilus kuhlii*	Least Concern	Not listed	Reported
9	Wild Boar	*Sus scrofa*	Least Concern	Schedule III	Reported

Supply Chain Catchment Area

As per the literature review[115], local consultation and field survey, thirty-three (33) mammals were recorded (reported and observed) from the supply chain catchment area. Two Endangered [Asiatic Elephant (*Elephas maximus*), & Lion-tailed Macaque (*Macaca Silenus*)]; seven Vulnerable [Bonnet Macaque (*Macaca radiata*), Fishing Cat (*Prionailurus viverrinus*), Four-horned Antelope (*Tetracerus quadricornis*), Indian Bison (*Bos gaurus*), Leopard (*Panthera pardus*), Sambar (*Rusa unicolor*), & Sloth Bear (*Melursus ursinus*)]; three Near Threatened [Grey Slender Loris (*Loris lydekkerianus*), Rusty-spotted Cat (*Prionailurus rubiginosus*),

114 https://www.inaturalist.org/observations?lat=13.915696751721786&lng=79.82653432883035&place_id=any&radius=31.50479994315241&subview=map&view=species&iconic_taxa=Mammalia

115 https://www.inaturalist.org/observations?nelat=15.331648278652699&nelng=80.10501201869587&place_id=any&subview=map&swlat=14.099062414189637&swlng=79.26455791713337&view=species&iconic_taxa=Mammalia

& Tufted Grey Langur (*Semnopithecus priam*)] have been recorded from the study area as per IUCN Red List (Online Version 2022-2). Ten (10) Schedule I species - Asiatic Elephant, Blackbuck, Fishing Cat, Four-horned Antelope, Grey Slender Loris, Indian Bison, Leopard, Lion-tailed Macaque, Mouse Deer, & Rusty-spotted Cat) were listed under the Schedule I category as per the Wildlife (Protection) Act, 1972 (Table 4-40). Both the Endangered mammals [Asiatic Elephant (*Elephas maximus*), & Lion-tailed Macaque (*Macaca Silenus*)] were restricted to the protected areas. Six, out of seven Vulnerable species, Fishing Cat (*Prionailurus viverrinus*), Four-horned Antelope (*Tetracerus quadricornis*), Indian Bison (*Bos gaurus*), Leopard (*Panthera pardus*), Sambar (*Rusa unicolor*), & Sloth Bear (*Melursus ursinus*) were reported from the protected areas. Only Bonnet Macaque (*Macaca radiata*) - Vulnerable was also observed in the supply chain catchment area.

Table 4-40: Mammals from the study area (Supply Chain Catchment Area)

Sr.No.	Common English Name	Binomial Scientific Name	IUCN Red List - Categories	Wildlife (Protection) Act. 1972 - Schedules	Reported / Observed
1	Asiatic Elephant	*Elephas maximus*	Endangered	Schedule I	Reported
2	Blackbuck	*Antilope cervicapra*	Least Concern	Schedule I	Reported
3	Bonnet Macaque	*Macaca radiata*	Vulnerable	Schedule II	Observed
4	Brown Rat	*Rattus norvegicus*	Least Concern	Schedule V	Reported
5	Chital	*Axis*	Least Concern	Schedule III	Reported
6	Common Palm Squirrel	*Funambulus palmarum*	Least Concern	Schedule IV	Observed
7	Fishing Cat	*Prionailurus viverrinus*	*Vulnerable*	Schedule I	Reported
8	Four-horned Antelope	*Tetracerus quadricornis*	Vulnerable	Schedule I	Reported
9	Golden Jackal	*Canis aureus*	Least Concern	Schedule II	Reported
10	Greater Bandicoot-Rat	*Bandicota indica*	*Least Concern*	Schedule IV	Reported
11	Greater Shortnosed Fruit Bat	*Cynopterus sphinx*	Least Concern	Schedule V	Reported
12	Grey Slender Loris	*Loris lydekkerianus*	Near Threatened	Schedule I	Reported
13	Indian Bison	*Bos gaurus*	Vulnerable	Schedule I	Reported
14	Indian Creasted Porcupine	*Hystrix indica*	Least Concern	Schedule IV	Reported
15	Indian Flying Fox	*Pteropus giganteus*	Least Concern	Schedule V	Reported
16	Indian Gerbil	*Tatera indica*	*Least Concern*	Schedule IV	Reported
17	Indian Giant Squirrel	*Ratufa indica*	Least Concern	Schedule II	Reported
18	Indian Giant Squirrel	*Ratufa indica*	Least Concern	Schedule II	Reported
19	Indian Grey Mongoose	*Herpestes edwardsii*	Least Concern	Schedule II	Observed
20	Indian Hare	*Lepus nigricollis*	Least Concern	Schedule IV	Reported
21	Jungle Cat	*Felis chaus*	Least Concern	Schedule II	Reported
22	Leopard	*Panthera pardus*	Vulnerable	Schedule I	Reported
23	Lesser Asiatic Yellow House Bat	*Scotophilus kuhlii*	*Least Concern*	*Not listed*	Reported
24	Lesser Bandicoot Rat	*Bandicota bengalensis*	Least Concern	Not listed	Reported
25	Lion-tailed Macaque	*Macaca silenus*	Endangered	Schedule I	Reported
26	Mouse Deer	*Moschiola indica*	Least Concern	Schedule I	Reported
27	Northern Plains Gray Langur	*Semnopithecus entellus*	Least Concern	Schedule II	Reported
28	Rusty-spotted Cat	*Prionailurus rubiginosus*	Near Threatened	Schedule I	Reported
29	Sambar	*Rusa unicolor*	Vulnerable	Schedule III	Reported
30	Sloth Bear	*Melursus ursinus*	Vulnerable	Schedule II	Reported
31	Small Indian Civet	*Viverricula indica*	Least Concern	Schedule II	Reported
32	Tufted Grey Langur	*Semnopithecus priam*	Near Threatened	Schedule II	Reported

Sr.No.	Common English Name	Binomial Scientific Name	IUCN Red List - Categories	Wildlife (Protection) Act. 1972 - Schedules	Reported / Observed
33	Wild Boar	*Sus scrofa*	Least Concern	Schedule III	Reported

4.5.3.5 Protected and Key Biodiversity Areas

There is no protected area (PA)[116] as well as Important Bird and Biodiversity Area (IBA)[117] within the proximity of 10 km. The nearest protected area (also an IBA), Nelapattu Bird Sanctuary is about 15 km away from the manufacturing unit in the southeast direction[118, 119]. Pulicat Bird Sanctuary (also an IBA) is also situated about 23 km away from the manufacturing unit in the southeast direction (Figure 4-38). Sri Penusila Narasimha Wildlife Sanctuary (also an IBA), and Sri Venkateshwara National Park & Sanctuary (also an IBA) are also situated in the surroundings of catchment area.

4.5.3.5.1 Nelapattu Bird Sanctuary

Nelapattu Bird Sanctuary is situated in Nelapattu Village of Doravarisatram Mandal in Nellore District in the state of Andhra Pradesh and was notified in 1976[120]. The sanctuary supports atleast 187 bird species including 50 migratory bird species. The sanctuary supports the largest pelicanry - Spot-billed Pelican (*Pelecanus philippensis*), in India. It is also a breeding site for Black-headed Ibis (*Threskiornis melanocephalus*), Asian Openbill (*Anastomus oscitans*), Black-crowned Night-heron (*Nycticorax nycticorax*), and Little Cormorant (*Microcarbo niger*)[121].

4.5.3.5.2 Pulicat Bird Sanctuary

Pulicat Lake is an extensive brackish to saline lagoon with associated marshes and a massive freshwater to brackish swamp to the north. The backwaters attract large congregations of Greater Flamingo (*Phoenicopterus roseus*) and Lesser Flamingo (*Phoeniconaias minor*), Grey Pelican (*Pelecanus philippensis*), Painted Stork (*Mycteria leucocephala*), Grey Heron (*Ardea cinerea*), and species of Ducks, Teals, Terns, Gulls, and Waders. It has been declared as a Biodiversity Heritage Site by the Andhra Pradesh Biodiversity Board. Atleast 113 species of birds have been recorded from the Sanctuary including one Endangered - Black-bellied Tern (*Sterna acuticauda*), four Vulnerable - Marbled Teal (*Marmaronetta angustirostris*), Greater Spotted Eagle (*Clanga clanga*), Asian Woollyneck (*Ciconia episcopus*), & Great Knot (*Calidris tenuirostris*)[122].

4.5.3.5.3 Sri Venkateshwara Sanctuary & National Park

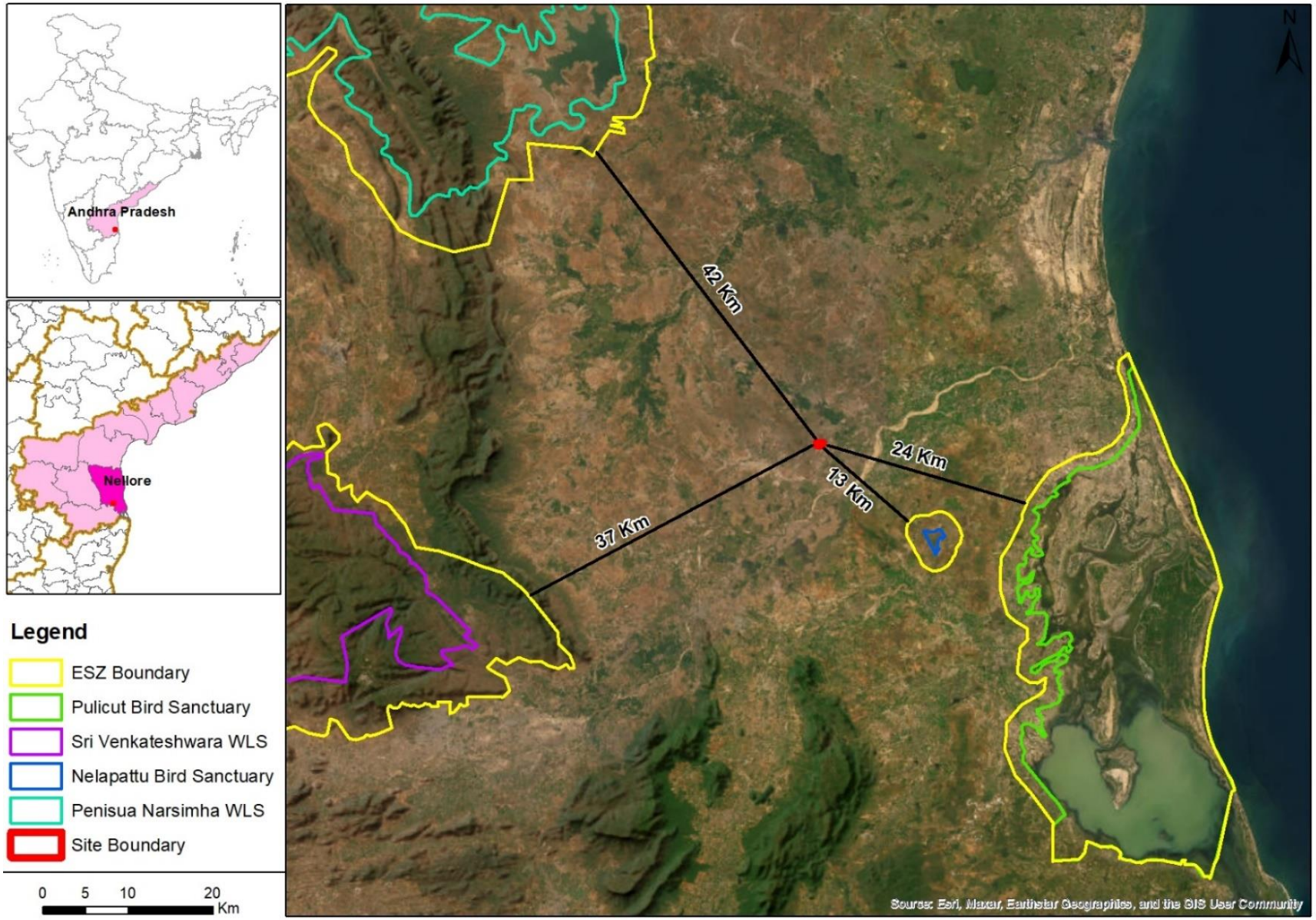
Sri Venkateswara Wildlife Sanctuary & National Park is located in Chittoor and Cuddapah Districts of Andhra Pradesh includes the holy and sacred seven hills, the abode of Lord Venkateswara[123]. The protected area is the home of Endangered flora like *Cycas beddomei* Dyer, and *Pterocarpus santalinus* L.f. This area is extremely important due to its location at the junction of Eastern and Western Ghats. It supports atleast 178 bird species, including two Vulnerable birds - Asian Woollyneck (*Ciconia episcopus*), & Yellow-throated Bulbul (*Pycnonotus xantholaemus*)[124].

4.5.3.5.4 Sri Penusila Narasimha Wildlife Sanctuary

Sri Penusula Narasimha Wildlife Sanctuary, previously known as the Veliconda Wildlife Sanctuary, spreads over the districts of Cuddapah and Nellore in Andhra Pradesh. The sanctuary is a domain of rich habitat for unexplored bio- diversity, especially many endangered flora and its associated fauna. The sanctuary is ornamented with mosaic of geo-morphological features supporting variety of flora & fauna. Most of the sanctuary possess hilly terrain with plateaus, ridges, gorges and deep valleys which support dry deciduous forests with an under growth of grasses[125]. Sixty-eight bird species were recorded from the sanctuary, including Critically Endangered - Jerdon's Courser (*Rhinoptilus bitorquatus*) and Vulnerable - Yellow-throated Bulbul (*Pycnonotus xantholaemus*)[126].

[116] http://wiienvis.nic.in/Database/Maps_PAs_1267.aspx
[117] Rahmani A.R., Islam M.Z. and Kasambe R.M. (2016) Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated). Bombay Natural History Society, Indian Bird Conservation Network, Royal Society for the Protection of Birds and BirdLife International (U.K.), p. 1992 + xii.
[118] http://wiienvis.nic.in/Database/Maps_PAs_1267.aspx
[119] Rahmani A.R., Islam M.Z. and Kasambe R.M. (2016) Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated). Bombay Natural History Society, Indian Bird Conservation Network, Royal Society for the Protection of Birds and BirdLife International (U.K.), p. 1992 + xii.
[120] https://moef.gov.in/wp-content/uploads/2017/06/Nelapattu%20Bird%20Sanctuary%2C%20Andhra%20Pradesh.pdf
[121] Rahmani A.R., Islam M.Z. and Kasambe R.M. (2016) Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated). Bombay Natural History Society, Indian Bird Conservation Network, Royal Society for the Protection of Birds and BirdLife International (U.K.), p. 1992 + xii.
[122] Kannan, V., Manakadan, R., Rao, P., Mahapatra, K.K., Sivakumar, S., and Santharam, V. (2008) The waterbirds of Pulicat Lake, Andhra Pradesh-Tamil Nadu, India, including those of the adjoining wetlands and heronries. *JBNHS* 105(2): 162–180.
[123] https://moef.gov.in/wp-content/uploads/2021/06/sri-venkateshwara.pdf
[124] Anand Mohan, B. (2000) Birds in and around Sri Venkateswara Wildlife Sanctuary, Andhra Pradesh. *Zoo's Print Journal* 15(10): 339–343.
[125] https://moef.gov.in/wp-content/uploads/2017/06/penusila.pdf
[126] Jeganathan, P. (2003) Preliminary faunal survey in the Sri Penusula Narasimha Wildlife Sanctuary, Andhra Pradesh. Bombay Natural History Society, Mumbai, pp. 13.

Figure 4-38: Ecological Sensitivity in the study area



4.5.3.6 Bird Migration Flyways

India majorly lies in the Central Asian Flyway[127] (Figure 4-38). More than 300 species travel along the Central Asian Flyway, including a significant movement of the family Anatidae (Ducks, Geese and Swan), Gruidae (Cranes), etc. that travel from Europe/North Asia to the Indian subcontinent and occupy medium to large water bodies. As per the eBird Database[128], at least 122 migratory birds including one Critically Endangered [White-Rumped Vulture (*Gyps bengalensis*)]; one Endangered [Great Knot (*Calidris tenuirostris*)]; six Vulnerable [Common Pochard (*Aythya ferina*), Greater Spotted Eagle (*Clanga clanga*), Indian Spotted Eagle (*Clanga hastata*), River Tern (*Sterna aurantia*), Tawny Eagle (*Aquila rapax*), & Yellow-throated Bulbul (*Pycnonotus xantholaemus*)]; and 29 Schedule I [Black Baza, Black Eagle, Black Kite, Black-winged Kite, Bonelli's Eagle, Booted Eagle, Brahminy Kite, Changeable Hawk-Eagle, Crested Goshawk, Crested Serpent-Eagle, Eurasian Buzzard, Eurasian Sparrowhawk, Eurasian Spoonbill, Fulvous Whistling-duck, Greater Spotted Eagle, Indian Grey Hornbill, Indian Peafowl, Montagu's Harrier, Oriental Honey-buzzard, Osprey, Pallid Harrier, Peregrine Falcon, Red-necked Falcon, Rufous-bellied Eagle, Shikra, Short-toed Snake-Eagle, Tawny Eagle, Western Marsh-Harrier, & White-eyed Buzzard] species were reported from the surrounding area of the manufacturing unit and catchment area (Table 4-29 and Table 4-31). This secondary information also reports one vulture and thirty-five raptor species from the region (Table 4-30 and Table 4-32).

The only Critically Endangered - White-Rumped Vulture (*Gyps bengalensis*) was last time reported from the Pulicat Bird Sanctuary in Jan. 2016, and after that no record is available in the region for the species[129]. As per the available secondary records, the presence of migratory Great Knot (*Calidris tenuirostris*) - Endangered is restricted along the coasts. The nearest records for this Endangered species are available from the Pulicat Bird Sanctuary (about 23 km from the manufacturing unit)[130]. Grey-fronted Green-pigeon (*Treron affinis*) - Endemic to Eastern Ghats was also reported from the region, specifically from the forests of Sri Venkateshwara National Park (near Tirupati) and Guindy National Park, Chennai[131]. Thus, due to the absence of recent records (White-Rumped Vulture) and suitable habitat (Great Knot & Grey-fronted Green-pigeon), the presence of the above-mentioned species in the study area is very unlikely.

As number of seasonal and several perennial water bodies are present within the study area (manufacturing unit as well as supply chain catchment area, the congregation of migratory water birds specifically, - Greater Flamingo, Northern Pintail, Glossy Ibis, Bar-headed Goose, Black-tailed Godwit, Northern Shoveler, Common Pochard, & Garganey - in the study area for manufacturing unit[132]; and Greater Flamingo, Northern Pintail, Garganey, Glossy Ibis, Northern Shoveler, Eurasian Coot, Bar-headed Goose, Black-tailed Godwit, Tufted Duck, & Common Pochard - in the catchment area[133] was reported. Pulicat Lake (Pulicat Bird Sanctuary), Kanigiri Reservoir and Badvel Big Tank (Badvel Pedda Cheruvu), are the key site for the bird congregation in the region.

[127] http://datazone.birdlife.org/userfiles/file/sowb/flyways/7_Central_Asia_Factsheet.pdf

[128] https://ebird.org/barchart?byr=2001&eyr=2023&bmo=1&emo=12&r=L3852120,L10692120,L20383898,L5435997,L5424106,L6425561,L14354303,L10134565,L8042657,L14320101,L10891558,L17894576,L10807842,L10068228,L6873924,L12270884,L14091458,L3167817,L1076318,L14354309,L13720473,L11676689,L6720719,L12531875,L10068233,L11539895,L10139618,L967216,L10278697,L10282520,L967219,L5540948,L20501356,L14354258,L14320085

[129] https://ebird.org/map/whrvul1?bmo=1&emo=12&byr=2001&eyr=2023&env.minX=79.467&env.minY=13.659&env.maxX=80.111&env.maxY=14.314&gp=true

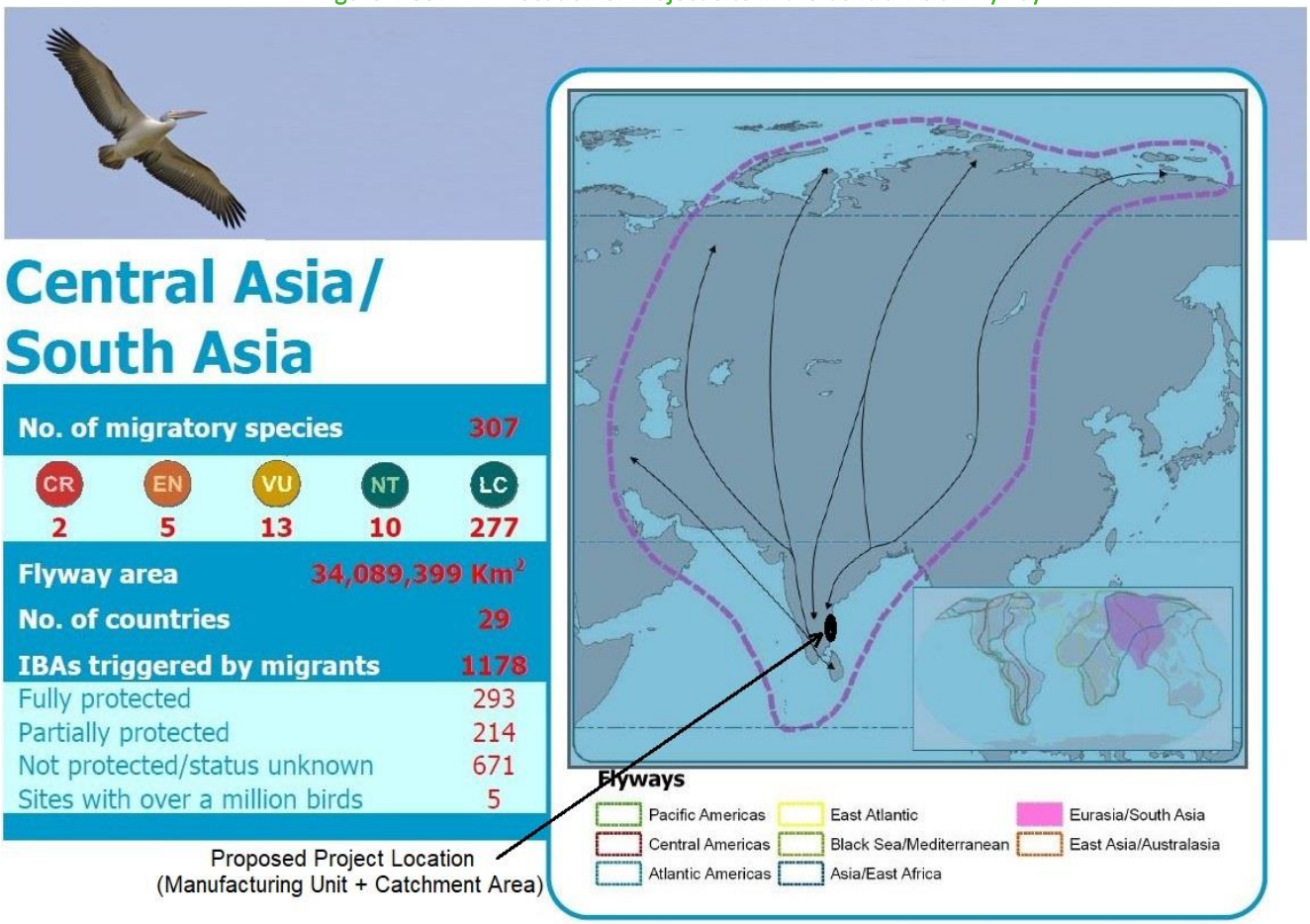
[130] https://ebird.org/map/grekno?bmo=1&emo=12&byr=2001&eyr=2023&env.minX=79.467&env.minY=13.659&env.maxX=80.111&env.maxY=14.314&gp=true

[131] https://ebird.org/map/pomgrp2?bmo=1&emo=12&byr=2001&eyr=2023&env.minX=79.467&env.minY=13.659&env.maxX=80.111&env.maxY=14.314&gp=true

[132] eBird Database [https://ebird.org/hotspot/L5435997, https://ebird.org/hotspot/L5424106, https://ebird.org/hotspot/L6425561, https://ebird.org/hotspot/L14354303, https://ebird.org/hotspot/L10891558, https://ebird.org/hotspot/L6873924, https://ebird.org/hotspot/L12270884, https://ebird.org/hotspot/L3167817, https://ebird.org/hotspot/L1076318, https://ebird.org/hotspot/L10068233, https://ebird.org/hotspot/L10278697, https://ebird.org/hotspot/L14354258, https://ebird.org/hotspot/L14354309]

[133] eBird Database [https://ebird.org/hotspot/L3852120, https://ebird.org/hotspot/L10692120, https://ebird.org/hotspot/L20383898, https://ebird.org/hotspot/L5435997, https://ebird.org/hotspot/L5424106, https://ebird.org/hotspot/L6425561, https://ebird.org/hotspot/L14354303, https://ebird.org/hotspot/L10134565, https://ebird.org/hotspot/L8042657, https://ebird.org/hotspot/L14320101, https://ebird.org/hotspot/L10891558, https://ebird.org/hotspot/L17894576, https://ebird.org/hotspot/L10807842, https://ebird.org/hotspot/L10068228, https://ebird.org/hotspot/L6873924, https://ebird.org/hotspot/L12270884, https://ebird.org/hotspot/L14091458, https://ebird.org/hotspot/L3167817, https://ebird.org/hotspot/L1076318, https://ebird.org/hotspot/L13720473, https://ebird.org/hotspot/L11676689, https://ebird.org/hotspot/L6720719, https://ebird.org/hotspot/L12531875, https://ebird.org/hotspot/L10068233, https://ebird.org/hotspot/L11539895, https://ebird.org/hotspot/L10139618, https://ebird.org/hotspot/L967216, https://ebird.org/hotspot/L10278697, https://ebird.org/hotspot/L10282520, https://ebird.org/hotspot/L967219, https://ebird.org/hotspot/L5540948, https://ebird.org/hotspot/L20501356, https://ebird.org/hotspot/L14354258, https://ebird.org/hotspot/L14320085, https://ebird.org/hotspot/L14354309]

Figure 4-39: Location of Project Site in the Central Asian Flyway[134]



4.5.3.7 Critical Habitat Triggers

To list out the potential species, which may trigger critical habitat, IBAT proximity report was generated for the catchment area. Based on the literature reviews and field survey, atleast 28 species of conservation importance from the region, which may trigger Critical Habitat as per IFC PS 6 have been listed under ***Table 4-41***.

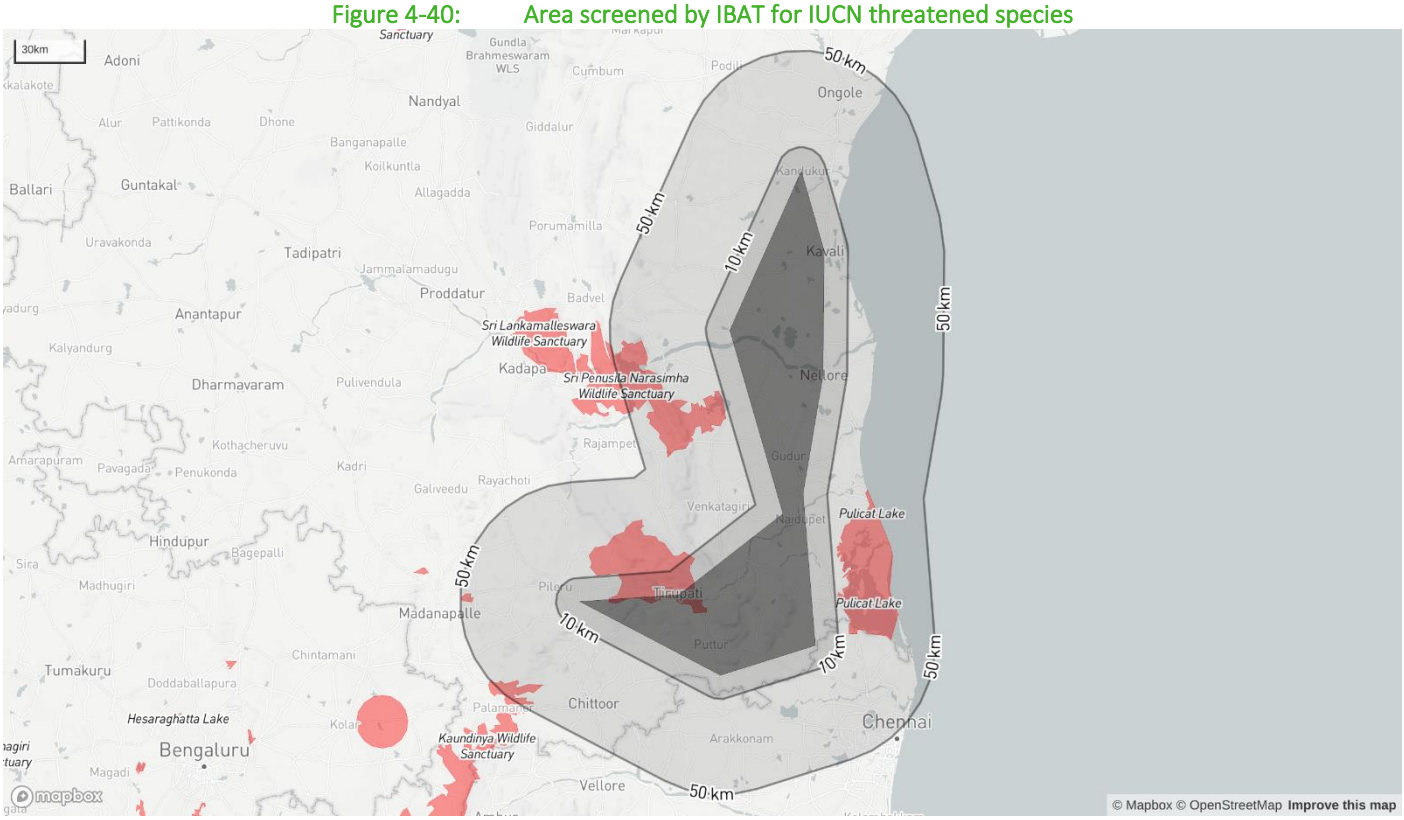
[134] http://datazone.birdlife.org/userfiles/file/sowb/flyways/7_Central_Asia_Factsheet.pdf

Table 4-41: Species which may trigger Critical Habitat

S.N.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List – Categories	Wildlife (Protection) Act. 1972 - Schedules	CH criterion	Number of Observations / Individuals with Source
Herpetofauna							
1	Rishi Valley Geckoella	*Cyrtodactylus rishivalleyensis*	-	Endangered	Not listed	Criterion 1	1 observation - Aug. 2017[135]
2	Scaly Gecko	*Hemidactylus scabriceps*	-	Endangered	Not listed	Criterion 1	1 observation - Jun. 2021[136]
Avifauna							
3	White-Rumped Vulture	*Gyps bengalensis*	R	Critically Endangered	Schedule IV	Criterion 1	3 - Jan. 2016[137]
4	Steppe Eagle	*Aquila nipalensis*	M	Endangered	Schedule I	Criterion 1	1 - Jan. 2022[138] 1 - Dec. 2019[139] 1 - Nov. 2019[140] 1 - Aug. 1999[141]
5	Great Knot	*Calidris tenuirostris*	M	Endangered	Schedule IV	Criterion 1	3 - Oct. 2022[142] 6 - Feb. 2022[143] 1 - Sep. 2022[144] 1 - Aug. 2021[145] 10 - Jun. 2018[146] 27 - Mar.2017[147] 5 - Mar. 2014[148]

[135] https://www.inaturalist.org/observations/62371179
[136] https://www.inaturalist.org/observations/83567528
[137] https://ebird.org/hotspot/L3167817
[138] https://ebird.org/checklist/S100787124
[139] https://ebird.org/checklist/S62491124
[140] https://ebird.org/hotspot/L2583669
[141] https://ebird.org/checklist/S20388777
[142] https://ebird.org/hotspot/L3167817
[143] Meezuru, Andhra Pradesh [https://ebird.org/india/checklist/S103945323; https://ebird.org/india/checklist/S103945324]
[144] https://ebird.org/hotspot/L2357332
[145] https://ebird.org/india/checklist/S93876719
[146] https://ebird.org/checklist/S46577766
[147] Arani River Pulicat, Tamil Nadu [https://ebird.org/checklist/S35169637; https://ebird.org/checklist/S35324942; https://ebird.org/checklist/S35466747]
[148] https://ebird.org/checklist/S25291701

Figure 4-40: Area screened by IBAT for IUCN threatened species



4.6 Ecosystem Services

The benefits provided to humans through the transformations of environmental assets such as land, water, vegetation, and atmosphere into a flow of essential goods and services such as clean air, water, and food are termed as ecosystem services. Ecosystem services can be defined as the process of natural systems that directly or indirectly benefit humans or enhance social welfare.

4.6.1 Ecosystem and their services

The manufacturing unit at Naidupeta and the catchment area, comprises of majorly two types of ecosystems which are terrestrial ecosystem and aquatic ecosystems. The terrestrial ecosystem may be further divided into forest, plantation and grassland ecosystems, while the aquatic ecosystem into freshwater and marine ecosystems.

4.6.1.1 Forest Ecosystem

The Seshachalam and Tirumala hills, along with the surrounding scrub land, are home to several protected and reserved forest areas, including the Sri Venkateshwara National Park and Wildlife Sanctuary and the Sri Penusila Narsimha Wildlife Sanctuary.

Provisioning Services: These forests provide valuable provisioning services, such as supplying non-timber forest products (NTFT) that are utilized by local communities, provide food, fiber, and medicinal plants that support the local communities[149].
Regulating Services: The district's forests provide a range of regulating services. The forests help regulate the local climate and reduce soil erosion.
Supporting Services: the ecosystem supports soil formation, nutrient cycling, and seed dispersal. The forests provide habitats for a range of plant and animal species, contributing to biodiversity conservation. Mammals like Asian Elephant, Leopard, Sloth Bear, Sambar Deer, Cheetal, Mouse Deer, Barking Deer, Slender Loris and Indian Giant Squirrel (https://forests.ap.gov.in/nationalparks.php).
Cultural Services: The district's cultural heritage is closely linked to its natural environment. The forest is important sites for spiritual practices especially the Sri Venkateshvara Swami Temple a Hindu temple situated in the hill town of Tirumala. The district's natural beauty also attracts tourists, contributing to the local economy.

[149] Reddy, A. M., Babu, M. V. S., & Rao, R. R. (2019). Ethnobotanical study of traditional herbal plants used by local people of Seshachalam Biosphere Reserve in Eastern Ghats, India. Herba Polonica, 65(1), 40-54.

Measures for sustainable use of natural resources

Measures that the client have to practice to contribute for the sustainable use of natural resources in regions to avoid risk of significant impact on abovementioned ecosystem services and habitat conversion

Supply Chain Transparency and Mapping: Establish a comprehensive system to trace the origin of wood and identify the specific landuse associated with the supply areas in collaboration with suppliers.

Risk Monitoring and Prioritization: During the operational stage, it is advised to conduct comprehensive risk assessments to identify regions experiencing significant habitat conversion due to production activities. Conservation priority should be given to regions containing critical habitats or ecosystems that are affected during the lifetime of the project.

Supplier Engagement and Evaluation: Engage with farmers and primary suppliers to communicate the importance of sustainable resource use. Regularly assess suppliers' commitment to avoiding significant habitat conversion through dialogue and evaluation.

Ongoing Monitoring and Auditing: Implement a continuous monitoring and auditing system to review primary supply chains. Conduct regular site visits or remote assessments to verify the accuracy of reported information.

Procurement Guidelines and Criteria: Develop clear procurement guidelines that explicitly state the client's commitment to avoiding the sourcing of products from natural habitats. Set criteria for supplier selection that prioritize those who demonstrate active efforts towards habitat preservation.

Capacity Building and Training: Offer training programs and capacity-building initiatives to farmers, educating them about sustainable land use practices and the importance of habitat preservation.

4.6.1.2 Plantation Ecosystem

The entire region is practising the agroforestry since long time. *Eucalyptus globulus* is the key agroforestry tree species followed by *Casuarina latifolia*, and *Leucaena leucocephala* (Subabul) in some areas. In Nellore region, about 22942.27 ha land is occupied by the *Eucalyptus* plantation[150].

Provisioning Services: Locals collect dry twigs to use as firewood, and use the leaves as fodder from the plantations
Regulating Services: The plantations reduce soil erosion, increase aesthetic value and help in carbon fixation.
Supporting Services: It also supports soil formation, and nutrient cycling.

4.6.1.3 Grassland / Agriculture land Ecosystem

Though grassland areas in lowlands are not covering significant area, however the small patches provide various services and acts as catchment areas for small to medium sized water bodies and fodder for livestock. The grasslands converted into agriculture lands which play as grasslands ecosystem during the cropping season.

Provisioning Services: The district's agricultural/grasslands provide food, fodder, fiber, and medicinal plants that support the local communities. The major crops grown in the region include paddy, sugarcane, mango, and groundnut.

4.6.1.4 Freshwater Ecosystem

Swarnamukhi River and Swarnamukhi Barrage, Kandaleru Reservoir, Sarvepalli Reservoir and other medium and small sized water bodies. The wetlands act as natural water filters, preventing pollutants from entering waterways.

Provisioning Services: The wetlands provide aquaculture opportunity which is used as food[151] and commercial support the local communities[152].

Regulating Services: Wetlands provide a range of regulating services. The wetlands act as natural water filters, preventing pollutants from entering waterways. The local communities also depend on these ecosystems for drinking water and irrigation for agriculture.

[150] http://www.apfdcl.com/pages/Activities/Eucalyptus.aspx
[151] Patil, P. G., & Krishnan, M. (1998). The social impacts of shrimp farming in Nellore District, India. Aquaculture Asia. Bangkok, 3(1), 3-5.
[152] Krishnan, M., & Birthal, P. S. (2002). Aquaculture development in India: An economic overview with special reference to coastal aquaculture. Aquaculture Economics & Management, 6(1-2), 81-96.

4.6.1.5 Marine Ecosystem

Pulicat Lake is a large saline lagoon locate on coast of Bay of Bengal. The lake is an important ecosystem that provides a range of valuable services to both humans and wildlife[153].

Biodiversity conservation: The lake is home to a wide variety of plant and animal species, making it an important site for biodiversity conservation. The habitat in Pulicat Lake includes wetlands, marshes, mudflats, and shallow waters, which support a diverse array of plant and animal life. Some of the important plant species found in the lake's habitat include mangroves, sea grasses [154], and salt-tolerant shrubs[155]. The lake is also an important feeding and breeding ground for a variety of water birds, including pelicans, flamingos, and herons[156]. These gives as recreational value to the region.

Fisheries: The lake supports a variety of fish species that are important for the local fishing industry, providing livelihoods for many people in the region[157]. Flood control: The lake acts as a natural buffer against floods, absorbing excess water during periods of heavy rainfall and reducing the risk of flooding downstream (Erambalur & Basha 2016). Carbon sequestration: The lake's mangrove forests, and other vegetation help to store carbon, mitigating the impacts of climate change[158]. Tourism and recreation: The lake is a popular destination for tourists and local visitors, providing opportunities for boating, bird watching, and other outdoor activities[159]. Overall, Pulicat Lake provides a range of important ecosystem services that contribute to the social, economic, and ecological well-being of the region

[153] Saraswathy, R., & Pandian, P. K. (2016). Pulicat lake: A fragile ecosystem under threat. Slovak Journal of Civil Engineering, 24(3), 8-18.
[154] Erambalur, R., & Basha, S. K. M. (2016). Floral Diversity of Mangrove Ecosystem of Pulicat Lake, Andhra Pradesh. Imperial Journal of Interdisciplinary Research, 2(5), 164-169.
[155] Basha, S. K. M., LAKSIIMI, E. R., & RAMIREDDY, K. (2014). Floristic Studies and its Conservation of Pulicat Lake-Andhra Pradesh. J. Econ. taxon. Bot, 38(1).
[156] Kannan, V., & Pandiyan, J. (2012). Shorebirds (Charadriidae) of Pulicat Lake, India with special reference to conservation. World J. Zool, 7(3), 178-191.
[157] Thirunavukkarasu, N., Gokulakrishnan, S., Premjothi, P. V. R., & Inbaraj, R. M. (2011). Need of coastal resource management in Pulicat Lake–challenges ahead. Indian Journal of Science and Technology, 4(3), 322-326.
[158] Kaladharan, P., Vijayakumaran, K., Edward, L., Lavanya, R., & Dash, B. (2021). Blue carbon stock of seagrass meadows of Chilika and Pulicat Lakes along the Eastern coast of India. Fishery Technology, 58, 143-146.
[159] Thirunavukkarasu, N., Gokulakrishnan, S., Premjothi, P. V. R., & Inbaraj, R. M. (2011). Need of coastal resource management in Pulicat Lake–challenges ahead. Indian Journal of Science and Technology, 4(3), 322-326.

5 Stakeholder Identification and Engagement

A stakeholder is "a person, group, or organization that has a direct or indirect stake in a project/organization because it can affect or be affected by the Project/company's actions, objectives, and policies". Stakeholder thus vary in terms of degree of interest, influence and control they have over the Project. While those stakeholders who have a direct impact on or are directly impacted by the Project are known as primary Stakeholders, those who have an indirect impact or are indirectly impacted are known as Secondary Stakeholders. Considering the nature of the Project and its setting, the stakeholders have been identified and listed in the ***Table 5-1*** given below:

Table 5-1: Identified Stakeholders

Category	Primary Stakeholders	Secondary Stakeholder
Community	• Wood Plantation Farmers • Plantation Nursery • Labors engaged in plantation & transport • Local Wood Aggregators • Transporters • Opinion holders • Community leaders	Nil
Institutional Stakeholders	• APIIC • APFDC (Andhra Pradesh Forest Development Corporation limited) • Local Gram Panchayats • Project Investors	• Village Institutions (education and health department) • Political Parties
Government Bodies	• Regulatory Authorities • District Administration	• State Administration
Other Groups	• Employees • Contractors and sub-contractors • Contractual workers	• Media • Local NGOs

5.1 Stakeholder Mapping & Profile

This section provides the stakeholder identification and mapping for the project based on the current planning stage. The identification is based on present status and understanding of the project. The analysis of the identified stakeholders is based on stakeholders' profiling and the significance of impact/influence each stakeholder in relation to the Project.

The influence and priority have both been primarily rated as:

- High Influence: This implies a high degree of influence of the stakeholder on the project in terms of participation and decision making or high priority to engage with the stakeholder
- Medium Influence: Which implies a moderate level of influence and participation of the stakeholder in the project as well as a priority level to engage the stakeholder which is neither highly critical nor are insignificant in terms of influence
- Low Influence: This implies a low degree of influence of the stakeholder on the project in terms of participation and decision making or low priority to engage that stakeholder

The intermediary categories of low to medium or medium to high primarily imply that their influence and importance could vary in that range subject to context specific conditions or also based on the responses of the project towards the community.

The coverage of stakeholders as stated above includes any person, group, institution, or organization that is likely to be impacted (directly or indirectly) or may have interest/influence over project. Keeping this wide scope of inclusion in stakeholder category and the long life of project, it is difficult to identify all potential stakeholders and gauge their level of influence over project at the outset of the project. Therefore, the project proponent is advised to consider this stakeholder mapping as a live document which should be revised periodically and update the same as per the nature of the project lifecycle

The following Table 5-2 provides a brief profile of the stakeholder groups identified, their key interests and concerns and the way they may be involved in the project lifecycle.

Table 5-2: Stakeholder Mapping (Profile of stakeholder identified, their key interests and concerns and the way they may be involved in the project lifecycle)

Relevant Stakeholders	Profile	Concerns and Expectations from the project	Influence of Stakeholder on Project	Influence of Project on Stakeholder	Influence Rating
Primary Stakeholders					
Wood Plantation Farmers	• The stakeholder group is spread across the potential 4 districts that is Tirupati, Nellore, Prakasham and Chittoor respectively. • This stakeholder group consist of the famers who will be cultivating and selling the wood to the project. • Although they would be selling /supplying wood to the project but there will be no formal contract farming on behalf of the project. • Famers are free to supply or sell their wood to any wood-based industry in the region. As informed since long time the area is having the presence of wood-based industries therefore farmers are very much experienced in wood cultivation and farming business. Most of these farmers are doing wood cultivation as cash crop and generally less fertile land is used for wood cultivation.	• The expectations and concern of this group from the project: – The Key expectations are with respect to getting good price for the wood – Get advance notice with respect to rates and especially changes in the procurement policy – Getting technical support and training – Getting advanced variety of saplings and concessions in the rates of sapling especially for the weaker sections of society of farmers belonging to SC/ST communities	• Due to the nature of the project this stakeholder group is very important and requires continuous engagement as the project is dependent on them for the supply of wood. • As this group is very large and spread over large geographical area (4 districts) therefore there might be fringe elements who can potentially negatively influence the project	• The project can prove to be potential source of livelihood /employer of the people in the area. • Project has potential to develop the capacity of stakeholders in terms of technical knowledge as well as can develop new model local entrepreneurs. • Project can be instrumental in bringing community development in their areas through CSR activities.	• Influence of Stakeholder: **HIGH** • Influence of Project: **HIGH**
Plant Nursery	• This stakeholder group is one of the key groups who will be responsible for the onetime supply of the quality saplings to farmers. Although their numbers will be less however the same will be spread over different parts of the region. Most of these nurseries were privately owned however project need to have supply	• Timely formal agreements for supply of saplings • Advance notices for projected sapling requirements • Training and Capacity buildings on nursery management • Financial support for technological advancement	• As the entire wood supply is dependent on the supply of right species of tree therefore this stakeholder group is concorded to be critical for the business continuity • The group will be widely distributed in the region therefore any potential issue	Project will be providing increased business opportunity and livelihood to the people engaged in plant nursery business The project will incapacitate individuals to grow and equip with better knowledge of nursery management	• Influence of Stakeholder: **HIGH** • Influence of Project: **HIGH**

Relevant Stakeholders	Profile	Concerns and Expectations from the project	Influence of Stakeholder on Project	Influence of Project on Stakeholder	Influence Rating
	agreement with these nurseries and provide technical support.	• Advice on species selection and disease control	can lead negative impact on the project	Project can potentially make new entrepreneurs	
Wood Transporters / individual truck owner /associations	This stakeholder group will be important from the supply standpoint. They will be spread across the project and districts. Further most of the transporters in India are having trade associations/ unions. Often seen these associations have power to influence the fright and fright rates. Although supply of wood does not come directly under the purview of project and mostly it is taken care off by the wood aggregators. However, any potential issues may have direct impact on wood supply and production.	• Getting timely payments • Smooth freight movements • Insurance and no accidents • Timely delivery and signing off • Less waiting time at the factory • Compliance to legal permits and licenses	• As mentioned before this stakeholder is not directly associated with the project however for ensuring the supply of wood, they contribute important part therefore this group have significant influence on the project	The project via wood aggregators will contribute towards giving more business and livelihood opportunity Project can provide necessary training and capacity building in road safety fleet management, traffic management and legal compliances	• Influence of Stakeholder: **HIGH** • Influence of Project: **HIGH**
Wood Aggregators	This stakeholder group is most critical for ensuring the supply of wood based raw material for the project. The group will be spread all over the region and have strong relationship with the potential wood farmers. As understood from the discussion wood aggregators are functional at different level and working is different capacities at village level there will be small aggregators who might be associated with the big aggregators Woking at cluster level and so on. Hence their numbers might be less however they have very strong influence on the wood supply chain.	• Getting confirmed advance projection for wood supply • Getting enough wood supply from the famers to meet the demand • Ontime transporting wood to the factory • Timely payment • Supply of wood as per the specifications	• The stakeholder group will be having high influence on the project because wood supply is totally dependent on them. Although there might be some direct purchase options as well, but majority of the wood shall be procured from them, and any potential issues may have impact of supply of wood based raw material	The project will have high influence on terms of employment, livelihood and income and providing more business opportunity	• Influence of Stakeholder: **HIGH** • Influence of Project: **HIGH**

Relevant Stakeholders	Profile	Concerns and Expectations from the project	Influence of Stakeholder on Project	Influence of Project on Stakeholder	Influence Rating
Opinion Holder and Community Leaders	This stakeholder group is comprised of those individuals of the local community who hold traditional and rational power. These stakeholder group members include the elders, community and political leaders in the village and play a critical role in the decision making in the local community	• The expectations and concerns of this group from the project includes: – Receiving benefits from the project in terms of employment and development of infrastructure and the community – Regular updates on the project activities and the opportunities from the same	• This group, though powerful enough to affect the functioning of the Project in their vicinity • This stakeholder group may play an important role in the public opinion formation, implementation of the CSR activities planned by the project	These groups due to their social status, may already have access to several economic benefits from the other Projects, and thus may not be completely dependent upon the Project for access to development opportunities	• Influence of Stakeholder: Low/ **MEDIUM** • Influence of Project: **LOW/MEDIUM**
Local Gram Panchayats	This stakeholder group is comprised of the lowest level of local governance. The gram panchayats consist of one or more revenue villages and are the lowest level of decision-making bodies for development activities in the villages	• The expectations and concerns of this group from the project: – Receiving benefits from the project in terms of employment and development of infrastructure – Implementation of community development programmes in consultation with the Gram Panchayat and the local community – Preference to the local community in contractor and employment opportunities from the project – Regular updates on the project activities and the opportunities from the project	• The panchayat members can influence the decision-making process of the landowners and the entire community, at large; and • This stakeholder may also play an important role in the implementation CSR activities planned and the execution of other plans such as stakeholder engagement and grievance management.	The project can play an important role in the development of the villages by undertaking CSR activities in collaboration with the Gram Panchayat, especially in areas where there is a paucity of government funds	• Influence of Stakeholder: **LOW** • Influence of Project: **LOW**
Regulatory Authorities	This stakeholder group is comprised of the central, state and district level regulatory authorities. These	The key expectations and concerns of the group from the project include:	• The failure of the project to comply with the various rules and regulations applicable can	The influence of the project on the stakeholders pertains to the role the	• Influence of Stakeholder: **HIGH** • Influence of Project: **LOW**

Relevant Stakeholders	Profile	Concerns and Expectations from the project	Influence of Stakeholder on Project	Influence of Project on Stakeholder	Influence Rating
	authorities influence the project in terms of establishing policy, granting permits and approvals for the project, monitoring, and enforcing compliance with the applicable rules and regulations	• Project's compliance to the regulatory requirements; and • Timely disclosure of information and provisioning of updated through the life of the project.	affect the timely implementation of the project • This stakeholder group is also critical for various permits/clearances required for the commissioning of the project	project will play in the development of the Project in the area	
District Administration	This stakeholder group is comprised of the government bodies at the district level. These bodies are vested with funds and decision-making authority through the decentralization process. Accordingly, the bureaucracy, the forest officer, RTO, Industrial estate, and Revenue Officer have become extremely influential.	The key expectations and concerns of the group from the project include: • Project's compliance to the regulatory requirements • Timely disclosure of information and provisioning of updates throughout the life of the project	• This stakeholder group is critical for obtaining various permits/clearances required for the commissioning of the project and its smooth functioning thereafter • This group serves as important points of contact between the state level authorities and the local community	The influence of the project on the stakeholders pertains to the role the project will play in the development of the Project in the area	• Influence of Stakeholder: **HIGH** • Influence of Project: **LOW**
Staff & Contractors and Sub-Contractors	This stakeholder group is comprised of the technical & non-technical staff of Greenlam and staff and workers of sub-contractors	The primary concerns and expectations of the group from the project include: • Timely completion of the project • The role of the project in continued economic opportunity and work generation • Avoidance of any reputational risks associated with the project due to any future community unrest or project activities • Clarity in terms of scope of work, expectations, key performance indicators and timelines • Timely and adequate disclosure of information to allow the	• This stakeholder group is critical for the smooth functioning and timely implementation of the project • This group may also play an important role in the formation of public opinion towards the project	The influence of the project on the group pertains to the role of the project in business opportunities and the process of contract closure	• Influence of Stakeholder: **HIGH** • Influence of Project: **HIGH**

Relevant Stakeholders	Profile	Concerns and Expectations from the project	Influence of Stakeholder on Project	Influence of Project on Stakeholder	Influence Rating
		project activities to be carried out • Fair business opportunities and contract closure • Business continuity • Payment of wages and other concerns related to Labor welfare s			
Contractual workers	This group is comprised of skilled and semi-skilled workers, involved in the project on a contractual basis. This group is most likely to be comprised of the semi-skilled workers involved in the construction work of the project.	The primary concerns and expectations of the stakeholder group pertaining to the project is as follows: • The role of the project in continued economic opportunity, work generation and a source of income • Timely settlement of dues and payments in keeping with the legal requirements • Continued work opportunities • Safety at work.	• This stakeholder group is critical for the smooth functioning and timely implementation of the project • This group may also play an important role in the formation of public opinion towards the project	The influence of the project on the group pertains to the roles of the project in the continuance of economic opportunities, timely payment of wages and ensuring the health and safety of the workers	• Influence of Stakeholder: **MEDIUM** • Influence of Project: **HIGH**
Secondary Stakeholders					
Village Institutions	This stakeholder group is comprised of health, education institutions and training centres at the village level. The institutions in the immediate vicinity of the project are the primary schools in the villages	The main concerns and expectations of the group from the project pertain to: • Adequacy of community development activities in the area • Contribution of the project towards the overall development of the area • Involvement in the formulation and implementation of the community development activities; and	The influence of the group on the project pertains to the role of the played by these institutions in the opinion formation and implementation of community development programmes and CSR activities	The influence of the project on the group pertains to the role of the project in the development of these institutions	• Influence of Stakeholder: **LOW** • Influence of Project: **LOW**

Relevant Stakeholders	Profile	Concerns and Expectations from the project	Influence of Stakeholder on Project	Influence of Project on Stakeholder	Influence Rating
		• Timely and adequate disclosure of information pertaining to the project.			
Political Parties	This stakeholder group is comprised of political parties, which are active in the area. This group plays a critical role in the sensitization of the population and the creation of the public opinion	The key expectations and concerns of the group from the project include: • The role of the project in the overall development of the area • The impact of the project on the local community • Adequate community development activities throughout the life of the project; and • Timely disclosure of information pertaining to the project activities.	The influence of this stakeholder group on the project pertains to the role of the political parties in the formulation of public opinion towards the project.	The influence of the project on the group is expected to be extremely limited, pertaining to the role of the project in the development of the area	• Influence of Stakeholder: **MEDIUM** • Influence of Project: **LOW**
State Administration	The state administration is comprised of the state level agencies of the various departments/authorities such as industries department, revenue department, labour department and land department etc.	The main expectations and concerns of the stakeholder group from the project include: • Compliance to the regulatory requirements for the project • Project's role in the development of the area • Timely disclosure of information pertaining to the project activities	This stakeholder group is also critical for the obtaining of the various permits/clearances required for the commissioning of the project	The influence of the project on the stakeholders pertains to the role the project will play in the development of solar energy in the state	• Influence of Stakeholder: **HIGH** • Influence of Project: **LOW**
Media	The media, comprising of both print and visual media, has a presence in the district. They are known to have played an extremely important role in generating awareness amongst the community.	The main expectations and concerns of the stakeholder from the project include: • Compliance to the regulatory requirements for the project • Project's role in the development of the area • Maintenance of positive relationship with the local	The influence of the stakeholder group on the project is likely to pertain to the opinion formation amongst other stakeholders towards the project	The influence of the project on the stakeholder is likely to be extremely limited due to the nature of the project activities	• Influence of Stakeholder: **Medium** • Influence of Project: **LOW**

Relevant Stakeholders	Profile	Concerns and Expectations from the project	Influence of Stakeholder on Project	Influence of Project on Stakeholder	Influence Rating
		community and other stakeholders • Timely disclosure of information in regard to the project activities			

5.2 Stakeholder Consultations

Engagement undertaken – Pre-impact assessment

According to the discussions undertaken with the local community and the project team, it is understood that no community engagements have been carried out by the project proponent and the engagement at present are limited to local regulatory authority which includes department of Industries, district administration and forest department.

Engagement as part of the Impact assessment – this assignment

As part of ESIA process, consultations were carried out with the community living close to the integrated plant, farmers engaged in wood planation, transporters, APFCD, nursery owners and big landlords. These consultations were carried to assess the potential impacts of the project on the different stakeholders, broad socio-economic profile of the community as well as the potential risks and concerns of the stakeholders. The subsequent section provides an understanding of the engagement activities undertaken as part of the ESIA process. The summary of the discussion carried out during the ESIA process is given in table Table 5-3below:

Table 5-3: Summary of Stakeholder Consultations

S.No	Date	Location	Participants	Discussion and important issues and expectations
1	20-03-2023	Menakuru	Project Team (Wood Procurement), Social & Env expert of consultant & Local Villagers close to the plant	It is one of the communities located close to the plant however does not having any adverse impact due to the project. As informed due to industrial growth there is an increase in the livelihood opportunities and there is changing trends in the occupation profile of the community. Also due to industries lot of community development initiatives were undertaken and the community does not have any major concern with the project and looking for more direct and indirect employment and livelihood opportunity due to the proposed project.
2	21-03-2023	Nagari	Project Team (Wood Procurement), Social & Env expert of consultant & Local Villagers (Jayachandra Naidu, Subramaniyam, Pandu Naidu and others)	The community in this village is traditionally growing sugarcane as their main cash crop, however as reported sugar cane farming is not very profitable due to shortage and increased wages of labour. Based on the current scenario people want to shift to wood plantation. Community wants to have direct supply contract with the company and assurance of rates from the company
3	21-03-2023	Satyavedu	Project Team (Wood Procurement), Social & Env expert of consultant & APDFC (Ananda Reddy, Janakirama Reddy, DDC Anjaneya Reddy)	They are one of the leading government agencies in wood cultivation and selling business. Most of their planation is managed by their own staff on government. land. The wood is sold through auction process. APFDC could be one of the major potential suppliers for the company. The staff has welcomed the project and expects long term professional relations with the company.
4	21-03-2023	Tripuranthaka Puramkota	Project Team (Wood Procurement), Social & Env expert of consultant & Local Villagers	As informed during the consultations most of the community member are into mango cultivation and few of them were also doing wood plantation. As informed by the community, mango requires lot of inputs in terms of annual maintenance of orchids, fertilization, pest, and disease management. Besides that, the cost of labour and transport has also increased due to which farmers are finding less profits in mango cultivation. Hence as cash crop people have expressed their willingness for wood cultivation, however they fear with respect to the changing prices of wood.
5	22-3-2023	Arimenupadu	Project Team (Wood Procurement), Social & Env expert of consultant & farmers and nursery owner (Rajuramaju, Muppala	As informed farmers cultivate lemons as cash crop which is the main source of earning for the village. The village is having nearly 1500 acres of less fertile land where they can carry on the wood plantation. However, they faced drought in year 2009 & 2019 which has negatively impacted the wood cultivation and due to this lot of community member have

S.No	Date	Location	Participants	Discussion and important issues and expectations
			Madhuraj, Kattam Prabakara Reddy)	discontinued the planation. Further the farmers in this area have demanded free of cost saplings to SC/ST's and other community members.
6	22-3-2023	Rachapalem	Project Team (Wood Procurement), Social & Env expert of consultant & Farmers	As per the consultations most of the community members are engaged in wood cultivation since 1972 and have fair understanding of the wood-based industry. As informed they sell their wood to local aggregators and do not have any contractual agreement with companies . Reportedly most of the village members were retired govt employees hence could not do any other cultivation. The same requires less inputs provides good returns to them. Further as they are not dependant on agriculture therefore wood cultivation provides long term additional income to the respective families. The per income of the plantations is subject to market prices and rate of wood is not fixed, it ranges from 4500 to 6500 per tonnes and on an average 40-50 MT is produced in one Ha of land.
7	22-3-23	Sydapuram Gangadevi palli (S.G Palli)	Project Team (Wood Procurement), Social & Env expert of consultant & Local Villagers & Aggregator (Padmanaba Naidu)	As per the consultation with the farm owners it was understood that due to labour cost people are doing wood cultivation. Further wood plantation also secures the land from the opportunistic encroachments and provide income in the long term. During the site visit it was observed that wood harvesting is generally done by the local wood aggregator and payment is made to the owner before loading the lot. As far as harvesting is concerned generally local aggregator gives wood harvesting contracts to local community. These local community have gained expertise over wood logging as they are doing the same job since generations. And no formal training on EHS aspects and handling of machines is given to these wood loggers either by the company or the wood aggregators. As part of the contract the required machines and equipment such as chain saw , axe and ropes etc and food is provided by the aggregator .
8	23-3-23	Ravullakollu	Project Team (Wood Procurement), Social & Env expert of consultant & Local Villagers (Sundararama Reddy Ketha, Mathala Rama Naidu, Cherukuru Venkateshvaralu and others)	During the period of 2010, the Eucalyptus cultivation was practiced. Due to market rate problem, the wood plantation was discontinued and uprooted in the year 2018-2019. Currently, villagers are facing labor problem and labor from prakasam district are engaged for cultivation and harvesting.
9	23-3-23	Podalakur	Project Team (Wood Procurement), Social & Env expert of consultant and Viswanathan (transporter)	As per the discussion it was understood that fright rate is based on trip (which is based on the distance and generally rate of charge for loading and unloading is 1500 per ton). Freight cost includes maintenance, tyre change, food, fitness certificate. Truck drivers have to work for long hours, typically working hours is up to 15 per day (for 15 days approximately 10 trips) The key concern of the transporters is the long waiting time for loading and unloading.
10	23-3-23	Narampeta	Project Team (Wood Procurement), Social & Env expert of consultant and big	It was understood from the discussion that farmers currently have 800 acres of Eucalyptus plantation and most of their wood is procured by ITC. Historically, they started their plantation in 2004 and first harvesting was done in 2009. Every 3rd yield uprooting is done, and new plants are planted.

S.No	Date	Location	Participants	Discussion and important issues and expectations
			farmers (Subbarao, Baskara Rao)	They are ready to do plantation for Greenlam if the rate is equal to or above the market rate.
11	24-3-23	Yedlurupadu	Project Team (Wood Procurement), Social & Env expert of consultant & Local Villagers (Nageshwara Raj, Srinivasalu and other)	During the period of 2010, the Eucalyptus cultivation was practiced. Due to market rate problem, the wood plantation was discontinued and uprooted. Currently Community is cultivating tobacco as cash crop however the due to cost of labor and maintenance they are ready to shift to wood plantations under the agreement of assured purchase and long term commitment and continuity and market rate.
12	24-3-23	Muttukuru	Project Team (Wood Procurement), Social & Env expert of consultant & , Aggregators loading workers	As informed workers engaged in wood aggregator business are daily causal workers, the aggregators do not employ workers on full time basis. The hiring is done as per the need. As informed workers are paid on daily basis and the women workers are paid less as compared to men. The reasons of wage differences are due to the nature of work. Women were not given task of heavy loading and unloading. Further it was observed that worker work in a harsh condition and most of the workers were seen working without PPEs.

6 Brief Scenario of Wood Based Industry & Supply Chain

Mankind has used wood due to its versatility since time immemorial for housing construction, furniture, agricultural implements, transport vehicle, and above all a fuel for various household needs. As per the Policy paper NCCF160 (Network for Certification and Conservation of Forests) suggests that the major consumption of wood in India is still in the form of fuel wood accounting for 75 % in the rural areas and 21.7 % in the urban areas (NSSO). It is estimated that about 270 million tons of fuel wood, 280 million tons of fodder, over 12 million cubic meter (cum) of timber and a range of non-wood forest products are extracted from the forests of India annually.

After economic reforms, India has made impressive economic growth in recent times, as evident from the rise in income of people. This growth is leading to increase in consumption of wood and wood products such as furniture, construction timber, paper etc. Reducing supplies from natural forests and rising demand of wood products has caused a large gap between demand and supply. This has resulted in turn in increasing focus on production of timber and wood in non-forest areas also known as Tree Outside Forests under agroforestry and farm forestry systems, as envisaged in the National Forest Policy, 1988. National Forest Policy, 1988, brought in policy shift towards using forests for conservation, eco system services. The policy envisaged the forest-based industries to raise the raw material needed for meeting its own requirements, preferably by establishment of a direct relationship between the factory and the individuals, and to encourage farmers to grow tree species required for industries. This policy shift caused enhanced focus on 'Trees Outside Forests' (ToF), particularly agroforestry, to reduce pressure on forests and to meet the needs of the people in respect of wood and wood products. According to ISFR (Indian Forest Report) 2019, notionally 2.89% of TGA (Total Geological Area) of the country is under tree cover161, generally known as trees outside forests (ToF) but actually it forms a part of ToF162.

FSI has published Technical Information Series Vol. 2. No. 1 titled "Tree Outside Forest Resources in India" wherein extent of ToF in the country is reported to be 29.38 Mha (8.94% of TGA) comprising of tree cover 9.5 Mha and Forest cover outside RFA 19.88 Mha with Growing stock of 1642.29 million cum and potential annual yield of 85.16 million cum

6.1 Wood production from Trees Outside Forests (TOF)

There is no official estimate of the amount of annual wood production from ToF. According to a study by Center of Science and Environment in 2017 the total wood requirement was estimated to be 68.9 million cum (49 Million cum for construction, furniture etc., 8.47 million cum for plywood and panel products, 15.52 million cum for paper and paperboards) the availability was 70.9 million cum: 3.175 form forests, 44.34 form ToF, 5.38 from bamboo, 18.01 from imports. (Shrivastava S. and Ajay K. Saxena, 2017). A High Level Expert Group constituted by the XV finance Commission submitted its report in July 2020, mentioned that in 2017 total consumption of wood was 65 million cum of which 3 million cum was produced from forests, around 47 Million cum was produced from plantations (mainly agro forestry systems), and balance 15 million cum was imported (Anon, 2020). This clearly brings out the fact that around 25% of the demand for industrial wood is met from imports. Of the balance met with through domestic production around 94% is from ToF, primarily from Agroforestry.

6.2 Brief Profile of wood based industries in the region

It is evident from the various data sources there is significant presence of wood based industry in the southern states especially in Andhra Pradesh, Karnataka, Telangana, Tamil Nadu respectively. As per the secondary data mentioned above most of these industries are sourcing their wood from the agro-forestry. Major Industries includes plyboard, laminate, veneer and Paper & Pulp Industries.

6.3 Major Paper & Pulp Industries in the Region:

Some of the foremost paper & pulp industries operational in the region includes Tamil Nadu Newsprint and Papers Limited, JK Paper Ltd, Seshasayee Paper & Boards Limited, ITC Paperboards and Specialty Division Ltd. Westcoast Paper Mills, International Paper APPM Ltd., among others.

[160] This policy paper is intended for their own internal use however here it used to present some facts and figures about wood based industries in India. https://nccf.in/storage/2022/09/Sustainable-Trade-of-Wood-and-Wood-Based-Products-in-India-by-Mr-A.-K.-Bansal-Chairperson-SDG-NWFR-and-PCA-Group-of-NCCF.pdf

[161] Tree cover comprises of tree patches of size less than one ha occurring outside the recorded forests. It includes trees in all formations, including scattered trees. Tree cover is estimated using a sampling based methodology wherein high-resolution satellite imagery is used for stratification

[162] Trees outside forests refers to all trees growing outside recorded forest area (as per boundaries furnished by the States, and the areas under green wash in Survey of India topo sheets

ITC is the largest player in the pulp and paper sector with a 4% capacity of entire India. Its Bhadrachalam unit is the biggest wood-based plant in the country and sources 95 per cent of its raw material from these plantations. As per 2014 data, over 80,000 farmers in the country are growing pulpwood for ITC.

Major Plyboard Industries in the region

As per the state portal besides many small & medium sizes units the project catchment area (AP, Telangana, Karnataka & Tamil Nadu) there is a presence of Green Panel Max and Virgo's HPL plant Hindupur in Andhra Pradesh.

6.4 Argo Forestry in India

As per the study carried out by the Indian Council for Agriculture Research year 1987 (GB Singh), to support such a large population the amount of food, fodder, fibre, timber and energy required will be enormous.

As per the study ' Argo Forestry in India ICAR-Central Agroforestry Research Institute, Jhansi ICAR-CSSRI Regional Research Station, Lucknow. "Agroforestry in India has got impetus from the National Agroforestry Policy (2014) and currently, the policy is implemented as a sub-mission on Agroforestry in different states. The information on the extent of the agroforestry area the study reports the national level actual estimation of area under agroforestry, and it was carried out using sub-pixel classification and object-based image analysis method. The total area under agroforestry in the country is 28.43 m. ha. which is 8.65% of the total geographical area of the country.

"Further as per the study (Multifunctional Agroforestry Systems in India: Science-Based Policy Options by Rajasthan Pollution Control Board 2011) Agroforestry systems in India include trees in farms and a variety of local forest management and ethnoforestry practices. India is estimated to have between 14,224 million and 24,602 million trees outside forests, spread over an equivalent area of 17 million ha, supplying 49% of the 201 million tonnes of fuelwood and 48% of the 64 million m3 of timber consumed annually by the country.

Forest Survey of India earlier has estimated that 2.68 billion trees outside forests exist over an equivalent area of 9.99 million ha. More recent estimates suggest that an equivalent area of 92,769 km2 (i.e., 2.82% of the geographical area) is under tree cover in India. The current growing stock has been estimated to be about 1.616 billion cubic metres. For these calculations the tree cover has been defined as tree patches less than 1 ha with the canopy density >10%.

It is evident form the above data there has been significant growth in agroforestry in India both in terms of area and production of wood since the inception of National Forest Policy 1988 and National policy on agroforestry policy 2014.

Although exact data with respect to land used under agroforestry for the catchment area under study is not available however several studies suggests that nearly 95% of the wood is procured from agroforestry for industrial use. As per report, ITC one of the largest player in the pulp and paper sector with a 4% capacity of entire India. Its Bhadrachalam unit is the biggest wood-based plant in the country and sources 95 per cent of its raw material from these plantations. As per 2014 data, over 80,000 farmers in the country are growing pulpwood for ITC.

As per the stakeholder consultations carried out in the catchment area[163] most of the farmers in the region are engaged in wood cultivation and they are cultivating wood since year 2000. As informed, most of the farmers are doing agroforestry as cash crop and for food, they are growing their regular crops. Based on the consultations it was understood that most of the farmers use their less fertile land for wood agroforestry. As per the consultations the following reasons were sighted for adoption of agroforestry for the different farmers group:

- Better utilization of less fertile land and have greater profitability
- Less cost of inputs and can reap the crop at least 3 cycles without major investment
- It saves the land from encroachment for those farmers who live outside the villages
- Current labor cost is increased, and traditional agricultural practice is very labor intensive therefore most of the consulted farmers find difficult to carry the traditional agriculture practices.
- Due to climate change and erratic rain fall as well as market fluctuations the crop production is very unpredictable.

Besides this, some farmers have also reported bad experiences related to agroforestry and they were not able to cope with the changing rates of wood due to demand and supply gap and due to that they have shifted to other crops such as tobacco and lemon. However they are still open to continue with the agroforestry provided there is rate and buy back accordance form the

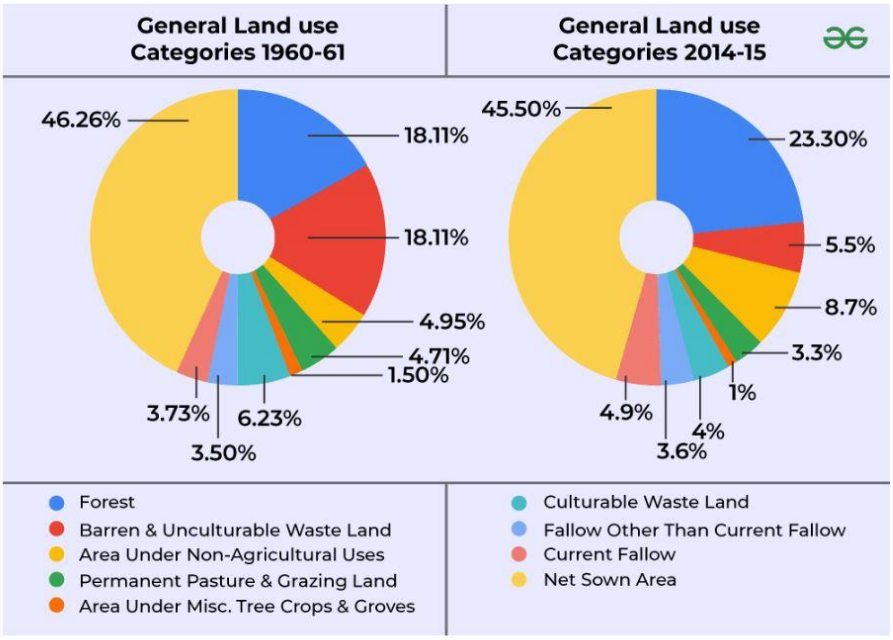
[163] Ref study area in Social baseline section of the report

company. However the percentage of such farmers in the sample is less as compared to those who are doing and will continue to do the agro forestry.

6.5 Land Use Changes

In India, the land is primarily used for agricultural purposes, with nearly 60% of the country's land area devoted to farming. India is one of the world's leading producers of food, and agriculture accounts for a significant portion of the country's economy.

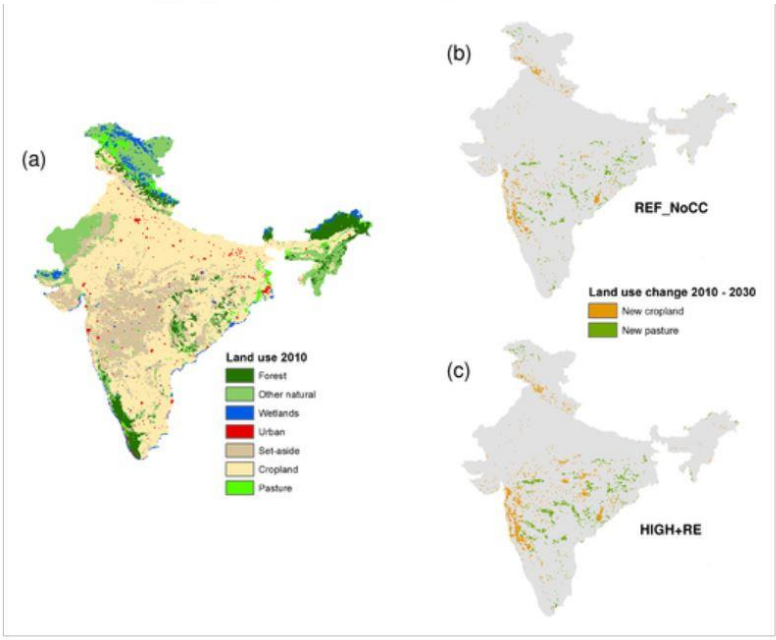
Other uses of land in India include forestry and grazing, which make up about 15% of the country's total land area. Less than 5% of India's land is urbanized, although this figure is growing as the country's population continues to increase.



Land Utilization and Land Use Patterns

As per the study (Agricultural Development and Land Use Change in India: A Scenario Analysis of Trade-Offs Between UN Sustainable Development Goals (SDGs).

By area, India is the world's seventh largest country along with a population of about 1.3 billion people in 2015 (FAO, 2017a; UN-Pop, 2017). India is characterized by an immense diversity in climate, topography, flora, fauna, land use, and socioeconomic conditions (FAO, 2017b). During the past 140 years, India has experienced remarkable land use and land-cover changes including deforestation, cropland changes, and urban expansion (Roy et al., 2015; Tian et al., 2014). Over half of the territory is used as cropland.



The extent and spatial pattern of land use change are calculated with the Landshift model. Figure shows the land use pattern in the base year 2010 aggregated to seven major classes. Figures depict the expansion of cropland and pasture until 2030.

Although detailed and scientific data with respect of changes in the land use due to Agroforestry the study catchment area is not available however form the above study as well site observations and stakeholder consultations confirms that most of the farmers are using their less fertile land for the agroforestry . However there are few cases where agriculture land was also reported to be converted for agroforestry on account of high labor cost involved in crop production and few of them were settled in the nearly by cities and could not continue the agriculture.

6.6 Agriculture and current trends

Agriculture[164] sector is the backbone of the country's development as most of the population still dependent on agriculture. The crop acreages also have been found to be changing in specific areas due to various factors such as season, climate and rainfall. Shift in cropping pattern by the farmers such as from the non-profitable crops to profitable or remunerative crops which have more productivity and high prices in the market. This change in cropping pattern is mainly to minimize the risk to cover crop profitability. The cropping pattern of Andhra Pradesh has been shifted to major crops like Paddy, Cotton, Maize, Sugarcane etc. The area under food crops has been decreased by 2.99 % but the area under non-food crops found to be increased by 2.11 % from 2015-16 to 2016-17 which indicates the area under cotton, tobacco etc. has been found to be increasing in Andhra Pradesh state. The total gross cropped area of the state was found to be decreasing by 0.37 % but the total production and productivity have been increased. Another study suggests India produces pulse (25.00%), rice (22.00%), wheat (13.00%) and cotton (25.00%). On the other hand, the country has gone through a substantial shift in cropping pattern especially in Tamil Nādu from food crops (agricultural crops) to horticultural crops over the last five years (2011-15) . The Telangana, a state on the south-eastern coast of India has a net cropped area of 4.5 million hectares of which 2.5 million hectares (56% of net cropped area) are under Rainfed Agriculture (Directorate of Economics and Statistics 2011).

It is evident from above data on agriculture that the agriculture sector is one of the biggest sectors providing employment to large sections of the society. The stakeholder consultations indicates that most of the people living in the study area are dependent on agriculture for their livelihood. As the study is area is very vast in terms of geographical area hence there is huge variations in agriculture practices. As informed study area is characterized by mainly three types of soil that is red laetrile , red loamy and back cotton soil. Accordingly there are variations in crop and availability of water. However as reported most of the farmers cultivate crops which are suitable for their soil and availability water. For Example in Nagri village most of the farmers cultivate Sugarcane as the cash crop because availability of water and black cotton soil where as in Arimenupadu people cultivate lemons as cash crop. Further in village Ravullakollu people are cultivating tobacco as cash crop because of the previous bad experience with agroforestry. So based on the site observations people generally cultivate paddy and other crops such as chickpeas and lintels of their own consumption and cash crop such as sugarcane, mangos, lemon and tobacco for commercial purpose. Based on the stakeholder consultations it was understood people have the fair understanding of the agroforestry and people understand the importance for crop production for their food security. And as informed most of the less fertile and barren land is generally used for agroforestry.

6.7 Use of Water for agroforestry

As understood from the stakeholder consultations the requirement of water including other inputs is less in agroforestry as compared to the traditional crops. Currently the exact scientific data with respect to water use is not available for the study area. However, based on the secondary research and stakeholder consultations it is evident that water use for crops is more as compared to agroforestry. As per the stakeholder consultations farmers in the region have evolved different strategies for wood cultivation. At some places farmers irrigate their plantation on regular intervals. Especially during first two years the requirement of water is more as compared to succeeding years. Further based on the secondary research ITC recommends irrigation for better yield. Whereas as in some areas irrigation is done during plantation stage as well as in summer season. And in rest of the month as when required. It was understood the water level and quality also varies at some places TDS is very high and water table is also very low hence artificial irrigation through tub wells is not very viable option. Whereas in some areas ground water is fit of irrigation and in such areas most of the farmers use artificial means of irrigation such as tube wells. However the exact

Agroforestry can increase the efficiency of water use (Ref)

Annual crops can only use a certain portion of available water. For example, in India, sorghum transpiration accounts for 41% of rainfall while in Niger millet transpiration accounts for 6 to 16% of the annual rainfall, with the remainder going to evaporation, runoff and drainage.

The integration of certain trees into these agricultural systems can capture a much larger amount of this rainfall. Research has shown that combinations such as Grevillea trees with maize can utilize 70 per cent of annual rainfall.

The planting of indigenous or exotic deciduous species that produce high-value tree products (such as fruit or timber), while practicing root and shoot pruning, can increase the efficiency of water use while providing new economic opportunities.

(Ref https://www.worldagroforestry.org/news/agroforestry-water-wise-farming#:~:text=Agroforestry%20can%20help%20retain%20water&text=Research%20has%20shown%20that%20some,content%20in%20adjacent%20cropping%20areas.&text=Another%20role%20of%20trees%20on,helping%20to%20maintain%20soil%20moisture

[164] https://issuu.com/tjprc/docs/2.ijasraug20182#:~:text=Maize%2C%20Sugarcane%20etc.-,The%20area%20under%20food%20crops%20has%20been%20decreased%20by%202.99,increasing%20in%20Andhra%20Pradesh%20state.

statistical details of water consumption across the catchment area is not available. Therefore due to absence of reliable data quantification of water use for irrigation could be done.

6.8 Wood Aggregation & Transport of Wood

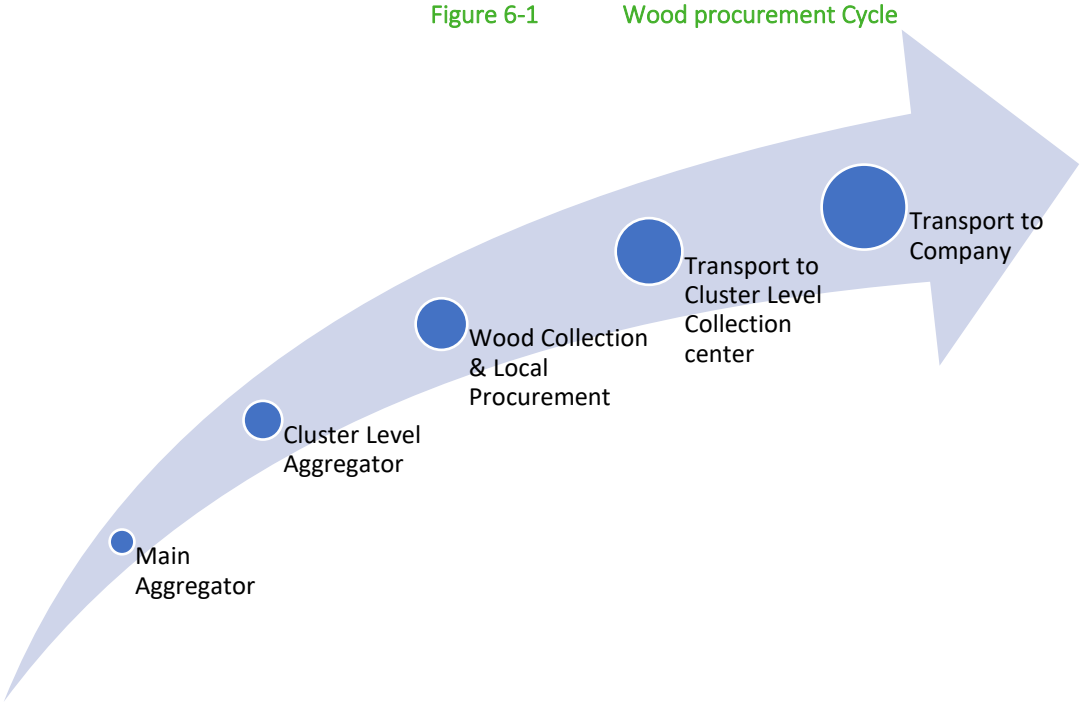
As per the stakeholder consultations with Greenlam and wood aggregators, it was understood that manufacturing companies generally have wood supply contracts with multiple wood aggregators. Companies prefer those aggregators who are located within the region as well as the capability to supply wood as per the requirement of the respective company. These contracts are based on the of the volume of the wood they need to supply. In order to ensure the supply of the wood throughout the operations cycle companies look of those aggregators who can supply wood without any gap therefore they don't procure wood directly from the farmers. The main reason for not procuring the wood directly from the farmers includes

- Reliability: As the farmers have the limited resources and well as limited quantity of wood therefore practically it not possible for them to supply wood without any gap. As well as supplying wood involves transportation cost, and their produce is limited hence it may not be very economically viable for to supply individually to the respective companies.
- Management: Management of large group of people especially farmers may not be possible within the industry practice. Further wood prices are not fixed it keeps changing based on demand and supply and if there is negative changes in the prices companies have to face the resistance from very large group of people, such public resistance may potentially cause reputational as well as business risk.
- Management of Finances: As industry practice payment is done on particular payment cycles and individual farmers generally want payment upfront whenever they sell their produce. The Stakeholder consultations with farmers confirms most of the aggregators make 50% payments as advance and 50% just before loading the truck. Further if the farmers don't get the payment upfront, it can cause potential doubts as well as create problems with their cash flow.

6.9 Process of Wood Collections & Supply

As per the stakeholder consultations as a general industry practice company have wood supply contracts with somewhat reputable wood aggregators. And the company will generally have relations with these aggregators and at grass root level company engages with farmers through their extension programme. Where field officer were engaged at cluster level to provide technical knowledge to the farmers and efforts will be made to increase the land under agroforestry. Further and second level the main wood aggregator will have their own wood supply with local /cluster level wood aggregator. These Cluster level aggregators will collect (purchase[165]) wood and transport to the collection centre and from there wood is transported to respective factories by the main wood aggregator. Graphic representation of wood procurement cycle is presented in Figure given below:

Figure 6-1 Wood procurement Cycle



[165] The cluster level aggregator will be responsible for sourcing, procurement , direct purchase from the farmers , transport of wood to the cluster level collection center.

6.10 Labour Management in the wood supply chain

As per the stakeholder consultations labour management at grass root level is done by the respective farmers during the plantation stage. The farm owners as when needed will take the services of the local labours for planning, fertilization & irrigation and as per local market payment of wage is done on daily basis (market daily wages rate ranges from 300 to 500 per day). Most of the works is of causal in nature and none of the farmers in the study area were reported to have full time permanent labours. And the wood harvesting is done by the cluster level aggregators. These cluster level aggregators give wood harvesting contracts to the local villagers who are expert in wood harvesting, the wood harvesting contracts includes cutting of wood, sizing & sorting and loading of wood to the tractors. From the farm the wood is transported by the local tractors owners to collection centres. Most of the collections centres are located within the range of 10-15 Kms. And from the collection centres wood is transported in multi axel trucks. At the cluster level transport is look after by the cluster level aggregator. And transportation of wood from the collection centres to the company is under the scope of main aggregator. Reportedly the main aggregator will have separate contract with transporters to transport wood from respective collection centre to the company.

Based on the review of entire supply chain it was understood that most of the labour engaged in the supply chain are informal in nature. And in most of the places the labour management practice are based on the market practices and very limited documentation. Most of the agreement with the labour and transporters remains verbal. The aggregators and the labours have limited training on EHS aspects.

6.11 Income & Livelihood of Farmers

As per the stakeholder consultations there is huge variations in the income level of the farmers across the region. The income level is dependent on the total land hold, type of land, productivity, nearness to the market and qualification. Land under plantation in the region ranges from 1 acre to 300 acres. Also there is no fixed patten of plantation. Land under plantation keeps changing as per the demand and rates. Plantation activity is carried out by both small and big farmers.

It was observed in village Rachaplem most of the farmers were retired govt. employee so they are having good pension as well additional income from the farming. Overall most of the farmers have income from multiple sources which includes sale of farm produce, small business, service , and manual labour etc. As reported the monthly income of the ranges from 15000 to 250000 per month. It was observed that people who are having less land and lacks skills have less income as compared to those who were having large land holding and fair qualifications and skills.

7 Impact Assessment & Mitigation Measures

This section assesses the manner in which the Project will interact with elements of the physical, ecological or social environment to produce impacts to resources/ receptors. It has been organized as per the construction and operational phases of the project life cycle to understand the risks and impacts associated with each phase.

7.1 Project Activities

An overview of the typical project activities during different phases of a particle board and resin manufacturing facility has been summarized below in ***Table 7-1***,

Table 7-1: Project Activities

Sr. No.	Project Phase	Activities
1	Pre-Construction Phase	• Site Survey • Land Identification and land acquisition/lease • Project approvals and licenses • Design & plan finalization for construction activities • Finalization of contractor
2	Construction Phase	• Contractor mobilization • Site preparation including fencing, clearing of land, pit filling, levelling and grading • Setting up of Project facilities such as boiler, fuel handling, water treatment plant, STP, ETP, etc. • Setting up batching plant, labour camp, site office, temporary storage areas, internal roads etc. • Construction of associated facilities such as site office, temporary storage areas, etc. • Transportation of heavy construction equipment's and vehicles • Abstraction of water for civil work
3	Operation and Maintenance Phase	• Operations for manufacturing of particle boards and resins • Procurement of wood, chemicals and other raw materials • Storage of the raw material and final products • Operation and maintenance (O&M) of the boiler, ETP and STP, Process machineries, equipment's etc. • Management of multiple waste streams • Regular transportation of raw material comprising of wood, chemicals, etc. and finished products • Regular Emission Monitoring • Regular and periodic maintenance of the facility • Agro Forestry

7.2 Scoping

The exercise was undertaken on the basis of desk based review of the relevant documents of the project and its surroundings. Further, a review of project documents provided by Greenlam through request for information were undertaken to substantiate the study prior to site visit.

Scoping has been undertaken to identify the potential area of influence for the project to identify potential interactions between the project and resources/receptors in the area of influence and the impacts that could result from these interactions and to prioritize these impacts in terms of their likely significance. This scoping exercise has been done in keeping with the present Project footprint (integrated manufacturing facility and the extent of the area to be used for wood procurement and supply chain) and is intended to ensure that the impact assessment focuses on the issues that are most important for decision-making and stakeholder interest.

Potential impacts have been identified through a systematic process whereby the features and activities (planned and unplanned) associated with the construction and operation phases of the project have been considered with respect to their potential to interact with resources/receptors. Potential impacts have been classified in one of three categories:

- No interaction: Where the project is unlikely to interact with resources/receptor;
- Likely interaction: Where this is likely to be an interaction, but the resultant impact is unlikely to change the baseline conditions in an appreciable/detectable way; and

- Significant interaction: Where the resultant impact has a reasonable potential to cause a significant effect on the resource/receptor.

7.2.1 Potential Impacts

All environmental, ecological and social impacts and risks described in IFC's Performance Standards and E&S Guidelines have been considered for the interaction matrix as presented in **Table 7-4**. Key environmental and social impacts due to project interaction are presented in *Table 7-2* below.

Table 7-2: Key Environmental, Social and Ecological Risks and Impacts due to Project interaction with E&S receptors

Sr.No.	Potential Risk/ Impact	Risks Identified
1	Impact on Soil	• During construction phase, activities such as site excavation, movement of heavy vehicles and equipment on unpaved roads, foundation work and backfilling may lead to soil compaction. Additional activities such as use of drilling fluids that can leave trace amounts of chemicals, improper waste disposal, discharge from labour camps and site office may affect the existing soil quality. • During operation phase, soil quality may be impacted due to ash deposition generated from combustion of coal or wood. Also, leakage or chemical spill due to handling of hazardous waste, chemicals, fuel etc.
2	Impact on Water Resources	• Water requirement during construction phase is primarily for civil work, domestic purpose and drinking purpose. During operation phase, water requirement will be as make up water for cooling towers, make up water for blow down loss from boiler, regeneration for demineralised water plant and other miscellaneous activities including domestic consumption. • Approximately 365 KLD water will be required during operation phase, of which 276 KLD would be fresh water and 89 KLD will be recycled water • Water supply from AIIPC will be the main source of water for the facility. Exact date for initiation of water supply from APIIC is not known. Till the APIIC water supply is initiated, GSL will use borewell water (installed within the manufacturing facility) and tanked water for their operations. • As per CGWB, Naidupet tehsil (manufacturing facility tehsil) falls is an area marked as "critical" in terms of groundwater development, whereas as per the Ground water assessment report developed by Andhra Pradesh Ground water and water audit department for the GSL site, Menakuru village (project location village) is categorised as Over-Exploited. • Since the project village is falling in over-exploited category and the mandal falls in critical category, ground water withdrawal by GSL has been permitted only by constructing the recommended artificial recharge structures. • According to the district disaster management plan, Project tehsil is prone to drought. As per the "Memorandum on Drought in AP 2014", out of 46 blocks of the district, 21 blocks experienced moderate drought and 25 blocks experienced severe drought. Naidupeta falls under "moderate droughts". It is anticipated that due to the site being vulnerable to droughts, water availability may be an issue. • There are surface water bodies in the vicinity of the manufacturing facility. A water body is located ~ 100 m (aerial distance) from facility towards north direction and a water canal flows at an aerial distance of 1.1 km in the west direction. It is anticipated that improper waste disposal, improper management of hazardous material, ash deposition, any leakage/spill from site may contaminate the soil and ground water of the area.

3	Impact on Air Quality	• During construction phase, air quality may be impacted largely due to the following activities:
		  ◦ Fugitive dust emissions from site clearance, piling work, handling of construction materials, emission due to movement of vehicles on unpaved roads, plying of vehicles, etc.
		  ◦ Vehicular emissions due to increased traffic movement on site and on the approach roads.
		  ◦ Exhaust emissions from construction machinery and other equipment; and
		  ◦ Emissions from diesel generators required to be run for construction power purposes
		• During operation phase, air quality may be impacted due to flue gas emissions from the boiler, fugitive emission due to transportation of raw material/fly ash, process emissions such as VOCs, formaldehyde and dust, vehicular emission due to deployment of vehicles for raw material transportation and other operations related activities including chemical handling, transfer of liquid raw material, and fugitive emissions during ash handling and disposal. There are settlements located within 500 m- 2km of the access roads and manufacturing facility. Therefore, it is anticipated that air

Sr.No.	Potential Risk/ Impact	Risks Identified
		emissions during construction and operation phase may have impact on the aforementioned receptors.
4	Impact on Ambient Noise	• The primary sources of noise during the construction phase may be heavy earth moving vehicles and various construction equipment's. The sources of noise in the construction phase also include construction activities, operation of D.G. sets and movement of vehicles. There will also be increased noise levels because of increased anthropogenic movement in the area • The main sources of noise pollution from the facility during operation phase would be operation of boilers, blowers cooling system, wood cleaning and processing activities such as peeling, chipping, sanding, trimming, and cutting of wood etc, vehicular movements, loading/unloading of raw materials and other transportation activity. Facility will also have D.G. sets for power back up.
5	Occupational Health & Safety	• The engagement with various construction and operation activities will involve a range of occupational health and safety risks and hazards mainly for the contractors and workers (local and/or migrant) who are involved in the construction and operation phase. • Lack of relevant PPEs, training on health and safety, absence of adequate H&S system will increase the risk of worker's exposure to construction and operation hazards. Some of the serious risks during construction and operation phase without adequate PPE include risk of fall while working at heights, risk of accidents, exposed to faulty electrical devices, such as cables, cords, hand tools, being struck in machinery or moving equipment or parts, etc. During operation phase, workers may be exposed to flue gas emission from boiler, fly ash, VOCs, formaldehyde, and Particulate Matter, wood dust. Also exposure to heat and burns, risk of fire and explosions which may cause respiratory disorders.
6	Change in socio-economic condition of the local community in the study area due to labour influx	The manufacturing facility is being established in the industrial estate and the labor influx is not very high considering the study area therefore potential impacts, if any, will be negligible and changes, if any, could not be measured.
7	Unhygienic and unsafe living conditions due to labour influx	Based on the current understanding of the project there might be labour influx of 1200-1500 workers during construction which might have potential for spread of vector-borne disease as well as potential conflicts with local community. Based on the current understanding duration of peak will be of 1-2 months during the overlap of Phase 1 and Phase 2 construction activities.
8	Labour rights and welfare	Based on the review of documents project is having formal agreement with the contractors and it is assumed the respective contractors are in compliance with the appliable labor laws.
9	Impacts of Accidental Spillage of Stored Chemicals and Untreated Effluents [Manufacturing Unit]	In the operational phase, accidental spillage of chemicals while transportation as well of stored chemicals and untreated effluents may impact the water quality as well as soil quality of surrounding habitats (water bodies and open scrub / barren land and may ultimately impact the floral and faunal species of the area.
10	Habitat Modification / Land Use Change due to extended agroforestry practices [Supply Chain Catchment Area]	The manufacturing facility is being established in the dedicated industrial area; but the raw material will be sourced from the different locations of Tirupati, Nellore, & Chittoor districts. The industry will increase the demand for wood in the catchment area; which may cause land use change, and ultimately habitat loss and/or modification. The consultation with farmers indicates that the fallow lands and comparatively lesser productive agricultural lands (used for non-food crops) will be preferred for agroforestry practices.
11	Impacts of Increased Traffic / Vehicle Movement for transportation of raw materials [Supply Chain Catchment Area]	During the operation phase, the raw materials will be collected from the catchment area and transported to the manufacturing unit. This will increase the traffic / vehicle movement on the major roads of the region and will introduce an extra movement of 160 trucks daily at the peak of operations. Nelapattu Bird Sanctuary (protected area) is present within the catchment area and NH 16 highway is passing close to the sanctuary area. Although no large mammals have been recorded but Golden Jackal (*Canis aureus*), Black-naped Hare (*Lepus nigricollis*), Bengal Monitor Lizard (*Varanus bengalensis*), tortoises and some species of snakes have been recorded from the sanctuary. Thus, the increase the traffic / vehicle movement may also raise the risk of road hits/kills.

Sr.No.	Potential Risk/ Impact	Risks Identified
12	Impacts on Ecosystem Services due to the increased agroforestry plantation [Supply Chain Catchment Area]	Due to operations of the industry, demand for wood pulp will increase in region. The demand for this new requirement leads the region to take interest in growing woody pulp trees species like Eucalyptus spp., Casuarina latifolia, Leucaena leucocephala (Subabul) to fulfil the demand. This new change in agriculture practice may have potential impacts on ecosystems / habitats especially private open scrub / barren land / fallow land / agriculture land / grasslands in a region. Among these grasslands and open scrublands ecosystem services are more likely to get impacted by agro forestation. Which may cause reduction in open space and altering habitat structure, potentially affecting biodiversity, and carbon & nutrient cycling, due to alterations in vegetation composition and density.

7.3 Scoped Out Interactions

Based on interactions defined in ***Table 7-4*** the impacts on the following resources have been scoped out.

Table 7-3: Scoped Out-Potential Interactions

S.no.	Impact	Rationale for Scoping Out
1	Land Use	The project is being developed in an industrial estate and the land has been allocated by the AIIPC. The project will lead not lead to alteration in land use of the project area as the land is already an industrial area land and land conversion will not be required.
2	Land Procurement Status and process, and related issues – Involuntary resettlement	Total land for the integrated plant is 26.90 ha (66.49 acres). Out of total 26.90 ha (66.49 acres), about 0.46 ha (1.13 acres) has been designated for the resin plant. The resin plant will be located within the project land premises. The plant is located on Plot No. 19A-1(UDL) (land admeasuring to an extent of 16.49 acres/66736.00 sq.m) and Plot No. 19 & 19A(UDL) (land admeasuring to an extent of 50.00 acres/202350.0 sq.m) in Industrial Park, Naidupeta, SPSR Nellore district. Since the facility is being constructed within the industrial park and does not involve land acquisition, potential issues associated with involuntary resettlement is scoped out.
3	Cultural Heritage	As the project is located in an industrial estate and potential impacts on cultural heritage are not envisaged, hence impact assessment on cultural heritage is scoped out.
4	Indigenous People	Project is located in an industrial estate, potential impacts on indigenous people are not envisage, hence scoped out from this study.
5	Habitat Modification and Loss due to Vegetation Clearance during construction [Manufacturing Unit]	The land allocated to the Greenlam is situated within an industrial area and several industries are already established in the dedicated industrial area. Industrial greenbelt will also be developed in 33% of the total land area in accordance with conditions of the EC. Thus, the impact of Habitat Modification and Loss due to Vegetation Clearance will be negligible and Scoped Out here.

Table 7-4: Impact Interaction Matrix

Potential Impact Interaction Matrix	Resources													
	Topography and Drainage	Land Use	Soil Environment	Groundwater Resources	Surface Water Resources	Air Environment	Noise Environment	Terrestrial Ecology	Aquatic Ecology	Land Based Livelihood	Economic Environment / Employment	Social and Cultural Environment	Occupational Health and Safety	Community Health & Safety
Construction Phase														
Site preparation including fencing, pit filling, levelling and grading	√	√	√			√	√	√			√		√	√
Transport of raw materials, heavy construction equipment's and vehicles						√	√	√					√	√
Mixing of construction material and operation of construction machinery	√						√	√					√	√
Setting up of facilities such as cooling towers, resin manufacturing plant, ETP's, boiler, fuel handling plant, ash handling plant, water treatment plant, compressed air plant etc	√		√	√	√	√	√	√	√				√	√
Handling and disposal of construction wastes including hazardous and non-hazardous wastes	√	√	√	√	√			√	√				√	√
Dismantling and removal of temporary support construction equipment/structure.	√	√	√	√		√	√						√	√
Survey development of agroforestry cluster and supply of raw material		√								√	√	√	√	√
Development of plant nursery		√								√		√	√	√
Labor Engagement								√	√		√	√	√	√
Operation Phase														
Storage, Handling and Charging of raw materials and final product		√	√	√	√	√	√						√	√
Operation of the integrated manufacturing plant including boiler, ash handling plant, compressed air plant, fuel handling plant, cooling towers, resin manufacturing plant, ETP's		√	√	√	√	√	√	√	√	√	√	√	√	√
Handling storage and management and disposal of solid waste, hazardous waste etc		√	√	√	√				√				√	√

No interaction

Potential Interaction ✓

7.4 Impact Assessment Methodology

This section assesses the manner in which the Project will interact with elements of the physical, ecological or social environment to produce impacts to resources/ receptors. It has been organized as per the construction and operation phases of the project life cycle to understand the risks and impacts associated with each phase.

7.4.1 Impact Estimation and Assessment

Criteria	Sub-Classification	Defining Limit
Spread: refers to area of direct influence from the impact of a project activity	Insignificant / Local spread	impact is restricted within the foot prints of the Project boundary or within 500m of the boundary
	Medium Spread	impact is spread beyond 500m up to 2 km of the Project boundary
	High spread	impact is spread beyond 2 km to 5 km from footprint boundary of the Project
Duration: based on duration of impact and the time taken by an environmental component to recover back to its best possible pre-project state	Insignificant / Short Duration	when impact is likely to be restricted for duration of less than 12 months;
	Long Duration	when impact is likely to be extended up to 10 years
	Permanent	when impact is likely to be extended beyond 10 years
Intensity: defines the magnitude of Impact	Insignificant intensity	when resulting in changes in the environmental baseline conditions is up to 10%
	Low intensity	when resulting in changes in the baseline conditions up to 20%
	Moderate intensity	when resulting in changes in the baseline conditions for up to 30%
	High intensity	when change resulting in the baseline conditions beyond 30%
Nature: refers to whether the effect is considered positive or negative	Positive	When impact will result in positive or beneficial change in the project area
	Negative	When impact will result in negative or adverse change in the project area
Frequency: refers to extent of occurrence of any activity/ task	Intermittent	Activities which may be undertaken intermittently but may not be continuous or have impact only when undertaken beyond certain intensity
	Routine	Activities which will be undertaken on regular and daily basis as part of construction or operation of the project

The potential impacts from Pre-construction, Construction, and Operation phases of the project are discussed in the subsequent sections.

7.4.2 Impact Significance Criteria

Spread	Duration	Intensity	Magnitude
Local	Short	Low/Insignificant\t	**Negligible**
Local	Short	Moderate	**Small**
	Long	Low	
	Long	Moderate	
	Permanent	Low	

Spread	Duration	Intensity	Magnitude
Medium	Short	Low/ Insignificant	
	Long	Insignificant	
Local	Short	High	Substantial
	Long	High	
	Permanent	Moderate	
Medium	Short	Moderate	
	Long	Low	
	Long	Moderate	
	Permanent	Low	
	Permanent	Moderate	
High	Short	Low	
	Short	Moderate	
	Long	Low	
	Long	Moderate	
	Permanent	Low	
Local	Permanent	High	Major
Medium	Short	High	
	Long	High	
	Permanent	High	
High	Short	High	
	Long	High	
	Permanent	Moderate	

In case of social and ecological impacts due to the project activities, vulnerability of the impacted receptor shall also be assessed in addition to characterising the magnitude of impact. Multiple factors have been considered while defining the vulnerability of the resource/receptor, which may be biological, cultural or human as presented in table below. Other factors have been also considered while characterising vulnerability, such as legal protection, government policy, stakeholder views and economic value.

The ***vulnerability characterization*** used herein for social and ecological receptors are

- Low
- Medium
- High.

Furthermore, for health and safety impacts due to the project activities, probability of incidence occurrence has been considered. The probability of an incidence occurrence has been established via qualitative scale as presented in Table 7-5

The ***probability*** used herein for health and safety incidence are:

- Unexpected
- Possible
- Expected

Table 7-5: Criteria for Receptor Vulnerability

Receptors	Sub criteria	Low	Medium	High
Impact on Local Community	The impact on local community of their socio-economic condition would be raised due to: • Potential loss of land-based livelihood • Potential Loss of Livelihood • Labour Influx • Employment Opportunities	• Minimum vulnerability consequently with a high ability to adapt to changes brought by the Project and opportunities associated with it	• Some but few areas of vulnerability; but still retaining an ability to at least in part adapt to change brought by the Project	• Profound or multiple levels of vulnerability that undermine the ability to adapt to changes brought by the Project
Habitat Sensitivity	Not Applicable	• Habitats with negligible interest for biodiversity. • Habitats with no, or only a local designation / recognition, habitats of significance for species listed as of Least Concern (LC) on IUCN Red List of Threatened Species • Habitats which are common and widespread within the region, or with low conservation interest based on expert opinion	• Habitats within nationally designated or recognized areas • Habitats of significant importance to globally Vulnerable (VU) Near Threatened (NT), or Data Deficient (DD) species • Habitats of significant importance for nationally restricted range species • Habitats supporting nationally significant concentrations of migratory species and / or congregator species • Low value habitats used by species of medium value	• Habitats within internationally designated or recognized areas • Habitats of significant importance to globally Critically Endangered (CR) or Endangered (EN) species • Habitats of significant importance to endemic and/or globally restricted-range species • Habitats supporting globally significant concentrations of migratory species and / or congregator species • Highly threatened and/or unique ecosystems, areas associated with key evolutionary species • Low or medium value habitats used by high value species
Species Sensitivity	Not Applicable	• Species with no specific value or importance attached to them • Species and sub-species of Least Concern (LC) on the IUCN Red List of Threatened Species • Not meeting criteria for medium or high value	• Species on IUCN Red List as Vulnerable (VU) Near Threatened (NT), or Data Deficient (DD) • Species protected under national legislation • Nationally restricted range species, nationally important numbers of migratory, or congregator species • Species not meeting criteria for high value, and species vital to the survival of a medium value species	• Species on IUCN Red List as Critically Endangered (CR) or Endangered (EN) • Species having a globally restricted range (i.e., plants endemic to a site, or found globally at fewer than 10 sites, fauna having a distribution range (or globally breeding range for bird species) less than 50,000 km2) • Internationally important numbers of migratory, or congregator species • Key evolutionary species, and species vital to the survival of a high value species

Table 7-6: Probability of Incidence Occurrence

Probability	Defining Limit
Unexpected	The incident is unexpected but may happen at any time during routine operations (probability less than 20%)
Possible	The incident is expected to happen at any time during routine operations (probability greater than 20% and less than 50%)
Expected	The incident will occur during normal routine operations (probability greater than 50%)

7.5 Impacts during Construction Phase- Manufacturing Facility

Apart from impact assessment during construction phase, construction phase audit along with gap assessment has also been undertaken for the project. Observations with respect to EHS, OHS, working conditions etc have been updated as part of Appendix 23.

7.5.1 Impacts on Physical Environment

The proposed Project site is located in a rural setup with no major industrial/ anthropogenic activities. This section outlines the potential impacts on the physical environment due to project activities planned during different phases of the Project lifecycle.

7.5.1.1 Air Quality

The potential sources of air emission during the construction period includes:

- Fugitive dust emissions from excavation work, digging, stacking of soils, filling, handling of construction material, transportation of material, plying of heavy construction machinery etc.;
- Vehicular emissions due to traffic movement at the facility and on the connecting roads;
- Gaseous emissions from operation of diesel generators for power requirement during construction phase.

The fugitive emissions from the batching plant set up within the Project boundary, construction material loading and unloading areas are likely to remain highly localized and confined to the manufacturing facility but would require adequate mitigation measures to prevent their spread outside the footprint of the facility.

Based on ambient air quality monitoring conducted at five locations twice a week for 4 weeks within 5 km radius of the manufacturing facility, all the parameters were found to be within permissible limits (refer ***Table 4-15)***. The manufacturing facility is spread across an area of 26.90 ha of land and the air quality impacts would be confined to 500 m of the construction activity area and the access route. Since there are no settlements located within 500 m of the facility, impact on community is anticipated to be negligible. However, there are other industries present within 500 m radius of the facility, hence workers working in the nearby industries may be impacted. Further the construction activities will also involve increase in the number of vehicles entering the region for transportation of construction material and manpower, i.e. average of 20-25 vehicles/day and during peak construction is 30-35 vehicles/day. The number of vehicles mentioned is the number of vehicles entering the site, i.e., inclusive of two wheeler/three wheeler/ four wheeler. Villages along the access roads are anticipated to be impacted due to increased emissions.

Control Measures Proposed and being implemented

Based on the site visit, the following control measures have been understood to be implemented

- Excavated soil at the construction site are handled adequately and top soil is heaped and water sprinkling is done to minimize dust generation
- Speed of vehicles on site is limited to 10-15km/h which helps in minimizing fugitive dust emissions due to vehicular movement.
- Periodic water sprinkling is done at the construction area to avoid dust emission.

Impact Magnitude

Impacts on ambient air quality during construction activities will be for limited period i.e. 18 months therefore, the impact duration has been assessed to be short. Furthermore, since there will be dust emissions due to construction activities at the manufacturing facility and along the access routes, the spread has been assessed to be local, i.e. limited to 500m from the manufacturing facility as well as access roads. The intensity and frequency has been classified as medium and routine respectively

as the construction activities will be undertaken regularly during the construction period. Therefore, the impact magnitude based on the impact significance criteria has been classified as Small.

Additional Mitigation Measures

- Emissions from the D.G. set and other stationary machines will be controlled by ensuring that the engines are always properly tuned and maintained;
- Cease or phase down work if excess fugitive dust is observed. Investigate the source of dust and ensure proper suppression measures;
- Idling of vehicles and equipment must be prevented

	Nature of Impact	Spread of Impact	Duration	Intensity	Frequency	Significance of Impact
Without Mitigation Measures	Negative	Local	Short	Medium	**Routine**	**Small**
With Mitigation Measures	Negative	Local	Short	Low	**Routine**	**Negligible**

7.5.1.2 Ambient Noise

The facility is located in the industrial area and therefore prescribed to CPCB and WHO standards set for industrial areas (Day time Leq = 75). The sources of noise in the construction phase include civil work, operation of batching plant, operation of DG sets and construction machineries such as cranes, drillers, bull dozers etc. and movement of vehicles for loading and unloading, fabrication, etc.

General noise levels generated from the operation of the equipment and machinery is provided below:

Name of Source	**Noise Level at 16 m (50 ft) from Source in dB (A)***	**Noise Level at 1 m from source (calculated) in dB (A)**
Air Compressor	87	111
Back Hoe/Loader	81	105
Concrete Mixer Truck	85	109
Concrete Pumper	70	94
Concrete Vibrators	77	101
Cranes - mobile	81	105
Dump Truck	83	107
Hammering	86	110
Jackhammer	88	112
Pile Driver	100	124
Radial Arm Saw	80	104

There will also be increased noise levels because of increased anthropogenic movement in the area. Since there are no settlements located within 500 m of the facility, noise impact due to construction activity at the facility on community is not anticipated. However, there are workers working at the other nearby industries, who are anticipated to be impacted due to high noise levels due to operation of machineries, cranes, batching plant and vehicles.

According to the noise monitoring results presented in Table 4-16, the Leq day time and Leq night for all the locations were observed to be within permissible limits of 75 dB (A) and 70 dB(A) respectively as per CPCB and IFC EHS guidelines for industrial areas as well as 55 dB (A) and 45 dB(A) respectively as per CPCB and IFC EHS guidelines for residential area. However, construction activities may increase noise levels in the area which will last for limited period of construction phase (while some of the high noise activities such as operation of machineries, vehicles may be limited to lesser duration).

Control Measures Proposed and being implemented

- The working hours for construction activities are defined i.e. from 8 am to 6pm. . Based on the consultation undertaken, it was understood that the working hours are defined and are being complied with, However, Daily attendance register with in and out time was not available at site for review
- Operation of high noise level construction machineries are restricted during daytime only. If work is extended beyond the defined hours, it was reported, that it is limited to activities that do not produce noise
- Periodic inspection of machineries and vehicles are done and appropriate lubrication and tightening of moving parts are done in case of increased noise levels during operation
- All vehicles entering the facility are instructed to obey speed limits and not to blow horns unless absolutely necessary.

Impact Magnitude

Impacts on ambient noise quality during construction activities will be for limited period i.e. 18 months, therefore, the impact duration has been assessed to be short. Furthermore, since there will be noise emissions due to construction activities at the facility and along the access routes due to movement of construction vehicles, the spread has been assessed to be local i.e. limited to 500m from the manufacturing facility. The intensity and frequency has been classified as high and routine respectively as the existing Leq day values at the study area is within the CPCB limits and the construction activities will contribute towards increasing the noise levels. However, such activities will last for a short period of time i.e., 18 months within the facility. Therefore, the impact magnitude based on the impact significance criteria has been classified as Substantial.

Additional Mitigation Measures

- Only well-maintained equipment should be operated on-site;
- Anti-honking sign boards to be placed in the parking areas and at entry / exit points
- If it is noticed that any particular equipment is generating too much noise then lubricating moving parts, tightening loose parts and replacing worn out components should be carried out to bring down the noise
- Machinery and construction equipment that may be in intermittent use should be shut down or throttled down during non-work periods

	Nature of Impact	Spread of Impact	Duration	Intensity	Frequency	Significance of Impact
Without Mitigation Measures	Negative	Local	Short	High	**Routine**	**Substantial**
With Mitigation Measures	Negative	Local	Short	Low	**Routine**	**Negligible**

7.5.1.3 Soil Environment

7.5.1.3.1 Soil Erosion

During the construction phase, the top soil will be susceptible to soil erosion to some extent due to site clearance activities. The removal of stabilized top soil would result in slope destabilization and increase in soil erosion. Excavation work and other infrastructure work for building construction will also lead to soil erosion, loss of top soil and soil compaction.

Soil Erosion: Erosion of soil results when soil grading removes vegetation cover and exposes soil to wind and rain. It is of particular concern during monsoon season and will require careful management.

Soil Compaction: Use of heavy machinery and storage of material compact the soil. Compaction of soil as well as mixing of construction material with soil would also lead to reduced infiltration of water, decrease in permeability and increased runoff.

Control Measures Proposed and being implemented

- Top soil at the manufacturing facility is not excavated earlier then required to avoid soil erosion. The excavated topsoil has been stored and handled adequately, the soil was heaped and water was observed to be sprinkled to minimize dust generation. However the heap was quite large and the same was not observed to be covered with tarpaulin and as understood, the top soil will be used for green belt development
- Areas for top soil utilization have been identified before start of construction activities and top soil will be utilized for plantations and landscaping within the facility. Also, top soil has been distributed to nearby villagers (as required)

- Excavated soil is being used as filling material (wherever possible) within the facility; and
- Use of existing roads to access the facility.

Impact Magnitude

Since the construction phase will last for limited period of time i.e., 18 months, the duration has been classified as short. Furthermore, since the soil erosion and compaction may occur due to movement of vehicles on unpaved roads, the spread has been classified as medium. The intensity has been classified as low to moderate and the frequency has been classified as routine. Therefore, based on impact significance criteria, the impact magnitude is assessed to be Small to Substantial.

Additional Mitigation Measures

- The stock piles of the soil should be kept moist/covered to avoid wind erosion of the soil;
- As a best practice, site clearance, piling, excavation will not be carried out during the monsoon season to minimize erosion and run-off.

	Nature of Impact	Spread of Impact	Duration	Intensity	Frequency	Significance of Impact
Without Mitigation Measures	Negative	Medium	Short	Low to Moderate	**Routine**	**Small to Substantial**
With Mitigation Measures	Negative	Local	Short	Low	**Routine**	**Negligible**

7.5.1.3.2 Soil Contamination

General construction waste generated generally comprises of surplus or off-specification materials such as concrete, wooden pallets, steel cuttings/filings, packaging paper or plastic, wood, metals etc. Municipal domestic wastes consisting of food waste, plastic, glass, aluminum cans and waste paper is also likely to be generated by the construction workforce at canteen facility/ rest area. A small proportion of the waste generated during construction phase will be hazardous and may include used oil, hydraulic fluids, waste fuel, grease and waste oil containing rags. If improperly managed, solid waste and wastewater could create impacts on land.

Since the manufacturing facility is an under construction facility, and as reported during the site visit, due to absence of kitchen or cooking facilities within the project site, no food waste is being generated.

As observed during site visit, waste Inventorization is not being undertaken. Facility has not developed waste management plan comprising of disposal of construction debris, recyclables, etc. Separate designated area for storage of hazardous waste has not been provided during the construction phase however as reported, no hazardous waste is being generated.

Control Measures undertaken for the Project

Onsite workers are provided with adequate trainings on waste management. Requirement to impart EHS trainings to the workers has been included in the contractor's agreement

- Sewage generated onsite is treated and disposed through septic tanks and soak pits as per specifications given in IS 2470: 1995 (Part I and II)
- Construction waste generated at the site is being reused to the extent possible and remaining waste such as scraps, metals etc. as mentioned is being disposed through authorized vendor.
- GSL ensure that the EPC contractor follows and implements the guidelines for contractors and sub-contractors.
- Membership with Coastal Waste Management Project (Unit-2) has been obtained for management of hazardous waste. GSL has undertaken Membership with Coastal Waste Management Project (Unit-2) for management of hazardous waste and is valid until 29.03.2024. As understood, coastal waste management (unit 2), a division of Mumbai waste management, (a subsidiary of Re-Sustainability limited) is responsible for hazardous waste transportation and disposal.

Impact Magnitude

Any leaks and spills of oil from construction activities may contaminate the soil in facility site and nearby areas, therefore the spread has been classified as medium. Furthermore, contamination of soil may last for long period of time, thus the duration has been classified as long. The intensity has been classified as moderate as the soil contamination may have impact on the soil of manufacturing facility and nearby areas. Therefore, the impact magnitude as per impact significance criteria has been assessed to be Substantial.

Additional Mitigation Measures

- During servicing/repair of equipment or vehicles, a drip tray to be used to prevent oil/grease spills onto the soil, especially in case of emergency repairs;
- Waste to be managed as per the site specific waste management plan (refer as Appendix 5) as well as hazardous material management plan (refer Appendix 6)
- Oil spill kits should be maintained onsite to handle minor leaks and spillage
- Contractor should ensure that no unauthorized dumping of used oil and other hazardous waste is undertaken;
- Designated areas should be provided for Municipal Solid Waste and daily collection and period disposal should be ensured;
- Construction and Demolition Waste should be stored separately and be periodically collected by an authorized treatment and storage facility;
- All waste should be stored in a shed that is protected from the elements (wind, rain, storms, etc.) and away from natural drainage channels;
- A log book should be maintained for quantity and type of hazardous waste generated. Daily collection and period disposal should be ensured for waste generated on site;
- Use of spill control kits to contain and clean minor spills and leaks;
- Unloading and loading protocols should be prepared for diesel, oil and used oil respectively and workers trained to prevent/contain spills and leaks, and
- In case of accidental/unintended spillage, the contaminated soil should be immediately collected and stored as hazardous waste;
- As a best practice, site clearance, piling, excavation and access road strengthening will not be carried out during the monsoon season to minimize erosion and run-off
- Corrective Action Plans developed as part of Construction Phase audit to be implemented on site (Refer Appendix 23)

	Nature of Impact	Spread of Impact	Duration	Intensity	Frequency	Significance of Impact
Without Mitigation Measures	Negative	Medium	Long	Moderate	**Routine**	**Substantial**
With Mitigation Measures	Negative	Local	Short	Low	**Routine**	**Negligible**

7.5.1.4 Water Resources

7.5.1.4.1 Water Availability in Project Area

Water is a prime requirement for the execution of civil works, especially with regard to preparation of raw materials like concrete etc. for civil works associated with the facility. Water requirement during construction phase for civil work and dust suppression activities etc. is estimated to be approximately 150 KLD and domestic water requirement is estimated to be ~ 2 to 3 KLD.

The facility is located in a developing industrial area and has installed 4 borewells to a depth of 70m with an expected yield of 5.000 to 6.000 LPH within the boundary for fulfilling the water requirement (for construction activity) during construction phase. However, all 4 borewell will not be used during construction phase, as water requirement for construction phase is 150KLD which can be fulfilled using 1 or 2 borewells operational for 10 hours. The Potable water requirement is and will be met through packaged drinking water.

As per CGWB, Nellore District, Naidupeta Tehsil (manufacturing facility) falls is an area marked as “critical” in terms of groundwater development whereas as per the ground water assessment report developed by Andhra Pradesh Ground Water and Water Audit Department, Menakuru village (project location village) is categorized as Over-Exploited.

Control Measures undertaken for the Project

- Workers are being sensitized on water conservation and encourage optimal use of water. Requirement to conduct such trainings have been communicated to the contractors engaged by GSL as part of Training and Awareness SOP.

Impact Magnitude

Since the facility is using water abstracted from the bore wells installed within the premises during construction phase, the spread has been classified as local-medium. Furthermore, water requirement for construction phase will last for limited period i.e., 18 months, the impact duration has been considered as short. Also, once the water supply form APIIC is initiated, GSL will rely on the water supplied and will not extract ground water. Since, project mandal has been marked as "critical" and project village as "over exploited "in terms of groundwater development, the impact intensity has been classified as high. Therefore, based on impact significance criteria, the impact magnitude has been classified as Substantial.

Additional Mitigation Measures

- Regular inspection for identification of water leakages and preventing wastage of water is necessary for efficient utilization of water;
- Blending of low quality water with fresh water for construction uses to ensure efficient use of natural resource; and
- Recycling/reusing to the extent possible.

	Nature of Impact	Spread of Impact	Duration	Intensity	Frequency	Significance of Impact
Without Mitigation Measures	Negative	Local	Short	High	**Routine**	**Substantial**
With Mitigation Measures	Negative	Local	Short	Moderate	**Routine**	**Small**

7.5.1.4.2 Water Contamination

There is a potential for contamination of groundwater resources resulting from improper management of sewage at in manufacturing facility or other accidental spills/leaks at the storage areas.

The soil type of the area is loamy, sandy loam and sandy. This type of soil usually has high percolation (measured in the range of 1 to 8 inches or more per hour) into the subsoil and subsequently the ground water. Furthermore, accidental spillage of chemical and fuel may easily contaminate the ground water. Therefore, the spillage of chemicals and fuel may cause measurable changes in the ground water quality during construction activities (i.e. 18 months), however the water quality may be impacted for longer.

Control Measures proposed and being implemented

- Provision of onsite septic tanks and soak pits for sewage treatment and disposal, thereby reducing the environmental impact of wastewater discharge. A licensed vendor is engaged for cleaning of septic tanks and soak pits
- Open defecation and random disposal of sewage is strictly restricted. Workers are provided with 17 portable toilets within the site boundary, of which 2 are for women, i.e., separate male and female toilets are present. Two female toilets are provided as there are no female construction workers, females have been engaged in pantry and for cleaning work.
- Daily inspection (observations) on land, soil contamination, leaks and spills are being conducted to avoid soil and water contamination by GSL as well as contractor's EHS officer
- The Batching Plant is set up away from any drain inlet and is present within the facility.
- Adequate stormwater drainage have been developed in and around the facility to avoid any disruption to the existing drainage channels within the facility premises. As observed, no disruptions have been done to the existing drainage channels within/nearby the facility premises.

Impact Magnitude

Since, any spillage or leaks may contaminate the groundwater of the area, the spread has been classified as Medium. Furthermore, there will be long term impact on groundwater quality in case of leaks/spills, the duration has been classified as

long. The intensity has been classified as moderate due to high percolation rate of sandy soil, which may seep the contaminant deep into ground water and the groundwater in the project area has been classified as critical as per CGWB report in terms of ground water development. Therefore, based on impact significance criteria, the impact magnitude has been classified as Substantial.

Additional Mitigation Measures

- Spill/ leakage clearance plan to be adopted for immediate cleaning of spills and leakages
- Separate designated area for storage of hazardous waste to be provided, Hazardous material should be kept on impervious layer with secondary containment,
- In case of accidental/unintended spillage, the contaminated soil should be immediately collected and stored as hazardous waste
- Periodically monitor the ground water quality and ground water levels. Ground water quality and water levels to be monitored on half yearly basis, during pre- and post-monsoon.

	Nature of Impact	Spread of Impact	Duration	Intensity	Frequency	Significance of Impact
Without Mitigation Measures	Negative	Medium	Long	Moderate	**Routine**	**Substantial**
With Mitigation Measures	Negative	Local	Short to Long	Low	**Routine**	**Small to Negligible**

7.5.1.5 Topography and Drainage

The topography of the site was observed to be almost flat with minor slope with elevation ranging from 38 m to 45 m above mean sea level. Micro watershed drainage channels are located within 5 km of the Project site. A water body is located ~ 100 m (aerial distance) from site towards north direction, a stream flows toward east direction, located at a distance of 1.6 km (aerial distance) and a water canal flows at an aerial distance of 1.1 km in the west direction. Swarnamukhi River flows 5.6 km (aerial distance) of the project location, towards east direction.

Control Measures proposed and being implemented

- Levelling and grading activities were carried out with as little disturbance to the existing contour and drainage channels to the extent possible, in order to retain the general slope of the site.
- Uncontaminated spoil generated from excavation work is being reused to the extent possible for backfilling purpose, restoration of contaminated location within the project boundary etc.
- Spoils which cannot be reused are being disposed through authorized vendor.
- To the extent possible, disruption/alteration of micro-watershed drainage patterns are being avoided.

Impact Magnitude

Since site levelling and clearance activities have been undertaken, destabilization of slope and further blockage of drainage channels and water logging at site may be anticipated, therefore, the spread has been classified as Medium. Furthermore, long term impacts on the micro drainage channels and local watershed drainage can be anticipated, therefore the duration has been classified as permanent. The intensity has been classified as low as the none of the drainage channels present within 1 km radius have been affected directly, however, the micro shed drainage channels present within the site and in the vicinity may have been impacted. Therefore, based on impact significance criteria, the impact magnitude has been classified as Substantial.

Additional Mitigation Measures

- GSL shall ensure that no natural watercourse and/or water resources will be obstructed due to any industrial operations
- To the extent possible, disruption/alteration of micro-watershed drainage patterns are being avoided

	Nature of Impact	Spread of Impact	Duration	Intensity	Frequency	Significance of Impact
Without Mitigation Measures	Negative	Medium	Permanent	Low	Intermittent	Substantial
With Mitigation Measures	Negative	Local	Long	Low	Intermittent	Small

7.5.2 Impacts on Socioeconomics

7.5.2.1 Unhygienic and unsafe living conditions due to labour influx

The project will employee skilled, semi-skilled and unskilled workers which include contractual and regular employees as well as local and Migrant workers. The regular skilled workers comprise of migrant workers, from different districts and states in the country depending upon the need for technical expertise. Semi-skilled/unskilled laborer can be hired locally from the project village and the AoI villages. The details regarding the workforce of the Project site are estimated to 1200-1500 contractual workers, however, bifurcation of number in between skilled, semi-skilled and unskilled, and migrant and local is not known at this stage of pre-construction phase of the project.

The labor influx is likely to create the following issues:

- During the site visit it was observed that temporary labor camps were built for construction phase migrant workers, where they are not provided with adequate space for living and the rooms were over crowed. The arrangements lack proper beddings , ventilation, and safe electrical connections.
- These camps lack adequate basic amenities which includes but not limited to sanitation, safe drinking water, separate & safe place for cooking, adequate measures for firefighting etc..
- Due to poor sanitary conditions there might be outbreak of vector bone and other diseases including covid which might affect the workers and adjoining communities.
- There might be potential conflicts and violence among labors and issues related to substance and alcohol disturb the social harmony.

Control Measures Planned for the Project

- EHS conditions were observed to be included sub-contractor agreement, which also mentions overall requirement including Health and Safety (including government mandated COVID-19 guidelines).
- Regular cleaning of the camps , review, and inspections measures are in place.

Impact Magnitude

Based on the available data and site assessment it was assessed that project construction activities will be carried out in phases therefore as informed at any point of time the number of labors will not exceed from 1000-1200. And most of the labors will be accommodated in the labor camps provided by the respective contractors close to the project. It is likely to have local impact due to labor influx during construction stage . The duration of theses impact will be limited to construction period therefore such impact may be felt for shorter duration and spread will be generally around the construction site. Hence the impact significance is rate as Substantial

Proposed Mitigation Measures

The following measures should be put in place to ensure that the overall health & safety and convenience of labor:

- The accommodation facility for regular employees /workers should be constructed to meet the requirement of IFC's guidelines on worker accommodation.
- As the construction of the project was already started the camps should be retrofitted to meet the basic requirements of the above-mentioned guidelines including well ventilated rooms with adequate bed and beddings, windows & doors should have insect nets, proper electrical connections with fan or any other arrangements for thermal comfort. In addition, there should be separate toilet blocks for men and women and separate bathing and washing space.
- Separate space for cooking , washing utensils and storage of food and fuel
- The camps should be equipped to handle fire emergency.
- Regular spray and other mechanism for disease control including health monitoring

- Develop check list for regular review & monitoring of the camps especially of the health and sanitation aspect and Dos & Don'ts to check any potential violence, substance, and alcohol abuse.
- The Project shall provide training or induction program related to the gender sensitization and gender-based violence to all employees at the time of commencement of their job

	Nature of Impact	Spread of Impact	Duration	Intensity	Frequency	Significance of Impact
Without Mitigation Measures	Negative	High	Short	High	Intermittent	Substantial
With Mitigation Measures	Negative	High	Short	High	Intermittent	Substantial

7.5.2.2 Increased local employment & livelihood

As per the available data it was understood that total manpower requirement for the project is nearly 1200-1500 persons, which will include both skilled and nonskilled workers. The work force engaged mostly will be migrant workers working for different contractors. Besides that, some unskilled jobs shall also be provided to local labors.

Besides direct employment opportunities project will also be instrumental in creating other local livelihood opportunities in the surrounding localities in terms of giving more business to local grocery shops, fruit/ vegetables & other items related to supply of food & ration, fuel, rents, taxi, tractors, water tankers, trucks hotel , restaurants /Dhaba's etc.

Enhancement Measures adopted

As per the discussions with the management (although there are no specific policies towards local employment etc.) where possible efforts are made to use the available local resources which broadly includes local procurement of ration, engaging local labor, tanker for water supply, project managerial staff/ officers are encouraged to live close to the plant on rented accommodation etc.

Impact Magnitude

Based on the available data and site assessment it was assessed that project will provide direct employment to nearly 1200-1500 persons ,beside direct employment project also will be instrumental in providing the indirect employment and livelihood to nearby communities and service providers across states/ regions. As informed, most of workers will be mostly from outside the state therefore the spread will be high. The duration of theses impact will be limited to construction period therefore such impact may be felt for shorter duration. Hence the impact significance is rated as Substantial

Proposed Enhancement Measures for the Project

While the significance of the impact on economy and employment opportunities during the construction phase is understood to be positive, the following enhancement measures should be put in place to ensure that the local community receive maximum benefit from the presence of the Project:

- Project should develop guidelines/policies towards local employment and livelihood opportunity enhancement and include the local employment reporting the annual report .
- Project should proactively disclose the local labor and other requirement at notice board and there should be open door policy towards local vendors registration
- Preference should be provided to local labor. However, the preference shall be based on available skillset and knowledge
- Project shall provide equal access to both female and male local population in available employment opportunities and for greater employability of residents, technical/vocational training may be arranged for female and male, if required
- Establish the functional stakeholder engagement including external communication plan and roll out grievance handling mechanism which should have provisions for receiving external grievances as well.
- The project proponent will establish a mechanism to audit sub-contractors and suppliers with respect to compliance of utilizing local labor and resources,

	Nature of Impact	Spread of Impact	Duration	Intensity	Frequency	Significance of Impact
Without Mitigation Measures	Positive	High	Short	Low	Intermittent	Substantial
With Mitigation Measures	**Positive**	High	Short	Moderate	Intermittent	Substantial

7.5.2.3 Occupational Health & Safety

The engagement with various construction activities will involve a range of occupational health and safety risks and hazards mainly for the contractors and workers (local and/or migrant) who are involved in the construction works. Lack of relevant PPE's will increase the risk of worker's exposure to construction hazards. Some of the serious risks during construction phase without adequate PPE include risk of fall while working at heights, risk of accidents, exposed to faulty electrical devices, such as cables, cords, hand tools etc.

Following potential occupational health and safety risks are envisaged due to construction activities:

- Fall from height during erection and installation of machineries and other storage components
- Risk while working at confined spaces at excavated areas
- Accidents during driving heavy duty vehicles for transportation of construction material at site including transportation of raw material as well as manufactured products
- Fire hazards and accidents while handling chemicals and oils and operating construction machineries including cranes and mechanical lifting equipment
- Electrocution while working with live electrical components like electrical parts etc.
- Diseases due to unhygienic conditions at site including contaminated drinking water for workers
- Hearing problems due to noise generation from construction machineries
- Respiratory problems due to dust emissions from construction site.
- Exposure to extreme heat while working at site during summers
- Risk of accidents from being struck in machinery or moving equipment or parts
- Exposed to faulty electrical devices, such as cables, cords, hand tools etc.

Control Measures Planned for the Project

- Greenlam at the corporate level has a dedicated environmental, health and safety (EHS) plan, Occupational Health & Safety Plan and emergency response plan (ERP) which is applicable to the project. Measures provided in the respective plans with respect to health and safety are implemented at site by GSL.
- All construction activities are carried out during daytime hours and vigilance is maintained for any potential accidents
- Construction vehicles are routed only during non- peaking hours i.e. other than during 0700 to 1100 hours and 1600 to 1900 hours.
- Adequate personal protective equipment such as ear plugs, safety helmet, safety shoes etc. are provided to the workers
- Health and safety training on working at height, material handling, working at confined space is being imparted to the workers
- Permit-required confined spaces to be provided with safety measures for venting, monitoring, and rescue operations, to the extent possible. The area adjoining an access to a confined space should provide ample room for emergency and rescue operations.
- Cranes and other lifting equipment are operated by trained and authorized persons
- Excavated areas are temporarily fenced to avoid access to outsiders;
- Project specific Emergency action Plan is present in the EHS Plan, and a site specific Emergency Response Plan has been developed by GSL at the site which includes the contact details of the Emergency Rescue Team
- A work permit system has been implemented by EPC Contractor for all the workmen on the project premises for relevant tasks
- GSL has develop a systematic monitoring and auditing mechanism for monitoring the contractors and sub-contractors in terms of resources, migrant workers, child labour and forced labour, health and safety, payment of wages etc.

- GSL has included aspects pertaining to health & safety and environment as part of the Guidelines for Greenlam's Sub-Contractor Compliance for Ethical Trade Initiatives as well as Supplier Code of Conduct policy.
- EHS plan has been included in the contract agreements to ensure adherence to the policies and practices adopted by GSL. The same has been communicated to the contractors and EHS monthly and weekly checklist received from the contractors ensures the monitoring and the adherence

Impact Magnitude

The nature of impact was assessed to be negative due to project with direct impact. The duration of the impact is assessed to be short .i.e. during construction phase only. The geographical spread of impact is expected to be local, mainly confined to the project construction site and/or within 500m of the boundary. Therefore, intensity of the impact is assessed as moderate-high and the overall impact significance is assessed as small-substantial.

Additional Mitigation Measures

- Workers who are engaged in welding works will be provided with welder's protective eye shields;
- The use of any toxic chemical will be strictly in accordance with the manufacturer's instructions;
- Electrical and maintenance work should not be carried out during poor weather and during lightning strikes;
- Obtain and check safety method statements from contractors;
- Monitor health and safety performance and have an operating audit system;
- Training of the workers on climbing techniques, and rescue of fall- arrested workers;
- Appropriate safety harnesses and lowering/raising tools should be used for working at heights;
- Lifting operations are carried out with proper plans and with equipment of adequate capacity;
- As part of the contract agreements, the contractor will be required to ensure provision of basic amenities of drinking water, adequate number of toilets, wash rooms, sanitation and cleanliness, lighting, availability of provisions and groceries to the labors;
- A first aid box with adequate medicines to be provided at the site and appoint a trained person to take charge of it. The location of first aid arrangements to be displayed on site;
- All equipment should be turned off and checked when not in use;
- The nearest hospital, ambulance, fire station and police station should be identified in the implemented emergency management plan;
- Implementation of all COVID-19 related safety and emergency response measures, as relevant and as prescribed by the government. Government guidelines on social distancing, face mask, face shield, regular disinfection and screening of workers to be followed at Site
- Establish a grievance redressal mechanism in place, to allow for the employees and workers to report any concern or grievance related to work activities.
- Compliance with the ESAP, developed as part of construction phase audit undertaken for the project . ***(Refer Appendix 23)***.

	Nature of Impact	Spread of Impact	Duration	Intensity	Frequency	Significance of Impact
Without Mitigation Measures	Negative	Local	Short	High	Intermittent	**Substantial**
With Mitigation Measures	Negative	Local	Short	Moderate-High	Intermittent	**Small to Substantial**

7.5.3 Impacts on Biological Environment

7.5.3.1 Impacts on the Habitat and Species due to Construction Activities

All the construction activities conducted during the establishment of the manufacturing unit, will increase the movement of people and goods; noise; and the potential for sedimentation/pollution of water resources due to excavation and filling operations in the study area. These activities are evaluated in terms of habitat and species disturbance. There is a possibility, that the anthropogenic migration has resulted in increased stress on the fauna of the region, requiring them to remain vigilant for extended periods of time, preventing proper reproduction, nesting, mating, socialization, and foraging. Anthropogenic movements (transportation of people and goods) and noise from construction activities can also disturb the fauna of the surrounding area.

During the habitat survey, it was observed that a water body (with 67 Acres area and used for agricultural)is situated about 100 away from the northern boundary of the manufacturing unit. The labor camps was also constructed within the 500 m range of the water body.

As the land allocated for the manufacturing unit is situated within an industrial area and the construction activities were in full swing at the time of the site survey, no significant floral species were observed within the manufacturing unit area. As per the baseline, the study area represents fifty-eight floral species including one Globally IUCN Endangered - *Tectona grandis* L.f. and Near Threatened - *Aegle marmelos* (L.) Corrêa species. Both the above-mentioned species are very common in the region. *Tectona grandis* is used to grow for its timber use.

One Vulnerable as per IUCN Red List (Online Version 2022-2), Bonnet Macaque (*Macaca radiata*) was also observed in the study area (Manufacturing Unit).

Control Measures planned for the Project

According to the discussion with the project officials, the workers and supervisors will receive internal and external training on wildlife encounter situations and the do's and don'ts of dealing with these situations.

Impact Magnitude

During the construction phase, all the above-mentioned activities will be performed for a limited, thus the **Duration** has been short. As the construction activities will be performed in the boundary of manufacturing unit, labor camps, mixing plants and equipment storage sites, the **Spread** has been classified as medium. The **Intensity** has been classified as moderate as the numbers of species are inhabiting the area impacted by the construction activities. Thus, the impact magnitude has been classified as ***Substantial*** based on the impact significance criteria (***7.4.2***).

Proposed Mitigation Measures

The mitigations proposed to minimize the impact(s) on Habitat and Species have been given as,

- Night-time (6:00 pm to 6:00 am) construction and transportation activities should be avoided
- The areas of high animal activity, such as forests / open scrubs and water bodies the construction and transportation activities should be avoided during dawn (6:00 am to 7:30 am) and dusk (5:00 pm to 6:30 pm)
- Hazardous materials should be avoided to store near water body and drains
- Temporary fencing should be installed over excavated areas
- Efforts should be made to minimize construction noise and sound barriers should be considered if noise levels are high
- Construction activities must implement proper housekeeping, properly dispose of discarded packaging materials, and provide labor camps with adequate sanitary facilities
- Movement of workers between camps and construction sites should be restricted and they should not be allowed to visit in natural areas not included the planned construction activities

	Nature of Impact	Spread of Impact	Duration	Intensity	Receptor Vulnerability	Significance of Impact
Without Mitigation Measures	Negative	Medium	Short	Moderate	Medium (Habitat) Medium (Species)	**Substantial**
With Mitigation Measures	Negative	Local	Short	Moderate	Medium (Habitat) Medium (Species)	**Small**

7.6 Impacts during Operation Phase- Manufacturing Facility

7.6.1 Impacts on Physical Environment

7.6.1.1 Air Quality

Source of air emission during operation phase includes:

- Vehicular movement

- Exhaust Emission from operation of D.G. sets used as power backup
- Flue gas emissions from boilers
- Fugitive Fly ash emission from boilers
- Vehicular emission due to traffic movement within and outside the plant premises for sourcing of wood
- Air pollution due to volatile organic chemical emission and Loss of chemical from tank
- Flue gases from heating process of resin
- Process emissions such as VOCs, formaldehyde etc.
- Fugitive dust emissions from handling and movement of materials
- Dust particulates from coal and ash handling systems, fly ash from stack flues, fly ash dust particles from ash silos and ash disposal area
- Wood dust arises from mechanical operations such as chipping and chip grading, and from cutting and sanding of pressed board

Major air pollutants envisaged to be released during operation phase is Particulate Matter(PM), CO, CO_2 and nitrogen oxides (NOx), VOC's, SO_2, and formaldehyde. According to the primary ambient air monitoring conducted within 5 km of the project site all the parameters were found to be within NAAQS permissible limit for all the samples. The values for monitoring results were within IFC EHS guideline values for SO2, CO and NO2, However, the values for PM10 and PM2.5 were exceeding the Interim target 3 and EHS guidelines (refer Table 4-15).

The manufacturing unit will have 5 stacks within the facility at Boiler, Hot water generator, Thermic fluid heater, Thermal Energy Plant and DG sets. The flue gas emissions and VOC's from Steam Boiler, Thermic fluid heater, Hot Water Generator, boiler and resin manufacturing process may disperse in the air up to a significant distance depending upon the meteorological condition of the Project area. Furthermore, wood veneering will be undertaken within plant premises, debarking/peeling/clipping/chopping steps will have dust emissions, also during transportation particles may disperse up to a distance of 5 km depending on the wind velocity of the project area. However, vehicular emission may be restricted at ground level and may potentially spread up to a distance of 500 m. There will be potential emission from fly ash and bottom ash generated due to combustion of at boiler.

Volatile organic compounds (VOCs) are released where wood is heated in particle dryers, veneer dryers and presses, and when pressed board cools. VOCs are also released in the manufacture and application of decorative coatings for boards. Formaldehyde and VOC emissions from wood-based panels are considered as one of the major causes of poor indoor air quality. The formaldehyde in wood-based panels primarily comes from urea-formaldehyde resin (which is being manufactured at the captive resin plant), however drying and hot-pressing techniques are helpful in reducing the formaldehyde and VOC emissions from wood-based panels. Therefore formaldehyde emissions are anticipated within the manufacturing facility. VOC's in the wood based panels mainly comes from the wood chips[166].

Air emissions during the operation phase will also be due operation of diesel generator sets. Five no. of D.G. set of capacity 4 x 1000 KVA & 1 x 750 KVA are proposed to be installed for power back up. The emissions from the diesel generators will occur only in event of a power outage leading to the use of the DG sets as back-up power. D.G. set will be provided by stack of adequate height.

GHG Emissions from the Integrated Manufacturing Facility (Per Annum). For GHG calculations two scenarios have been considered.

- Scenario-1: Scope 1 emission from stationary combustion from Biomass, Wood and Coal in the boiler and Diesel as fuel in machines, DG sets and vehicles present within the project boundary and scope 2 emissions from purchased electricity used for powering the machines and the facility has been considered.
- Scenario-2: Under Scope 1 emissions, coal usage has been omitted considering it is for emergency usage only. Remaining sources will remain same as Scenario 1.

Calculation details have been presented in

Table 7-7.

[166] https://www.researchgate.net/publication/257171847_Formaldehyde_and_VOC_emissions_at_different_manufacturing_stages_of_wood-based_panels

Table 7-7 GHG Emission Calculations

Fuel Type	Bituminous Coal	Eucalyptus Wood (Wood and Wood Residues)	Biomass (Agricultural By product)	Diesel[167]	Purchased Electricity (Scope 2)
Scenario 1- Emergency Case Scenario (where coal is used for 21 days per annum)					
Quantity (MT/Annum)	4032	251850 [168]	52560[169]		9000KVA
Quantity (Litres/Annum)	--	--	--	24,960	--
HHV (MMBtu per short ton)	24.93	17.48	8.25	0.138	--
Quantity in MMBtu/annum	91169.61	3992920.57	103239.50	909.94	--
CO2 (tonnes)	8504.301	0	0	67.299	31,940.71[170]
CH4 (tonnes)	1.003	28.7490	3.304	0.003	0
N2O (tonnes)	0.146	14.375	0.434	0.001	0
CO2e (tonnes)	8571.037	4614.219	207.408	67.520	0
Biofuel CO2 (tonnes)	0	374535.949	12199.812	0	0
EF (kgCO2e/unit)	94.012[171]	94.955[172]	120.176[173]	74.203[174]	0.6077[175]
Total Scope 1 Emissions (tonneCO2e)	8571.60 (Stationary Sources) and 386735.76 (Biogenic)				--
Total Scope 2 Emissions (tonneCO2e)	--	--	--	--	31,940
Scenario 2- No Coal Usage					
Quantity (MT/Annum)	0	251850 [176]	52560[177]	--	9000KVA
Quantity (Litres/Annum)	--	--	--	24,960	--
HHV (MMBtu per short ton)	--	17.48	8.25	0.138	--
Quantity in MMBtu/annum	0	3992920.57	103239.50	909.94	
CO2 (tonnes)	0	0	0	67.299	31,940.71
CH4 (tonnes)	0	28.7490	3.304	0.003	0
N2O (tonnes)	0	14.375	0.434	0.001	0

[167] Considered as Distillate Fuel Oil No. 2
[168] 129210 MT/Annum of Wood Waste & 122640 MT/Annum of Eucalyptus wood used (Total Fuel for boiler comprising of sourced Wood & biomass and inhouse wood waste)
[169] Sourced wood and biomass is 175200 MT/Annum considering 30% is biomass will be used. Therefore 52560 MT/Annum of Biomass will be procured
[170] Power Factor = 0.8 (For commercial and industrial systems, a power factor of 0.8 is often used as a general rule of thumb); Operating Hours per Day = 20; Days per Year = 365; The formula to convert kVA to kWh is: kWh = kVA × Power Factor × Hours

[171] EPA, "Emission Factors for Greenhouse Gas Inventories," Table 1 Stationary Combustion Emission Factors, March 9, 2018 (https://www.epa.gov/climateleadership/center-corporate-climate-leadership-ghg-emission-factors-hub).
[172] EPA, "Emission Factors for Greenhouse Gas Inventories," Table 1 Stationary Combustion Emission Factors, March 9, 2018 (https://www.epa.gov/climateleadership/center-corporate-climate-leadership-ghg-emission-factors-hub).
[173] EPA, "Emission Factors for Greenhouse Gas Inventories," Table 1 Stationary Combustion Emission Factors, March 9, 2018 (https://www.epa.gov/climateleadership/center-corporate-climate-leadership-ghg-emission-factors-hub).
[174] EPA, "Emission Factors for Greenhouse Gas Inventories," Table 1 Stationary Combustion Emission Factors, March 9, 2018 (https://www.epa.gov/climateleadership/center-corporate-climate-leadership-ghg-emission-factors-hub).
[175] IGES List of Grid Emission Factors, https://pub.iges.or.jp/pub/iges-list-grid-emission-factors, https://unfccc.int/sites/default/files/resource/IFI%20Default%20Grid%20Factors%202021%20v3.1_unfccc.xlsx
[176] 129210 MT/Annum of Wood Waste & 122640 MT/Annum of Eucalyptus wood used (Total Fuel for boiler comprising of sourced Wood & biomass and inhouse wood waste)
[177] Sourced wood and biomass is 175200 MT/Annum considering 30% is biomass will be used. Therefore 52560 MT/Annum of Biomass will be procured

Fuel Type	Bituminous Coal	Eucalyptus Wood (Wood and Wood Residues)	Biomass (Agricultural By product)	Diesel[167]	Purchased Electricity (Scope 2)
CO2e (tonnes)	0	4614.219	207.408	67.520	0
Biofuel CO2 (tonnes)	0	374535.949	12199.812	0	0
EF (kgCO2e/unit)	--	94.955[178]	120.176[179]	74.203[180]	0.6077[181]
Total Scope 1 Emissions (tonneCO2e)	386735.76 (Biogenic Emissions only)				--
Total Scope 2 Emissions (tonneCO2e)	--	--	--	--	31,940

As per the EIA report developed for the facility, for calculation of maximum ground level concentrations (GLC's), air dispersion\ modelling software (AERMOD version 7.1.0) was used. The resultant concentrations were observed to be within the permissible levels for residential/rural conditions wrt to the environment baseline undertaken as per the EIA report. Contribution to the ground level concertation (as reported in the EIA report) has been presented below:

Pollutants	Maximum Cumulative Contribution (µg/m3)
Particulate matter (PM10)	0.097
Particulate matter (PM2.5)	0.029
Sulphur dioxide (SO2)	0.302
Nitrogen dioxide (NO2)	0.325

As reported, in EIA report, the incremental concentrations when superimposed over the existing maximum baseline concentrations, the resultant concentrations were observed to be within the permissible levels for residential/rural conditions.

Proposed Control Measures Planned for the Project

Stack Emissions

- The emissions from the Steam Boiler of capacity proposed 1 x 8 TPH shall be routed through multi cyclones separator followed by bag filters with the stack type and height fixed in consultation with the APPCB. Electrostatic precipitators and bag filters are proposed to be installed with the boilers to arrest the particulate matter
- Adequate stack height will be provided for D.G. Sets 4 x 1000 KVA & 1 x 750 KVA as per CPCB norms and as per the CTO Obtained. GSL will provide canopy and adequate stack height of DG set so as to comply with the provisions of notification No GSR-371 E dated 17-5-2002 (amended from time to time) issued by MOEF under Environment Protection Act, 1986.
- Proposed 2 x 80 Lakh K.cal/hr hot water generator with stack height 30 mts, 2 x 80 Lakh K.cal/hr Thermic Fluid Heater with stack height 30 mts, & 300 Lakh K.cal/hr Thermal energy plant with stack height 30 mts. Bag filter will be connected to Thermic fluid heater
- GSL will establish adequate number of air monitoring stations, including one online station (continuous ambient air quality monitoring station), in consultation with the APPCB and take appropriate measures to ensure that the GLC will comply with the NAAQM norms notified by MoEF&CC, GoI on 16.11.2009.
- A sampling port with removable dummy of not less than 15 cm diameter will be provided in the stack at a distance of 8 times the diameter of the stack from the nearest constraint such as bends etc. A platform with suitable ladder shall be provided below 1 meter of sampling port to accommodate three persons with instruments. A 15 AMP 250 V plug point to provide on the platform

[178] EPA, "Emission Factors for Greenhouse Gas Inventories," Table 1 Stationary Combustion Emission Factors, March 9, 2018 (https://www.epa.gov/climateleadership/center-corporate-climate-leadership-ghg-emission-factors-hub).
[179] EPA, "Emission Factors for Greenhouse Gas Inventories," Table 1 Stationary Combustion Emission Factors, March 9, 2018 (https://www.epa.gov/climateleadership/center-corporate-climate-leadership-ghg-emission-factors-hub).
[180] EPA, "Emission Factors for Greenhouse Gas Inventories," Table 1 Stationary Combustion Emission Factors, March 9, 2018 (https://www.epa.gov/climateleadership/center-corporate-climate-leadership-ghg-emission-factors-hub).
[181] IGES List of Grid Emission Factors, https://pub.iges.or.jp/pub/iges-list-grid-emission-factors, https://unfccc.int/sites/default/files/resource/IFI%20Default%20Grid%20Factors%202021%20v3.1_unfccc.xlsx

Process Emissions

- The process emissions containing the HBr, HCl, NH3, HF, H2S and Mercaptans will be routed through two stages scrubber system. The packing media in the scrubber is 25 mm poly propylene rings. Scrubbed liquid shall be treated and reused or subjected to MEE. GSL will establish suitable scrubbing system in consultation with the APPCB.
- The volatile vapors generated during process will be routed through condensers and the condensate shall be reused in the plant
- Kettle will be connected to the vapor condenser. The VOC emission in terms of handling losses will be reduced by storing raw material in a tank and handling raw material feeding will be carried out by pumps in a close loop
- Most of the raw materials are in liquid form. All the liquids will be stored in tanks or barrels in dedicated storage area. The containers will be kept tightly closed to prevent vapor emissions. All liquids will be charged through pumps with suitable seals to prevent any leakages and vapor emissions
- Manufactured resin will be transported within the plant using pipelines
- Entire manufacturing activity will be carried out in closed reactors / vessels. Special care will be taken while loading and unloading of raw material in to the reactors to prevent spillages, overflow and vapor formation.
- Air collected from around the presses, which will normally contain formaldehyde since this is a component of many of the resins used in board formation, should be routed to the utility plant for use as combustion air, thus destroying the formaldehyde, or to control devices such as dry or wet ESPs or wet scrubbers.
- The roads inside the industry premises will be paved to prevent any dusting due to vehicle movement. Separate inward & outward paved roads for movement of trucks with raw material and finished goods will be provided
- The area of the greenbelt will not be less than 33% of the total area of the site. Greenbelt with tall growing trees will be developed along the boundary of the site

Impact Magnitude

Considering the above, the spread has been classified as Medium, duration has been classified as permanent. The project will generate air emission which will be a routine activity and with the implementation of embedded controls, there will be limited impact due to air emission during operation of the project. The intensity has been classified as moderate to low. Therefore, based on impact significance criteria, the impact magnitude has been classified as Substantial.

Additional Mitigation Measures

<u>Air Emissions Management</u>

- GSL to properly operate and maintain multi-stage scrubbers to the process vents to control the process emissions. GSL shall ensure that online pH measuring facility with auto recording system is connected to the scrubbers.
- GSL to implement adequate measures to control all fugitive emissions from the plant.
- In case of failure to achieve the prescribed emission as guaranteed by the manufacturer which is in compliance to the emission norms as per CPCB Guideline, GSL will replace APCD devices with better technology or as per the technology prescribed by MoEFCC
- According to the Point Source Air Emissions Prevention and Control Technologies provided in IFC EHS guidelines for air emissions and ambient air quality, the reduction efficiency of fabric filter should be 99-99.7% and that of ESP should be 97-99%.
- Electrostatic Precipitator (ESP) shall comply with the specifications defined by Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2010
- Coal dust would be generated generally at the conveyor transfer points, coal unloading area and coal stockpile area. Hence, track hopper, coal transfer points and coal stockyard to be provided with dust suppression facilities.
- Dust collection system to also be provided in coalbunkers to evacuate dust and hazardous gases like Methane from the coalbunkers. Collected dust to be returned to either the associated belt conveyor or to the coalbunker. The dust collector outlet emission would be restricted to 100 mg / Nm^3.
- GSL to store fly ash specifically in hopper/silos and should be periodically maintained to avoid overloading of fly ash
- Characteristic analysis of ash content should be conducted prior to disposal of ash to the farmers.
- GSL to ensure that handling of wooden chips and particles is undertaken by pneumatic means rather than by open conveyor or by bulk transport. Enclosure of wooden chip storage area to be provided.
- Proper maintenance of engines and use of vehicles with Pollution Under Control (PUC) Certificate within the project premises

- Sudden acceleration or de-acceleration of vehicles produces more pollution than a vehicle maintaining a constant speed. Smoother flow of traffic within the parking area and within the project premises would ensure lesser pollution from the vehicles;

Indoor Air Quality Management

- Formaldehyde and VOC emissions to be reduced at source by limiting the press temperature to the minimum feasible level, and formulating resins to minimize excess formaldehyde
- GSL shall not use or generate odor causing substances or Mercaptans and cause odor nuisance in the surroundings.
- The evaporation losses in solvents to be controlled by taking the following measures:
  - Chilled brine circulation to be carried out to effectively reduce the solvent losses into the atmosphere.
  - Transfer of solvents to be done by using pumps instead of manual handling.
  - Closed centrifuges to be used to reduce solvent losses.
  - All the solvent storage tanks to be connected with vent condensers to prevent solvent vapors.
  - The reactor vents to be connected with primary & secondary condensers to prevent escaping of solvent vapor emissions into atmosphere.
- Raw materials and chemicals required for resin manufacturing to be transported in closed containers or trucks
- Manufactured resin to be stored in a separate area
- Adoption of good housekeeping practices
- Fugitive emissions from storage tanks will be avoided by providing air condensers
- GSL to ensure that handling of wooden chips and particles is undertaken by pneumatic means rather than by open conveyor or by bulk transport. Enclosure of wooden chip storage area to be provided.

Monitoring Measures

- GSL shall properly Continuous Emission Monitoring System and maintain the monitoring system to all the stacks / vents in the plant. GSL to display online data outside the main factory gate on quantity and nature of hazardous chemicals being used in the plant, water & air emissions and solid waste generated within the factory premises, as per Hon'ble Supreme Court order.
- Data on ambient air quality will be regularly submitted to the Ministry including its Regional Office located at SPSR Nellore and the State Pollution Control Board/ Central Pollution Control Board once in six months
- GSL to comply with all the conditions stipulated in the EC dt.06.01.2022 issued by SEIAA, A.P.
- GSL to ensure compliance of the National Ambient Air quality standards notified by MoEFCC, GoI vide notification No. GSR. 826 (E), dated. 16.11.2009 and IFC/WB standards during operational phase of the project at the periphery.
- GSL to calculate the GHG emissions annually
- Proper maintenance of engines and use of vehicles with Pollution Under Control (PUC) Certificate
- Sudden acceleration or de-acceleration of vehicles produces more pollution than a vehicle maintaining a constant speed. Smoother flow of traffic within the parking area and within the project premises would ensure lesser pollution from the vehicles;
- Indoor air quality to be monitored for VOC and hazardous air pollutant (HAP) emissions. GSL to properly operate and maintain VOC monitoring system with auto recording facility.
- As a best practice, a three tier plantation of 15 m width along the project boundary may be done to suppress air emissions. Details for tree species have been included in the Greenbelt map, however, the species proposed are ornamental in nature and do not contribute to emission sequestration.
- The It is recommended to plant native species/emission sequestration species. GSL to engage a third party consultant for identifying the species for plantation.

	Nature of Impact	Spread of Impact	Duration	Intensity	Frequency	Significance of Impact
Without Mitigation Measures	Negative	Medium	Permanent	Moderate-Low	Routine	**Substantial**
With Mitigation Measures	Negative	Medium-Local	Permanent	Low	Routine	**Substantial - Small**

7.6.1.2 Ambient Noise

Source of noise emission during operation will include:

- Boiler
- Diesel generator
- Rotary equipment's like feed pumps, fans, blowers
- Noise generating units like process equipment of particle board, pre-laminated particle board and HPL plant
- Noise generation from wood cleaning and processing activities such as peeling, chipping, sanding, trimming, and cutting of wood etc.
- vehicular movements, loading/unloading of raw materials and other transportation activity. Facility will also have D.G. sets for power back up.
- Vehicular movements for loading/unloading of raw and finished materials and other transportation activity
- Noise primarily from debarking drums and chipping machinery, mechanical breakdown processes used for the raw timber, and sanding and cutting machinery

According to the noise monitoring results presented in Table 4-16**,** the Leq day time for all the locations were observed to be within the permissible limits as per CPCB and IFC EHS guidelines for residential areas as well as industrial area. The Leq Night for all the locations within residential as well as residential area were found to be within permissible limits of 45 dB(A). Operation of the project may contribute to increasing the noise levels in the project area. There are no residential receptors within a radius of 1 km and the nearest residential receptor from the site is located at an aerial distance of 1.8km.

The project will deploy approximately 1000 workers (on roll and contractual workers) during operation phase who will be exposed to the noise emissions. There will be potential noise emission due to movement of vehicles for transportation of raw materials and finished goods. Settlements located near the access roads may be potentially impacted due to vehicular noise.

Proposed Control Measures Planned for the Project

- The area of the greenbelt will not be less than 33% of the total area of the site. Greenbelt with tall growing trees will be developed along the boundary of the site
- The D.G. Sets 4 x 1000 KVA & 1 x 750 KVA shall be installed in a closed area with a silencer and suitable noise absorption systems. The ambient noise level shall not exceed 75 dB(A) during day time and 70 dB(A) during night time.
- The noise level produced by any rotating equipment will be controlled and will not exceed 85 dB(A) at a distance of 1.0-m from its boundary in any direction under any load condition. The sources of intermittent noise generating equipment will be provided with appropriate acoustic barriers so that the noise level within 1 m of these facilities when in operation will be less than 75 dB(A).
- All rotary equipment like fans, blowers, pumps and compressors would be of low noise design. The grouting of the equipment's will be made free from vibrations.
- All pipes and valves downstream of pressure control valve (including pressure control valve) will be one schedule higher than needed by pressure considerations to attenuate the noise. For safety relief valves the allowable noise level will not exceed 115 dB(A) for one-quarter hour or less per day.
- All noise source emission machines will be housed in closed spaces of different dimensions and will be installed in open or under sheds. The noise levels at the source will be in the range of 80-100 dB(A).

Impact Magnitude

The project is located in an Industrial area with no residential settlements present within 1km radius of the project, However workers present within the manufacturing facility will be impacted as they will be working with high noise emitting/generating equipment's or machineries. It is anticipated that noise levels during operation phase can exceed the anticipated noise limits if the embedded measures are not incorporated. Furthermore, overall noise levels can also exceed the applicable standard for industrial areas during day and night-time. Therefore the spread has been classified as Local spread with Long Duration. The noise generation will be a routine activity as the machineries and equipment will be operational during the working hours (12-14 hours/day). The intensity has been assessed as moderate considering the project equipment's will comply to the regulatory norms as per embedded controls. Therefore, based on impact significance criteria, the impact magnitude has been classified as small.

Additional Mitigation Measures

- Enclosures, noise and vibration mufflers, acoustic barriers and anti-vibration mats to be provided at places with high noise generation process or machineries

- Debarking and chipping should be carried out in enclosed space/building
- Pump operators (near STP, storage tanks, hoppers etc.) are generally exposed to higher noise. Housing / casing will be provided for all noise generating machines
- Installing acoustic barriers without gaps and with a continuous minimum surface density of 10 kg/m2 in order to minimize the transmission of sound through the barrier from high noise areas and/or high noise generating machineries. Barriers should be located as close to the source or to the receptor location to be effective
- GSL to restrict the noise generation from steam turbine generator and other major equipment ≤ 85 dB(A) at a distance of 1 m to comply with the Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2010.
- Periodic inspection of the project equipment should be conducted
- Adequate PPE's (earmuffs, earplugs) to be provided to employees working in high noise generation area's and machineries
- Quarterly indoor noise monitoring to be undertaken (while the plant is fully operational) to mitigate or manage high noise levels and implementation of noise management measures
- Periodic noise monitoring should be conducted on quarterly basis or as per CTO obtained for the project operations at site to ensure noise parameters are within prescribed MoEFCC guideline as well as IFC EHS guidelines.
- The noise sampling and monitoring should be conducted for 48 hours with the use of noise monitors that should be capable of logging data continuously over this time period
- DG sets should be provided with acoustic enclosures
- Strict adherence to maintenance schedule of generators, as specified by vendors
- Anti-honking sign boards to be placed in the parking areas and at entry / exit points
- GSL to comply with all the conditions stipulated in the EC dt.06.01.2022 issued by SEIAA, A.P.

	Nature of Impact	Spread of Impact	Duration	Intensity	Frequency	Significance of Impact
Without Mitigation Measures	Negative	Medium-Local	Long	Moderate-Low	Routine	Small
With Mitigation Measures	Negative	Local	Long	Low	Routine	Small

7.6.1.3 Soil Environment

During operation phase of the project, the following types of wastes will be generated:

- Nonhazardous wastes including fly ash from boiler; municipal solid wastes including food wastes from canteen; and domestic waste water kitchens and toilets, wood trimmings, board off-cuts, paper waste, Dust from Screens and sanding etc.
- Hazardous wastes including used oil from DG sets, transformers, gear box; contaminated rags; chemical waste, chemical sludge from effluent treatment plant (ETP), organic residue, salts, spent solvents waste oils, used oils, detoxified containers or drums, discarded bags & liners, oily wastewater from transformers, switchyard, and boiler area etc.
- Accidental spillage of chemicals and materials.
- Effluent generated from the manufacturing process

According to the soil monitoring conducted at project site, the soil type within 5 km radius of the manufacturing facility was found to be moderately alkaline to strongly alkaline-in nature. The soil is characterized with loamy to sandy loam soil which is non calcareous in nature with low concentration of soluble salts.

Therefore, improper handling of aforementioned wastes at site may lead to soil contamination in the project area. Any leaks or spills of used oil, chemicals and effluents may have potential negative impact on the soil quality.

Proposed Control Measures Planned for the Project

- Hazardous waste generated from the industry such as organic residue, salts, spent solvents waste oils, used oils etc., will be disposed as per the Hazardous and other Wastes (Management and Tran boundary movement) Rules, 2016 and its amendments thereof.
- The Hazardous waste / Solid and disposal: Ash from Boiler will be Sold to Brick manufactures, Wood Trimming loss will be used as fuel in Boilers, Paper Waste will be sent to Authorized Recyclers/ Used as fuel in Boilers, Dust from Screens and sanding will be used in Thermal energy plant to dry wood chips and for press heating as fuel, Detoxified containers or Drums after detoxification will be sent to Authorized agencies. Used Bags, Waste Oil & Used batteries will be sent to Authorized Recyclers, Discarded bags & liners will be sent to Authorized Recyclers Empty big drums & Empty small drums will be sent Authorized\ Recyclers, Ash generation will be sold to brick industries, ETP Sludge will be sent to TSDF.
- The Organic and Inorganic solid wastes, Spent Carbon, process residues will be sent to the authorized users or recyclers approved by the APPCB
- Untreated wastewater from the premises will not be discharged outside. Treated water will be recycled for secondary purposes and landscaping i.e. non-contact purposes only.
- Strict compliance with the E-Waste Management Rules, 2020, and report compliance.
- Implement monitoring of waste factors for different streams of effluents and solid waste.
- Provision of hazardous waste container (drums) cleaning/washing system (Container detoxification).

Impact Magnitude

Nature of impact due to hazardous and hon hazardous waste generation during operation phase is anticipated to be negative with direct impact. The geographical extent of impact is assessed to be limited to local. The duration of impact is assessed to be long-term and would be restricted to the project site with the implementation of embedded control measures. The impact intensity has been assessed as moderate based on the nature of the waste and the embedded controls for treatment, management and disposal respectively and the type of soil in the area that have medium-high percolation rate, therefore, any leaks/spillage of hazardous oil may seep into the soil and further into groundwater. Therefore, the impact magnitude as per impact significance criteria has been assessed to be Small.

Additional Mitigation Measures

Monitoring Measures

- GSL to provide continuous effluent quality monitoring system and connect the data to the APPCB server.
- GSL to comply with all the conditions stipulated in the EC dt.06.01.2022 issued by SEIAA, A.P.
- GSL to ensure that there shall be no discharge into the Telugu Ganga canal located adjacent to Northern boundary of the site, under any circumstances.
- Quarterly soil quality testing should be conducted within (2 samples) and outside (1-2 samples) project boundary to monitor potential cases of soil contamination due to project activities
- Transportation vehicles and equipment should undergo regular maintenance in a designated area to avoid any oil leakage
- Regular onsite environmental inspection should be carried out at site including visual observations on chemical stains on land, leaks and spills, identification of cracks on paved surfaces particularly at the waste storage, cleaning dykes etc. and hazardous waste storage areas
- GSL to display online data outside the main factory gate on quantity and nature of hazardous chemicals being used in the plant, water & air emissions and solid waste generated within the factory premises, as per Hon'ble Supreme Court order.

Waste Storage Measures

- GSL to inventorize the storage quantities of hazardous chemicals (raw materials), products, as per the hazard nature of reactivity / toxicity / flammability / explosive stored/handling in the premises as defined in the Management of Storage, Import of Hazardous Chemicals (MSIHC) Rules, 1989 and the details shall be furnished to the Factories Department and to the Regional Office, APPCB on monthly basis duly certifying the same
- GSL to place the chemical drums and / or any drums in a shed provided with concrete platform only. The Platform shall be provided with sufficient dyke wall and effluent collection system. GSL to provide containers detoxification facility. Container & Container liners shall be detoxified at the specified covered platform with dyke walls and the wash wastewater shall be routed to low TDS collection tank
- Oil spill kits should be maintained onsite to handle minor leaks and spillage
- Fuel/oil/ lubricants will be stored on impervious floor in the storage area having secondary containment and housekeeping/ concerned staff will be trained for safe handling of oil and lubricants etc.

- All waste should be stored in a shed that is protected from the elements (wind, rain, storms, etc.) and away from natural drainage channels
- Board off-cuts to be minimized by control of the pressed-board dimensions and gradual minimization of trimming margins. Remaining offcuts can be recycled as furnish in particleboard manufacture, used as the core of blockboard, or burnt in the wood waste-burning utility system
- Unloading and loading protocols should be prepared for diesel, oil and used oil respectively and onsite workers should be trained to prevent/contain spills and leaks.
- Waste to be managed as per the site specific waste management plan (refer as appendix 5) as well as hazardous material management plan (refer Appendix 6)
- Ensure that no unauthorized dumping of used oil and other hazardous waste is undertaken at the site;
- The workers engaged during the project operations to be trained on segregation of waste with demarcated bins for recyclables and perishables placed in common areas;
- Hazardous material and waste will be properly labelled, stored onsite at a location provided with impervious surface and in a secondary containment
- In case of accidental/unintended spillage, the contaminated soil should be immediately collected and stored as hazardous secondary containment system

	Nature of Impact	Spread of Impact	Duration	Intensity	Frequency	Significance of Impact
Without Mitigation Measures	Negative	Medium	Long	Moderate	Routine	**Small**
With Mitigation Measures	Negative	Local	Long	Moderate-Low	Routine	**Small**

7.6.1.4 Water Resources Availability and Quality

During operation phase, water requirement will be for the following purposes

- Particle board process
- Cooling tower, evaporation and blow down
- Steam boiler and feed water
- Resin plant process
- Washing
- Drinking and Domestic Use
- Fire Hydrant

According to the water utilization plan, approximately 365 KLD water will be required for project operations of which ~276 KLD is fresh water requirement and the remaining ~ 89 KLD is recycled. As understood, the water requirement will be fulfilled by the borewells as well as AIIPC Water source. As per Central Groundwater Authority (CGWA), Ministry of Jal Shakti, Notification dated 24 September 2020[182], industries will have to obtain authorization from CGWA before abstraction and use of groundwater. As per CGWB, Nellore District, Naidupeta Mandal (location of manufacturing facility) falls is an area marked as "critical" in terms of groundwater development, whereas as per the Ground Water Assessment Report developed by Andhra Pradesh Ground Water and Water Audit Department, Menakuru village (location of manufacturing facility) is categorised as Over-Exploited.

Permission for installation of four (04) borewells has been received from government of Andhra Pradesh, Ground Water and Water Audit Department via letter no 1168/Hg-II/2018 dated 31st August 2021 and the facility is withdrawing the ground water during the construction phase as well. As per the approval received, GSL is permitted to pump out 220 KLD of groundwater from four (4) newly recommended bore wells with I0 hours of pumping per day. Since the manufacturing facility falls in over-exploited category and the mandal falls in Critical category, ground water withdrawal by GSL has been permitted to constructing 3 three recharge ponds (artificial recharge structures) from which 33,7500 Liters (i.e. 50% recharge rate) can be recharged. However GSL to recharge twice the quantum of groundwater extracted in their premises. (refers ***section 2.6*** for details)

For the remaining water requirement for fresh water, i.e. 56KLD. The required water shall be met from Water supply source from APIIC Industrial Area. Also as reported tanker water will be used and as when required. Also, the ground water extraction from the

[182] Central Groundwater Authority (CGWA), Ministry of Jal Shakti ((Department Of Water Resources, River Development and Ganga Rejuvenation), Notification dated 24 September 2020. Link: http://jalshakti-dowr.gov.in/sites/default/files/CGWA_GWExtraction_Notification_24-09-2020.pdf

borewells will only be limited till the APIIC industrial area water supply is initiated. Water supply from APIIC will be the main source of water for the facility.. Exact date for initiation of water supply from APIIC is not known. Till the APIIC water supply is initiated, GSL will use borewell water and tanked water for their operations.

A waste water treatment will be installed within the manufacturing site with the use of STP-ETP setup. The reject water from the operation activities and domestic activities will be treated and reused within the project premises to meet the remaining water requirement.

The total wastewater generation from the integrated plant (including resin plant) is about 111.15 KLD. The main sources of effluent generation are mainly from process, washings, and utilities like cooling tower, RO/DM plant, boiler & domestic effluents. The effluent generated from process, washings, cooling tower, RO/DM plant, boiler blow down will be sent to effluent treatment plant and treated effluent will be reused for greenbelt development. Effluent from phenol formaldehyde resin is proposed to be sent to forced evaporation system. The storm water in the project area will be collected through storm water drains and collected in the storm water tank. The overflow be led to subsoil in order to improve the fresh water table. Rain water harvesting with rain water harvesting structures is planned with harvesting pits. Wastewater generated will be treated and treated water will be used for greenbelt thereby reducing load on fresh water demand.

Proposed Control Measures Planned for the Project

- The total water requirement will not exceed 365.3 KLD (Fresh water – 276.1 KLD & Recycled water – 89.2 KLD, of which only 220KLD will be extracted from ground water borewell, 56KLD will be sourced tanked water (Telugu Ganga canal and/or Swarnamukhi River and supplied through third party tankers).
- Effluent treatment plant of capacity 73KL / day, STP of 40cum/day and MEE of 15KLD will be developed. Treated water will be used within the process as well as for landscaping and non-contact purposes. Also, Zero discharge concepts will be adopted.
- The GSL will provide separate storm water drains and harvest the rainwater from the rooftops to recharge the ground water. Rain water harvesting will be undertaken. Rainwater harvesting pond of approx. 500 KL capacity with recharge pits of diameter 2mtrs and depth of 4 mtrs will be constructed for recharge of groundwater aquifers
- Ensure that no natural watercourse and/or water resources will be obstructed due to any industrial operations.
- High COD & Low TDS effluent will be sent to incinerator, Low COD & Low TDS will be sent to conventional ETP and the Low COD & High TDS effluents are routed through Stripper with scrubber followed by MEE and rejects of MEE will be sent to ATFD. The Organic and Inorganic solid wastes, Spent Carbon, process residues will be sent to the authorized users or recyclers approved by the APPCB
- The condensate of the MEE will be sent to RO. The permeate from the RO plant will be re-used in the plant and rejects to MEE.
- Sewage Treatment Plant is being developed consisting of Bar Screen chamber, Raw sewage collection Moving bed Biological Reactor (Aeration Tank), Settling Tank, pressure sand filter, Activated carbon filter, Treated water sump and Sludge drying beds.
- Provision of steam stripping system to handle volatile matter in the effluents

Impact Magnitude

The nature of impact of water availability and quality was assessed to be negative due to project with direct impact. The duration of the impact is assessed to be short-term- to long term, as the ground water is proposed to be abstracted throughout the operation phase till the APIIC water supply is not initiated, post initiation of water supply form APIIC, the plant will be relying on the same, however water usage is being considered as a routine activity. Also, considering the state of ground water development in the manufacturing facility area and considering the characteristics of wastewater generated, the facility will install ETP, STP and MEE and the facility will be zero discharge facility. The quality of groundwater is anticipated not to be impacted with the proper management and implementation of embedded control measures. Treated wastewater after confirming to the discharge standards will be used for landscaping purpose. The facility has provisions for reducing fresh water intake, so as to reduce the stress on the ground water availability. The geographical extent of impact is assessed to be limited to local-medium spread. Therefore, intensity of the impact is assessed as low-moderate and the overall impact significance on ground water resource and quality is assessed as small-substantial.

Additional Mitigation Measures

Design Measures

- Provide magnetic flow meters with totalizers at the outlet of the unit.
- The LTDS and HTDS effluents to be stored in above ground level collection tanks separately. Hoods to be provided to the tanks and connect to the scrubber to mitigate emissions.
- Provide tank in tank system for effluent collection at production blocks. Free board to be maintained in the tanks to prevent spillages.
- Explore installation of water efficient plumbing fixtures that use less water without any reduction in quality and service
- Provide magnetic tamper proof flow meters to measure quantity of different streams of effluents generated and routed through the treatment systems
- Native species have been to be proposed for landscaping which will adjust to natural weather conditions and water availability

Operation Measures

- Comply with all the conditions stipulated in the EC dt.06.01.2022 issued by SEIAA, A.P.
- Floor washing to be admitted into the effluent collection system only and to not be allowed to find their way in storm drains or open areas. All pipe valves, sewers, drains to be leak proof.
- Post operation of APIIC water supply, GSL to ensure that APIIC water supply is used as primary source of water procurement for the fresh water requirement of 265KLD during the operation phase instead of ground water abstraction.
- GSL to limit the use of ground water borewell and to use APIIC water supply as primary source of water for its operations.
- GSL to recharge twice the quantum of groundwater extracted in their premises, i.e GSL to recharge 440KLD (1,60,600KL/Annum). Since GSL is developing 3 artificial recharge pits for recharging 50% of the water abstracted, remaining water quantity to be recharged offsite.
- Operational spoils including hazardous materials shall not be allowed to contaminate watercourses and the dump sites for such materials shall be secured so that they shall not leach into the ground water
- Water utilization to be documented

Monitoring measures

- Ensure vendor supplying water tankers have adequate permits to supply water to the project
- GSL to ensure and track water source for the tanked water. GSL to refrain from procuring water from ground water abstraction units in over-exploited area(s).
- Digital flow meters/ water meters with telemetry for accounting daily groundwater withdrawals by GSL in the permitted groundwater abstraction structures to be installed.
- GSL to construct shall piezometer at VES No.7 to a depth of 60m and install digital water level recorders with telemetry for daily water level monitoring.
- Ensure no discharge into the Telugu Ganga canal which is located adjacent to northern boundary of the site or aquifers under any circumstances.
- Operate and maintain online real time monitoring system along with web camera facilities and shall ensure that it is connected to APPCB / CPCB websites as per CPCB directions.
- Provide tank in tank system for effluent collection at production blocks. Free board to be maintained in the tanks to prevent spillages.
- GSL to maintain dry condition in the drains present outside of the facility in non-rainy season.
- Workers should be sensitized on water conservation measures and encourage optimal use of water
- Regular inspection should be carried out for identifying water leaks and preventing water wastage
- Regular monitoring of ground water level and quality will be carried out by establishing a network of existing wells in and around project area in consultation with the competent Ground Water Department. Data thus collected should be sent at regular intervals to MoEF&CC, CGWA and CGWB, Southern, Region, Hyderabad
- Water audit to be undertaken on annual basis to understand water usage and to identify measures for water reduction
- Display online data outside the main factory gate on quantity and nature of hazardous chemicals being used in the plant, water & air emissions and solid waste generated within the factory premises, as per Hon'ble Supreme Court order.

	Nature of Impact	Spread of Impact	Duration	Intensity	Frequency	Significance of Impact
Without Mitigation Measures	Negative	Medium	Long	Moderate	Routine	Substantial
With Mitigation Measures	Negative	Local-medium	Short-Long	Moderate-Low	Routine	Small-Substantial

7.6.2 Impacts on Socioeconomics

7.6.2.1 Increased local employment & livelihood

As per the available data it was understood that total manpower requirement for the project is estimated to be 850 persons, which includes both skilled and nonskilled workers. The work force will include workers from different states across India including migrant and local workers working for different contractors and on roll staff of the company.

Besides direct employment opportunities project will also be instrumental in creating other local livelihood opportunities in the surrounding localities in terms of giving more business to local grocery shops, fruit/ vegetables & other items related to supply of food & ration , fuel, rents , taxi , tractors, water tankers , trucks hotel , restaurants /Dhaba's etc.

The project will be having direct impact on the lives of the people engaged in the wood planation/cultivation / supply of the wood to the plant. As per stakeholder consultations most of the wood (2158 Metric tons / day) shall be procured locally from adjoining 4 districts covering 87 mandals.

As per the rough estimates, plantation activities will be carried out in phase wise manner covering 6000 Ha annually and will be done for 5 year planation cycle covering total 300000 Ha (74131 acres) of land. Assuming 3 acre of planation per farmers nearly 24710 farmers will be engaged for the project. Further nearly 500 small and big wood aggregators will be engaged for the project. Wood aggregators will be responsible for wood harvesting, transportation, loading & unloading, etc. All these operations will provide additional local employment to skilled and unskilled workers.

Proposed Control Measures Planned for the Project

- Project will have the Human Resource (HR) policies to care of the HR and labour issue of the directly employed workforce
- Project will have detailed contract agreement with the supplies and vendors which will ensure the compliance with the applicable laws including labour laws
- Project will have detailed wood procurement plan and strategy to develop and train the farmers on wood cultivation
- Project will provide necessary guidelines to farmers for sustainable wood cultivation
- Periodic compliance audit and monitoring will be carried out

Impact Magnitude

Based on the available data and site assessment it was assessed that project is likely to provide direct employment as well as will potentially create livelihood opportunities for various stakeholder in the supply chain. The spread of the stakeholders will be regional and livelihood opportunity in the supply chain may extend across the states. The duration of the impact will be long term with high. Hence the impact significance is rated as Major

Proposed Enhancement Measures for the Project

While the significance of the impact on economy and employment opportunities during the operation phase is understood to be positive, the following enhancement measures should be put in place to ensure that the local community receive maximum benefit from the presence of the Project:

- Project should align and update their HR polices with the requirement of PS 2 and ensure the compliance of applicable labour laws and cover the contracted labour as well.
- All the staff and workers working at plant should be provided with necessary HR and Labor induction training and accordingly develop the annual training calendar

- The contract terms with wood supply aggregators should explicitly mention about the compliance of appliable labour laws and other requirements of PS-2 such as prohibition of child labor, forced labor , payment of minimum wages , safe working conditions etc.
- Carry out biannual labor and working conditions audit
- During initial phase separate six monthly labor audits should be carried out for wood aggregators to ensure the compliance of labor laws and companies EHS polices. One they are trained the frequency of audit may be reviewed.
- Develop stakeholder engagement plan as part of engagement plan /, organize annual famers meet or open forums where they can raise their potential concerns. Standard SEP for the project is given as Appendix 15.
- Establish strong grievance management system covering contracted workers, farmers and other stakeholder and carry out proper disclosure of the GRM to staff and workers and have the dedicated resources of the implementation of the system. Standard GRM for the project is given as ***Appendix 15***
- Project should develop guidelines/policies towards local employment and livelihood opportunity enhancement
- Project should proactively disclose the local labor and other reequipment at notice board and there should be open door policy towards local vendors registration
- Preference should be provided to local labor. However, the preference shall be based on available skillset and knowledge
- Project shall provide equal access to both female and male local population in available employment opportunities and for greater employability of residents, technical/vocational training may be arranged for female and male, if required
- Establish the functional stakeholder engagement including external communication plan and roll out grievance handling mechanism which should have provisions for receiving external grievances as well.
- The project proponent will establish a mechanism to audit sub-contractors and suppliers with respect to compliance of utilizing local labor and resources

	Nature of Impact	Spread of Impact	Duration	Intensity	Frequency	Significance of Impact
Without Mitigation Measures	Positive	High	Permanent	Low	Routine	Substantial
With Mitigation Measures	Positive	High	Permanent	Moderate	Routine	Major

7.6.2.2 Occupational Health & Safety

The engagement with various operation activities will involve a range of occupational health and safety risks and hazards mainly for the contractors and workers (local and/or migrant) who are involved in the operation and maintenance works. Lack of relevant PPE's will increase the risk of worker's exposure to operation and maintenance hazards. Some of the serious risks during operation phase without adequate PPE include risk of accidents, exposed to faulty electrical devices, such as cables, cords, hand tools, exposure to hazardous material and waste, spillage of hazardous chemicals, risk due to fire hazards etc, etc.

During operation phase, workers will be exposed to the following health and safety hazards:

- High noise levels due to continuous operation of boiler, steam generator, DM plant, Cooling Tower, ESP etc.
- Exposure to heat and flue gas emissions due to combustion in boiler and manufacturing of resin causing respiratory diseases like acute lower respiratory infections.
- Formaldehyde and VOC emissions
- Boiler Explosion causing damage to life and property
- Fire hazards at transformer area, chemical and cylinder storage area, coal/wood areas etc.
- Accidents due to movement of vehicles for transportation of wood to project site.
- Slip/Trip, fall, electric shock etc.
- Dust emission or dispersal of particles during veneering/manufacturing of boards and resins at project site causing respiratory problems.
- Wood dust inhalation, especially of PM10, may cause irritation, asthma, allergic reaction, and nasopharyngeal cancer amongst wood processing workers
- Exposure to flammable, toxic or corrosive chemicals

- Muscular disorder through activities including removal of raw material (including wood logs) from storage, transportation of raw material on the shop floor, handling trolleys, loading & unloading of raw material and finished products
- Injuries from machineries used for board and particle board processing plants which may have cutting equipment, such as chippers, mills, flakers, saws and sanding equipment. In addition, process machinery such as multi-opening presses and drive systems may present risk of trapping. Accidents may happen when machines are inadvertently switched on during maintenance and cleaning
- Injuries due to vehicle movement in log yards are common, in addition to injuries from logs that roll off or are dropped by handling equipment or are dislodged from log stacks.

Poor indoor air quality within the manufacturing facility increases the risk of respiratory infections and diseases among the workforce working within the manufacturing facility. Formaldehyde and VOC emissions from wood-based panels are recognized as one of the major causes of poor indoor air quality. These emissions may be strongly influenced by the raw materials and manufacturing techniques of the panels. The formaldehyde in wood-based panels primarily comes from urea-formaldehyde resin (which is being manufactured at the captive resin plant), and there is a linear relationship between the formaldehyde content in resins and formaldehyde specific emission rate from wood-base panels, however drying and hot-pressing techniques are helpful in reducing the formaldehyde and VOC emissions from wood-based panels. Therefore formaldehyde emissions are anticipated within the manufacturing facility. VOC's in the wood based panels mainly comes from the wood chips[183].

Proposed Control Measures Planned for the Project

- GSL at the corporate level has a dedicated environmental, health and safety (EHS) plan, Occupational Health & Safety Plan and emergency response plan (ERP) which is applicable to the project. Measures provided in the respective plans with respect to health and safety being implemented at site.
- Adequate personal protective equipment such as ear plugs, safety helmet, safety shoes etc. are provided to the workers
- Cranes and other lifting equipment are operated by trained and authorized persons
- GSL has develop a systematic monitoring and auditing mechanism for monitoring the contractors and sub-contractors in terms of resources, migrant workers, child labour and forced labour, health and safety, payment of wages etc.;
- A separate environmental management cell with suitable qualified personnel will be set-up under the control of a Senior Executive, who will report directly to the Head of the Organization.

Impact Magnitude

The nature of impact was assessed to be negative due to project with direct impact. The duration of the impact is assessed to be short-long. The geographical spread of impact is expected to be local, mainly confined to the project site. Therefore, intensity of the impact is assessed as moderate-high and the overall impact significance is assessed as small-substantial.

Additional Mitigation Measures

Management Measures

- GSL at the corporate level has a dedicated environmental, health and safety (EHS) plan, Occupational Health & Safety Plan and emergency response plan (ERP) which is applicable to the project. The plans to be aligned with the requirement of IFC EHS requirement
- All workers to be provided with adequate on-job trainings including the EHS-OHS aspects and risks of machine operation and trained in the safe use of cutting equipment; ·
- GSL to ensure that the facility is equipped with heating, ventilation and air conditioning (HVAC) and industrial evaporative cooling systems. They are to be maintained and operated so as to prevent growth and spreading of disease agents (e.g. Legionnella pneumophilia) or breeding of vectors (e.g. mosquitoes and flies).
- Developing and maintaining a risk register for identifying safety controls and safety monitoring of potential OHS& EHS risks that may happen during the operation phase
- GSL to prepare a safety report and carry out an independent safety audit report of the respective industrial activities including chemical storages / isolated storages by an expert not associated with such industrial activity as required under Rule 10 of MSIHC Rules, 1989 and get it approved by the Factories Dept., and submit the

[183] https://www.researchgate.net/publication/257171847_Formaldehyde_and_VOC_emissions_at_different_manufacturing_stages_of_wood-based_panels

compliance along with copy of the safety report, safety audit report and safety certificate at concerned Regional Office, APPCB.

- Monthly environmental, health and safety (EHS) inspection should be conducted at site to identify EHS risks associated with project operation and working conditions.
- Quarterly/ half yearly emergency mock drills including fire mock drill should be conducted at site
- GSL to submit risk assessment report covering worst scenario clearly describing impact within the manufacturing facility premises and outside the premises and emergency response system.
- Establish a grievance redressal mechanism in place, to allow for the employees and workers to report any concern or grievance related to work activities.
- GSL to inventorize the storage quantities of hazardous chemicals (raw materials), products, as per the hazard nature of reactivity / toxicity / flammability / explosive stored/handling in the premises as defined in the Management of Storage, Import of Hazardous Chemicals (MSIHC) Rules, 1989 and the details shall be furnished to the Factories Department and to the Regional Office, APPCB on monthly basis duly certifying the same.
- GSL to identify major accident hazard chemicals & list out the hazardous chemicals endangered to human health & environment and the details shall be furnished to the Factories Department and to the Regional Office, APPCB time to time duly certifying the same by the industry. GSL to extend training to the working personnel's while handling hazardous chemicals for prevention of accidents and necessary antidotes to ensure the safety, as per the MSIHC Rules, 1989.
- GSL to carryout calibration of safety equipment's and leak detection systems at regular intervals and shall certify the same with the Factories Department. That certified copy shall be submitted to the APPCB, Regional Office. The industry shall install fluorescent Wind Vane at the highest point in the industry premises
- Safety inspection, testing and calibration: GSL to undertake regular inspection and testing of all safety features and hazard control measures focusing on engineering and personal protective features, work procedures, places of work, installations, equipment, and tools used. The inspection should verify that issued PPE continues to provide adequate protection and is being worn as required. All instruments installed or used for monitoring and recording of working environment parameters should be regularly tested and calibrated, and the respective records maintained.
- GSL to exchange its onsite emergency plan with the neighboring units i.e. M/s. Hindustan National Glass & M/s. Delta Bio Pharma.
- GSL to submit a copy of the NOC issued by the Andhra Pradesh State Disaster Response and Fire Service Dept., (APSDRFSD) at concerned Regional Office, APPCB.

Design Measures

- GSL to ensure that all cutting equipment to be fitted with safety guards capable of preventing access to moving cutting blades; Chippers to be fitted with safety guards which prevent the insertion of body parts; · All cutting equipment to be adequately contained to prevent the expulsion of blade fragments in case of blade breakage; Moving gears, chains, belts and rollers to be fully enclosed.
- Complete mechanization of log yard activities to reduce human contact with logs during handling and stacking activities
- GSL to provide sufficient fresh air supply for indoor and confined work spaces. Factors to be considered in ventilation design include physical activity, substances in use, and process related emissions. Air distribution systems should be designed so as not to expose workers to draughts.
- GSL to provide mechanical ventilation systems and should be maintained in good working order. Point-source exhaust systems to be provided for maintaining a safe ambient environment and should have indicators to ensure correct functioning
- Proper circulation of air and proper ventilation to be provided to ensure adequate temperature in work, rest room and other welfare facilities during working hours. Exposure to hot or cold working conditions in indoor or outdoor environments can result temperature stress-related injury or fatigue
- Acoustically designed cabins for heavy noise generating boilers, generators and other equipment will be provided. The inlet air and exhaust gas streams would be provided with silencers for noise reduction
- Install custom designed racking systems so material can be moved by forklift

Implementation Measures

- Personnel working in the facility to be provided with required PPE's and they are also be provided with adequate training and information on safety and health aspects. Personal protective equipment (IS approved) like safety helmet, safety shoes/gumboots hand gloves, gas mask/ nose mask, PVC apron, SCBA Set, PVC pressure suit, goggles, hood, etc. to be provided to the required personnel. A PPE inventory should be developed and maintained on site

- GSL to ensure that the workers who are required to handle corrosive, oxidizing, or reactive chemicals should be provided with specialized training and provided with, and wear, appropriate PPE (gloves, apron, splash suits, face shield or goggles, etc).
- Where corrosive, oxidizing, or reactive chemicals are used, handled, or stored, qualified first-aid should be ensured at all times. Appropriately equipped first-aid stations should be easily accessible throughout the place of work, and eye-wash stations and/or emergency showers should be provided close to all workstations where the recommended first-aid response is immediate flushing with water
- Regular housekeeping to ensure that dust is removed from the facility, including a biannual blow down or vacuuming of the entire facility
- A first aid box with adequate medicines to be provided at the site and appoint a trained person to take charge of it. The location of first aid arrangements to be displayed on site;
- The use of any toxic chemical will be strictly in accordance with the manufacturer's instructions;
- Permit to work system should be implemented to ensure that work at confined space, work at height and cranes and lifting equipment is operated by trained and authorized persons only
- Adequate number and appropriate cranes, forklifts, adjustable trolleys, etc to be ensured.
- Lifting operations are carried out with proper plans and with equipment of adequate capacity and appropriate safety harnesses and lowering/raising tools should be used for working at heights
- Electrical and maintenance work should not be carried out during poor weather and during lightning strikes. All equipment should be turned off and checked when not in use;
- Safe drinking water as per IS 10500:2012 should be provided to the workers
- Workers should be provided with 1 hour break in every 8-hour shift
- The nearest hospital, ambulance, fire station and police station should be identified in the implemented emergency management plan;
- Workers should be provided information on communicable diseases such as COVID-19, HIV, Influenza etc. and preventive measures should be communicated to avoid such diseases.
- Adequate fire arrangement such as portable fire extinguishers, fire hydrant, fire buckets and automatic fire detection system should be installed in compliance to National Fire Protection Authority (NFPA) fire safety standards and local fire authority requirements

Monitoring Measures

- In case any worker develop symptoms of COVID-19, they should be asked to isolate immediately and return to work only after recovery.
- Indoor air quality to be monitored for VOC and hazardous air pollutant (HAP) emissions. GSL to properly operate and maintain VOC monitoring system with auto recording facility
- Annual health checkup of workers should be conducted for all workers, and half yearly health checkup to be undertaken for employees/workers exposed to VOCs. The annual and half yearly health checkups to be extended to contract workers as well.
- Occupational health checkup program for the workers to be undertaken periodically. Pre- medical checkup of workers should be conducted prior to appointment at operational phase
- Noise level within the site should be maintained within prescribed limits as per CPCB guidelines and as per IFC EHS guidelines.

	Nature of Impact	Spread of Impact	Duration	Intensity	Frequency	Significance of Impact
Without Mitigation Measures	Negative	Local	Short-Long	High	Routine	Substantial
With Mitigation Measures	Negative	Local	Short-Long	Moderate-High	Routine	Small Substantial

7.6.2.3 Community Health and Safety

Limited applicability for construction and operation phase. As the project is situated within a designated industrial area with nearest residential settlements present in the Menakuru village located at ~ 1.8 km (aerial distance) from manufacturing facility towards South-East direction.

The major community health and safety risks include disputes among local and migrant labourers due to work related dissatisfaction, public accessibility and management of emergency situations, any viral or contagious disease due to influx of migrant workers in the study area, women safety due to influx of migrant workers etc. The movement of vehicles, material and commuters via the main access road may be a potential risk for daily commuters and cattle of nearby village. The specific receptors may include daily commuters from nearby villages, animals grazing in nearby vacant land parcels.

Possible sources of impacts to community health and safety, considering the ongoing construction phase activities like construction activities, daily road commuters, workers and staff mobility, mobility of vehicles carrying construction materials etc. and upcoming operational phase are as follows:

- Potential risk of accidents on access/ village road by trucks and vehicles engaged at the Facility for supply of construction materials during construction phase and raw or finished goods during operational phase;
- Any spread of disease, virus by influx of migrant workers; and
- Women safety due to influx of migrant staff and workers and road commuters etc.

The community may be also exposed to accidents due to transportation of material including wood, chemical, finished goods etc to and fro from the plant periodically through roads and state highways. Based on the traffic survey data presented in ***Table 4-17*** and Hourly Road Traffic Scenario presented in ***Figure 4-21***, it is observed that T2 Menakuru road is busier than T1. The hourly traffic scenario depicted that the majority of traffic in the two roads is due to movement of motorized Two/Three Wheelers (Scooter, M. Cycle, Auto, Moped) travelling up and down the roads followed by heavy Motor Vehicles comprising of Truck, Bus, Dumper, Tanker, Trailer for T1 and for T2. It is anticipated that deployment of project vehicles during both construction and operation phases of the proposed project will increase traffic levels in the two roads which will further increase the chances of accidents of community, livestock and passer-by travelling through these roads. Assessment of Traffic density has been undertaken for construction as well as operation phase to assess the increase in the traffic as wells to assess the adequacy of the existing road network to handle the increment in the traffic due to the project.

Table 7-8 Assessment of Traffic Density

	Heavy Motor Vehicles (Truck, Bus, Dumper, Tanker, Trailer, I.e 6 wheeler)	Light Motor Vehicles (Car, Jeep, Van, Metador, Tractor, Tempo, i.e 4 wheeler)	Two/Three Wheelers (Scooter, M. Cycle, Auto, Moped)
T1 (Up and Down)			
1.	1008	752	1284
2.	1177	852	1759
Total Vehicles	2185	1604	3043
Total PCU[184]/day	6555	1604	1521.5
T2 (Up and Down)			
3.	1372	996	1415
4.	1222	897	1366
Total Vehicles	2594	1893	2781
Total PCU[185]/day	7782	1893	1390.5

Construction Phase: The traffic contribution from integrated manufacturing facility on T1 and T2 would be ~50 vehicles/day (to and fro, 20-25 vehicles entering the facility/day) during non-peak construction phase and ~70 vehicles during peak construction phase (to and fro, 30-35 vehicles entering the facility). Considering that 70% of the vehicles will be trucks and 20% of the vehicles will be two wheelers and 10% will be light motor vehicles. The movement of vehicles during non-peak construction would be 115PCU/day and during peak construction time would be 161PCU/day.

With the present level of traffic on T1 (two lane highway) and T2 (two lane highway) and the predicted increase in the exiting traffic due to the project has been estimated by comparison with the recommendation stipulated by Indian Road Congress (IRC), i,e., the maximum load of 15000PCU/day for a two lane highway. Total Traffic load of 9795PCU/day on T1 and 11180 PCU/day on

[184] PCU Rating: 0.5 for two and three wheeler, 1 for Light Motor Vehicle, 3 for Heavy Motor Vehicles
[185] PCU Rating: 0.5 for two and three wheeler, 1 for Light Motor Vehicle, 3 for Heavy Motor Vehicles

T2 is anticipated during non-peak construction and 9841 PCU/day on T1 and 11226 PCU/day onT2 in anticipated during peak construction hours. Based on the above calculation, it is observed that the road network is adequate and the estimated traffic is well within the stipulated IRC maximum traffic load.

Operation Phase: The traffic contribution from integrated manufacturing facility to T1 and T2 ~160 trucks/day (entering the facility), i,e 320 trucks/ day (to and fro) during operation phase). The movement of vehicles during would be 960PCU/day.

With the present level of traffic on T1 (two lane highway) and T2 (two lane highway) and the predicted increase in the existing traffic due to the project has been estimated by comparison with the recommendation stipulated by Indian Road Congress (IRC), i,e the maximum load of 15000PCU/day for a two lane highway. Total Traffic load of 10640 PCU/day on T1 and 11979 PCU/day on T2 is anticipated. Based on the above calculation, it is observed that the road network is adequate and the estimated traffic is well within the stipulated IRC maximum traffic load.

The movement of the vehicles will be distributed throughout per day and not necessarily during the peak hours. Dedicated Truck parking space has been provided with the project premises to avoid traffic congestion outside the plant premises.

Proposed Control Measures Planned for the Project

- GSL will develop noise barriers such as vegetation to limit ambient noise at plant property lines
- Wheel washing area will be provided within the manufacturing facility premises
- Truck parking for 50 trucks has been provided within the plant premises. Also additional parking space is also present within the premises to accommodate four wheelers and two wheelers. (Refer Table 2-19 for details)

Impact Magnitude

The nature of impact was assessed to be negative due to project with direct impact. The duration of the impact is assessed to be short-long. The geographical spread of impact is expected to be local, mainly confined to the 500m radius of the access roads or manufacturing facility. Therefore, intensity of the impact is assessed as low-moderate and the overall impact significance is assessed as small-substantial.

Additional Mitigation Measures

- Traffic management of vehicles engaged during both ongoing construction phase and upcoming operational phase. Traffic management plan to be followed
- Limiting the hours of operation for specific pieces of equipment or operations, especially mobile sources operating between 8am-6pm
- Limiting the use of access road during day time to avoid congestion and risks of accidents
- Trucks/ dumpers will be covered by tarpaulin sheets during off site transportation;
- Anti-honking sign boards to be placed in the parking areas and at entry / exit points
- As part of the stakeholder engagement and information disclosure process, the community will be provided with an understanding of the activities to be undertaken and the precautions taken for safety;
- Installing mandatory suitable mufflers on engine exhausts and compressor components as the ambient noise levels are already exceeding the ambient air quality standards
- Installing acoustic barriers without gaps and with a continuous minimum surface density of 10 kg/m2 in order to minimize the transmission of sound through the barrier.
- GSL to exchange its onsite emergency plan with the neighboring units i.e. M/s. Hindustan National Glass & M/s. Delta Bio Pharma.
- As part of stakeholder engagement, the project will also propagate emergency scenarios and health awareness amongst the community including pregnant women, infants and senior citizens
- The traffic movement for the project in the area will be regulated to ensure road and pedestrian (including livestock) safety.
- Dedicated route for deployment of heavy-duty vehicles should be defined.
- Put in place a grievance mechanism to allow for the workers and community members to report any concern or grievance related to project activities; and
- Dedicated safety sign boards in local language should be provided around the project site. Dedicated safety sign boards in local language should be provided around the project site.

	Nature of Impact	Spread of Impact	Duration	Intensity	Frequency	Significance of Impact
Without Mitigation Measures	Negative	Local	Short-Long	Moderate	Routine	Substantial
With Mitigation Measures	Negative	Local	Short-Long	Moderate-Low	Routine	Small Substantial

7.6.3 Impacts on Biological Environment

7.6.3.1 Impacts of Accidental Spillage of Stored Chemicals and Untreated Effluent

In the operational phase, accidental spillage of stored chemicals and untreated effluents may impact the water quality as well as soil quality of surrounding habitats (water bodies and open scrub and may ultimately impact the floral and faunal species of the area.

During the habitat survey, it was observed that a water body is situated about 100 away from the northern boundary of the manufacturing unit; open scrub is also present in the buffer of 5 km from the manufacturing unit.
As per the baseline, the study area represents fifty-eight floral species including one Globally IUCN Endangered - *Tectona grandis* L.f. and Near Threatened - *Aegle marmelos* (L.) Corrêa species. Both the above-mentioned species are very common in the region. *Tectona grandis* is used to grow for its timber use.

One Vulnerable as per IUCN Red List (Online Version 2022-2), Bonnet Macaque (*Macaca radiata*) was also observed in the study area (Manufacturing Unit).

Control Measures Planned for the Project

According to the discussion with the project officials and shared documents, the client will follow all the mandatory requirements to reduce the chance of and accidental spillage as per the guidelines of APPCB (described under ***Section 7.6.1***)

Impact Magnitude

During the operational phase, the chemicals will be stored, and the effluents will be generated stored throughout the project life, thus the **Duration** has been long-term. As the construction activities will be performed in the boundary of manufacturing unit, labor camps, mixing plants and equipment storage sites, the **Spread** has been classified as medium. The **Intensity** has been classified as moderate as the numbers of species are inhabiting the area impacted by the construction activities. Thus, the impact magnitude has been classified as ***Substantial*** based on the impact significance criteria (Section ***7.4.2***).

Additional Mitigation Measures

- Authorized vendors for disposal of hazardous and nonhazardous waste should be identified prior to operation phase and dedicated contract should be executed with the vendor.
- Quarterly soil quality testing should be conducted within manufacturing unit (2 samples) and outside the unit (2 samples - within 500 m range) project boundary to monitor potential cases of oil/chemical leaks and/or spillage
- Chemicals used for the industrial activities, should be stored properly as per the guidelines of state/central agencies
- Oil / chemical spill kits should be maintained onsite to handle minor leaks and spillage
- All waste should be stored in a shed that is protected from the elements (wind, rain, storms, etc.) and away from natural drainage channels
- Regular onsite environmental inspection should be carried out at site including visual observations on chemical stains on land, leaks and spills, identification of cracks on paved surfaces particularly at the garage and hazardous waste storage areas
- Untreated wastewater from the premises will not be discharged outside. And the treated water should be recycled for secondary purposes and landscaping i.e. non-contact purposes only.
- GSL to ensure that no unauthorized dumping of used oil and other hazardous waste is undertaken at and around the manufacturing unit;
- Hazardous material and waste should be properly labelled, stored, and disposed / hand overed to the authorized vendor

- In case of accidental/unintended spillage, the contaminated soil should be immediately collected and stored as hazardous waste containment system

	Nature of Impact	Spread of Impact	Duration	Intensity	Receptor Vulnerability	Significance of Impact
Without Mitigation Measures	Negative	Medium	Long	Moderate	Medium (Habitat) Medium (Species)	Substantial
With Mitigation Measures	Negative	Medium-Local	Long	Moderate-Low	Medium (Habitat) Medium (Species)	Small

7.7 Impacts due to Agroforestry Plantation from the Project

7.7.1 Impacts on Physical Environment

Plantation activity will be carried out in phases for the project, with an annual target of 6000 ha and will be covering 30000 ha in five years. Plantation activity and wood procurement for the manufacturing facility is proposed to be done from 87 Mandals falling in 10 Revenue Divisions of 3 Districts. The agroforestry activities will be done by farmers and aggregators and they will not specifically undertake activities for GSL. The following potential impacts anticipated from the plantation activities are

- Greenhouse Gas (GHG) Emissions due to plantation activities
- Potential Soil degradation and Contamination risk from Plantation activities
- Stress on water resource due to plantation activities
- Potential H&S risks associated with plantation activity

Greenhouse Gas (GHG) Emissions due to plantation activities: Land use changes, such as converting agricultural land and barren/fallow land to plantation areas, can be considered responsible for the release of GHG emissions in the form of carbon dioxide.

Potential Soil degradation and Contamination risk from Plantation activities: Physical and chemical degradation of soils may result from unsuitable management techniques. Potential contamination of soils caused by accidental spills during transfer, mixing, storage, and application of pesticides and fertilizers. Although the experts (sapling providers) in the area suggest not to use chemical fertilizers, however as understood during consultation with farmers, chemical fertilizer (urea, DAP) are used for better growth of the trees.

Solid Waste Management (Plantation Activities): Non Crop waste such as pesticide containers, waste pesticides, and packaging have the potential to contribute to adverse health, safety, or environmental impacts. Potential contamination of soils (which may further contaminate groundwater, or surface water resources) caused by accidental spills of pesticide during transfer, mixing, storage, and application during plantation activities. Also, inadequate nutrient management may result in decrease in soil fertility and increase in contamination of ground water resources and eutrophication of surface water resources from surface runoff and leaching of nutrients from the soil.

Stress on water resource due to plantation activities: Reduction in surface or groundwater resources used for irrigation and Contamination of water sources due to over irrigation (leaching of nutrients and contaminants). Sediments or runoff soil may become a significant pollutant due to their physical and chemical properties. Suspended sediments in surface water carry pollutants such as pesticides, nutrients, and trace metals, affecting water quality. Sediment loading reduces storage and flow capacities of streams, lakes, and reservoirs; may adversely affect water supplies; and increases the risk of flooding. Soil erosion may be exacerbated by heavy rainfalls, storms, and steep or long slopes, and may contribute to subsequent sedimentation of surface water bodies.

Potential contamination of soils, groundwater, or surface water resources caused by accidental spills of pesticide during transfer, mixing, storage, and application during plantation activities. Also, inadequate nutrient management may result in decrease in soil fertility and increase in contamination of ground water resources and eutrophication of surface water resources from surface runoff and leaching of nutrients.

Potential H&S risks associated with plantation activity includes:

- Biological hazards (contact with venomous animals, such as stinging insects, spiders, scorpions, snakes, disease vectors (e.g., mosquitoes, ticks), and with certain wild mammals (e.g., tigers, wild pigs)
- Wounds from equipment or sharp objects
- Extreme/adverse weather
- Manual handling
- Chemical hazards including but not limited to exposure to hazardous products, including pesticides and herbicides
- Exposure to vibration and noise from equipment operation.
- Physical hazards resulting from felling operations
- Machinery & vehicles - accidents may occur in the use of machines and vehicles, including worker transportation, farm tractors, harvesting and felling machinery, and a variety of other machines used on plantations and in forests. These may include vehicle collisions; vehicle and machinery roll-overs; uncontrolled movement resulting in personal injury (e.g., crushing by moving vehicles); damage or loss of asset; injury, entrapment, or death due to faulty or unguarded equipment and machinery.

Impact Magnitude

During the operational phase, all the above-mentioned activities will be performed for throughout the project life, thus the Duration has been long-term, and the Spread has been classified as medium-high. The Intensity has been classified as moderate-low. Thus, the impact magnitude has been classified as Major-Substantial based on the impact significance criteria (Section *7.4.2*) without implementation of additional mitigation measures.

Additional Mitigation Measures

- GSL to ensure addition of the below mentioned clauses incorporating the proposed mitigation measures in agreement with the wood suppliers/plantation contractor. Clauses to be considered to be included but not limited to the following:

  #### GHG Emissions

  - Where available, use abated nitrogen fertilizers, which have lower GHG emissions associated with their manufacture, or use nitrification or urease inhibitors, which reduce soil emissions
  - Existing agricultural land or forest land is not being converted for plantation activity.

  #### Management of Soil degradation and Contamination risk

  - Adequate and suitable technology to be implemented by the plantation contractor to minimize damage to soil structure, conserve soil organic matter, and reduce soil erosion
  - Use cover crops, intercropping along contours with legumes to create multi-species shelterbelts, and/or windbreaks to reduce evapotranspiration and soil loss through wind and water erosion
  - Replenish soil organic matter by recycling crop residues, compost, and manures
  - Employ suitable erosion control management practices (e.g., contour and strip planting, terracing, discontinuous trenching, intercropping with trees, and grass barriers) in sloping areas.
  - Use flow control weirs and diversion canals wherever possible to reduce erosion in areas with field drainage
  - Minimize the use of pesticides by implementing a pest and disease early warning system, by using biological pest and disease control methods, and by implementing control measures before outbreaks require large-scale control
  - All packaging for pesticides and herbicides is returned from farm after use and properly stored until final disposal.
  - Use of large container and/or bulk systems for fuels, oils, fertilizers, and chemicals to reduce the volume of waste containers
  - Management of expired and unwanted pesticides as hazardous wastes in accordance with the General EHS Guidelines and Food and Agriculture Organization (FAO) Guidelines for the Management of Small Quantities of Unwanted and Obsolete Pesticides.
  - Implementation of measures to reduce soil runoff to be considered such as conservation tillage, terraces, and raised ridges which follow the land contour.
  - Required trainings on pesticides application along with pest identification, weed identification, and field scouting to be provided along with use of mechanical weeding and / or thermal weeding. Also, trainings for Preferential use selective pesticides, where appropriate, rather than broad-spectrum products to minimize impacts on non-target species to also be provided

- It is to be ensured that the pesticides used are manufactured, formulated, packaged, labeled, handled, stored, disposed of, and applied according to the FAO's International Code of Conduct on Pesticide Management.
- It is to be ensured that that purchase, store, use, or trade of pesticides that fall under the World Health Organization's (WHO) Recommended Classification of Pesticides by Hazard Classes 1a (extremely hazardous) and 1b (highly hazardous), or Annexes A and B of the Stockholm Convention are prohibited
- It is to be ensured that the pesticides listed in WHO Hazard Class II (moderately hazardous) are not used. These chemicals should not be accessible to personnel without proper training, equipment, and facilities in which to handle, store, apply and dispose of these products properly.
- Preferential use selective pesticides, where appropriate, rather than broad-spectrum products to minimize impacts on non-target species
- Conduct periodic soil analysis to detect changes in soil fertility to ensure that inform decisions on fertilizer application rates to be undertaken, and avoid unsustainable nutrient depletion and over-fertilization.
- Ensure that all personnel are trained in and use appropriate management procedures for the storage, handling, and application of all types of fertilizers, including organic wastes

Management of water stress

- Adequate and suitable Irrigation technology to be implemented by the plantation contractor such as reduction in evaporation by avoiding irrigation during periods when evaporation is elevated (e.g., in periods of higher temperatures, reduced humidity, or high winds). Use trickle or drip irrigation techniques (if practical), or install "under canopy" rather than overhead sprinklers; Consider collecting storm water through catchments; Reduction in evapotranspiration by using shelterbelts and windbreaks; in case of use of herbicides, they are to be applied at the appropriate time of year to control undesirable vegetation and reduce its water consumption; avoid use of overly saline water for irrigation to prevent salinization most effectively
- Maximization of the retention of rainwater through appropriate "rain harvesting" techniques, which may include Storing runoff from rainy periods for use during dry spells by using tanks, ponds, cisterns, and earth dams; Controlling weeds through the use of cover crops, mulching, or herbicides to encourage beneficial but low-water-use soil cover plants; Maintain protective vegetation in canals and drainage systems to reduce canal bank scouring and slow runoff.
- Implementation of measures to reduce soil runoff to be considered such as conservation tillage, terraces, and raised ridges which follow the land contour so as to reduce silting or excess soil runoff in water bodies thereby reduction in carrying capacity of the surface water source..

Management of Health & Safety Measures

- GSL to ensure addition H&S clauses incorporating the proposed mitigation measures in agreement with the wood suppliers and wood aggregators for the safety of plantation workers and wood transporters. Clauses to be considered to be included but not limited to the following:
    - Adequate training on use of the tools and PPEs
    - Provision of adequate PPEs such as protective steel capped boots, hardhats, high visibility jackets, eye protection, gloves and insect repellents
    - Ensure use of appropriate protective clothing, such as a long-sleeved shirt, long pants, hat, gloves, and boots
    - On-site first-aid equipment (including, for example, antivenom serum) and trained personnel should be available, as well as procedures for emergency evacuation.
    - Use of low toxicity rated pesticides and herbicides and train personnel on use of pesticides, herbicides and fertilizers, etc.
    - Plantation workers, wood aggregators/suppliers to be trained in safe working procedures in tree felling, log stacking and deck areas, including avoidance of falling logs and planning of escape routes;
- GSL to include clause on defensive driving in the agreement with the wood transporter to prevent any discomfort to the community. GSL to ensure that transporter fulfill the following requirements:
    - Take into account load capacity of the trucks
    - Well maintained vehicles to be used and daily checks of the vehicles to be undertaken
    - Adequate stacking to be done, thus avoiding possible accidents.
    - Use strap and ropes of proper strength
    - Drivers to be trained & licensed. Obey road rules and speed limits and drive in a careful manner and be considerate to other road users

- Drivers to adapt their driving to suit weather and traffic and road conditions
- Transport routes within log yards should be clearly demarcated and vehicle movement should be closely controlled
- Log stacks should be no higher than a safe height defined by risk assessment which should take account of site specific circumstances including stacking methodology
- Log decks should have stops, chains, or other guards to prevent logs from rolling down and off the deck
- It is recommended that the wood stacking be done in a pyramid shape, that is, forming a base with more logs at the bottom than at the top. In addition, the pile height must not exceed the truck's front panels or the sides struts. With proper stacking, cargo stability can be maintained throughout the journey. In this way, the possibility of load sliding is limited, thus avoiding possible accidents

- GSL to ensure that the contractors and wood aggregators of GSL adhere to Supply Chain Management Plan (Appendix 16) and Local Wood Aggregators and other informal provider management plan (Appendix 17)

	Nature of Impact	Spread of Impact	Duration	Intensity	Frequency	Significance of Impact
Without Mitigation Measures	Negative	Medium	Long	High	Routine	Major-substantial
With Mitigation Measures	Negative	Medium	Long	Moderate-High	Routine	Substantial-Small

7.7.2 Impacts on Socioeconomics

7.7.2.1 Increased livelihood opportunity

Based on the site assessment and stakeholder consultation the proposed project will be instrumental in creating more livelihood opportunity due to the agroforestry industry in the region. As understood from the discussion there will be potential boost in the agroforestry plantation, which implies that there will be more demand for agriculture labour, increased demand for transport vehicles, demand for saplings etc. The project will be having direct impact on the lives of the people engaged in the wood planation/cultivation / supply of the wood to the plant. As per stakeholder consultations most of the wood (2158 Metric tons / day) shall be procured locally from adjoining 4 districts covering 87 mandals.

As per the rough estimates, plantation activities will be carried out in phase wise manner covering 6000 Ha annually and will be done for 5 year planation cycle covering total 300000 Ha (74131 acres) of land. Assuming 3 acre of planation per farmers nearly 24710 farmers will be engaged for the project. Further nearly 500 small and big wood aggregators will be engaged for the project. Wood aggregators will be responsible for wood harvesting, transportation, loading & unloading, etc. All these operations will provide additional local employment to skilled and unskilled workers.

as well as indirect opportunities for other local livelihood in the surrounding localities in terms of giving more business to local grocery shops, fruit/ vegetables & other items related to supply of food & ration , fuel, rents , taxi , tractors, water tankers , trucks hotel , restaurants /Dhaba's etc.

Proposed Control Measures Planned for the Project

- Project will have detailed contract agreement with the supplies and vendors which will ensure the compliance with the applicable laws including labour laws
- Project will have detailed wood procurement plan and strategy to develop and train the farmers on wood cultivation
- Project will provide necessary guidelines to farmers for sustainable wood cultivation which extension programme and field officers shall be deputed at cluster level.
- Project will develop model farm for the farmers where they can get the necessary support for achieving maximum benefits from agroforestry
- Periodic compliance audit and monitoring will be carried out

Impact Magnitude

Based on the available data and site assessment it was assessed that project is likely create livelihood opportunities for various stakeholder in the supply chain. The spread of the stakeholders will be regional and livelihood opportunity in the supply chain may extend across the states. The duration of the impact will be long term with high. Hence the impact significance is rated as **Major**

Proposed Enhancement Measures for the Project

While the significance of the impact on economy and employment opportunities during the operation phase is understood to be positive, the following enhancement measures should be put in place to ensure that the local community receive maximum benefit from the presence of the Project:

- The contract terms with wood supply aggregators should explicitly mention about the compliance of appliable labour laws and other requirements of PS-2 such as prohibition of child labor, forced labor , payment of minimum wages , safe working conditions etc.
- Project should provide necessary training g of agroforestry to new farmers and train them on multicrop farming and other techniques for getting maximum benefits from agroforestry.
- Develop stakeholder engagement plan as part of engagement plan /, organize annual famers meet or open forums where they can raise their potential concerns. Standard SEP for the project is given as Appendix 15.
- Establish strong grievance management system covering, farmers and other stakeholder and carry out proper disclosure of the GRM to community and have the dedicated resources of the implementation of the system. Standard GRM for the project is given as ***Appendix 15***
- Project should develop guidelines/policies towards CSR & livelihood opportunity enhancement
- Project should proactively disclose the local labor and other reequipment at notice board and there should be open door policy towards local vendors registration
- Establish the functional stakeholder engagement including external communication plan and roll out grievance handling mechanism which should have provisions for receiving external grievances as well.

	Nature of Impact	Spread of Impact	Duration	Intensity	Frequency	Significance of Impact
Without Mitigation Measures	Positive	High	Permanent	Low	Routine	**Substantial**
With Mitigation Measures	Positive	High	Permanent	Moderate	Routine	**Major**

7.7.3 Impacts on Biological Environment

7.7.3.1 Risks of Deforestation due to Illegal Tree Logging

During the habitat survey, it was observed that numbers of forest patches and open scrubs are situated within the supply chain catchment area (***Figure 4-2***). The establishment of manufacturing facility will increase the demand for wood in the supply chain catchment area; which may cause a risks of deforestation due to illegal tree logging from the nearby forest and open scrub areas.

As per the discussion with forest deportment the entire region is practicing agroforestry for pulp and paper industry since long time and no illegal logging has been reported. Thus, illegal logging of trees from the nearby forest areas will be very unlikely.

Control Measures planned for the Project

Greenlam will follow its internal policy that strictly prohibits the acceptance of wood sourced from forests or natural habitats.

Impact Magnitude

During the operational phase, all the above-mentioned activities will be performed for throughout the project life, thus the **Duration** has been long-term. The **Spread** has been classified as medium. The **Intensity** has been classified as insignificant as per

the chance of tree logging and the numbers of species are inhabiting the area. Thus, the impact magnitude has been classified as ***Small*** based on the impact significance criteria (Section ***7.4.2***).

Proposed Mitigation Measures

The mitigations proposed to minimize the impact(s) on Habitat and Species have been given as,

- Strictly follow the policy - not to accept the wood from the forest / natural habitat
- Regular inspection of resourcing cluster centers to check the source of raw materials
- To ensure that the sourced wood originates from sustainable and environmentally friendly sources, it is crucial to implement a tracking and tracing mechanism that aids in verifying its origin and minimizing habitat disruption [see Appendix 16]
- Establish communication with farmers and primary suppliers to convey the significance of employing sustainable resource utilization practices and actively participating in habitat conservation efforts.

	Nature of Impact	Spread of Impact	Duration	Intensity	Receptor Vulnerability	Significance of Impact
Without Mitigation Measures	Negative	Medium	Long	Insignificant	Medium (Habitat) Medium (Species)	**Small**
With Mitigation Measures	Negative	Medium	Long	Insignificant	Medium (Habitat) Medium (Species)	**Small to Negligible**

7.7.3.2 Habitat Modification / Land Use Change due to extended agroforestry practices

The manufacturing facility is being established in the dedicated industrial area; but the raw material will be sourced from the different locations of Tirupati, Nellore, & Chittoor districts. The industry will increase the demand for wood in the catchment area; which may cause land use change, and ultimately habitat loss and/or modification. The consultation with farmers indicates that the fallow lands and comparatively lesser productive agricultural lands (used for non-food crops) will be preferred for agroforestry practices.

During the habitat survey, it was observed that numbers of water bodies, and patches of forest, open scrubs are situated within the conceptualized catchment area (***Figure 4-2***).

As per the baseline, Five globally Endangered (as per IUCN RedList), *Cycas beddomei* Dyer (Peritha), *Eucalyptus gunnii* Hook.f. (Cider Gum), *Prunus ceylanica* (Wight) Miq. (Ceylon Cherry), *Pterocarpus santalinus* L.f. (Red Sandalwood), *Tectona grandis* L.f. (Teak) have been recorded from the study area. Out of these Endangered species, *Eucalyptus gunnii* (Cider Gum) has been introduced from Australia for plantation because of its timber quality; no natural population was observed / reported from the study area. *Cycas beddomei* (Peritha), *Prunus ceylanica* (Ceylon Cherry), and *Pterocarpus santalinus* (Red Sandalwood) were reported from the forest area specifically from the nearby protected areas, Sri Venkateshwara National Park. *Tectona grandis* (Teak) has been planted for its timber value, while no natural population of Teak was observed during the primary survey in the study area. Seven globally Vulnerable (as per IUCN RedList), *Chloroxylon swietenia* (Roxb.) DC. (Ceylon Satinwood), *Cleistanthus collinus* (Roxb.) Benth. ex Hook.f. (Toxic Gooseberry), *Eucalyptus melliodora* A. Cunn. ex Schauer (Yellow Box), *Gossypium hirsutum* L. (Mexican Cotton), *Santalum album* L. (Sandalwood), *Saraca asoca* (Roxb.) de Wilde (Sita Ashok), *Vanda spathulata* (L.) Spreng (Spoon-Leaf Vanda) have also been recorded from the study area. *Eucalyptus melliodora* (Yellow Box), and *Gossypium hirsutum* (Mexican Cotton) have been introduced from Australia and Central America (Mexico) respectively. While the other Vulnerable species have been reported from the nearby protected forest areas.

The only reported one Endangered herpetofauna [Rishi Valley Geckoella (*Cyrtodactylus rishivalleyensis*)] was reported from the forest areas; while the two Vulnerable herpetofauna [Indian Flapshell Turtle (*Lissemys punctata*), & Indian Star Tortoise (*Geochelone elegans*)] were confined to the large water bodies.

Two Endangered mammals [Asiatic Elephant (*Elephas maximus*), & Lion-tailed Macaque (*Macaca Silenus*)] were restricted to the protected areas. Six, out of seven Vulnerable species, Fishing Cat (*Prionailurus viverrinus*), Four-horned Antelope (*Tetracerus quadricornis*), Indian Bison (*Bos gaurus*), Leopard (*Panthera pardus*), Sambar (*Rusa unicolor*), & Sloth Bear (*Melursus ursinus*) were reported from the protected areas. Only Bonnet Macaque (*Macaca radiata*) - Vulnerable was also observed in the catchment area.

Control Measures planned for the Project

No raw materials (wood) from the forest / natural habitat will be accepted / collected.

Impact Magnitude

During the operational phase, all the above-mentioned activities will be performed for throughout the project life, thus the **Duration** has been long-term. The **Spread** has been classified as medium. The **Intensity** has been classified as moderate as the numbers of species are inhabiting the area. Thus, the impact magnitude has been classified as ***Substantial*** based on the impact significance criteria (Section ***7.4.2***).

Proposed Mitigation Measures

The mitigations proposed to minimize the impact(s) on Habitat and Species have been given as,

- Strictly follow the policy - not to accept the wood from the forest / natural habitat
- All the forest patches present within the Supply Chain Catchment Area (***Figure 4-36***) should be considered as exclusion zone and no wood should be precured from these exclusion zones
- Conducting regular inspections of resourcing cluster centers to verify the origin of raw materials. In addition, biannual third-party audits of the wood supply chain can effectively meet the need for ensuring the sustainable utilization of resources

	Nature of Impact	Spread of Impact	Duration	Intensity	Receptor Vulnerability	Significance of Impact
Without Mitigation Measures	Negative	Medium	Long	Moderate	Medium (Habitat) Medium (Species)	**Substantial**
With Mitigation Measures	Negative	Medium	Long	Low	Medium (Habitat) Medium (Species)	**Substantial**

7.7.3.3 Impacts of Increased Traffic / Vehicle Movement for transportation of raw materials

During the operation phase, the raw materials will be collected from the catchment area and transported to the manufacturing unit. This will increase the traffic / vehicle movement on the major roads of the region and will introduce an extra movement of 160 trucks daily at the peak of operations.

One protected area, Nelapattu Bird Sanctuary is present within the catchment area and NH 16 highway is passing close to the sanctuary area. Although no large mammals in the sanctuary, however Golden Jackal (*Canis aureus*), Black-naped Hare (*Lepus nigricollis*), Bengal Monitor Lizard (*Varanus bengalensis*), tortoises and some species of snakes have been recorded from the sanctuary. Thus, the increase the traffic / vehicle movement may also raise the risk of road hits/kills.

Impact Magnitude

During the operational phase, all the above-mentioned activities will be performed for throughout the project life, thus the **Duration** has been long-term. The **Spread** has been classified as medium. The **Intensity** has been classified as Low as per the numbers of species impacted. Thus, the impact magnitude has been classified as ***Substantial*** based on the impact significance criteria (Section ***7.4.2***).

Proposed Mitigation Measures

mitigations proposed to minimize the impact(s) on Habitat and Species have been given as,

- Vehicle drivers should be instructed not to blow horns until necessary
- Vehicle drivers should be trained to identify the wildlife crossing sign boards on the highway and be more alert of those stretches
- Vehicle drivers should follow the speed limit instructed by highway authorities (in the form of signboards)
- Annual awareness/training programmes should be conducted for drivers to minimize the risk of wildlife hitting and/or being killed on highways and road safety
- EHS guidelines for the wood aggregator- undertaking form wood aggregator on compliance of EHS guidelines

	Nature of Impact	Spread of Impact	Duration	Intensity	Receptor Vulnerability	Significance of Impact
Without Mitigation Measures	Negative	Medium	Long	Moderate-Low	Medium (Habitat) Medium (Species)	**Substantial**
With Mitigation Measures	Negative	Local-Medium	Long	Low	Medium (Habitat) Medium (Species)	**Small**

7.7.3.4 Impacts on Ecosystem Services due to the increased agroforestry plantation

Due to presence of the proposed industry, demand for wood pulp will increase in region. The demand for this new requirement leads the region to take interest in growing woody pulp trees species specifically *Eucalyptus* spp. as well as *Casuarina latifolia*, and *Leucaena leucocephala* (Subabul), to fulfil the demand. This new change may have potential impacts on private owned open scrub/ barren land, and agriculture land in a region due to the land use change. Which may cause reduction in open space and altering habitat structure, potentially affecting biodiversity, and carbon & nutrient cycling, due to alterations in vegetation composition and density. The consultation with farmers indicates that the fallow lands and comparatively lesser productive agricultural lands (used for non-food crops) will be preferred for agroforestry practices. Therefore, in areas where lands utilized for food crop cultivation are less likely to undergo conversion. Agroforestry practitioners tend to favor lands currently unused for food crops or those that are fallow. The shift towards agroforestation in food cultivation lands will be discouraged, this practice should be actively endorsed by Greenlam.

Impact Magnitude

During the operational phase, all the above-mentioned activities will be performed for throughout the project life, thus the **Duration** has been long-term. The **Spread** has been classified as medium. The **Intensity** has been classified as Low as per the available habitats and numbers of species impacted. Thus, the impact magnitude has been classified as ***Substantial*** based on the impact significance criteria (Section ***7.4.2***).

Proposed Mitigation Measures

Mitigations proposed to minimize the impact(s) on Habitat have been given as,

- Agroforestry plantation should not be promoted on agricultural land designated for food crops cultivation; while the lands unused for food crops or those that are fallow should be promoted
- The selection of appropriate clones or hybrids is recommended to decrease the reliance on chemical fertilizers and pesticides, thus minimizing their usage
- Wood sourcing from the exclusion areas/zones (forest patches present within the supply chain catchment area) should be restricted to prevent habitat disruption
- Implementing a mechanism for tracking and tracing the origin of sourced wood aids in ensuring it comes from sustainable and non-habitat-disruptive sources [see Appendix 16]
- The promotion of genetically modified species should be prohibited to safeguard natural habitats from potential ecological disturbances
- Strict adherence to the prohibition of banned pesticides contributes to the conservation of habitats and prevents their degradation

	Nature of Impact	Spread of Impact	Duration	Intensity	Receptor Vulnerability	Significance of Impact
Without Mitigation Measures	Negative	Medium	Long	Moderate-Low	Medium (Habitat) Medium (Species)	**Substantial**
With Mitigation Measures	Negative	Local-Medium	Long	Low	Medium (Habitat) Medium (Species)	**Small**

8 Hazard Analysis & Risk Assessment

8.1 Objective, Philosophy & Methodology of Risk Assessment

Objective:

The main objective of the Risk Assessment study is to determine damage due to major hazards having damage potential to life and property and provide a scientific basis to assess safety level of the facility.

The secondary objective is to identify major risk in manufacture of chemicals, storage of chemicals and provide control through assessment to prepare on- site, off site, disaster management plan for control of hazards.

Philosophy:

The main philosophy of risk assessment is to find out the real cause of accident and then based on it to suggest appropriate remedial measures to prevent its recurrence.

To find out unsafe action negligence, omission or personal fault

Methodology:

To identify Vulnerable Zone for toxic dispersion, pool fire, Tank on fire (Thermal Radiation), Flash Fire, and Explosion over pressure (Vapor Cloud Explosion) a software, ALOHA (Areal locations of Hazardous atmospheres) is used.

8.2 Details of Raw Materials and Product

Details of raw materials and final product including hazardous chemicals are as presented in *Table 8-1* and *Table 8-2* below.

Table 8-1: Details of Raw Materials

S.No	Description	Physical Form	Type of Packing/ Storage/ mode of storage	Source (purchase from)	Capacity of storage (MT)	Transportation
			Raw Materials			
1.	Formaldehyde	Liquid	Vertical Storage Tanks	Manufacturer or Trader	300	Manufacturer or traders, transported by road via trucks
2.	Phenol	Liquid	Vertical Storage Tanks	Manufacturer or Trader	400	
3.	Melamine	Powder	Storage in Bags	Manufacturer or Trader	100	
4.	Di-ethylene glycol (DEG)		Vertical Storage Tanks	Manufacturer or Trader	50	
5.	Liquid Ammonia	Liquid	Stored in Drums	Manufacturer or Trader	0.1	
6.	Cardinol		Vertical Storage Tanks	Manufacturer or Trader	100	
7.	Methanol	Liquid	Underground tank	Manufacturer or Trader	40	
8.	Caustic	Solid/Flakes	Stored in Bags	Manufacturer or Trader	1	
9.	Formic acid	Liquid	Stored in Drums	Manufacturer or Trader	1	
10.	Urea	Solid/Granules	Stored in Bags	Manufacturer or Trader	100	
11.	Ammonium chloride	Solid/Flakes	Stored in Bags	Manufacturer or Trader	50	
12.	Releasing agent	Liquid	Stored in Drums	Manufacturer or Trader	0.5	
13.	Wetting agent	Liquid	Stored in Drums	Manufacturer or Trader	0.5	
14.	Caprolactam	Crystalline	Stored in Bags	Manufacturer or Trader	10	

S.No	Description	Physical Form	Type of Packing/ Storage/ mode of storage	Source (purchase from)	Capacity of storage (MT)	Transportation
15.	Wax Emulsions	Liquid	Vertical Storage Tanks	Manufacturer or Trader	50	
16.	Green Dye	Powder	Storage in Drums	Manufacturer or Trader	1	
Manufactured for Particle board and High-Pressure Laminate boards						
17.	Urea formaldehyde resin	Semi solid	Vertical Storage Tanks	--	200	Manufacturer or traders, transported by road via trucks
18.	Melamine urea formaldehyde	Semi solid	Vertical Storage Tanks	--	200	
19.	Melamine formaldehyde resin	Semi solid	Vertical Storage Tanks	--	125	
20.	Phenol formaldehyde resin	Semi solid	Vertical Storage Tanks	--	160	

List of Hazardous Chemicals along with their Toxicity Level as per Manufacture, Storage and Import of Hazardous Chemical Rules (MSIHC Rules)

Table 8-2: List of Hazardous Chemicals along with their Toxicity Level as per MSIHC Rules

Sr. no.	Chemicals	TLV	Toxicity Level			Flammable Limit					Chemical Class (As per MSIHC Rules)
			LD50 Oral mg/ Kg	LD50 Dermal mg/Kg	LC50 mg/l	LEL%	UEL%	FP 0C	BP 0C	Class (As per petroleum classification)	
1	Phenol	5 ppm	317	669	125	1.7	8.5	79(CC) 85(OC)	182	C	Flammable, Toxic, Hazardous
2	Formaldehyde (37%)	0.3/l ppm	100	270	203	6	36.5	500C CC 600C CC	96	B	Flammable, Toxic, Hazardous
3	Methanol	200 ppm	5628	15800	64000 ppm/ 4 hr	6	36.5	12 0C	64.5	A	Very highly flammable
4	Caustic Soda	2 mg/m3	N.A	N.A	N.A	N.A	N.A	N.A	1388	--	Hazardous
5	Melamine	N.A	3161	1000	N.A	N.A	N.A	93.3 0C	N.A	C	Slightly flammable
6	Urea	--	8741	--	--	N.A	N.A	N.A	N.A	--	N.A
7	Liquid Ammonia	25 ppm	N.A	N.A	300 µg/	16%	25%	N.A	N.A	N.A	N.A
8	Formic Acid	5 ppm	1100mg/ kg	N.A	15 g/m3 (Rat)	18%	38%	N.A	N.A	N.A	N.A

Note: CC: Close Cup; OC: Open Cup; N.A.: Not Available.

The Toxicity level of hazardous chemicals as per Manufacture, storage and import of Hazardous Chemical (Amendment) Rules, 2000 (MSIHC) is shown as below

Table 8-3: Toxicity Index as per MSIHC Rule 2000

S.No		Toxicity	Oral Toxicity LD50 (mg/Kg)	Dermal Toxicity LD50 (mg/Kg)	Inhalation Toxicity LD50 (mg/Kg)
1.	1	Extremely Toxic	>5	<40	<0.5
2.	2	Highly Toxic	>5- 50	>40-200	>0.5-2
3.	3	Toxic	>50-200	>200-1000	>2-10

8.3 Hazard Identification and Preventive Measures

Identified hazards, along with the risk involved and affected persons are presented in the table below -

8.3.1 Raw Material Storage Hazards and Controls

Table 8-4: Raw Material Storage hazards and controls

Name of material stored	Quantity (Max)	Operating press/ temperature	Hazard Rating Systems	Type of hazard / Risk involved	Persons Affected
Phenol	400 MT	NTP	TLV – 5 PPM STEL-10 PPM NFPA Ratings: Health: 4 Flammability: 2 Instability: 0 Flash Point: 79.440C	• Toxic when contact with Skin • Causes burns • Toxic if swallowed • Irritating to Skin, Eyes and • Respiratory System	• Operators • Maintenance Technicians
Control Measures: • Dyke provision to storage tank • Safety boards displayed on the tank • Good ventilation must be provided. • For accidental contact with skin, nearby provision of soapsuds • Use water spray to keep fire-exposed containers cool. • Wear a self-contained breathing apparatus (SCBA) to prevent contact with thermal decomposition products. • Handling of Phenol with Safety glasses, hand gloves, gumboot					
Formaldehyde	300 MT	NTP	TLV – 0.3 PPM (1 ppm) NFPA Ratings: Health - 3 Flammability - 2 Reactivity - 0 Flash Point: 500C	• Flammable • Very toxic by inhalation. • Very toxic in contact with skin. • Very toxic if swallowed. • Causes burns. • Limited evidence of a carcinogenic effect. • Risk of serious damage to the eyes. • May cause sensitization by skin contact.	• Operators • Maintenance • Technicians

Name of material stored	Quantity (Max)	Operating press/ temperature	Hazard Rating Systems	Type of hazard / Risk involved	Persons Affected
Methanol	40 MT	NTP	TLV – 200 PPM (8-hr TWA) STEL-250 PPM NFPA Ratings: Health: 1 Flammability: 3	• Highly Flammable • Toxic by inhalation • Toxic when contact with Skin • Toxic if swallowed • Danger of very serious irreversible effects.	• Operators • Maintenance • Technicians

8.3.2 Process hazards and controls

Table 8-5: Process hazards and controls

Name of hazardous process and operation	Material in the process / operation	Type of hazard possible toxic gas release / fire / explosion / run away reaction / rupture, etc.	Control measured provided
Boiler	Steam	• Handling of anti-scaling • Heat burns	• Annual inspections • Safety interlocks to be provided • Safety and pressure gauge valves fitted • Properly supported and protected against corrosion • Testing of Jackets and joints of tubes regularly
Reactor Vessel	Formaldehyde (37%), Melamine, Urea	• Exothermic Run- away reaction • Release of Heat and Flammable gases • Fire, Toxic gas release and Explosion	• Raw Materials quantity must be controlled either volumetrically or gravimetrically. • Process control devices must be installed includes the use of sensors, alarms, trips and other control systems that either take automatic action or allow for manual intervention to prevent the conditions for uncontrolled reaction occurring. • High Temperature indicator valve and alarm system must be provided • Auto cut-off system must be provided after reaching of predetermined maximum safe temperature. • Pressure gauge must be provided. • Safety Control valve must be provided. • The Vessel Emergency Relief vent should discharge to a suitably designed catch pot or should be so positioned that people working in the area and members of the public will not be in danger if the contents of the vessel are discharged. • Use skilled worker • Proper selection of MOC • Mechanical seal in all pumps and reactors • Transportation of finished product from vessel to storage tank through

Name of hazardous process and operation	Material in the process / operation	Type of hazard possible toxic gas release / fire / explosion / run away reaction / rupture, etc.	Control measured provided
Particle Board Processing Area	Wood Dust	• Airborne hazard • Fire and Explosion Hazards	• A dust measurement survey is recommended to assess your workplace and to identify any wood dust issues. • Use of dust masks must be ensured. • Cleaning with mechanized dust collectors can be explored. • Water sprinkling in the places where dust dispersion can occur. • Eliminate as many potential ignition sources as possible. • Provide adequate training for plant personnel, including the findings of the risk assessment • Install adequate explosion relief, discharging to a safe area. Alternatively, use flameless explosion vents • Install explosion suppression. • Install explosion containment • Install explosion isolation equipment

8.3.3 General Hazards & controls

Table 8-6: General Hazards & controls

Type of Emergency	Identification of Area	Possible Causes	Possible Results	Preventive/control Measures
Fire	Tank farm area	• Fire due to Bottom nozzle failure • Damage of Storage tank Pump discharge nozzle failure • Unloading road tanker hose rupture	• Major fire in the tank farm, it may spread all over the company and surrounding area • May cause fatalities	• Licensed and isolated storage tank farm. • Flame proof fittings. • Earthling while unloading. • Spark arrestor at main gate. • Dip pipes on the tank for unloading. • Provision of dyke. • Earthling of tanks and pumps. • Get approval from an explosive department for plan approval, equipment layout & emergency control measures. • No electrical junction box close to storage materials. • Hot work permit system followed for hot working in the warehouse.

Type of Emergency	Identification of Area	Possible Causes	Possible Results	Preventive/control Measures
Toxic Gas Release	Tank Farm Area and Reaction Vessel area	• Cylinder blast • Rupture of discharge valve • Rupture of gas cylinder body • Bursting of pipelines	• Major gas exposure in the company and /or surrounding area of the company resulting in irritation to respiratory track eyes and suffocation. More inhalation results in fatalities.	• Storage Tank stored under shed and good ventilated area. • Procured by license holder party. • Fitted with valve protection cap. • Valve opened with special key. • Loading/unloading done safely. • Trained persons for Material Handling in Tank Farm and Storage Tank area. • Periodic hydraulic testing through competent person by supplier • Painted according to its colour code.
Explosion	All Material handling areas	• Vapor explosion due to contact of spark to accumulated flammable vapor in confined area	• Improper discharge of static charge • Use of non FLP equipment for solvent handling • Metal to metal impact • Electrical short circuit • Open flame	• Flameproof electric installation areas & use spark less tools • Isolated storage of Flammable material drums • Hot work permit for hot working in the plant • Earthling for human static charge • Good, ventilated area for Flammable material storage
Material handling	In Plant	Flammable, eye irritating & body accident	Fire and health Hazards	• Trained employee • Required PPE and Fire • Protective equipment Provided • Good engineering practice • Separate storage is with dyke valve system provided
Methanol, Formaldehyde and Melamine Fire Protective System	Storage and other Operation Area	Spillage, Leakage and overflow,	Fire Hazard	• Required Fire Extinguisher Provided • Flame Proof Electrical Fitting • Proper Earthling arrangement • Fire Hydrant System with Jockey Pump • Gas Detector

8.3.4 Safe Practice for Handling, Storage, Transportation and Unloading of Hazardous Chemicals

For Storage/Handling:

- Separate from strong oxidant & keep it in well ventilated room.
- Dyke wall shall be provided to all above ground storage tank.
- Fire hydrant system shall be installed.
- Safety shower and eye washer shall be installed near storage area.
- Flame proof light fitting shall be provided at flammable storage area.
- Proper selection of MOC for chemicals storage tank.
- Sprinkler system shall be installed at flammable material storage area
- Earthing/bonding shall be provided for static charges.
- Flame arrestor shall be provided on flammable material storage tank vent.
- Level gauge and level measurement instrument shall be provided on material storage tank.
- Lightening arrestor on all chimney and building shall be provided.
- Hazardous material should be stored away from the plant and safe distance shall be maintained.
- Safety permit system shall be followed for loading, unloading of hazardous chemical.
- Fencing, caution note, hazardous identification board should be provided.

For Transportation & Unloading:

- Solvent shall be received by road tanker and stored in above ground storage tank in separated bulk storage area.
- Loading and unloading procedure shall be prepared for material received through road tanker.
- Earthing/bonding shall be provided for static charges.
- Flexible steel hose shall be used for unloading from the road tanker.
- Flame proof electric motor shall be used during loading/unloading.
- NRV shall be provided on pump discharge line.
- Fixed pipeline with pumps shall be provided for transfer to vessel.
- TREM CARD will be provided to all transporters and shall be trained for transportation Emergency of hazardous chemicals.
- Personal Protective Equipment (safety goggles, hand gloves, apron, masks, gum boots etc.) shall be provided.
- Only authorized person shall be permitted in storage tank area and register will be maintained

8.4 Occupational Health Surveillance Programme

Health surveillance is the monitoring of a person's health to identify changes in health status due to occupational exposure to a hazardous substance. It includes biological monitoring.

Ideally, the avoidance of work-related diseases should be achieved by the prevention or controlling exposures to hazardous substances in the workplace. Where a process cannot be designed or maintained to eliminate the risk of exposure, it may be necessary for workers to undergo health surveillance.

Aims of health surveillance:

- Identify those at increased risk

Health surveillance is used to identify workers who have an increased risk of developing an occupational disease. For example, people who have existing skin, kidney, liver and eye disorders, heart problem; additionally smokers and pregnant women are at increased risk of being severely affected if exposed to Methanol.

- Compliance with regulations

Health surveillance is sometimes required by laws and codes of practice (for example, a worker exposed to lead in battery manufacture or a spray-painted exposed to isocyanates in two-pack paints). Each state or territory has regulations containing a schedule of hazardous substances for which health surveillance is mandated.

- Early detection

The major purpose of health surveillance is to detect adverse health effects at an early stage so that the worker may be protected from further injury, either by control of the process or by removal from exposure.

- Evaluating effectiveness of control measures

Health surveillance is not a control measure and should not be the sole means of determining whether control measures are effective. However, it can provide useful information on the effectiveness of safe working practices.

- Epidemiology and disease

Health surveillance can be used to evaluate the health experiences of groups of workers exposed to specific hazardous agents or working within a particular industry.

Workers should be made aware that health surveillance is sometimes necessary to ensure their ongoing health. Health surveillance is often used in addition to workplace monitoring. Workplace monitoring will only indicate the potential for exposure of workers to a hazardous substance. It can never be an indication of the actual amount of substance absorbed or the effect on the body of absorbing the hazardous substance.

When a toxic substance (such as an industrial chemical) is present in the environment, it contaminates air, water,

food, or surfaces in contact with the skin: environmental monitoring evaluates the amount of toxic agent in these media.

As a result of absorption, distribution, metabolism, and excretion, a certain internal dose of the toxic agent (the net amount of a pollutant absorbed in or passed through the organism over a specific time interval) is effectively delivered to the body and becomes detectable in body fluids.
Subsequent interaction with a receptor in the critical organ (the organ which, under specific conditions of exposure, exhibits the first or the most important adverse effect) leads to biochemical and cellular events. Both the internal dose and the elicited biochemical and cellular effects may be measured through biological monitoring.

8.5 Occupational Health Programme

- The health & physical hazards caused due to toxic, irritant, corrosive, flammable materials.
- Monitoring of occupational hazards like noise, ventilation, chemical exposure etc. will be carried out regularly and its record will be maintained.
- Good housekeeping, use of PPE, Engineering controls, Enclosure processes, scrubber system, display of safety boards, SOP of loading / unloading, local exhaust ventilation, safety shower etc. are important safety measures have taken to keep these chemicals within TLV.
- Appropriate personal protective equipment will be provided & ensure the usage of them.
- Workers will be trained on safe material handling of hazardous chemicals.
- Prepare & display the safe operating procedure for hazardous chemicals storage, handling & transporting or using.
- Periodical medical examination of the workers & Liver Function Testes will be done.
- Register (form no.37) for work place air monitoring will be done.
- Employee training and education will be carried out.
- Control the noise at source by substitution, isolation, segregation, barriers etc.
- Local exhaust ventilation and scrubber should be installed where it is required to reduce fumes, vapors, temperature and heat stress.
- Insulate all hot equipment to reduce air temperature.
- Reduce the level of physical activity by sharing workload with other or by using mechanical means.

8.6 Chemicals Which are Exposed to Workers Directly or Indirectly

(1) Formaldehyde
(2) Phenol
(3) Methanol

Details pertaining to raw materials consumption is presented in the table below-

Table 8-7: Raw Material Consumption

Sr. No.	Name of the product	Name of Raw Materials	Quantity in MT/Day
1	Phenol Formaldehyde Resin	Phenol	38.361
		Formaldehyde	42.294
		Cardinol	3.339
		Methanol	0.371
		Caustic	0.037

Sr. No.	Name of the product	Name of Raw Materials	Quantity in MT/Day
2	Melamine Formaldehyde Resin	Formaldehyde (37%)	5.4
		Melamine	4.63
3	Urea Formaldehyde Resin	Urea	3.18
		Formaldehyde (37%)	3.75
		Releasing Agent	0.00288
		Wetting Agent	0.01
4	Melamine Urea Formaldehyde Resin	Formalin	16.99
		Urea	3.84
		Melamine	5.92
		Caustic	0.05
		Formic acid	0.04

8.7 Treatment of Workers affected by Accidental Spillage of Chemicals

Treatment of workers affected by accident spillage shall be as follows:

- Hazards With Acute Exposure
  - Contact with skin may cause severe burns or systemic poisoning.
  - Systemic effects may occur from any route of exposure, especially after skin absorption.

- Hazards With Chronic Exposure
  - Repeated or prolonged exposure may harm the respiratory system, can irritate and inflame the airways.
  - Methanol affects the central nervous system, liver, and kidneys.

- Special Safety Precautions
  - Prevent contact with skin by wearing neoprene gloves, lab coat, and resistant apron.
  - Wear safety glasses or a face shield if splashing may occur.
  - Store in a cool, dry, well-ventilated area, away from heated surfaces or ignition sources.
  - Skin contact requires immediate washing of the affected area with soap and water.
  - Remove contaminated clothing and launder before wearing again.

- Procedure for treating workmen after skin contact.
  - Skin contact requires immediate flushing of the contaminated area with soap and water at a sink or emergency shower for a good fifteen minutes. Remove contaminated clothing. In case of eye contact, promptly flush the eyes with copious amounts of water for 15 minutes (lifting upper and lower lids occasionally) and obtain medical attention. If methanol is ingested, obtain medical attention immediately. If large amounts of methanol are inhaled, move the person to fresh air and seek medical attention at once. It is recommended to provide the safety shower and eyewash station in plant.

Antidotes

- Antidotes for Methanol
  - Ethanol (30 % solution from inside, 5 % solution from outside i.e. by intravenous injection)
  - Epicake syrup

  - In case of acidosis give sodium bicarbonate
  - In case of delirium give diazepam 10 mg by intravenous injection
  - Folinic acid (leucovorin 1 mg/Kg iv, 4 hloyu)

- Antidotes for Formaldehyde
  - Milk
  - Activated Charcoal or Water

- Antidotes for Phenol
  - Polyethylene glycol 300 or 400
  - Activated Charcoal and 240 ml Milk

8.8 Minimization of the manual handling of hazardous substance

Whether moving materials manually or mechanically, your employees should know and understand the potential hazards associated with the task at hand and how to control. Their workplaces to minimize the danger. Employers and employees should examine their workplaces to detect any unsafe or unhealthful conditions, practices, or equipment and take corrective action.

Provide flameproof electrical motor & transfer chemicals through the pipelines. Use specially designed pallets to hold, move raw materials, finished products through work areas. Minimize lifting of raw materials, heavy loads by using appropriate platforms, trolleys etc. Avoid the moving, manual handling of hazardous material.

8.9 Do's and Dont's

Dos and Don'ts for chemical handling, material storage, fire prevention and housekeeping are as presented in subsequent sections.

8.9.1 Handling of Chemicals

Do's	Don'ts
• Know the hazards of the chemical before handling. • Know the antidotes for chemical, which you are handling. • Do keep material safety data sheet in locations where chemicals are being handled and study it. • Use appropriate personal protective equipment like gloves, aprons, and respirator; face shield etc. depending upon nature of the work. • Label every chemical that you use and tightly close the container. • Use eye wash fountain / safety shower in case of splash of chemicals in the eye or body for at least 15 minutes. • Segregate toxic, flammable chemicals and keep them under control. • In addition to draining and closing valves, lines should be blanked before taking up maintenance work. • Provide proper ventilation at the chemical handling area to limit their concentration within prescribed level.	• Do not store the chemicals that are incompatible with other chemicals. • Do not spill the chemicals. • Do not dispose chemical without neutralizing. • Do not keep large inventory of chemicals. • Do not allow empty containers of hazardous chemicals to be used by others. • Do not use compressed air for transferring chemicals. • Do not stand near chemical transfer pump while it is in operation with temporary hose connection. • Pouring of chemicals by hand or doing siphoning by mouth should never be adopted. • Chemicals drums should never be moved without protection. • Do not attempt to neutralize the acid / alkali on the skin. Use water only. • Do not use solvent for cleaning hands.

8.9.2 Material Handling

Do's	Don'ts
• Use proper lifting tool and tackle having adequate capacity. • Only authorized persons should operate material handling equipment's. • Each tool, tackle or equipment should have number and safe working load (SWL) marked on it. • Assess weight of the material, distance to be carried and hazards etc. before lifting the load. • Inspect and test all the lifting tools and tackles regularly as per Factory Rules. • Wear Personal Protective Equipment's while handling of material. • Wherever possible, mechanized material handling shall be adopted. • While lifting a load physically, keep the load as near as possible to the body with feet properly placed for body balance. • Bend knees, keep back straight, keep the load • closed to the body and lift the load.	• Do not use the equipment for the purpose other than its design intention. • Do not allow personnel to move underneath lifted load. • Do not load the equipment above its safe working load. • Do not use makeshift arrangements for lifting equipment without inspection and test. • Do not use defective tool and tackles. • Keep the tools & tackles free from adverse effect of atmosphere by applying suitable protective coating. • The angle between the legs of two leg sling should not exceed 90 degree. • Do not allow male and female adult to lift a load manually higher than 55 kgs and 30 kgs respectively. • Do not hold the load with tip of the fingers; • grasp the load firmly with palm.

8.9.3 Fire Prevention

Do's	Don'ts
• Follow 'NO SMOKING' sign. • Deposit oily rags and waste combustible material in the identified containers and dispose them suitably. • Fire Hose used for any other purpose should be permanently marked and taken out of fire hydrant system. • Keep minimum inventory of flammable and combustible substances. • Take permission before breaking or removal of fire barrier and ensure subsequent relocation of fire barrier. • Check periodically the operability of fixed • fire fighting system. • Attend any abnormality / deficiency with fire protection system promptly. • Provide earthling or bonding to prevent accumulation of static charges to tanks where flammable chemicals are stored / handled. • Use instruments that are intrinsically safe • in explosive atmosphere.	• Do not leave flammable material like acetone, kerosene etc. used as cleaning agent at the work area. • Do not over tighten fire hydrant valves with F-lever. • Do not allow wild grass growth around storage of the gas cylinders and switchyard. • Do not obstruct accessibility to the fire related equipment. • Do not destroy the inspection tag provided with the fire equipment. • Do not misuse fire-fighting equipment other than intended purpose. • Do not store the flammable material in the open container. • Do not use instruments that are not intrinsically safe in the explosive atmosphere.

8.9.4 House Keeping

Do's	Don'ts
• Assign places for everything and maintain things at assigned places. • Clean the area after completion of work. • Use aisle space free for personnel and material movement. • Ensure adequate illumination and ventilation for the job. • Drop paper, plastic, glass, metal and bio- medical waste in a separate bin kept for this purpose. • Know the location where emergency equipment such as first aid box, firefighting equipment, SCBA, Stretchers are kept. • Arrest all types of spills such as chemical, water, oil, air / gas, steam etc. and clean up the area immediately. • Ensure exits are indicated / painted for use • during emergency.	• Do not leave combustible materials in the work area. • Do not smoke in the area of work. • Do not allow dust bin to overflow. • Do not generate extra waste. • Do not disturb the safety equipment from assigned location. • Do not block emergency switches and on/off switches of the equipment by storming of materials in front of work. • Do not leave cleaning agent like acetone, isopropyl alcohol, kerosene etc. at the work area after completion of work. • Do not block fire exit point by storing materials or by means. • Do not leave a spillage unattended.

8.10 Risk Analysis and Consequence Analysis

ALOHA is an air dispersion model, which ca be used as a tool for predicting the movement and dispersion of gases. It predicts pollutant concentrations downwind from the sources of a spill, taking into consideration the physical characteristics of the spilled material. ALOHA also accounts for some of the physical characteristics of the release site, weather conditions, and the circumstances of the release. Like many computer programs, it can solve problems rapidly and provide results in a graphic, easy to use format. This can be helpful during an emergency response or planning for such a response.

ALOHA provide output as amount of chemical discharged from the source as well as its concentration in air it takes into account different levels of concentrations for a specified chemical.

Software used for calculation- ALOHA (Areal locations of Hazardous atmospheres)

Aloha is a computer program designed especially for use by people responding to chemical accidents, as well as for emergency planning and training. ALOHA can predict the rates at which chemical vapors may escape into the atmosphere from broken gas pipes, leaking tanks and evaporating puddles. It can then predict how a hazardous gas cloud might disperse in the atmosphere after an accidental chemical release.

ALOHA provides output as amount of chemical discharged from the source as well as its concentration in air it takes in to account different levels of concentrations for a specified chemical. Different concentration levels are given below:

ERPG 1: is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined, objectionable odor.

ERPG 2: is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action.

ERPG 3: is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing life threatening health effects.

IDLH: The Immediately Dangerous to Life or Health (IDLH) level. A chemical's IDLH is an estimate of the maximum concentration in the air to which a healthy worker could be exposed without suffering permanent or escape-impairing health effects.

AEGLs estimate the concentrations at which most people—including sensitive individuals such as old, sick, or very young people—will begin to experience health effects if they are exposed to a hazardous chemical for a specific length of time (duration). For a given exposure duration, a chemical may have up to three AEGL values, each of which corresponds to a specific tier of health effects. The three AEGL tiers are defined as follows:

AEGL-3 is the airborne concentration, expressed as parts per million (ppm) or milligrams per cubic meter (mg/m3), of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

AEGL-2 is the airborne concentration (expressed as ppm or mg/m3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.

AEGL-1 is the airborne concentration (expressed as ppm or mg/m3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic nonsensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.

The consequence analysis has been done for selected scenarios. This has been done for weather conditions having wind speed 1.50 m/s.

To find out the quantitative Risk Assessment study by using Aloha software, we consider two scenarios as follow

1. Leaking tank, chemical is not burning and forms and evaporating puddle
2. BLEVE, tank explodes and chemical burns in a fireball

Input data and consequence for aloha are as below:

1 METHANOL

SITE DATA:

- Location: NAIDUPETA, MENAKURU VILLAGE, TIRUPATI, INDIA,
- Building Air Exchanges Per Hour: 0.50 (unsheltered single storied)
- Time: May 21, 2023, 1258 hours ST (user specified)

CHEMICAL DATA:

- Chemical Name: METHANOL
- CAS Number: 67-56-1
- Molecular Weight: 32.04 g/mol
- AEGL-1 (60 min): 530 ppm AEGL-2 (60 min): 2100 ppm AEGL-3 (60 min): 7200 ppm
- IDLH: 6000 ppm
- LEL: 71800 ppm
- UEL: 365000 ppm
- Ambient Boiling Point: 64.7° C
- Vapor Pressure at Ambient Temperature: 0.27 atm
- Ambient Saturation Concentration: 277,352 ppm or 27.7%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)

- Wind: 1.5 meters/second from NE at 3 meters
- Ground Roughness: open country
- Cloud Cover: 0 tenths
- Air Temperature: 35° C
- Stability Class: F
- No Inversion Height
- Relative Humidity: 50%

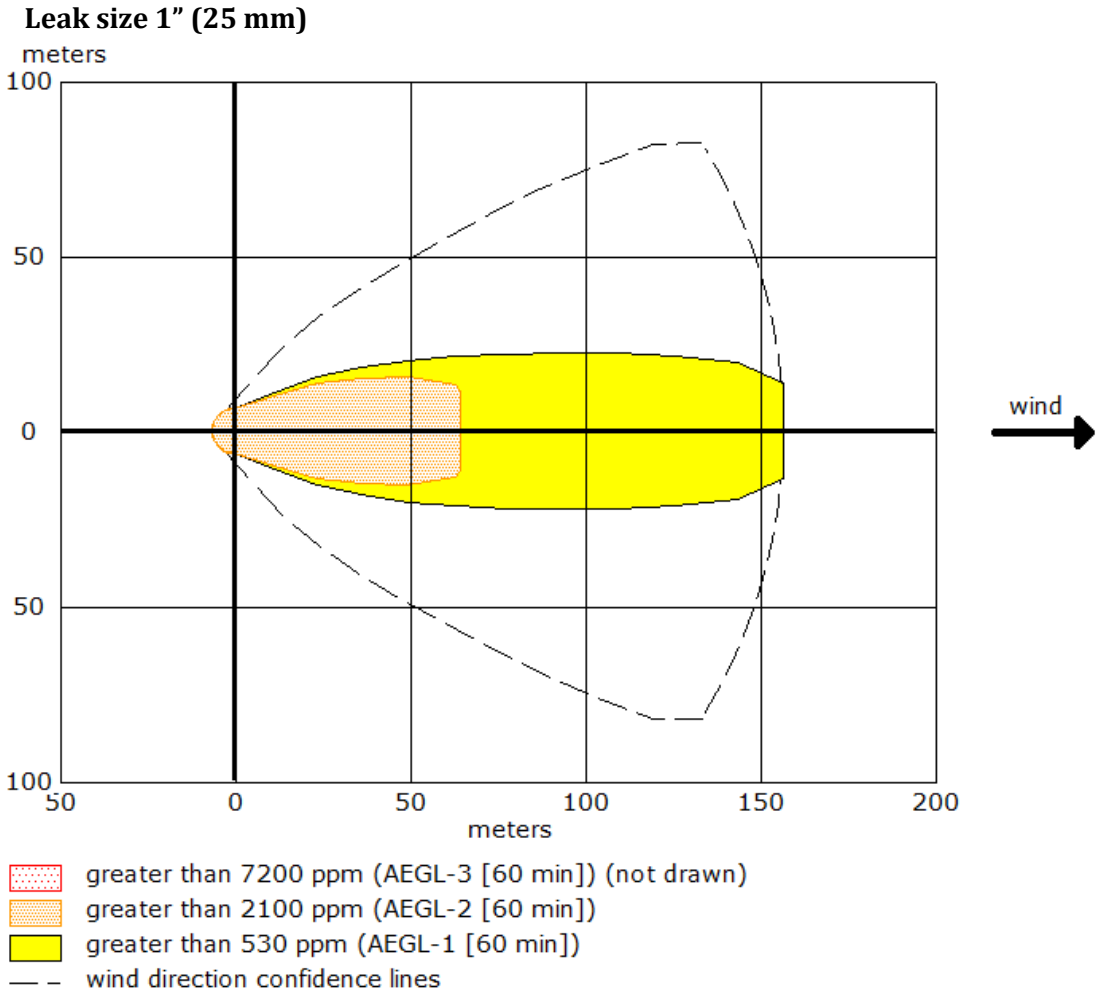
SOURCE STRENGTH:

Leak from hole in horizontal cylindrical tank
Flammable chemical escaping from tank (not burning)

- Tank Diameter: 2.75 meters
- Tank Length: 7.5 meters
- Tank Volume: 44.5 cubic meters
- Tank contains liquid
- Internal Temperature: 35° C
- Chemical Mass in Tank: 38.3 tons
- Tank is 100% full
- Circular Opening Diameter: 1 inches
- Opening is 0 meters from tank bottom
- Ground Type: Default soil
- Ground Temperature: equal to ambient
- Max Puddle Diameter: Unknown
- Release Duration: ALOHA limited the duration to 1 hour
- Max Average Sustained Release Rate: 11.9 kilograms/min (averaged over a minute or more)
- Total Amount Released: 478 kilograms
- Note: The chemical escaped as a liquid and formed an evaporating puddle.
- The puddle spread to a diameter of 17.2 meters.

Scenario: Leaking tank, chemical is not burning and forms an evaporating puddle

Figure 8-1: Scenario: Leaking tank, chemical is not burning and forms an evaporating puddle



THREAT ZONE:

- Model Run: Heavy Gas
- Red : 30 meters --- (7200 ppm = AEGL-3 [60 min])
- Note: Threat zone was not drawn because effects of near-field patchiness make dispersion predictions less reliable for short distances.
- Orange: 64 meters --- (2100 ppm = AEGL-2 [60 min])
- Yellow: 157 meters --- (530 ppm = AEGL-1 [60 min])

When Methanol is leaking from tank and is NOT burning, forms an evaporating puddle; the Acute Exposure Guideline Levels (AEGLs) for the methanol tanks is 30 m as per the maximum AEGL -3, which predicts severe impact on health. Similarly, the remaining Acute Exposure Guideline Levels (AEGLs) are subjected to within the unit at 64 and 157 meters with lower concentrations 2100 ppm and 530 ppm respectively.

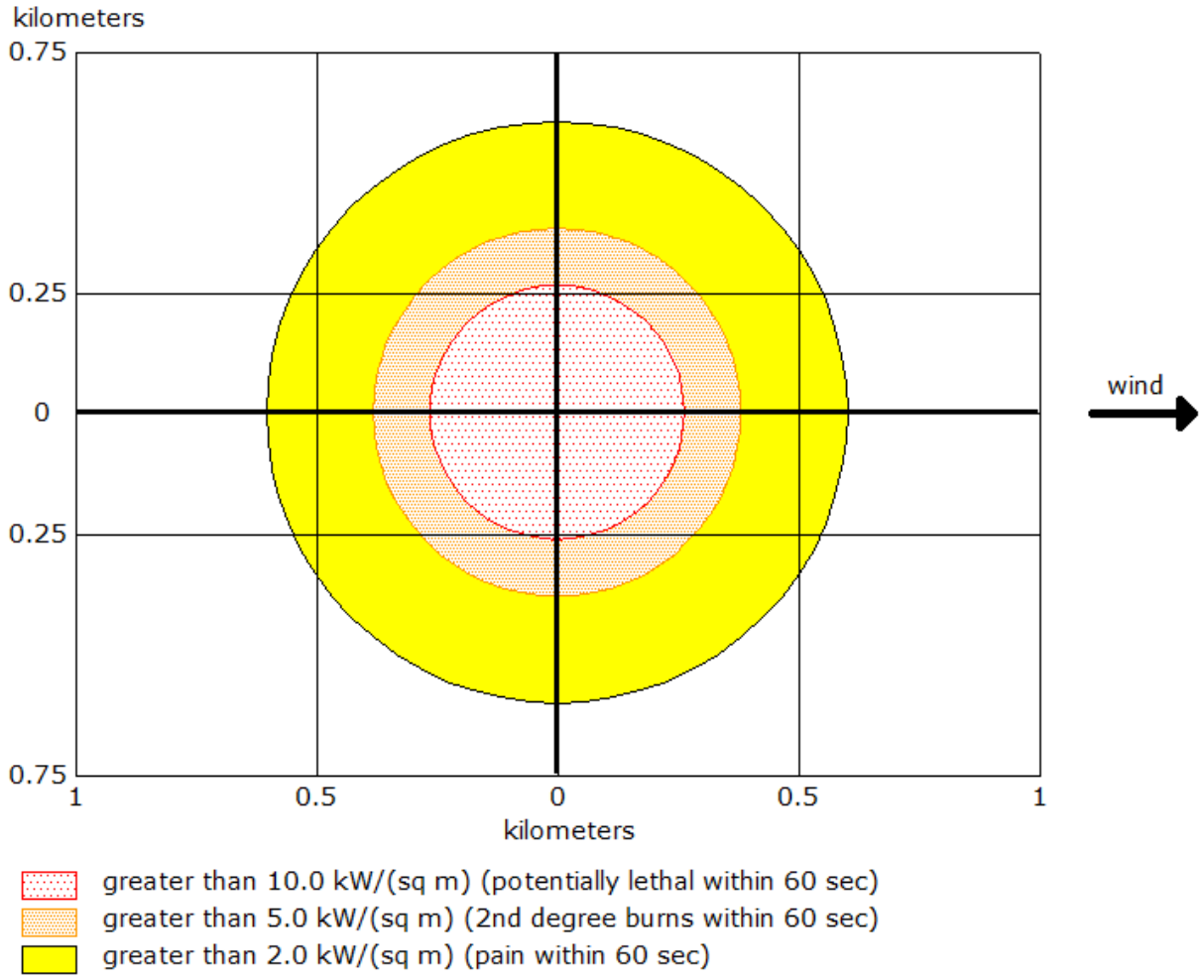
Scenario: BLEVE, tank explodes and chemical burns in a fireball

SOURCE STRENGTH:

- BLEVE of flammable liquid in horizontal cylindrical tank
- Tank Diameter: 2.75 meters
- Tank Length: 7.5 meters
- Tank Volume: 44.5 cubic meters
- Tank contains liquid
- Internal Storage Temperature: 35° C
- Chemical Mass in Tank: 38.3 tons
- Tank is 100% full

- Percentage of Tank Mass in Fireball: 100%
- Fireball Diameter: 189 meters
- Burn Duration: 12 seconds

Figure 8-2: Scenario: BLEVE, tank explodes and chemical burns in a fireball



THREAT ZONE:

- Threat Modelled: Thermal radiation from fireball
- Red: 263 meters--- (10.0 kW/(sq m) = potentially lethal within 60 sec
- Orange: 381 meters--- (5.0 kW/(sq m) = 2nd degree burns within 60 sec
- Yellow: 602 meters--- (2.0 kW/(sq m) = pain within 60 sec)

Methanol storage is planned in an underground tank at the south-east corner of the Premises, which is located far from the main plant. Also, predominant wind direction is from north-waste to south-east direction and there is green cover patch is adjacent to the SE boundary. Therefore, direct exposure to people or community is not anticipated. Chemical storage shall be planned at the safe distance from the methanol. It should be ensured that combustible materials such as oiled rags, wooden supports, oil buckets etc. are not kept in the storage and process areas as well as road tankers loading/unloading sites where there is maximum possibility of presence of flammable hydrocarbons in large quantities, to reduce the probability of secondary fires.

PHENOL

CHEMICAL DATA:

- Chemical Name: PHENOL
- Molecular Weight: 94.10 g/mol
- AEGL-1 (60 min): 15 ppm AEGL-2 (60 min): 23 ppm AEGL-3 (60 min): N/A
- IDLH: 250 ppm
- LEL: 17000 ppm

- UEL: 86000 ppm
- Ambient Boiling Point: 181.7° C
- Vapor Pressure at Ambient Temperature: 0.0014 atm
- Ambient Saturation Concentration: 1,386 ppm or 0.14%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)

- Wind: 1.5 meters/second from NE at 3 meters
- Ground Roughness: open country
- Cloud Cover: 0 tenths
- Air Temperature: 35° C
- Stability Class: F
- No Inversion Height
- Relative Humidity: 50%

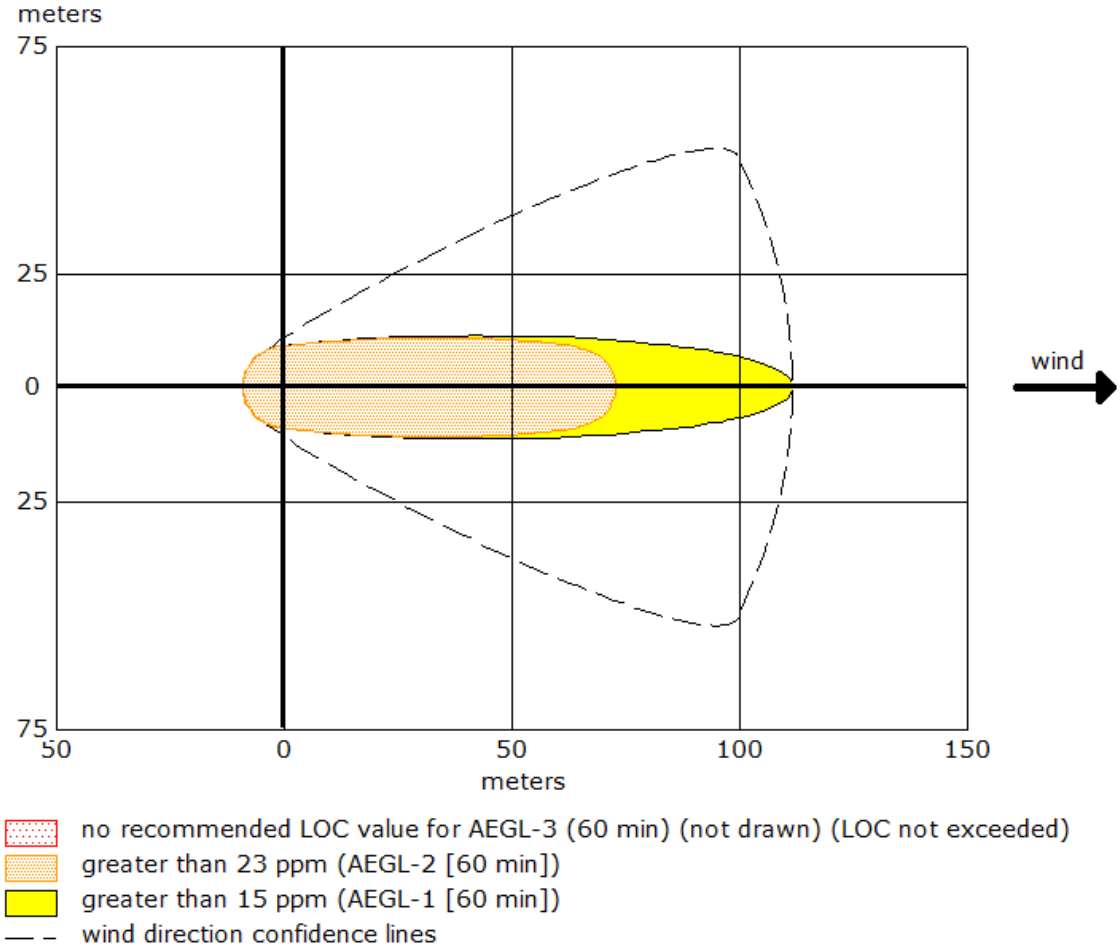
SOURCE STRENGTH:

- Leak from hole in horizontal cylindrical tank
- Flammable chemical escaping from tank (not burning)
- Tank Diameter: 4.5 meters
- Tank Length: 6.3 meters
- Tank Volume: 100 cubic meters
- Tank contains liquid
- Internal Temperature: 35° C
- Chemical Mass in Tank: 100 tons
- Tank is 73% full
- Circular Opening Diameter: 1 inches
- Opening is 0 meters from tank bottom
- Ground Type: Default soil
- Ground Temperature: equal to ambient
- Max Puddle Diameter: Unknown
- Release Duration: ALOHA limited the duration to 1 hour
- Max Average Sustained Release Rate: 247 grams/min (averaged over a minute or more)
- Total Amount Released: 8.48 kilograms
- Note: The chemical escaped as a liquid and formed an evaporating puddle.
- The puddle spread to a diameter of 19.0 meters.

Scenario: Leaking tank, chemical is not burning and forms and evaporating puddle

Leak size 1” (25 mm)

Figure 8-3: Scenario: Leaking tank, chemical is not burning and forms and evaporating puddle



THREAT ZONE:

- Model Run: Gaussian
- Red : no recommended LOC value--- (N/A = AEGL-3 [60 min])
- Orange: 73 meters--- (23 ppm = AEGL-2 [60 min])
- Yellow: 112 meters--- (15 ppm = AEGL-1 [60 min])

Scenario: BLEVE, tank explodes and chemical burns in a fireball

Threat Modeled: Thermal radiation from fireball
Red : LOC was never exceeded --- (10.0 kW/(sq m) = potentially lethal within 60 sec)
Orange: LOC was never exceeded --- (5.0 kW/(sq m) = 2nd degree burns within 60 sec)
Yellow: LOC was never exceeded --- (2.0 kW/(sq m) = pain within 60 sec)

2 FORMALDEHYDE

CHEMICAL DATA:

- Chemical Name: FORMALDEHYDE
- Molecular Weight: 30.03 g/mol
- AEGL-1 (60 min): 0.9 ppm AEGL-2 (60 min): 14 ppm AEGL-3 (60 min): 56 ppm
- IDLH: 20 ppm LEL: 70000 ppm UEL: 730000 ppm
- Ambient Boiling Point: 95.9° C
- Vapor Pressure at Ambient Temperature: 2.49e-004 atm
- Ambient Saturation Concentration: 251 ppm or 0.025%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)

- Wind: 1.5 meters/second from NE at 3 meters
- Ground Roughness: open country
- Cloud Cover: 0 tenths
- Air Temperature: 35° C
- Stability Class: F
- No Inversion Height
- Relative Humidity: 50%

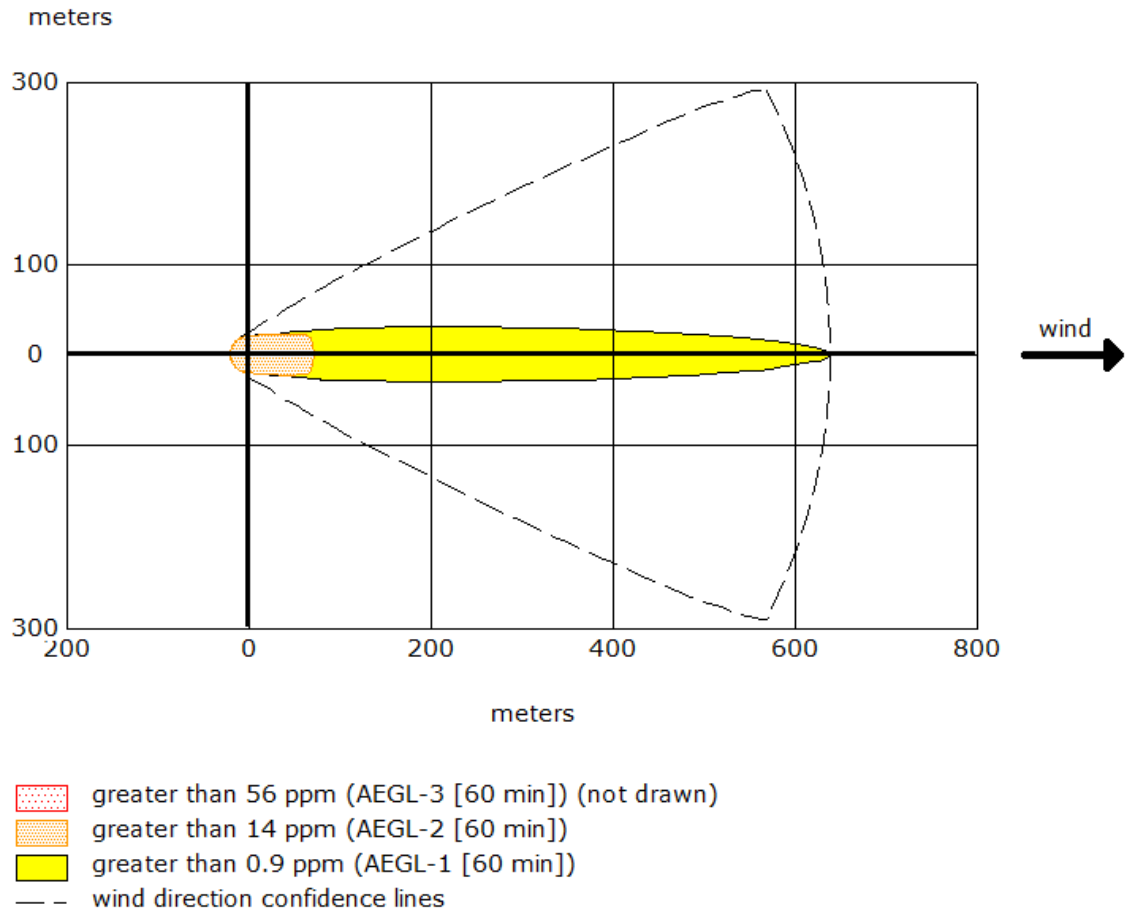
SOURCE STRENGTH:

- Leak from hole in horizontal cylindrical tank
- Flammable chemical escaping from tank (not burning)
- Tank Diameter: 4.5 meters
- Tank Length: 6.3 meters
- Tank Volume: 100 cubic meters
- Tank contains liquid
- Internal Temperature: 35° C
- Chemical Mass in Tank: 517 tons
- Tank is 100% full
- Circular Opening Diameter: 1 inches
- Opening is 0 meters from tank bottom
- Ground Type: Default soil
- Ground Temperature: equal to ambient
- Max Puddle Diameter: Unknown
- Release Duration: ALOHA limited the duration to 1 hour
- Max Average Sustained Release Rate: 74.9 grams/min (averaged over a minute or more)
- Total Amount Released: 2.65 kilograms
- Note: The chemical escaped as a liquid and formed an evaporating puddle.
- The puddle spread to a diameter of 42 meters.

Scenario: Leaking tank, chemical is not burning and forms an evaporating puddle

Leak size 1” (25 mm)

Figure 8-4: Leaking tank, chemical is not burning and forms and evaporating puddle



Scenario: BLEVE, tank explodes and chemical burns in a fireball

Threat Modeled: Thermal radiation from fireball
Red : LOC was never exceeded --- (10.0 kW/(sq m) = potentially lethal within 60 sec)
Orange: LOC was never exceeded --- (5.0 kW/(sq m) = 2nd degree burns within 60 sec)
Yellow: LOC was never exceeded --- (2.0 kW/(sq m) = pain within 60 sec)

Consequence Results

Consequence distances for AEGL and thermal radiation from fireball are as presented below

Table 8-8: Consequence Distances for AEGL

S. No.	Chemical	Scenario	Leak Size (inch)	Weather	Distance in (m)		
					AEGL-1	AEGL-2	AEGL-3
1	Methanol	Leaking tank, chemical is not burning and forms and evaporating puddle	1	1.5F	157	64	30
2	Phenol	Leaking tank, chemical is not burning and forms and evaporating puddle	1	1.5F	112	73	NR

S. No.	Chemical	Scenario	Leak Size (inch)	Weather	Distance in (m)		
					AEGL-1	AEGL-2	AEGL-3
3	Formaldehyde	Leaking tank, chemical is not burning and forms and evaporating puddle	1	1.5F	640	70	NR

Table 8-9: Consequence Distances for Thermal radiation from fireball

S. No.	Chemical	Scenario	Leak Size (inch)	Weather	Distance downwind to intensity level (m)		
					2 kW/m²	5 kW/m²	10 kW/m²
1	Methanol	BLEVE, tank explodes and chemical burns in a fireball	1	1.5F	602	381	263
2	Phenol	BLEVE, tank explodes and chemical burns in a fireball	1	1.5F	NR	NR	NR
3	Formaldehyde	BLEVE, tank explodes and chemical burns in a fireball	1	1.5F	NR	NR	NR

8.11 Risk Reduction Measurement & Recommendation

- Storage tank of Formaldehyde, Ammonia and methanol should be installed away from the plant area.
- Wind indicator should be provided at the highest level of the plant to know the wind direction.
- Automatic sprinkler system for the flammable material tanks (over ground tanks only) may be provided as knock on effect in case of fire is possible.
- Chemical storage shall be planned at the safe distance from the methanol. It should be ensured that combustible materials such as oiled rags, wooden supports, oil buckets etc. are not kept in the storage and process areas as well as road tankers loading/unloading sites where there is maximum possibility of presence of flammable hydrocarbons in large quantities, to reduce the probability of secondary fires.
- Hydrocarbon, smoke and fire detectors should be suitably located and linked to fire fighting system to reduce the response time and ensure safe dispersal of vapours before ignition can occur.
- Containment dykes with proper sloping and collection sumps should be provided so that any spillages in the bulk storage and other handling areas shall not stagnate and shall be quickly lead away to a safe distance from the source of leakage. This reduces the risk of any major fire on the bulk storages and the risk to the environment shall be minimized/ eliminated.
- Inspection of the storage tanks as per prefixed inspection schedule for thickness measurement, joint and weld efficiency etc.
- Provision of flameproof electrical fittings / equipment's.
- Proper maintenance of earth pits.
- Strict compliance of security procedures like issue of identity badges for outsiders, gate passes system for vehicles, checking of spark arrestors fitted to the tank lorries etc.
- Strict enforcement of no smoking.
- Periodic training and refresher courses to train the staff in safety fire fighting.
- Employee training and education
- Structural fireproofing in the process area could be considered as a safety measure in the light of probable spill and fires in the area.
- Emergency drills should be carried out periodically to ensure preparedness must continue.
- Many operations involve use of highly toxic/flammable materials and these needs to be documented as SOPs. These must be made and kept updated on priority.
- Extensive training on use of Self-Contained Breathing apparatus (SCBAs) must be ensured for emergency control.
- Many of the raw materials used for resin are either toxic or flammable. It is therefore important to ensure that these materials are stored in closed, well ventilated totally safe areas. A fire alarm system (heat and smoke detection) should be provided for the storage area where the material is stored as toxic fumes arise on combustion.
- Loose drums of waste materials, often solvent laden, must be removed from the working areas and close watch kept.
- Proper Earthing needs to be provided through plug type systems or through the agitators/liquid.
- Ventilation should be provided for any enclosed area where hydrocarbon or toxic vapors may accumulate.
- All personnel should be trained in handling emergency situations and should be apprised of their role in handling emergency situation and to ensure adequacy of the emergency procedures simulated exercise should be carried out.
- Flame arrestor should be provided.
- Adequate number of caution boards highlighting the hazards of chemicals should be provided at critical locations.
- Monitoring of occupational hazards like noise, ventilation, chemical exposure etc. will be carried out regularly and its record will be maintained.
- Good housekeeping, use of PPE, Engineering controls, Enclosure processes, scrubber system, display of safety boards, SOP of loading / unloading, local exhaust ventilation, safety shower etc. are important safety measures will be taken to keep these chemicals within TLV.
- Appropriate personal protective equipment will be provided & ensure the usage of them.
- Workers will be trained on safe material handling of hazardous chemicals.
- Prepare & display the safe operating procedure for hazardous chemicals storage, handling & transporting or using.
- Local exhaust ventilation and scrubber should be installed where it is required to reduce fumes, vapors, temperature and heat stress.

- Reduce the level of physical activity by sharing workload with other or by using mechanical means.

Following FIRE safety devices will be provided to protect from any malfunctioning of plant equipment's. Following fire protection systems will be provided.

- Water storage of adequate capacity to meet the requirements of water for firefighting purposes.
- Fire hydrants and automatic sprinkler system. Diesel driven pumps and headers to supply water to fire hydrant network.
- Adequate Portable fire extinguishers, sand bucket, wheeled fire & safety equipment should be provided at the required places.
- Equipment required for personal safety like blankets, gloves, apron, gum boots, face mask helmets, safety belts, first aid boxes etc. should be provided. Proximity suits and self-contained breathing apparatus to be provided.

9 Environment & Social Management and Monitoring Plan

This section presents the Environmental and Social Management Plan (ESMP) for the Project. The purpose of this ESMP is to specify the standards and controls required to manage and monitor environmental and social impacts during construction and operation phase. To achieve this, the ESMP identifies potential adverse impacts from the planned activities and outlines mitigation measures required to reduce the likely negative effects on the physical, natural and social environment. This is in accordance with the applicable reference standards which emphasizes the importance of managing social and environmental performance throughout the lifecycle of the Project.

9.1 Organizational Structure

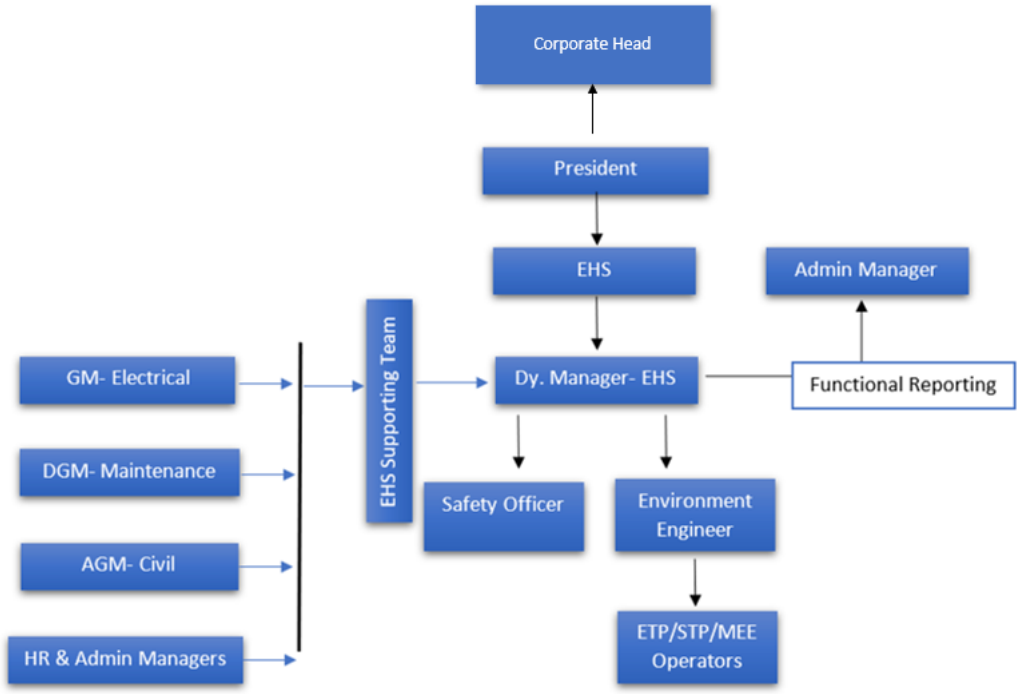
To ensure the efficacy of environmental and social management plan, certain institutional mechanism with well-defined roles and responsibilities is essential for effective implementation of identified mitigation measures both during construction and operation phases.

GSL has a dedicated EHS team onsite during the construction phase. The EHS team comprise of a dedicated onsite EHS Deputy Manager and a safety officer. EHS Deputy Manager is currently responsible for day to day management of EHS aspects, monitoring of contractor's performance as well as development of mechanisms for dealing with day to day environmental and social issues, going forward a safety officer will also be engaged to support EHS deputy manager. They also ensures that the activities of the contractors are conducted in accordance with good practice measures and implementation of E&S management measures as required through contractual documentation. At the time of site visit, EHS Deputy Manager and has already been deputed at site is currently looking after the EHS management at site. As understood, the EHS Deputy Manager has previous experience in the same sector and directly reports to the EHS Head. Refer to Details pertaining to organization structure of the construction phase have been elaborated in the Construction Phase Audit Report (Refer Appendix 23).

GSL will have ultimate responsibility for implementing the provisions of the ESMP during construction as well as operation phase. This role will include the on-going management of environmental and social impacts, monitoring of contractor's performance as well as development of mechanisms for dealing with day to day environmental and social issues. GSL will also ensure that the activities of its contractors are conducted in accordance with good practice measures, implementation of which will be required through contractual documentation.

Figure 9-1 presents the organization structure at the project level for the EHS team supported by various departments during operation phase. The organizational structure is supplemented with a brief understanding of the roles and responsibilities. This understanding is then followed by function integration at the corporate level and at the Project level. It also goes on to explain the inter-linkages of the function at the Corporate level, Project level and the EHS team.

Figure 9-1: EHS Organizational Structure- Operational Phase



Source: GSL

GSL's EHS team will be responsible for managing the contractor and sub-contractors engaged during different phases and will be responsible for implementation of mitigation measures. GSL will have a dedicated onsite EHS Head and EHS Deputy Manager for this Project during the operation phase. The EHS Deputy Manager will take the overall responsibility for co-ordination of the actions required for environment and social management and mitigation and for monitoring the progress of the proposed ESMP for the project.

9.1.1 Roles and Responsibilities

An outline for responsibilities of the proposed EHS team is given below:

Role	Responsibility
GSL Site EHS Team	• Preparation of required documents on environmental and social management. • Ensuring availability of resources and appropriate institutional arrangements for implementation of ESMP. • Implementation of the health and safety measures. • Collection of the statistics of health of workers. • Providing support during routine medical check-ups of workers. • Awareness and implementing safety programmes. • Providing job specific induction training. • Compliance of regulatory requirements. • Carrying out environmental audits. • Identify unsafe acts and conditions and suggest remedies. • Develop safety culture and comply with company's EHS policy and standard requirements. • Encourage and enforce the use of PPE's; • Educate all employees for the use of PPE's and safe practices; • Direct, coordinate and orient the safety activities; • Promulgate the spread of policy, objectives, rules and/or regulations; • Perform a thorough investigation of all accidents and review the recommendations to avoid any repetition; • Monitoring the progress of implementation of ESMP and • Reviewing and updating the ESMP as and when required for its effective implementation
EHS Head	• Ensuring implementation of Corporate IMS related requirements • Implementation of on-site procedures related to the E&S • Tracking of E&S compliance related aspects for regulatory and lenders' requirements • Ensuring availability of resources and appropriate institutional arrangements for implementation of ESMP. • Approving the annual EHS training calendar of the facility • Ensuring incident reporting to corporate level • Identifying training and capacity building needs at Plants and coordinating with HR on training • Supervision of implementation of the ESMP, ESAP and other action plans developed for the site • Communication and reporting • Development of KPI's, resolution of issues and managing the manpower and the project. • Review findings of internal audit and monitoring reports • Ensuring annual E & S reporting to Lenders • Control of all amendments, revisions, issues and circulation of SOP's pertaining to IMS
Dy. Manager-EHS	• To assisting the EHS Head in conducting assessment of social and environmental risks of project sites; • To coordinate with the state regulatory authorities for environmental approvals / permits; • Liaison and coordinate with the local community, local administration, police, medical facilities, fire station, etc.; • Awareness and implementing safety programmes; • Providing job specific induction training; • Develop safety culture and comply with company's EHS policy and standard requirements • Direct, coordinate and orient the safety activities • Promulgate the spread of policy, objectives, rules and/or regulations; • Perform a thorough investigation of all accidents and review the recommendations to avoid any repetition; • Monitoring the progress of implementation of ESMP and • Reviewing and updating the ESMP as and when required for its effective implementation

Role	Responsibility
	• To conducting meetings with the local communities
Safety Officer	• Conduct relevant EHS trainings for the site staffs. • Prepare and Collate E&S reports at the site level and share the same to the Project Head • Monitoring initiatives and progress against policy and other management systems to be submitted at the frequency established • Ensuring contractors, sub-contractors and vendors adhere to practices, trainings, etc. in line with E&S Policies and practices; • To supervising contractors and workers in reporting E&S violations and assisting them to effective implementation of corrective action & preventive action • Encourage and enforce the use of PPE's

9.2 Integrated Management System Manual

Greenlam Industries Limited (GIL) at the corporate level has a dedicated Integrated Quality Manual (IMS) which is benchmarked against requirements of ISO 9001:2015, ISO 14001: 2015 & ISO 45001:2018. The IMS is applicable to Greenlam's businesses and operations that it carries out either directly or in association with turnkey contractors and subcontractors throughout the life cycle of the projects. Processes covered in the Integrated Management System include –

- Recruitment, Selection, Training and other Human Resource Processes
- Plant Administration, Gardening, Housekeeping
- Material, Service and Vendor Selection
- Materials and Service Procurement, Purchase
- Security, Man and Material Movement Through Gates
- Material Inward, Outward, Unloading
- Storage, Paper Godown, Raw Material, Packing Material and Finished Goods Storage, Stores
- Planning, Production, Manufacturing (High Pressure Laminates, Decowood (Veneer), Mikasa Flooring,
- Doors & Frames, Prelam and Cubicles)
- Maintenance (Civil, Mechanical and Electrical), Project Execution and Utilities` Operation
- Information Technology (IT), Electronic Data Processing (EDP)
- Quality Control & Quality Assurance, Environment, Health & Safety (EHS) Activities and Fire Safety
- Export and Domestic Dispatch,
- Water Storage, Filtration, Treatment, Distribution, Heating, Cooling, Reuse and Recycling
- Plant Related Internal and External Communications
- Statutory and Other Compliances, Certifications etc.
- Visitor, Vendor, Contractor and Contract Manpower Management

The developed IMS manual includes QEHS Policy, Procedures, Work Instructions and SOPs, Formats and Checklist for record keeping. GSL will be responsible for effective implementation of the IMS at the manufacturing site. The developed procedures have been mentioned below:

- Hazard Identification and Risk Assessment: The objective of the procedure is to establish, implement and maintain a process for hazard identification that is ongoing and proactive. The developed procedure includes a process to: (i) Identify OH&S Risks and Opportunities (ii) Opportunities to reduce risks and eliminate hazards. The procedure identifies the type of hazards, source of identification, risk consequence, matrix for hazard identification as well as risk matrix.
- Aspect-Impact Analysis: This procedure is to maintain documented information for its (i) environmental aspects and associated environmental impacts (ii) criteria used to determine its significant environmental aspects and (iii) significant environmental aspects. The developed procedure also includes process flow for aspect impact analysis.
- Emergency preparedness and response: This procedure includes the following components
    - potential emergency situations, including those that can have an environmental impact.
    - Implementation and maintenance processes needed to prepare for and respond to potential emergency situations.
    - Hazard Identification to consider Potential Emergency Situations.
    - Preparation guidelines for updated on-site emergency plan and details to authority for off-site emergency plan and required trainings
- Training and awareness

- Waste Management
- Permit to Work & Lockout-Tagout
- Incident management system
- Management Review
- Covid-19 Prevention
- Safe shutdown process

GSL to develop Project specific SOP's during operation phase. Post aligning of IMS with the requirement of IFC, The SOP's to be updated.

9.3 Existing Policies of Greenlam Industries Limited

9.3.1 Quality, Environment and Health & Safety (QEHS) Policy

Currently Greenlam Industries Limited has existing Quality, Environment and Health & Safety (QEHS) policy for its existing sites at Behror, Rajasthan and Nalagarh, Himachal Pradesh. Operations of both the facilities include the proposed operations of the current site i.e., manufacturing High Pressure Decorative Laminates, High Pressure Veneers, Veneered Decorative Plywood , Fire Rated and Non-Fire Rated Doors & Frames, Pre Laminated Particle Boards, Pre Laminated Medium Density Fibre board and Engineered Wood Flooring etc. The key objectives of the QHSE policy are as follows:

- strive to achieve Zero accident, zero defect and zero occupational disease in all products, processes and operations
- provide safe and healthy working conditions for the prevention of work-related injury and ill health
- eliminate hazards and reduce OH&S risks using hierarchy of controls. i.e. .. elimination ,substitution, engineering, administrative and personal protective equipment controls
- comply with all applicable statutory and other applicable requirements related to occupational safety & health, environment and quality that are relevant to its products, processes and operations
- fulfil customer requirements and try to exceed them wherever feasible
- integrate QEHS requirements in all of its processes and operations
- minimize our ground water consumption by recycling & reuse of our waste water and other practical measures
- Ensure consultation and participa1ion of workers' represen1atives in QEHS processes.
- Comply with other requirements that may be applicable 1o our products, services and operations due to any association, collaboration and subscription.
- continual improvement of QEHS management system
- Provide necessary resources to implement the policy and to achieve its objectives
- protect environment and prevent pollution by encouraging to plant and grow trees, promoting positive impact of its processes on environment, and minimizing negative impacts of its processes on environment

As reported QEHS policy on the lines of the existing policy will be developed for this facility.

9.3.2 Policy for association with Forest Stewardship council

Forest Stewardship Council (FSC) works to protect forests for future generations. The Policy for Association is a unique tool that allows us to clearly define FSC's ability to take such action against companies that engage in any one of the activities listed as unacceptable.

These unacceptable activities are:

1. Deforestation
2. Destruction of High Conservation Values
3. Illegal logging and illegal trade of timber
4. Human and traditional rights violations
5. Workers' rights violations
6. Use of genetically modified organisms

An association with FSC is formally established through any of the following contractual relationships: FSC membership agreement; FSC certificate holder license agreement; FSC certification body license agreement; FSC partnership agreement. FSC receives information about possible violations of the Policy for Association from various channels: official complaints from concerned stakeholders, media and NGO reports about companies engaging in unacceptable activities, ongoing legal cases against companies, etc.

Regardless of the source of the allegation, FSC collect and assess the evidence available to decide if there has indeed been a violation of the Policy for Association. If there is credible evidence of a violation, then FSC either begins a mediation process or launches an investigation.

Mediation: Alternative dispute resolution

In cases where FSC does not launch an investigation, it focus on finding solutions to concerns raised through other means, such as a mediation process. In this process, an independent mediator leads discussions between the complainant and the company accused of engaging in an unacceptable activity. The ultimate goal of this process is for all parties to agree on a remediation pathway that will bring about restitution and restoration.

Investigation

All concerns which FSC investigate are subject to the same rigorous process. FSC look for credible evidence of widespread wrongdoing before triggering an investigation. Based on the outcomes of the investigation, FSC's Board decides if FSC should disassociate from the corporate group. Such action is only taken against an organization where credible allegations are confirmed by independent investigators.

The investigation team delivers their report to FSC, complete with the evidence and level to which each allegation was verified. This report is presented to the FSC Policy for Association Decision Panel who will assess the conclusions of the investigation. The Panel may decide to recommend that FSC Board of Directors make the decision on excluding organization from the FSC scheme.

Exclusion

Upon being excluded from the FSC scheme the organization's trademark license agreements are immediately terminated, all certificates are withdrawn and they are blocked from further certification and association such as membership.

This exclusion extends beyond the organization found to engage in unacceptable activities, applying to any parent, subsidiary or sister company connected by more than 51% ownership. All companies are blocked from any FSC certification until a complete remedy and reform process has been fulfilled and all requirements met.

Excluded organizations can re-enter the FSC scheme after exhibiting the fulfilment of conditions addressing remedy caused by past harm and reformation. Only after concrete proof that these requirements have been fulfilled can the organizations potentially re-enter the FSC scheme.

9.4 Review and Reporting

Regular inspection and monitoring of the environmental and social aspects as part of construction and operation phase activities will increase the effectiveness of the implementation of this system and will ensure that Policies, Management Plan and ESMP is addressing the most relevant risks. Through the process of inspection, audit and monitoring, GSL will ensure that all the requirements of the applicable framework, as suggested in the report, are effectively met. The inspections and audits will be done by GSL (project team) as well as Corporate team (GIL) and the entire process of inspections and audits/ monitoring will be documented.

GSL will develop and implement a programme of regular reporting through the stages of the project lifecycle. The personnel delegated EHS roles shall be required to fully comply with the monitoring programme in terms of timely submissions of reports as per acceptable level of detail. Reporting will be done in form of environmental checklist, incident record register, training records, and environmental and social performance reports (weekly, monthly, quarterly, half-yearly, yearly etc.) for example environmental check list, incident record register, training records etc in line with the IMS developed by GSL.

Methods of communication have been designed into Management Procedures and Operational Procedures to promote interaction between all levels of the company. Responsibilities have been defined below for recording, reporting and sharing of data and information.

- Project Manager – Report E&S concerns to EHS Manager and review internal E&S and reports to senior management on the effectiveness of implementation.
- Site EHS Manager & Supervisor– Monitors and implements the Plans and Procedures

9.5 Inspection, Monitoring and Audit

Inspection and monitoring of the environmental impacts of the Project activities will increase the effectiveness of Management Plans and ESMP. Through the process of inspection and auditing, GSL will ensure that the conditions stipulated in various permits are complied. The inspections and audits will be done by trained personnel of GSL subject to be reviewed and conducted by EHS experts or external experts. The inspection and audit findings are to be implemented by the Project Manager in their respective projects. Following EHS&S monitoring schedule to be implemented at GSL facility.

Type or Monitoring and Audit	Frequency	Accountability
Routine inspections and monitoring	Fortnightly	Safety Officer and respective HOD's
Compliance to E&S licenses and legal compliance	Six Monthly	EHS Manager and HR Manager
Internal Audit (Including EHS, OHS, Supply chain, contractor management etc)	Half Yearly	EHS Manager & Plant Head

EHS Team at project level will ensure that permits for the projects under all applicable laws under national legislations are in place, current and valid. The EHS Personal, if necessary, in consultation with Legal and Compliance Team will regularly review the regulatory environmental and social licenses applicable to the project. Based on the required licenses, the EHS Personnel will maintain a document on monthly basis and update the license files. Project specific legal register should be available which include details of the existing permits and licenses, their validity and next renewal date, conditions stipulated under the particular permit, and how the project is complying with the condition. Any non-compliances will be immediately identified and corrective action will be taken accordingly.

Internally, the personnel delegated EHS roles, will share inspection and audit findings with their suggested measures regularly to the senior management and further to corporate level for their consideration. The same are also to be communicated within the staff working on the project. To maintain an open communication between the staff and management on EHS and social issues the followings are being used:

- Team Briefings
- On-site work group meetings; and
- Work Specific Instructions

9.6 ESMP review and amendments

The ESMP acts as an environment and social management tool which needs to be periodically reviewed to address changes in the organization, process, or regulatory requirements.

Following a review, EHS department in coordination with personnel delegated EHS will be responsible for making the amendments in the ESMP and seeking approval from the authorities. The amended ESMP will be communicated to all the staff on the Project. Also, review and updation of the ESMP to be undertaken on regular intervals, i.e., once every two years to update and amend the ESMP (Please note this annual review of the ESMP is to be undertaken in addition to regular amendments to ESMP).

9.7 Trainings and Capacity Building

Training is needed for effective implementation of ESMP. The training programme will ensure that all concerned members of the team understand the following aspects:

- Purpose of management plan for the project activities
- Requirements of the management plan and specific action plans
- Understanding the sensitive environmental and social features within and surrounding the project areas
- Aware of the potential risks from the Project activities
- GSL will ensure that environmental health and safety induction training and job specific trainings are identified and given to the concerned personnel during both construction and operation phase.
- Also general environmental awareness will be increased among the project team to encourage the implementation of environmentally sound practices and compliance requirements of the project activities. This will help in minimizing adverse environmental impacts, compliance with the applicable regulations and standards, and achieving performance beyond compliance. The same level of awareness and commitment should be imparted to the contractors and sub-contractors prior to the commencement of the project.

Some of the specific trainings that will be carried out on routine basis have been provided below

SN	Type of Training	Project Team	Contractors & Subcontractors
1.	Environmental, Health & Safety	✓	✓
2.	Occupational Health & Safety	✓	✓
3.	Safety Induction	✓	✓
4.	Fire Safety and Prevention	✓	✓
5.	Electrical Safety	✓	✓
6.	Equipment Handling and Machinery Use	✓	✓
7.	Material Handling	✓	✓
8.	Training of security personnel on behavioural aspects	✓	✓
9.	Emergency Response Preparedness	✓	✓
10.	Lock Out & Tag Out	✓	✓
11.	Operational Training	✓	✓
12.	Hazard Identification & Risk Assessment	✓	✓
13.	First Aid	✓	✓
14.	Incident/Accident Reporting and Investigation	✓	✓
15.	Near Miss Reporting	✓	✓
16.	HR Induction Training	✓	✓
17.	Transportation	✓	✓
18.	Handling of Chemicals and Hazardous waste	✓	✓
19.	Spill Control	✓	✓
20.	Contractor Management Training	✓	×
21.	PPE Training	✓	✓
22.	Biodiversity conservation, water management, pollution prevention	✓	✓
23.	Stakeholder engagement and grievance management	✓	×

The above listed trainings are the mandatory trainings which will be undertaken at the inception stage once the employee/worker joins the Company and/or Project. Post that, monthly refresher trainings can be undertaken, especially for the workers as per their skill level. Any other applicable training will be identified and implemented during the project lifecycle as per the need assessment, as part of mitigation measure and also capacity building of the staffs.

Also, general environmental awareness will be increased among the project's team and workers to encourage the implementation of environmentally sound practices and compliance requirements of the project. This will help in minimizing adverse environmental impacts, compliance with the applicable regulations and standards, and achieving performance beyond compliance.

The same level of awareness and commitment will be imparted to the contractors and sub-contractors prior to the commencement of the project. In case of subcontractors, the training and capacity building will be done by the GSL EHS Team. Trainings will be conducted in a language and format understandable to the target audience.

Trainings imparted at the Project will be documented. The documentary proof of trainings imparted will be held as hard copy and as soft / digital copy. The records of each training will include the following details:

- Day / Date;
- Name of personnel providing the training, and their designation;
- Training topic and coverage;

- Location;
- Time and Duration of training;
- List of equipment used;
- Name of all participants, along with signatures; and
- Photo log with time stamp

9.8 Environment and Social Management Plan

This section outlines the potential impacts, mitigation measures, monitoring and management responsibilities during construction and operation phases of the Project. The purpose of ESMP is to:

- Provide an institutional mechanism with well-defined roles and responsibilities for ensuring that measures identified in ESIA designated to mitigate potential impacts are implemented
- List all suggested mitigation measures and control techniques, safeguards identified through the ESIA process
- Provide project monitoring program for effective implementation of the mitigation measures and ascertain efficacy of the environmental & social management and risk control system in place
- Assist in ensuring compliance with all relevant legislations at local, state and national level for the Project.

Separate Construction and Operation Phase ESMP for the project has been presented in ***Table 9-1.***

9.9 Documentation

Documentation is an important step in the implementation of the ESMP. Responsibilities have to be assigned to relevant personnel for ensuring that the ESMP documentation system is maintained, and that document control is ensured through access by and distribution to, identified personnel in form of the following:

- Legal Register
- Operation control procedures
- Incident reports
- Emergency preparedness and response procedures
- Training records
- Monitoring reports
- Auditing reports; and
- Complaints register and issues attended/closed

Table 9-1: Environment and Social Management Plan

Sr. No.	Environmental/Social Resources	Impact/Issues	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of verification that mitigation has been met	Timeline/Frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
				Construction Phase						
1.	Management Plans	-	Construction Phase	• GSL to develop project specific SOP's and procedures. • The Waste management SOP to be updated based on the latest rules and amendments. Also, the waste management plan to be updated to include waste handling and storage requirements. • GSL to update the existing IMS procedures to be aligned with the requirements of IFC PS standards. The SOP's developed to be updated to include Air, Water and Noise Pollution Prevention and Management Procedure and Community Health & Safety Management Plan	GSL Project Management team	Updated SOPs	--	Project EHS representative	Project management team	--
2.	Policies	--	Construction Phase	• GSL should update the GRM procedure and include the provision of addressing the external grievances including community. • The GSL should widely display the GRM policy and procedure in the local language at conspicuous places and install complaint boxes. • GSL should establish the system for receiving , recording and tracking of grievances (as open and closed) and same should be reported to GRC on fortnightly basis. • GSL should form the project level GRC (Grievance Redressal Committee) and GRC should hold monthly meetings and minutes of the meeting of GRC should be recorded. • The workers and stakeholder should be made aware about the GRM policy and procedure • GSL should update the stakeholder engagement plan include the relevant stakeholder and accordingly carry out the engagement activities	GSL Project Management team	Copy of GRM updated policy and procedure	--	Project EHS representative	Project management team	--
3.	Organization Structure	--	Construction Phase	• GSL to train their EHS team on the requirements of IFC PS and other GIIPs.	GSL Project Management team	Training Records	--	--	Project management team	--
4.	Emergency Preparedness	--	Construction Phase	• The EPRP should include provision of emergency notifications to adjacent facilities. • The nearest hospital, ambulance, fire station and police station should be identified in the implemented emergency management plan	GSL Project Management team	Updated EPRP	--	--	Project management team	--
5.	Grievance Redressal Mechanism & Stakeholder Engagement	--	Construction Phase	• GSL should update the GRM procedure and include the provision of addressing the external grievances including community. • The GSL should widely display the GRM policy and procedure in the local language at conspicuous places and complaint boxes should be installed . • As per the GRM policy, GSL should establish the system for receiving , recording and tracking of grievances (as open and closed). • GSL should form the project level GRC (Grievance Redressal Committee) and GRC should hold monthly meetings and minutes of the meeting of GRC should be recorded.	HR/EHS and project management team	Copy of GRM updated policy and procedure; Training records , photographs and attendance sheet	--	--	Project management team	--

Sr. No.	Environmental/Social Resources	Impact/Issues	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of verification that mitigation has been met	Timeline/Frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
				• The workers and stakeholder should be made aware about the GRM policy						
6.	Air Quality	Particulate, fugitive and vehicular emission	Construction Phase	• Emissions from the D.G. set and other stationary machines will be controlled by ensuring that the engines are always properly tuned and maintained; • Cease or phase down work if excess fugitive dust is observed. Investigate the source of dust and ensure proper suppression measures; • Idling of vehicles and equipment must be prevented • GSL to ensure that the soil and sand stored within site are covered with tarpaulin. Also, it is to be ensured that the material being transported to the site is to be covered. • GSL to ensure that the access road with the site and near the construction area sprinkled regularly and kept damp	Contractor's EHS representative	Visual Observation and EHS Inspection	Monthly	Project EHS representative	Project management team	Report from contractor's EHS team to GSL EHS team
7.	Noise Quality	Impacts on receptors due to noise	Construction Phase	• Only well-maintained equipment should be operated on-site; • If it is noticed that any particular equipment is generating too much noise then lubricating moving parts, tightening loose parts and replacing worn out components should be carried out to bring down the noise • Machinery and construction equipment that may be in intermittent use should be shut down or throttled down during non-work periods; • Minimal use of vehicle horns and heavy engine breaking in the area needs to be encouraged • Anti-honking sign boards to be placed in the parking areas and at entry / exit points	Contractor's EHS representative	Visual Observation and EHS Inspection	Monthly	Project EHS representative	Project management team	Report from contractor's EHS team to GSL EHS team
8.	Soil Environment	Soil Erosion and Compaction	Construction Phase	• The stock piles of the soil should be kept moist/covered to avoid wind erosion of the soil; • As a best practice, site clearance, piling, excavation and access road strengthening will not be carried out during the monsoon season to minimize erosion and run-off	Contractor's EHS representative	Visual Observation and EHS Inspection	Monthly	Project EHS representative	Project management team	Report from contractor's EHS team to GSL EHS team
9.	Soil Environment	Soil Contamination	Construction Phase	• During servicing/repair of equipment or vehicles, a drip tray to be used to prevent oil/grease spills onto the soil, especially in case of emergency repairs; • Waste to be managed as per the site specific waste management plan (refer as appendix 5) as well as hazardous material management plan (refer appendix 6) • Oil spill kits should be maintained onsite to handle minor leaks and spillage • Contractor should ensure that no unauthorized dumping of used oil and other hazardous waste is undertaken; • Designated areas should be provided for Municipal Solid Waste and daily collection and period disposal should be ensured; • Construction and Demolition Waste should be stored separately and be periodically collected by an authorized treatment and storage facility; • All waste should be stored in a shed that is protected from the elements (wind, rain, storms, etc.) and away from natural drainage channels; • Hazardous material should be kept on impervious layer with secondary containment • A log book should be maintained for quantity and type of hazardous waste generated;	Contractor's EHS representative	Visual Observation and EHS Inspection	Monthly	Project EHS representative	Project management team	Report from contractor's EHS team to GSL EHS team

Sr. No.	Environmental/Social Resources	Impact/Issues	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of verification that mitigation has been met	Timeline/Frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
				• Daily collection and period disposal should be ensured for waste generated on site • Contractor should ensure that no unauthorized dumping of used oil and other hazardous waste is undertaken • Construction and Demolition Waste should be stored separately and be periodically collected by an authorized treatment and storage facility; • Use of spill control kits to contain and clean minor spills and leaks; • Unloading and loading protocols should be prepared for diesel, oil and used oil respectively and workers trained to prevent/contain spills and leaks, and • In case of accidental/unintended spillage, the contaminated soil should be immediately collected and stored as hazardous waste • As a best practice, site clearance, piling, excavation and access road strengthening will not be carried out during the monsoon season to minimize erosion and run-off						
10.	Water Resources	Water availability	Construction Phase	• Regular inspection for identification of water leakages and preventing wastage of water is necessary for efficient utilization of water; • Blending of low quality water with fresh water for construction uses to ensure efficient use of natural resource; and Recycling/reusing to the extent possible	Contractor's EHS representative	EHS Inspection	Monthly	Project EHS representative	Project management team	Report from contractor's EHS team to GSL EHS team
11.	Water Resources	Water Contamination	Construction Phase	• Spill/ leakage clearance plan to be adopted for immediate cleaning of spills and leakages • Separate designated area for storage of hazardous waste to be provided, Hazardous material should be kept on impervious layer with secondary containment, • In case of accidental/unintended spillage, the contaminated soil should be immediately collected and stored as hazardous waste • Periodically monitor the ground water quality and ground water levels. Ground water quality and water levels to be monitored on half yearly basis, during pre- and post-monsoon	Contractor's EHS representative	EHS Inspection	Monthly	Project EHS representative	Project management team	Report from contractor's EHS team to GSL EHS team
12.	Topography and Drainage	Change in topography due to site levelling and excavation	Construction Phase	• The GSL shall ensure that no natural watercourse and/or water resources will be obstructed due to any industrial operations • To the extent possible, disruption/alteration of micro-watershed drainage patterns are being avoided	Contractor's EHS representative	EHS Inspection	During site levelling and excavation work	Project EHS representative	Project management team	Report from contractor's EHS team to GSL EHS team
13.	Community Health & Safety	Accidents, fire hazard	Construction Phase	• GSL to develop a Community Health & Safety Plan • GSL to ensure and limit the use of access road during peak hours to avoid congestion and risks of accidents • Dedicated route for deployment of heavy-duty vehicles should be defined. • Trucks/ dumpers will be covered by tarpaulin sheets during off site transportation; • GSL to use Enclosures, mufflers, anti-vibration mats for all high noise and vibration generating machinery • Limiting the use of access road during day time to avoid congestion and risks of accidents • Trucks/ dumpers will be covered by tarpaulin sheets during off site transportation; • Anti-honking sign boards to be placed in the parking areas and at entry / exit points	Contractor's EHS representative	EHS Inspection	Monthly	Project EHS representative	Project management team	Report from contractor's EHS team to GSL EHS team

Sr. No.	Environmental/Social Resources	Impact/Issues	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of verification that mitigation has been met	Timeline/Frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
				• As part of the stakeholder engagement and information disclosure process, the community will be provided with an understanding of the activities to be undertaken and the precautions taken for safety; • Installing mandatory suitable mufflers on engine exhausts and compressor components as the ambient noise levels are already exceeding the ambient air quality standards • Dedicated safety sign boards in local language should be provided around the project site. Dedicated safety sign boards in local language should be provided around the project site					
14.	Occupational Health & Safety	Electrocution, accident, fire hazard, respiratory and hearing problems while working at site	Construction Phase	• Workers who are engaged in welding works will be provided with welder's protective eye shields; • The use of any toxic chemical will be strictly in accordance with the manufacturer's instructions; • Electrical and maintenance work should not be carried out during poor weather and during lightning strikes; • Obtain and check safety method statements from contractors; • Monitor health and safety performance and have an operating audit system; • Training of the workers on climbing techniques, and rescue of fall- arrested workers; • Appropriate safety harnesses and lowering/raising tools should be used for working at heights; • Lifting operations are carried out with proper plans and with equipment of adequate capacity; • As part of the contract agreements, the contractor will be required to ensure provision of basic amenities of drinking water, adequate number of toilets, wash rooms, sanitation and cleanliness, lighting, availability of provisions and groceries to the labours; • A first aid box with adequate medicines to be provided at the site and appoint a trained person to take charge of it. The location of first aid arrangements to be displayed on site; • All equipment should be turned off and checked when not in use; • The nearest hospital, ambulance, fire station and police station should be identified in the implemented emergency management plan; • Establish a grievance redressal mechanism in place, to allow for the employees and workers to report any concern or grievance related to work activities. • The contractors to ensure that all the workers engaged are using adequate PPE's and implementation of COVID appropriate guidelines	Contractor's EHS representative	EHS Inspection	Monthly	Project EHS representative	Project management team	Report from contractor's EHS team to GSL EHS team
			Socio-Economics - Construction Phase							
15.	Socio Economic Impacts	Working Conditions and Terms of Employment (include migrant workers and	Construction Phase	• GSL should ensure the all the mandatory records with respect to labor compliance such as wage , holiday and attendance register are maintained at site. • All the workers should be provided with the PF (UAN) account number and EISC cards. • GSL should ensure the compliance to applicable labour laws and carry out periodic monitoring of the compliance labor laws especially with regards to the payment of	HR& Admin/ Project Management /contractors	Updated workers accommodation policy, Inspection, approved Revised drawings , Bills, inspection check list , Fitness checks and training records	Daily, & Fortnightly	Project HR/ EHS Head	Project management team	Inspection report to project head

Sr. No.	Environmental/Social Resources	Impact/Issues	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of verification that mitigation has been met	Timeline/Frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
		worker's housing)		wages including payment of equal wages and other related acts. • GSL should provide necessary training to subcontracted workers on GRM and widely display the GRM process. • The GSL should develop/modify the labor camps as per Workers' accommodation: Processes and standards by IFC. • GSL should ensure that the camps should have proper thermal insulation and protection from the insects. • Adequate drainage facility & disposal bins shall be provided within the camps after proper inspection. • GSL should ensure that the use of (WHO) approved insecticide to avoid spread of any vector borne diseases . • The camps should be provided with the adequate facility of cooking , safe fuel and fire fighting arrangements • GSL should carry out periodic monitoring of the labor camps to ensure the proper sanitary and health and hygiene conditions of the camps to be maintained all the times during the construction period including checking of parameters of noise, dust and drinking water.						
16.	Socio Economic Impacts	Unhygienic and unsafe living conditions due to labour influx	Construction Phase	• The accommodation facility for regular employees /workers should be constructed to meet the requirement of IFCs worker camp recommendation guideline. • As the construction of the project was already started the camps should retrofitted to meet the basic requirements of the above-mentioned guidelines such as room should be properly ventilated, with adequate bed and beddings, widows & doors should have insect nets, proper electrical connections with fan or any other arrangements for thermal comfort, there should be separate toilet blocks for men and women, separate bathing and washing space, rooms should have proper • Separate space for cooking , washing utensils and storage of food and fuel • The camps should be equipped to handle fire emergency. • Regular spray and other mechanism for disease control including health monitoring • Develop check list for regular Review & monitoring of the camps especially of the health and sanitation aspect and Dos & Don'ts to check any potential violence , substance, and alcohol abuse. • The Project shall provide training or induction program related to the gender sensitization and gender-based violence to all employees at the time of commencement of their job	HR& Admin/ Project Management /contractors	Updated workers accommodation policy, Inspection, approved Revised drawings , Bills, inspection check list , Fitness checks and training records	Daily, & Fortnightly	Project HR/ EHS Head	Project management team	Inspection report to project head
17.	Socio Economic Impacts	Increased Local Employment & Livelihood	Construction Phase	• Project should align and update their HR polices with the requirement of PS 2 and ensure the compliance of applicable labour laws • All the staff and workers working at plant should be provided with necessary HR and Labour induction training and accordingly develop the annual training calendar • The contract terms with wood supply aggregators should explicitly mention about the compliance of appliable labour laws and other requirements of PS-2 such as prohibition of child labour, forced labour, payment of minimum wages, safe working conditions etc. • Carry out quarterly labour and working conditions audit • During initial phase separate six monthly labour audits should be carried out for wood aggregators to ensure the	HR & Admin/ Contractors/ CSR/ Procurement	Updated HR Polices , training calendar, training records, labor & working conditions Audit , SEP and GRM and records for consultations and grievances	Fortnightly & Monthly	HR & Amin/CSR/ procurement /Contractor	Project HR/EHS team	Labor compliance/livelihood and working conditions report to project head

Sr. No.	Environmental/Social Resources	Impact/Issues	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of verification that mitigation has been met	Timeline/Frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
				compliance of labour laws and companies EHS polices. One they are trained the frequency of audit may be reviewed. • Develop stakeholder engagement plan as part of engagement plan /, organize annual famers meet or open forums where they can raise their potential concerns. • Establish strong grievance management system covering contracted workers, farmers and other stakeholder and carry out proper disclosure of the GRM and have the dedicated resources of the implementation of the system • Project should develop guidelines/policies towards local employment and livelihood opportunity enhancement and include the local employment reporting the annual report. • Project should proactively disclose the local labour and other reequipment at notice board and there should be open door policy towards local vendors registration • Preference should be provided to local labour. However, the preference shall be based on available skillset and knowledge • Project shall provide equal access to both female and male local population in available employment opportunities and for greater employability of residents, technical/vocational training may be arranged for female and male, if required • Establish the functional stakeholder engagement including external communication plan and roll out grievance handling mechanism which should have provisions for receiving external grievances as well. • The project proponent will establish a mechanism to audit sub-contractors and suppliers with respect to compliance of utilizing local labour and resources						
				Ecological Impacts- Construction Phase						
18.	Ecological Impacts	Impacts on the Construction Phase Habitat and Species due to Construction Activities		• Night-time (6:00 pm to 6:00 am) construction and transportation activities should be avoided • The areas of high animal activity, such as forests and water bodies the construction and transportation activities should be avoided during dawn (6:00 am to 7:30 am) and dusk (5:00 pm to 6:30 pm) • Hazardous materials should be avoided to store near water body and drains • Temporary fencing should be installed over excavated areas • Efforts should be made to minimize construction noise and sound barriers should be considered if noise levels are high • Construction activities must implement proper housekeeping, properly dispose of discarded packaging materials, and provide labor camps with adequate sanitary facilities • Movement of workers between camps and construction sites should be restricted and they should not be allowed to visit in natural areas not included the planned construction activities	Contractor's EHS representative	EHS Inspection	Monthly	Project EHS representative of GSL	Project HR/EHS team	Report from Contractor EHS team to GSL EHS team
				Operation Phase						
								Physical Environment Operation Phase		

Sr. No.	Environmental/Social Resources	Impact/Issues	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of verification that mitigation has been met	Timeline/Frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
19.	Air Emission	Flue gas emission, dust emission and vehicular emission, particulate matter and VOC's	Operation phase	***Air Emissions Management*** • GSL to properly operate and maintain multi-stage scrubbers to the process vents to control the process emissions. GSL shall ensure that online pH measuring facility with auto recording system is connected to the scrubbers. • GSL to implement adequate measures to control all fugitive emissions from the plant. • In case of failure to achieve the prescribed emission as guaranteed by the manufacturer which is in compliance to the emission norms as per CPCB Guideline, GSL will replace APCD devices with better technology or as per the technology prescribed by MoEFCC • According to the Point Source Air Emissions Prevention and Control Technologies provided in IFC EHS guidelines for air emissions and ambient air quality, the reduction efficiency of fabric filter should be 99-99.7% and that of ESP should be 97-99%. • Electrostatic Precipitator (ESP) shall comply with the specifications defined by Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2010 • Coal dust would be generated generally at the conveyor transfer points, coal unloading area and coal stockpile area. Hence, track hopper, coal transfer points and coal stockyard to be provided with dust suppression facilities. • Dust collection system to also be provided in coalbunkers to evacuate dust and hazardous gases like Methane from the coalbunkers. Collected dust to be returned to either the associated belt conveyor or to the coalbunker. The dust collector outlet emission would be restricted to 100 mg / Nm^3. • GSL to store fly ash specifically in hopper/silos and should be periodically maintained to avoid overloading of fly ash • Characteristic analysis of ash content should be conducted prior to disposal of ash to the farmers. • GSL to ensure that handling of wooden chips and particles is undertaken by pneumatic means rather than by open conveyor or by bulk transport. Enclosures of wooden chip storage area to be provided. • Proper maintenance of engines and use of vehicles with Pollution Under Control (PUC) Certificate within the project premises • Sudden acceleration or de-acceleration of vehicles produces more pollution than a vehicle maintaining a constant speed. Smoother flow of traffic within the parking area and within the project premises would ensure lesser pollution from the vehicles; ***Indoor Air Quality Management*** • Formaldehyde emissions to be reduced at source by limiting the press temperature to the minimum feasible level, and formulating resins to minimize excess formaldehyde • GSL shall not use or generate odour causing substances or Mercaptans and cause odour nuisance in the surroundings.	GSL EHS representative	EHS Inspection	Quarterly	Project EHS representative of GSL	EHS Head at GSL	Report from EHS team to Project head and further to corporate team

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				• The evaporation losses in solvents to be controlled by taking the following measures: • Chilled brine circulation to be carried out to effectively reduce the solvent losses into the atmosphere. • Transfer of solvents to be done by using pumps instead of manual handling. • Closed centrifuges to be used to reduce solvent losses. • All the solvent storage tanks to be connected with vent condensers to prevent solvent vapours. • The reactor vents to be connected with primary & secondary condensers to prevent escaping of solvent vapor emissions into atmosphere. • Raw materials and chemicals required for resin manufacturing to be transported in closed containers or trucks • Manufactured resin to be stored in a separate area • Adoption of good housekeeping practices • Fugitive emissions from storage tanks will be avoided by providing air condensers • GSL to ensure that handling of wooden chips and particles is undertaken by pneumatic means rather than by open conveyor or by bulk transport. Enclosures of wooden chip storage area to be provided. ***Monitoring Measures*** • GSL shall properly Continuous Emission Monitoring System and maintain the monitoring system to all the stacks / vents in the plant. GSL to display online data outside the main factory gate on quantity and nature of hazardous chemicals being used in the plant, water & air emissions and solid waste generated within the factory premises, as per Hon'ble Supreme Court order. • Data on ambient air quality will be regularly submitted to the Ministry including its Regional Office located at SPSR Nellore and the State Pollution Control Board/ Central Pollution Control Board once in six months • GSL to comply with all the conditions stipulated in the EC dt.06.01.2022 issued by SEIAA, A.P. • GSL to ensure compliance of the National Ambient Air quality standards notified by MoEFCC, GoI vide notification No. GSR. 826 (E), dated. 16.11.2009 and IFC/WB standards during operational phase of the project at the periphery. • GSL to calculate the GHG emissions annually • Proper maintenance of engines and use of vehicles with Pollution Under Control (PUC) Certificate • Sudden acceleration or de-acceleration of vehicles produces more pollution than a vehicle maintaining a constant speed. Smoother flow of traffic within the parking area and within the project premises would ensure lesser pollution from the vehicles; • Indoor air quality to be monitored for VOC and hazardous air pollutant (HAP) emissions. GSL to properly operate and maintain VOC monitoring system with auto recording facility. As a best practice, a three tier plantation of 15 m width along the project boundary may be done to suppress air emissions. Details					

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				for tree species have been included in the Greenbelt map, however, the species proposed are ornamental in nature and do not contribute to emission sequestration. The It is recommended to plant native species/emission sequestration species. GSL to engage a third party consultant for identifying the species for plantation.					
20.	Noise Quality	Impacts on receptors due to noise	Operation Phase	• Enclosures, noise and vibration mufflers, acoustic barriers and anti-vibration mats to be provided at places with high noise generation process or machineries; • Pump operators (near STP, storage tanks, hoppers etc.) are generally exposed to higher noise. Housing / casing will be provided for all noise generating machines. • Debarking and chipping should be carried out in enclosed space/building • Installing acoustic barriers without gaps and with a continuous minimum surface density of 10 kg/m2 in order to minimize the transmission of sound through the barrier from high noise areas and/or high noise generating machineries . Barriers should be located as close to the source or to the receptor location to be effective • GSL to restrict the noise generation from steam turbine generator and other major equipment ≤ 85 dB(A) at a distance of 1 m to comply with the Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2010. • Periodic inspection of the project equipment should be conducted • Adequate PPE's (earmuffs, earplugs) to be provided to employees working in high noise generation area's and machineries • Quarterly indoor noise monitoring to be undertaken (while the plant is fully operational) to mitigate or manage high noise levels and implementation of noise management measures • Periodic noise monitoring should be conducted on quarterly basis or as per CTO obtained for the project operations at site to ensure noise parameters are within prescribed MoEFCC guideline as well as IFC EHS guidelines. • The noise sampling and monitoring should be conducted for 48 hours with the use of noise monitors that should be capable of logging data continuously over this time period • DG sets should be provided with acoustic enclosures • Strict adherence to maintenance schedule of generators, as specified by vendors • Limiting the hours of operation for specific pieces of equipment or operations, especially mobile sources operating between 8am-6pm • Anti-honking sign boards to be placed in the parking areas and at entry / exit points • GSL to comply with all the conditions stipulated in the EC dt.06.01.2022 issued by SEIAA, A.P.	GSL EHS representative	EHS Inspection	Quarterly	Project EHS representative of GSL	EHS Head at GSL	Report from EHS team to Project head and further to corporate team
21.	Soil Environment	Contamination	Operation Phase	***Monitoring Measures***	GSL EHS representative	EHS Inspection	Quarterly	Project EHS representative of GSL	EHS Head at GSL	Report from EHS team to Project

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				• GSL to provide continuous effluent quality monitoring system and connect the data to the APPCB server. • GSL to comply with all the conditions stipulated in the EC dt.06.01.2022 issued by SEIAA, A.P. • GSL to ensure that there shall be no discharge into the Telugu Ganga canal located adjacent to Northern boundary of the site, under any circumstances. • Quarterly soil quality testing should be conducted within (2 samples) and outside (1-2 samples) project boundary to monitor potential cases of soil contamination due to project activities • Transportation vehicles and equipment should undergo regular maintenance in a designated area to avoid any oil leakage • Regular onsite environmental inspection should be carried out at site including visual observations on chemical stains on land, leaks and spills, identification of cracks on paved surfaces particularly at the waste storage, cleaning dykes etc and hazardous waste storage areas • GSL to display online data outside the main factory gate on quantity and nature of hazardous chemicals being used in the plant, water & air emissions and solid waste generated within the factory premises, as per Hon'ble Supreme Court order. ***Waste Storage Measures*** • GSL to inventorize the storage quantities of hazardous chemicals (raw materials), products, as per the hazard nature of reactivity / toxicity / flammability / explosive stored/handling in the premises as defined in the Management of Storage, Import of Hazardous Chemicals (MSIHC) Rules, 1989 and the details shall be furnished to the Factories Department and to the Regional Office, APPCB on monthly basis duly certifying the same • GSL to place the chemical drums and / or any drums in a shed provided with concrete platform only. The Platform shall be provided with sufficient dyke wall and effluent collection system. GSL to provide containers detoxification facility. Container & Container liners shall be detoxified at the specified covered platform with dyke walls and the wash wastewater shall be routed to low TDS collection tank • Oil spill kits should be maintained onsite to handle minor leaks and spillage • Fuel/oil/ lubricants will be stored on impervious floor in the storage area having secondary containment and housekeeping/ concerned staff will be trained for safe handling of oil and lubricants etc. • All waste should be stored in a shed that is protected from the elements (wind, rain, storms, etc.) and away from natural drainage channels • Board off-cuts to be minimized by control of the pressed-board dimensions and gradual minimization of trimming margins. Remaining offcuts can be recycled as furnish in particleboard manufacture, used as the core of blockboard, or burnt in the wood waste-burning utility system					head and further to corporate team

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				• Unloading and loading protocols should be prepared for diesel, oil and used oil respectively and onsite workers should be trained to prevent/contain spills and leaks. • Waste to be managed as per the site specific waste management plan (refer as appendix 5) as well as hazardous material management plan (refer appendix 6) • Ensure that no unauthorized dumping of used oil and other hazardous waste is undertaken at the site; • The workers engaged during the project operations to be trained on segregation of waste with demarcated bins for recyclables and perishables placed in common areas; • Hazardous material and waste will be properly labelled, stored onsite at a location provided with impervious surface and in a secondary containment • In case of accidental/unintended spillage, the contaminated soil should be immediately collected and stored as hazardous secondary containment system						
22.	Water Resources	Water Contamination and Availability	Operation Phase	***Design Measures*** • Provide magnetic flow meters with totalizers at the outlet of the unit. • The LTDS and HTDS effluents to be stored in above ground level collection tanks separately. Hoods to be provided to the tanks and connect to the scrubber to mitigate emissions. • Provide tank in tank system for effluent collection at production blocks. Free board to be maintained in the tanks to prevent spillages. • Explore installation of water efficient plumbing fixtures that use less water without any reduction in quality and service • Provide magnetic tamper proof flow meters to measure quantity of different streams of effluents generated and routed through the treatment systems • Native species have been to be proposed for landscaping which will adjust to natural weather conditions and water availability ***Operation Measures*** • Comply with all the conditions stipulated in the EC dt.06.01.2022 issued by SEIAA, A.P. • Floor washing to be admitted into the effluent collection system only and to not be allowed to find their way in storm drains or open areas. All pipe valves, sewers, drains to be leak proof. • Post operation of APIIC water supply, GSL to ensure that APIIC water supply is used as primary source of water procurement for the fresh water requirement of 265KLD during the operation phase instead of ground water abstraction. • GSL to limit the use of ground water borewell and to use APIIC water supply as primary source of water for its operations. • GSL to recharge twice the quantum of groundwater extracted in their premises, i.e GSL to recharge 440KLD (1,60,600KL/Annum). Since GSL is developing 3 artificial	GSL EHS representative	EHS Inspection	Quarterly	Project EHS representative of GSL	EHS Head at GSL	Report from EHS team to Project head and further to corporate team

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				recharge pits for recharging 50% of the water abstracted, remaining water quantity to be recharged offsite. • Operational spoils including hazardous materials shall not be allowed to contaminate watercourses and the dump sites for such materials shall be secured so that they shall not leach into the ground water • Water utilization to be documented ***Monitoring measures*** • Ensure vendor supplying water tankers have adequate permits to supply water to the project • GSL to ensure and track water source for the tanked water. GSL to refrain from procuring water from ground water abstraction units in over-exploited area(s). • Digital flow meters/ water meters with telemetry for accounting daily groundwater withdrawals by GSL in the permitted groundwater abstraction structures to be installed. • GSL to construct shall piezometer at VES No.7 to a depth of 60m and install digital water level recorders with telemetry for daily water level monitoring. • Ensure no discharge into the Telugu Ganga canal which is located adjacent to northern boundary of the site or aquifers under any circumstances. • Operate and maintain online real time monitoring system along with web camera facilities and shall ensure that it is connected to APPCB / CPCB websites as per CPCB directions. • Provide tank in tank system for effluent collection at production blocks. Free board to be maintained in the tanks to prevent spillages. • GSL to maintain dry condition in the drains present outside of the facility in non-rainy season. • Workers should be sensitized on water conservation measures and encourage optimal use of water • Regular inspection should be carried out for identifying water leaks and preventing water wastage • Regular monitoring of ground water level and quality will be carried out by establishing a network of existing wells in and around project area in consultation with the competent Ground Water Department. Data thus collected should be sent at regular intervals to MoEF&CC, CGWA and CGWB, Southern, Region, Hyderabad • Water audit to be undertaken on annual basis to understand water usage and to identify measures for water reduction Display online data outside the main factory gate on quantity and nature of hazardous chemicals being used in the plant, water & air emissions and solid waste generated within the factory premises, as per Hon'ble Supreme Court order.						
23.	Impacts on Physical Environment due to Agroforestry Plantation	GHG Emission, Soil Degradation & Contamination, Stress on water resources,	Operation Phase	**GHG Emissions** • Where available, use abated nitrogen fertilizers, which have lower GHG emissions associated with their manufacture, or use nitrification or urease inhibitors, which reduce soil emissions	GSL EHS representative	EHS Inspection	Quarterly	Project EHS representative of GSL	EHS Head at GSL	Report from EHS team to Project head and further to corporate team

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				• Existing agricultural land or forest land is not being converted for plantation activity. **Management of Soil degradation and Contamination risk** • Adequate and suitable technology to be implemented by the plantation contractor to minimize damage to soil structure, conserve soil organic matter, and reduce soil erosion • Use cover crops, intercropping along contours with legumes to create multi-species shelterbelts, and/or windbreaks to reduce evapotranspiration and soil loss through wind and water erosion • Replenish soil organic matter by recycling crop residues, compost, and manures • Employ suitable erosion control management practices (e.g., contour and strip planting, terracing, discontinuous trenching, intercropping with trees, and grass barriers) in sloping areas. • Use flow control weirs and diversion canals wherever possible to reduce erosion in areas with field drainage • Minimize the use of pesticides by implementing a pest and disease early warning system, by using biological pest and disease control methods, and by implementing control measures before outbreaks require large-scale control • All packaging for pesticides and herbicides is returned from farm after use and properly stored until final disposal. • Use of large container and/or bulk systems for fuels, oils, fertilizers, and chemicals to reduce the volume of waste containers • Management of expired and unwanted pesticides as hazardous wastes in accordance with the General EHS Guidelines and Food and Agriculture Organization (FAO) Guidelines for the Management of Small Quantities of Unwanted and Obsolete Pesticides. • Implementation of measures to reduce soil runoff to be considered such as conservation tillage, terraces, and raised ridges which follow the land contour. • Required trainings on pesticides application along with pest identification, weed identification, and field scouting to be provided along with use of mechanical weeding and / or thermal weeding. Also, trainings for Preferential use selective pesticides, where appropriate, rather than broad-spectrum products to minimize impacts on non-target species to also be provided • It is to be ensured that the pesticides used are manufactured, formulated, packaged, labelled, handled, stored, disposed of, and applied according to the FAO's International Code of Conduct on Pesticide Management. • It is to be ensured that that purchase, store, use, or trade of pesticides that fall under the World Health Organization's (WHO) Recommended Classification of Pesticides by Hazard Classes 1a (extremely hazardous) and 1b (highly hazardous), or Annexes A and B of the Stockholm Convention are prohibited • It is to be ensured that the pesticides listed in WHO Hazard Class II (moderately hazardous) are not used. These chemicals should not be accessible to personnel without proper						

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				training, equipment, and facilities in which to handle, store, apply and dispose of these products properly. • Preferential use selective pesticides, where appropriate, rather than broad-spectrum products to minimize impacts on non-target species • Conduct periodic soil analysis to detect changes in soil fertility to ensure that inform decisions on fertilizer application rates to be undertaken and avoid unsustainable nutrient depletion and over-fertilization. • Ensure that all personnel are trained in and use appropriate management procedures for the storage, handling, and application of all types of fertilizers, including organic wastes **Management of water stress** • Adequate and suitable Irrigation technology to be implemented by the plantation contractor such as reduction in evaporation by avoiding irrigation during periods when evaporation is elevated (e.g., in periods of higher temperatures, reduced humidity, or high winds). Use trickle or drip irrigation techniques (if practical), or install "under canopy" rather than overhead sprinklers; Consider collecting storm water through catchments; Reduction in evapotranspiration by using shelterbelts and windbreaks; in case of use of herbicides, they are to be applied at the appropriate time of year to control undesirable vegetation and reduce its water consumption; avoid use of overly saline water for irrigation to prevent salinization most effectively • Maximization of the retention of rainwater through appropriate "rain harvesting" techniques, which may include Storing runoff from rainy periods for use during dry spells by using tanks, ponds, cisterns, and earth dams; Controlling weeds through the use of cover crops, mulching, or herbicides to encourage beneficial but low-water-use soil cover plants; Maintain protective vegetation in canals and drainage systems to reduce canal bank scouring and slow runoff. • Implementation of measures to reduce soil runoff to be considered such as conservation tillage, terraces, and raised ridges which follow the land contour so as to reduce silting or excess soil runoff in water bodies thereby reduction in carrying capacity of the surface water source..						
				Socio-Economic Impact- Operation Phase						
24.	Occupational Health & Safety	Electrocution, accident, fire hazard, respiratory and hearing problems while working at site	Operation Phase	***Management Measures*** • GSL at the corporate level has a dedicated environmental, health and safety (EHS) plan, Occupational Health & Safety Plan and emergency response plan (ERP) which is applicable to the project. The plans to be aligned with the requirement of IFC EHS requirement • All workers to be provided with adequate on-job trainings including the EHS-OHS aspects and risks of machine operation and trained in the safe use of cutting equipment; ·	GSL EHS representative	EHS Inspection	Quarterly	Project EHS representative of GSL	EHS Head at GSL	Report from EHS team to Project head and further to corporate team

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				• GSL to ensure that the facility is equipped with heating, ventilation and air conditioning (HVAC) and industrial evaporative cooling systems. They are to be maintained and operated so as to prevent growth and spreading of disease agents (e.g. Legionnella pneumophilia) or breeding of vectors (e.g. mosquitoes and flies). • Developing and maintaining a risk register for identifying safety controls and safety monitoring of potential OHS& EHS risks that may happen during the operation phase • GSL to prepare a safety report and carry out an independent safety audit report of the respective industrial activities including chemical storages / isolated storages by an expert not associated with such industrial activity as required under Rule 10 of MSIHC Rules, 1989 and get it approved by the Factories Dept., and submit the compliance along with copy of the safety report, safety audit report and safety certificate at concerned Regional Office, APPCB. • Monthly environmental, health and safety (EHS) inspection should be conducted at site to identify EHS risks associated with project operation and working conditions. • Quarterly/ half yearly emergency mock drills including fire mock drill should be conducted at site • GSL to submit risk assessment report covering worst scenario clearly describing impact within the manufacturing facility premises and outside the premises and emergency response system. • Establish a grievance redressal mechanism in place, to allow for the employees and workers to report any concern or grievance related to work activities. • GSL to inventorize the storage quantities of hazardous chemicals (raw materials), products, as per the hazard nature of reactivity / toxicity / flammability / explosive stored/handling in the premises as defined in the Management of Storage, Import of Hazardous Chemicals (MSIHC) Rules, 1989 and the details shall be furnished to the Factories Department and to the Regional Office, APPCB on monthly basis duly certifying the same. • GSL to identify major accident hazard chemicals & list out the hazardous chemicals endangered to human health & environment and the details shall be furnished to the Factories Department and to the Regional Office, APPCB time to time duly certifying the same by the industry. GSL to extend training to the working personnel's while handling hazardous chemicals for prevention of accidents and necessary antidotes to ensure the safety, as per the MSIHC Rules, 1989. • GSL to carryout calibration of safety equipment's and leak detection systems at regular intervals and shall certify the same with the Factories Department. That certified copy shall be submitted to the APPCB, Regional Office. The industry shall install fluorescent Wind Vane at the highest point in the industry premises • Safety inspection, testing and calibration: GSL to undertake regular inspection and testing of all safety features and hazard control measures focusing on engineering and personal protective features, work procedures, places of work, installations, equipment, and tools used. The					

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				inspection should verify that issued PPE continues to provide adequate protection and is being worn as required. All instruments installed or used for monitoring and recording of working environment parameters should be regularly tested and calibrated, and the respective records maintained. • GSL to exchange its onsite emergency plan with the neighbouring units i.e. M/s. Hindustan National Glass & M/s. Delta Bio Pharma. • GSL to submit a copy of the NOC issued by the Andhra Pradesh State Disaster Response and Fire Service Dept., (APSDRFSD) at concerned Regional Office, APPCB. ***Design Measures*** • GSL to ensure that all cutting equipment to be fitted with safety guards capable of preventing access to moving cutting blades; Chippers to be fitted with safety guards which prevent the insertion of body parts; · All cutting equipment to be adequately contained to prevent the expulsion of blade fragments in case of blade breakage; Moving gears, chains, belts and rollers to be fully enclosed. • Complete mechanization of log yard activities to reduce human contact with logs during handling and stacking activities • GSL to provide sufficient fresh air supply for indoor and confined work spaces. Factors to be considered in ventilation design include physical activity, substances in use, and process related emissions. Air distribution systems should be designed so as not to expose workers to draughts. • GSL to provide mechanical ventilation systems and should be maintained in good working order. Point-source exhaust systems to be provided for maintaining a safe ambient environment and should have indicators to ensure correct functioning • Proper circulation of air and proper ventilation to be provided to ensure adequate temperature in work, rest room and other welfare facilities during working hours. Exposure to hot or cold working conditions in indoor or outdoor environments can result temperature stress-related injury or fatigue • Acoustically designed cabins for heavy noise generating boilers, generators and other equipment will be provided. The inlet air and exhaust gas streams would be provided with silencers for noise reduction • Install custom designed racking systems so material can be moved by forklift ***Implementation Measures*** • Personnel working in the facility to be provided with required PPE's and they are also be provided with adequate training and information on safety and health aspects. Personal protective equipment (IS approved) like safety helmet, safety shoes/gumboots hand gloves, gas mask/ nose mask, PVC apron, SCBA Set, PVC pressure suit, goggles, hood, etc. to be provided to the required personnel. A PPE inventory should be developed and maintained on site					

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				• GSL to ensure that the workers who are required to handle corrosive, oxidizing, or reactive chemicals should be provided with specialized training and provided with, and wear, appropriate PPE (gloves, apron, splash suits, face shield or goggles, etc). • Where corrosive, oxidizing, or reactive chemicals are used, handled, or stored, qualified first-aid should be ensured at all times. Appropriately equipped first-aid stations should be easily accessible throughout the place of work, and eye-wash stations and/or emergency showers should be provided close to all workstations where the recommended first-aid response is immediate flushing with water • Regular housekeeping to ensure that dust is removed from the facility, including a biannual blow down or vacuuming of the entire facility • A first aid box with adequate medicines to be provided at the site and appoint a trained person to take charge of it. The location of first aid arrangements to be displayed on site; • The use of any toxic chemical will be strictly in accordance with the manufacturer's instructions; • Permit to work system should be implemented to ensure that work at confined space, work at height and cranes and lifting equipment is operated by trained and authorized persons only • Adequate number and appropriate cranes, forklifts, adjustable trolleys, etc to be ensured. • Lifting operations are carried out with proper plans and with equipment of adequate capacity and appropriate safety harnesses and lowering/raising tools should be used for working at heights • Electrical and maintenance work should not be carried out during poor weather and during lightning strikes. All equipment should be turned off and checked when not in use; • Safe drinking water as per IS 10500:2012 should be provided to the workers • Workers should be provided with 1 hour break in every 8-hour shift • The nearest hospital, ambulance, fire station and police station should be identified in the implemented emergency management plan; • Workers should be provided information on communicable diseases such as COVID-19, HIV, Influenza etc. and preventive measures should be communicated to avoid such diseases. • Adequate fire arrangement such as portable fire extinguishers, fire hydrant, fire buckets and automatic fire detection system should be installed in compliance to National Fire Protection Authority (NFPA) fire safety standards and local fire authority requirements ***Monitoring Measures*** • In case any worker develop symptoms of COVID-19, they should be asked to isolate immediately and return to work only after recovery.					

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				• Indoor air quality to be monitored for VOC and hazardous air pollutant (HAP) emissions. GSL to properly operate and maintain VOC monitoring system with auto recording facility • Annual health check-up of workers should be conducted for all workers, and half yearly health check-up to be undertaken for employees/workers exposed to VOCs. The annual and half yearly health check-ups to be extended to contract workers as well. • Occupational health check-up program for the workers to be undertaken periodically. Pre- medical check-up of workers should be conducted prior to appointment at operational phase • Noise level within the site should be maintained within prescribed limits as per CPCB guidelines and as per IFC EHS guidelines. • GSL to ensure addition H&S clauses incorporating the proposed mitigation measures in agreement with the wood suppliers for the safety of plantation workers. Clauses to be considered to be included but not limited to the following: • Adequate training on use of the tools and PPEs • Provision of adequate PPEs such as and insect repellents • Ensure use of appropriate protective clothing, such as a long-sleeved shirt, long pants, hat, gloves, and boots • On-site first-aid equipment (including, for example, antivenom serum) and trained personnel should be available, as well as procedures for emergency evacuation. • Use of low toxicity rated pesticides and herbicides and train personnel on use of pesticides, herbicides and fertilizers, etc.						
25.	Impacts due to Agroforestry Plantation	Health & Safety	**Operation Phase**	GSL to ensure addition H&S clauses incorporating the proposed mitigation measures in agreement with the and wood aggregators for the safety of plantation workers and wood transporters. Clauses to be considered to be included but not limited to the following : • Adequate training on use of the tools and PPEs • Provision of adequate PPEs such as protective steel capped boots, hardhats, high visibility jackets, eye protection, gloves and insect repellents • Ensure use of appropriate protective clothing, such as a long-sleeved shirt, long pants, hat, gloves, and boots • On-site first-aid equipment (including, for example, antivenom serum) and trained personnel should be available, as well as procedures for emergency evacuation. • Use of low toxicity rated pesticides and herbicides and train personnel on use of pesticides, herbicides and fertilizers, etc. • Plantation Workers, wood aggregators/suppliers to be trained in safe working procedures in tree felling, log stacking and deck areas, including avoidance of falling logs and planning of escape routes; GSL to include clause on defensive driving in the agreement with the wood transporter to prevent any discomfort to the community. GSL to ensure that transporter fulfill the following requirements: • Take into account load capacity of the trucks	GSL EHS representative	EHS Inspection	Quarterly	Project EHS representative of GSL	EHS Head at GSL	Report from EHS team to Project head and further to corporate team

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				• Well maintained vehicles to be used and daily checks of the vehicles to be undertaken • Adequate stacking to be done, thus avoiding possible accidents. • Use strap and ropes of proper strength • Drivers to be trained & licensed. Obey road rules and speed limits and drive in a careful manner and be considerate to other road users • Drivers to adapt their driving to suit weather and traffic and road conditions • Transport routes within log yards should be clearly demarcated and vehicle movement should be closely controlled • Log stacks should be no higher than a safe height defined by risk assessment which should take account of site specific circumstances including stacking methodology • Log decks should have stops, chains, or other guards to prevent logs from rolling down and off the deck • It is recommended that the wood stacking be done in a pyramid shape, that is, forming a base with more logs at the bottom than at the top. In addition, the pile height must not exceed the truck's front panels or the sides struts. With proper stacking, cargo stability can be maintained throughout the journey. In this way, the possibility of load sliding is limited, thus avoiding possible accidents. GSL to ensure that the contractors and wood aggregators of GSL adhere to Supply Chain Management Plan (Appendix 16) and Local Wood Aggregators and other informal provider management plan (Appendix 17)						
26.	Community Health & Safety	Accidents, fire hazards,	Construction and Operation Phase	• Traffic management of vehicles engaged during both ongoing construction phase and upcoming operational phase. Traffic management plan to be followed • Limiting the hours of operation for specific pieces of equipment or operations, especially mobile sources operating between 8am-6pm • Limiting the use of access road during day time to avoid congestion and risks of accidents • Trucks/ dumpers will be covered by tarpaulin sheets during off site transportation; • Anti-honking sign boards to be placed in the parking areas and at entry / exit points • As part of the stakeholder engagement and information disclosure process, the community will be provided with an understanding of the activities to be undertaken and the precautions taken for safety; • Installing mandatory suitable mufflers on engine exhausts and compressor components as the ambient noise levels are already exceeding the ambient air quality standards • Installing acoustic barriers without gaps and with a continuous minimum surface density of 10 kg/m2 in order to minimize the transmission of sound through the barrier.	Contractor's and GSL EHS representative	EHS Inspection	Monthly and Quarterly based on the project phase	Project EHS representative of GSL	EHS Head at GSL	Report from EHS team to Project head and further to corporate team

Sr. No.	Environmental/Social Resources	Impact/Issues	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of verification that mitigation has been met	Timeline/Frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
				• GSL to exchange its onsite emergency plan with the neighbouring units i.e. M/s. Hindustan National Glass & M/s. Delta Bio Pharma. • As part of stakeholder engagement, the project will also propagate emergency scenarios and health awareness amongst the community including pregnant women, infants and senior citizens • The traffic movement for the project in the area will be regulated to ensure road and pedestrian (including livestock) safety. • Dedicated route for deployment of heavy-duty vehicles should be defined. • Put in place a grievance mechanism to allow for the workers and community members to report any concern or grievance related to project activities; and • Dedicated safety sign boards in local language should be provided around the project site. Dedicated safety sign boards in local language should be provided around the project site.						
27.	Socio Economic Impacts	Increased Local Employment & Livelihood	Operation Phase	• Project should align and update their HR polices with the requirement of PS 2 and ensure the compliance of applicable labor laws • All the staff and workers working at plant should be provided with necessary HR and Labor induction training and accordingly develop the annual training calendar • The contract terms with wood supply aggregators should explicitly mention about the compliance of appliable labor laws and other requirements of PS-2 such as prohibition of child labor , forced labor , payment of minimum wages , safe working conditions etc. • Carry out quarterly labor and working conditions audit • During initial phase separate six monthly labor audits should be carried out for wood aggregators to ensure the compliance of labor laws and companies EHS polices. One they are trained the frequency of audit may be reviewed. • Develop stakeholder engagement plan as part of engagement plan /, organize annual famers meet or open forums where they can raise their potential concerns. • Establish strong grievance management system covering contracted workers , farmers and other stakeholder and carry out proper disclosure of the GRM and have the dedicated resources of the implementation of the system • Project should develop guidelines/policies towards local employment and livelihood opportunity enhancement and include the local employment reporting the annual report . • Project should proactively disclose the local labor and other reequipment at notice board and there should be open door policy towards local vendors registration • Preference should be provided to local labor. However, the preference shall be based on available skillset and knowledge • Project shall provide equal access to both female and male local population in available employment opportunities and for greater employability of residents, technical/vocational training may be arranged for female and male, if required • Establish the functional stakeholder engagement including external communication plan and roll out grievance handling	• HR & Admin/ Contractors/ CSR/ Procurement	Updated HR Polices , training calendar, training records, labor & working conditions Audit , SEP and GRM and records for consultations and grievances	Quarterly	HR & Amin/CSR/ procurement /Contractor	Project HR/EHS team	Labor compliance/livelihood and working conditions report to project head

Sr. No.	Environmental/Social Resources	Impact/Issues	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of verification that mitigation has been met	Timeline/Frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
				mechanism which should have provisions for receiving external grievances as well. • The project proponent will establish a mechanism to audit sub-contractors and suppliers with respect to compliance of utilizing local labor and resources						
				Ecological Impacts- Operation Phase						
28.	Ecological Impacts	Impacts of Accidental Spillage of Stored Chemicals and Untreated Effluent [Manufacturing Unit]	Operation Phase [Manufacturing Unit]	• Authorized vendors for disposal of hazardous and non-hazardous waste should be identified prior to operation phase and dedicated contract should be executed with the vendor. • Quarterly soil quality testing should be conducted within manufacturing unit (2 samples) and outside the unit (2 samples - within 500 m range) project boundary to monitor potential cases of oil/chemical leaks and/or spillage of Chemicals used for the industrial activities, should be stored properly as per the guidelines of state/central agencies • Oil / chemical spill kits should be maintained onsite to handle minor leaks and spillage • All waste should be stored in a shed that is protected from the elements (wind, rain, storms, etc.) and away from natural drainage channels • Regular onsite environmental inspection should be carried out at site including visual observations on chemical stains on land, leaks and spills, identification of cracks on paved surfaces particularly at the garage and hazardous waste storage areas • Untreated wastewater from the premises will not be discharged outside. And the treated water should be recycled for secondary purposes and landscaping i.e. non-contact purposes only. • GSL to ensure that no unauthorized dumping of used oil and other hazardous waste is undertaken at and around the manufacturing unit; • Hazardous material and waste should be properly labelled, stored, and disposed / hand overed to the authorized vendor • In case of accidental/unintended spillage, the contaminated soil should be immediately collected and stored as hazardous waste containment system	• GSL EHS representative	EHS Inspection	Quarterly	Project EHS representative of GSL	EHS Head at GSL	Report from EHS team to Project head and further to corporate team
29.	Impacts Due to Agroforestry	Risks of Deforestation due to Illegal Tree Logging [Catchment Area]	Operation Phase	• Strictly follow the policy - not to accept the wood from the forest / natural habitat • Regular inspection of resourcing cluster centres to check the source of raw materials • To ensure that the sourced wood originates from sustainable and environmentally friendly sources, it is crucial to implement a tracking and tracing mechanism that aids in verifying its origin and minimizing habitat disruption [see Appendix 16] • Establish communication with farmers and primary suppliers to convey the significance of employing sustainable resource utilization practices and actively participating in habitat conservation efforts.	GSL EHS representative	EHS Inspection	Quarterly	Project EHS representative of GSL	EHS Head at GSL	Report from EHS team to Project head and further to corporate team
30.	Impacts Due to Agroforestry	Habitat Modification / Land Use	Operation Phase	• Strictly follow the policy - not to accept the wood from the forest / natural habitat	• GSL EHS representative	EHS Inspection	Quarterly	Project EHS representative of GSL	EHS Head at GSL	Report from EHS team to Project

Sr. No.	Environmental/Social Resources	Impact/Issues	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of verification that mitigation has been met	Timeline/Frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
		Change due to extended agroforestry practices [Catchment Area]		• All the forest patches present within the Supply Chain Catchment Area (***Figure 4-36***) should be considered as exclusion zone and no wood should be precured from these exclusion zones • Conducting regular inspections of resourcing cluster centres to verify the origin of raw materials. In addition, biannual third-party audits of the wood supply chain can effectively meet the need for ensuring the sustainable utilization of resources						head and further to corporate team
31.	Impacts Due to Agroforestry	Impacts of Increased Traffic / Vehicle Movement for transportation of raw materials [Catchment Area]	Operation Phase	• Vehicle drivers should be instructed not to blow horns until necessary • Vehicle drivers should be trained to identify the wildlife crossing sign boards on the highway and be more alert of those stretches • Vehicle drivers should follow the speed limit instructed by highway authorities (in the form of signboards) • Annual awareness/training programmes should be conducted for drivers to minimise the risk of wildlife hitting and/or being killed on highways and road safety • EHS guidelines for the wood aggregator- undertaking form wood aggregator on compliance of EHS guidelines	• GSL EHS representative	EHS Inspection	Quarterly	Project EHS representative of GSL	EHS Head at GSL	Report from EHS team to Project head and further to corporate team
32.	Impacts Due to Agroforestry	Impacts on Ecosystem Services due to the increased agroforestry plantation [Catchment Area]	Operation Phase	• Agroforestry plantation should not be promoted on agricultural land designated for food crops cultivation; while the lands unused for food crops or those that are fallow should be promoted • The selection of appropriate clones or hybrids is recommended to decrease the reliance on chemical fertilizers and pesticides, thus minimizing their usage • Wood sourcing from the exclusion areas/zones (forest patches present within the supply chain catchment area) should be restricted to prevent habitat disruption • A set of criteria should be established to screen and evaluate the geographical sources of wood, ensuring sustainability and habitat preservation • Implementing a mechanism for tracking and tracing the origin of sourced wood aids in ensuring it comes from sustainable and non-habitat-disruptive sources • The promotion of genetically modified species should be prohibited to safeguard natural habitats from potential ecological disturbances • Strict adherence to the prohibition of banned pesticides contributes to the conservation of habitats and prevents their degradation	• GSL EHS representative	EHS Inspection	Quarterly	Project EHS representative of GSL	EHS Head at GSL	Report from EHS team to Project head and further to corporate team

10 Impact Summary and Conclusion

10.1 Introduction

This Environmental and Social Impact Assessment (ESIA) has been conducted to evaluate the impacts associated with the integrated manufacturing facility. The impact assessment has been conducted in compliance with the requirement of applicable reference framework (refer to ***Section 3***).

10.2 Magnitude of Impacts

The ESIA focused on interaction between the Project activities and various resources/receptors that could result in significant impacts. The table below presents the outcome of the comprehensive assessment of identified impacts due to various project activities.

Table 10-1 Impact Assessment Summary

Impact Description	Period	Impact Classification	Phase of the Project	Magnitude of Impact	
				Without Mitigation	With Mitigation
Environment					
Land Use	Permanent	Negative	Construction Phase	Small	Negligible
Ambient Air	Short Term	Negative	Construction Phase	Substantial	Negligible
	Permanent	Negative	Operation Phase	Substantial	Substantial to small
Ambient Noise	Short Term	Negative	Construction Phase	Substantial	Negligible
	Long Term	Negative	Operation Phase	Small	Small
Soil Erosion and Compaction	Long-term	Negative	Construction Phase	Substantial to small	Negligible
Soil Contamination	Long Term	Negative	Construction Phase	Substantial	Negligible
	Long Term	Negative	Operation Phase	Small	Small
Water Availability	Short Term	Negative	Construction Phase	Substantial	Small
	Long Term	Negative	Operation Phase	Substantial	Substantial to small
Water Contamination	Short Term	Negative	Construction Phase	Substantial	Small to Negligible
Topography and Drainage	Permanent	Negative	Construction Phase	Substantial	Small
Agro Forestry	Long Term	Negative	Operation Phase	Major- Substantial	Substantial to small
Social					
Unhygienic and Unsafe Living Conditions	Short Term	Negative	Construction Phase	Substantial	Substantial
Increased local Employment & Livelihood Opportunities	Short Term	Positive	Construction Phase	Substantial	Substantial
Increased local Employment & Livelihood Opportunities	Permanent	Positive	Operation Phase	Major	Major
Loss of Employment and Livelihood Opportunities	Permanent	Negative	Decommissioning Phase	Major	Major
Occupational Health & Safety	Short Term	Negative	Construction Phase	Substantial	Substantial to small
	Long Term	Negative	Operation Phase	Substantial	Substantial to small
Ecology					
Impacts on the Habitat and Species due to Construction Activities	Short Term	Negative	Construction Phase	Substantial	Small
Impacts of Accidental Spillage of Stored Chemicals and Untreated Effluent	Long Term	Negative	Operation Phase	Substantial	Small
Risks of Deforestation due to Illegal Tree Logging	Long Term	Negative	Operation Phase	Small	Small to Negligible

Impact Description	Period	Impact Classification	Phase of the Project	Magnitude of Impact	
				Without Mitigation	With Mitigation
Habitat Modification / Land Use Change due to extended agroforestry practices	Long Term	Negative	Operation Phase	Substantial	Substantial
Impacts of Increased Traffic / Vehicle Movement for transportation of raw materials [Catchment Area]	Long Term	Negative	Operation Phase	Substantial	Small
Impacts on Ecosystem Services due to the increased agroforestry plantation [Catchment Area]	Long Term	Negative	Operation Phase	Substantial	Small