Environmental and Social Impact Assessment (ESIA) for 14.9 MW Waste to Energy Plant at Vadodara, Gujarat

Project SPV: Goodwatts WTE Vadodara Private Limited

Project Location: Vadodara, Gujarat

Final Report

May 2024

Table of Contents

List of Tables

List of Figures

Name	Description
ACEL	Abellon Clean Energy Limited
WTE	Waste to Energy
Amsl	Above mean sea level
GETCO	Gujarat Energy Transmission Corporation Limited
GWVPL	Goodwatts WTE Vadodara Private Limited
VMC	Vadodara Municipal Corporation
AoI	Area of Influence
APCD	Air Pollution Control devices
BMTPC	Building Materials and Technology Promotion Council of India
CEA	Central Electricity Authority
CGWA	Central Groundwater Authority
CPCB	Central Pollution Control Board
CGWB	Central Ground Water Brochure
CMS	Convention of Migratory Species
CO2	Carbon dioxide
CPCB	Central Pollution Control Board
CSR	Corporate Social Responsibility
CTE	Consent to Establish
CTO	Consent to Operate
DG	Diesel Generator
ESP	Electro-static Precipitator
EHS	Environment, Health, and Safety
ESMP	Environmental and Social Management Plan
GSI	Geological Survey of India
GLC	Ground Level Concentration
GSS	Grid Substation
HWA	Hazardous Waste Authorization
ESIA	Environmental & Social Impact Assessment
IFC	International Finance Corporation
ILO	International Labour Organization
IMD	India Meteorological Department
kV	Kilowatt
KLD	Kilo Litres Per Day
kWh	Kilowatt per hour
Mbgl	Meters below ground level
MNRE	Ministry of New and Renewable Energy

MoEFCC	Ministry of Environment, Forest and Climate Change
MW	Mega Watt
NAAQ	National Ambient Air Quality
NAQUIM	National Project on Aquifer Management
NOC	No Objection Certificate
O&M	Operation and Maintenance
OBC	Other Backward Caste
PPE	Personal Protective Equipment
PPM	Parts per million
PM	Particulate Matter
PS	Performance Standards
PUC	Pollution under Control
PPA	Power Purchase Agreement
ROW	Right of Way
STP	Sewage Treatment Plant
RDF	Refuse Derived Fuel
SC/ST	Schedule Caste/Schedule Tribe
SPV	Special Purpose Vehicle
TPH	Tonnes Per Hours
TPD	Tonnes Per Day
TL	Transmission Line

1 Introduction

Abellon Clean Energy Limited (hereinafter referred to as "Client" or "ACEL" or "Company") has engaged a service provider (hereafter referred to as 'E&S Advisor') to undertake Environment and Social Impact Assessment of its 14.9 MW under-construction waste to energy plant located Makarpura Village, Taluka Vadodara, District Vadodara, Gujarat, India (hereinafter referred to as "Project").

Abellon Clean Energy Limited (ACEL) is a Waste to Energy (WTE) developer based out of Gujarat in India, who is developing 4 Nos of WTE plant of cumulative capacity 52.20 MW as of 2023. The company is headquartered in Ahmedabad, Gujarat and has forayed in renewable energy space (WTE, Bio-Mass and Solar Energy) since 2008. The Company is seeking financial assistance from International Finance Corporation (hereinafter referred to as "IFC") to fund the capital expenditure of the project and therefore, ACEL has engaged E&S advisors to undertake ESIA for the Project.

This ESIA report identifies and analyses environmental and social impacts associated with the construction and operation phase of the Project including a review of any legacy risks and impacts related to the project and determines the measures needed to prevent, minimize, mitigate, and compensate adverse impacts in compliance with the Applicable Reference Framework (refer ***Section 1.2***).

1.1 Objective

The primary objective of the ESIA is to -

- To establish the environmental and social baseline of the area of influence of the project (10 km radius) and associated facilities.
- Conduct consultations with the project stakeholders to ensure that all key stakeholders are aware of the objectives, impacts and mitigation measures adopted by the project.
- Undertake an analysis of alternatives.
- Assess the environmental and social impacts.
- Suggest mitigation measures for consideration in the project for implementation so as to minimize the identified impacts.
- Prepare Environmental and Social Management Plan (ESMP) for implementation & monitoring of the mitigation measures; and
- Categorize the Project as per IFC Categorization, based on outcome of the ESIA study.

1.2 Applicable Reference Framework

Applicable reference framework for this assignment includes the following:

- Applicable local, national, and international environmental and social legislations including Solid Waste Management Rules, 2016
- Applicable technical guidelines on waste to energy including revised guidelines of waste-to-energy Programme, Ministry of New and Renewable Energy (MNRE), Government of India
- Applicable guidelines/legislations on waste pickers and recycling
- IFC Performance Standards (PS) on Social and Environmental Sustainability (2012)
- World Bank Group (WBG) General EHS Guidelines, 2007
- WBG EHS Guidelines for Waste Management Facilities, 2007
- WBG EHS Guidelines Water and Sanitation, 2007
- WBG EHS Guidelines for Power Transmission & Distribution, 2007
- The International Labour Organization (ILO) conventions covering core labour standards and the basic terms and
- conditions of employment – Declaration of Fundamental Principles and Rights to Work,1998
- IFC/ERBD Guidance on Worker Accommodation, 2009
- UN Voluntary Principles on Security and Human Rights, 2000
- Addressing Gender-Based Violence and Harassment - Emerging Good Practice for the Private Sector, 2020

1.3 Scope of Work

The scope of work for the ESIA includes:

- Review of Project Information – Review of all the relevant (E&S) documents / information to assess impacts on various environmental and social components.

- **Review of legal framework** – Review of the compliance of the project with the reference framework as a part of this assignment.
- **Scoping Study** –Review of available primary and secondary data to focus on key issues/impacts and define the project's area of influence (AoI).
- **Site Visit** – Undertake site visit to the under-construction waste to energy plant to understand site settings, environmental and social baseline and identify potential project specific impacts. This also involved:
    - Identification of sensitive receptors in the study area
    - Stakeholder consultation comprising of local community, project site team, rag pickers, etc.
- **Analysis of Alternatives** – This includes covering site suitability as per IFC PSs, WBG EHS Guidelines, Site Selection Guidelines specified in the Solid Waste Management Rules /CPHEOO Guidelines and other applicable regulations based on the nature/type of wastes to be used as feedstock.
- **Establishment of Baseline** - Establish the baseline of the project area of influence (AoI) through review of data on environmental and social components collected from authenticated agencies/authorities and published secondary sources. Primary environmental, ecological, and social assessments at project location and its AoI was also undertaken to supplement secondary information.
- **Land use mapping** was conducted to identify sensitive receptors within the study area, including the land-use pattern along the route of the transmission line and water pipeline, based on a desk-based GIS review. Additionally, the land use mapping was utilized to assess historical and legacy issues related to land ownership and livelihood dependence on the allotted land for the power plant.
- **Stakeholder Consultation and Analysis** - Identify relevant stakeholders for the project, undertake consultation and information dissemination session with project affected persons and other relevant stakeholders as well as with local community in general to inform stakeholders about the objectives and potential impacts of proposed project and seek their inputs, concerns, and expectations.
- **Impact Assessment and Mitigation Measures** - Based on the project details and baseline information related to site locations, assessment of impacts for operation phase of the Project. Develop management plans with measures to avoid, minimize, mitigate, compensate/ offset for the identified impacts associated with various Project activities.
- **Environmental and Social Management Plan** - 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 project life.

1.4 Approach & Methodology

The ESIA comprised an E&S scoping which includes site visit and identification of key risks and impacts associated with the under-construction project that were analyzed during the ESIA study. The key tasks undertaken as part of the ESIA has been presented in subsequent sections.

1.4.1 Project Kick Off

E&S Advisor organized a kick-off discussion with the Client to obtain an overview of the status of the project, and their expectations. Kick off meeting also included discussion on timelines for the site assessment and the deliverables. After project kick off, indicative list of details/ documents required to be reviewed were shared.

1.4.2 Documentation Review

E&S Advisor reviewed a list of project-related documents to understand any sensitive environmental or social receptors and to compile existing information on baseline conditions. Documents reviewed as part of this assignment included Project location in Kmz, project layout, permits and license, technical specifications, policies, and other documents etc. made available in the data room by the client. A comprehensive list of information reviewed as part of this assignment has been attached as **Appendix 1.**

Based on a review of the documents, E&S Advisor prepared the legal, and administrative framework within which the field assessments will be carried out, including state and central regulations, obligations of implementing relevant international social and environmental treaties, agreements, and conventions and IFC PS. E&S Advisor has compiled desk based information on the environmental and social baseline of the Project areas which will be supported by primary data collection thereafter.

1.4.3 Detailed Site Visit & Baseline Data Collection

Team comprising of EHS, social and ecological experts conducted site visit to the Project location between 16th to 18th May (for Ecology and Biodiversity), followed by 12th-13th June to understand key environmental, and social sensitivities within the Project footprint and area of influence.

The focus of this visit was to better understand the site settings, sensitivities with respect to the Project and associated facilities. Visual observation of the on-going construction activities and consultation with key stakeholder groups was also undertaken during site visit. Details of activities undertaken during site visit is as presented in Table below.

Table 1-1 Site Assessment Activities

Date(s)	Location	Activities
16th May	5 km buffer of Project Site	• Ecology and Biodiversity Survey; • Consultations with the locals on ecology & biodiversity aspects.
17th & 18th May	10 km buffer of Project Site	• Discussion with client representative about the project infrastructures and project activities; • Ecology and Biodiversity Survey of the surrounding area; • Consultations with the locals.
12th-13th June	• Project Site • Along the proposed ROW for transmission line and pipeline • Existing Dumping ground for Vadodara Municipal Corporation • Villages/habitations around the Project area	• Discussion with project team on status of the Project and WTE plant process flow. • Site reconnaissance of the WTE plant to identify environmental and social sensitivities and risks. • Site reconnaissance of the underground and overhead transmission line route and water pipeline route connected from the nearby Gujarat Energy Transmission Corporation Limited (GETCO) Substation and sewage treatment plant, respectively. • Understanding of the process for waste receiving and handling, waste characterization, segregation, segregated storage, material recovery and conveyance to planned treatment facilities (internal transfer of waste) (to WTE/ to landfill). • Consultation with technical team, site representatives to understand the project process and layout. • Visit to the Transfer Station and the existing landfill. • Discussion with the project teams regarding HR policy, labor and progress of construction and contractor. • Consultation with labor to understand the labor welfare practices followed at project level. • Consultations with rag pickers to understand the potential issues with respect to their income and livelihood. • Transit walk /route survey along the TL and water pipeline route to understand the potential issues related to R&R and displacement if any. • Consultations with Sarpanch to understand their potential concerns and expectations from the Project.

1.4.3.1 Primary Environmental Baseline

The primary baseline data collection has been undertaken for a period of 4 weeks, through engagement of a third-party government accredited monitoring laboratory/ agency for following parameters as per WB sectoral EHS guidelines.

- Ambient Air Quality
- Ground water quality (drinking purpose). A separate study has been undertaken for the Phase 2 site contamination/historical pollution assessment.
- Traffic monitoring for the access road

- Surface water quality sampling and analysis; and
- Monitoring of Noise levels of the study area

The attributes, parameters, frequency, number of samples and locations for monitoring has been detailed in ***Section 5.2***.

1.4.3.2 Ecology & Biodiversity Survey

The ecological baseline (flora and fauna) survey was conducted to understand the ecological sensitivity of the study area, between 16th and 18th May 2023. The main objective of this exercise was to identify the potential impacts on the species and habitats (present in the vicinity) due to the project-related activities, so as to identify suitable impact mitigation and management strategy.

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. During the survey, different habitats (natural and modified) available within the study area were explored to assess the floral and faunal (specifically reptiles, birds, and mammals) diversity. The detailed methodology and outcomes of the survey have been explained under ***Section 5.5.***

1.4.3.3 Primary Social Baseline Assessment

The primary data collected for Project was based on key informant interview, schedule, focused group discussion & stakeholder consultations, transect walk and visual observations at site. During the site visit most of the primary data collected for the proposed project was qualitative in nature such as sources of income of the rack pickers, type of waste and market value of the waste, trade cycle, gender & caste profile of the people involved in waste collection, potential community concerns related to the project etc. Details of social baseline is given in ***Section 5.4***

1.4.4 Secondary Baseline Data Collection

Secondary baseline data collection involved identifying and collecting available published material and documents. Information's on various environmental aspects like soil, geology, hydrogeology, hydrology, drainage pattern, ecology, meteorology, etc. Type of secondary data and their different sources is as given in table below:

Table 1-2 Sources of Secondary Data Collection

S. No	Attribute	Source
1	Long term meteorological data	• India Meteorological Department (IMD) • District Statistical Handbook
2	Soil, Geology, Hydrogeology and hydrology	• District Resource Map • Geological Survey of India • Central Ground Water Board
3	Land use	• Satellite Imagery • ARC GIS Mapping
4	Natural Hazards	• Building Material and Technology Promotion Council of India (BMTPC) • India Meteorological Department (IMD)
5	Flora & Fauna	• https://www.iucnredlist.org/ • https://ebird.org/ • https://www.inaturalist.org/ • https://indiabiodiversity.org/
6	Socio-Economic Details	• Census of India • District Statistical Handbook • Ward details from Vadodara Municipal Corporation

1.4.5 Analysis of Alternatives

E&S Advisor undertook a comparison of reasonable alternatives in terms of their technical as well as a social, environmental and health and safety positive and negative impacts related to use of resources (i.e., water source options and impacts), provisional transmission line route/corridor, etc. Rationale towards considering the project design has been provided with respect to Project site, technology, contextual E&S risks, no project alternatives.

1.4.6 Stakeholder Consultation

Consultation with various stakeholders identified for the Project including project team, labors and ragpickers was undertaken as a part of this assessment. Details of stakeholder engagement and consultation are presented in ***Section 6*** of the report.

1.4.7 Impact Assessment and Mitigation Measures

Based on the project details and baseline information, an assessment of the E&S impacts was done which included the following:

- 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.
- Identifying and estimating the extent and quality of available data, key data gaps and uncertainties associated with predictions, and specifying topics that do not require further attention.

1.4.8 Environmental and Social Management Plan

Environmental and Social Management Plan (ESMP) to minimize E&S impacts associated with various Project activities has been developed. Also detailed Project specific Management Plans has been prepared in discussion with the Client.

1.5 Limitations

This report has been developed based on the Project level information provided by Abellon 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 Abellon site representative.
- 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.
- Ecological survey was conducted in non-migratory season during the daylight hours and thus the avifaunal and faunal activities recorded were restricted to diurnal hours only.
- As informed the contract for laying of transmission line was awarded to the respective contractor and payment of damages and crop compensation for obtaining user rights if any is in the scope of the contractors of however the work is yet to initiated hence details of affected private land owners was not available for review.
- As per the current understanding of the project , project is located outside the city limit and area is already identified as landfill site as per master plan. During the visit no human habitations were observed close the WTE plant.
- Further the project does not have impact in terms of livelihood , involuntary resettlement on community as well as sensitivities stakeholder with village sarpanch/ gram panchayat could not be arranged.

1.6 Structure of the Report

Chapter 1	Introduction (This Section)
Chapter 2	Project Description
Chapter 3	Applicable Legislative Regulatory & Administrative Regime
Chapter 4	Analysis of Alternatives
Chapter 5	Environment & Social Baseline Conditions

2 Project Description

This section provides an overview of under construction project, in terms of location, associated facilities, site settings, resource requirement, land details and status of the project.

2.1 Project Overview

The Government of Gujarat, in line with its Waste to Energy (WTE) Policy of 2016, aimed to promote the sustainable utilization of municipal solid waste for electricity generation and contribute to the Swachh Bharat Abhiyan (Clean India Mission). Following the policy and Government of India's Solid Waste Management Rules, 2016 that impose an obligation on municipal authorities to adopt suitable process for disposal of Municipal Waste, the Vadodara Municipal Corporation (VMC) issued a Request for Proposal (RfP) dated 14.12.2016 inviting proposals for Design, Construction, Operation and Maintenance of Processing Facility based on waste to energy in Vadodara.

Competitive bidders participated in the process, submitting their proposals. After the evaluation, VMC declared Abellon Clean Energy Limited (ACEL) as the successful bidder on 17.01.2017 to set up the waste-to-energy (WTE) plant in accordance with the provisions of the WTE policy and Gujarat Electricity Regulatory Commission (GERC) tariff and issued letter of award (LoA) to ACEL on 08.09.2017.

To fulfil the conditions stated in the LoA, ACEL established a special purpose vehicle (SPV) called Goodwatts WTE Vadodara Private Limited. The SPV was incorporated under the Companies Act 2013, and ACEL requested VMC to accept the SPV as the concessionaire for the project. The SPV, as the concessionaire, would resume the responsibilities outlined in the LoA and the subsequent concession agreement. This arrangement ensures that the waste-to-energy project in Vadodara is developed and operated by a dedicated entity, specifically established for this purpose, in accordance with the contractual obligations and provisions set forth by the Vadodara Municipal Corporation.

The concession agreement between the Vadodara Municipal Corporation (VMC) and ACEL was executed on 01.03.2019 for the implementation of a 1000 TPD Municipal Solid Waste Processing and Disposal Facility at Makarpura village in Vadodara tehsil and district, Gujarat, India. The waste-to-energy (WTE) plant, with a capacity of 14.9 MW, is under construction and located on land area measuring 6 acres. The salient features of the under-construction waste to energy project have been presented in ***Table*** below and project process flow has been presented as ***Figure 2-1.***

Table 2-1 Salient Features of the under-construction project

Sr. No.	Components	Description
1	SPV Name	Goodwatts WTE Vadodara Private Limited
2	Project Capacity	14.9 MW
3	Project Coordinates	22°13'49.20"N; 73°12'16.84"E
4	Project Location	Survey no. 346/A, Village Makarpura, Taluka Vadodara, District Vadodara, Gujarat, India
5	Project Current Status	Under construction with 49% construction work completed
6	Commercial Operation Date	The Project will be operational in two phases, where Phase 1 (7.5 MW) is planned to be commissioned in March 2025 and Phase II (7.4 MW) is planned to be commissioned in June 2025
7	Total Municipal Waste used per day (Proposed)	The Project will be utilizing 1000 TPD of waste per day. The MSW will be brought to the project from 4 transfer stations by various tippers and trucks.
8	Biomining activities	No legacy waste will be used for the Project.
9	Existing Transfer Stations (Managed by VMC)	Vadodara has total four operational transfer stations which are divided into four zones as detailed below. As reported by GWVPL, 1000 TPD municipal waste at the WTE plant will be received from these four operational transfer stations: • Atladara Transfer Station (West Zone): 250 TPD (~6 Km from project site) • Atladara Transfer Station (South Zone): 250 TPD (~ 6 Km from project site) • Vuda Circle Transfer Station (North Zone): 250 TPD (~ 10 Km from project site)

<table>
<tr><th>Sr. No.</th><th>Components</th><th>Description</th></tr>
<tr><td></td><td></td><td>• Gadheda Market Transfer Station (East Zone): 250 TPD (~ 9 Km from project site)</td></tr>
<tr><td>10</td><td>Proposed Boiler no. and capacity</td><td>2 Boilers of 40 tons per hour (TPH) capacity each.</td></tr>
<tr><td>11</td><td>Proposed Boiler Stack Height</td><td>50 m (compliant to CPCB guidelines (national requirements) as well as requirements of IFC EHS guidelines)

For details refer Section 2.7.1.1</td></tr>
<tr><td>12</td><td>Proposed Ash generation</td><td>70 TPD ash is generated per boiler, i.e. total of 140 TPD ash will be generated</td></tr>
<tr><td>13</td><td>Proposed Transmission Line</td><td>66 kV transmission line of 3.82 km length (1.62 km underground+ 2.2 km overhead) having 14 towers connecting the plant to GETCO Jambuva Substation</td></tr>
<tr><td>14</td><td>Land Requirement for the Project</td><td>The total land requirement for the project is 17.92 acres.
<table>
<tr><th>Project Component</th><th>Total Leased out Land Size (in acres)</th><th>Easement Rights (acres)</th><th>Total land requirement (acres)</th></tr>
<tr><td>Waste to energy plant</td><td>8.5</td><td>0</td><td>8.5</td></tr>
<tr><td>Overhead transmission line</td><td>0</td><td>9.77</td><td>9.77</td></tr>
<tr><td>Underground transmission line</td><td>0</td><td>0.26</td><td>0.26</td></tr>
<tr><td>Underground water pipeline</td><td>0</td><td>1.47</td><td>1.47</td></tr>
<tr><td>Temporary Workers' Accommodation [1] (Leased for const.)</td><td>0.7</td><td>0</td><td>0.7</td></tr>
<tr><td></td><td>Total</td><td></td><td>20.7</td></tr>
</table></td></tr>
<tr><td>15</td><td>Water Requirement and Source</td><td><u>Construction Phase</u>
Water requirement during construction phase is met through groundwater abstracted from one borewell located within the project premises and third party water tankers. GWVPL has obtained permission from Central Groundwater Authority (CGWA) for abstraction of 7.5 m3/day[2] groundwater for drinking and domestic purposes. Bottled water for drinking purposes is being procured from third party.

<u>Operation Phase</u>
During operation phase (considering both the phases), the project will require 1387 m3/day water for industrial purpose which will be obtained from 52 MLD[3] Tarsali STP of Vadodara Municipal Corporation (VMC) located 3.5 km (aerial distance) from site towards north direction and 7.5 m3/day water for domestic purpose from one borewell located within plant premises.
As per Phase II groundwater quality results, groundwater should not be used for any portable purpose such as drinking or any other domestic purposes due to arsenic contamination level above tap water requirements (Section 5.3.6.4.2).</td></tr>
<tr><td>16</td><td>Treated Water Pipeline</td><td>The project will lay down four km of underground water pipeline from the location to the Tarsali STP, Vadodara.</td></tr>
</table>

[1] The land for workers accommodation is leased by the respective contractor only for the construction period and the same will be dismantled after the construction is over and the land will be handed over to the respective owner. Therefore same is not included in the total land requirement for the project.

[2] 1KLD= 1 m^3/day

[3] 1MLD=1000 m^3/day

Sr. No.	Components	Description
17	Borewell	Project site has installed 1 bore well for abstraction of ground water to be used for construction purpose. Same borewell will be used during operation phase for meeting water requirement for domestic purpose.
18	Presence of Indigenous People (ownership of procured land or usage on procured land)	There is no presence of ST /indigenous people were observed in the project area. Further the project and its associated TL, water pipeline, treatment plant are located in a highly urbanized and industrial area, where there is no habitations of ST therefore are no project-induced impact on Indigenous people (schedule tribes in context of India . And the project is not located in any designated Schedule V area, nor any traditionally occupied lands or heritage of indigenous communities.
19	National Park, Protected Area, or ecologically sensitive sites	• There is no protected areas/Ramsar/Important Bird Areas within the 5 km radius. The nearest protected area, Vadhavana Ramsar site is situated about 30 km away from the project location in South-east direction. • Jambugodha Wildlife Sanctuary is situated about 50 km away from the project location in East direction. • However, the Tibmi lake is 11 km way from the project site which is significantly important site for migratory birds during the winter.
20	River / water bodies	There are 22 water bodies are present within the buffer of 5 km from the Project location. The nearest pond is ~115m in West and the tributary of river Vishwamitri is ~130m away from the project location in Southwest direction.
21	Natural Hazard in the Project area	The Project level details with respect to natural hazards as per Building Materials and Technology Promotion Council (BMTPC) Vulnerability Atlas of India, Third Edition[4] have been presented below: • **Earthquake**: The Project is located in an area categorised as Zone III i.e., moderate damage risk zone (MSK VII) • **Wind**: The Project is located in an area categorised as Moderate Damage Risk Zone with wind speed between 39-44 m/s • **Flood**: The Project is located in an area vulnerable to floods. According to City Disaster Management Plan for Vadodara, 2022-23[5] developed by Gujarat State Disaster Management Authority (GSDMA), Vadodara district face major floods in every three year. As per information available on public domain, there had been instance of flood in Vadodara city in 2019 due to heavy rainfall[6],[7]. • **Drought**: According to City Disaster Management Plan for Vadodara, 2022-23, probability of drought for Vadodara is low. **Design basis reports have been developed for civil/structural design where geotechnical investigation was undertaken along with structural analysis. Earthquake load and high wind load have been factored in the design load for industrial building.**

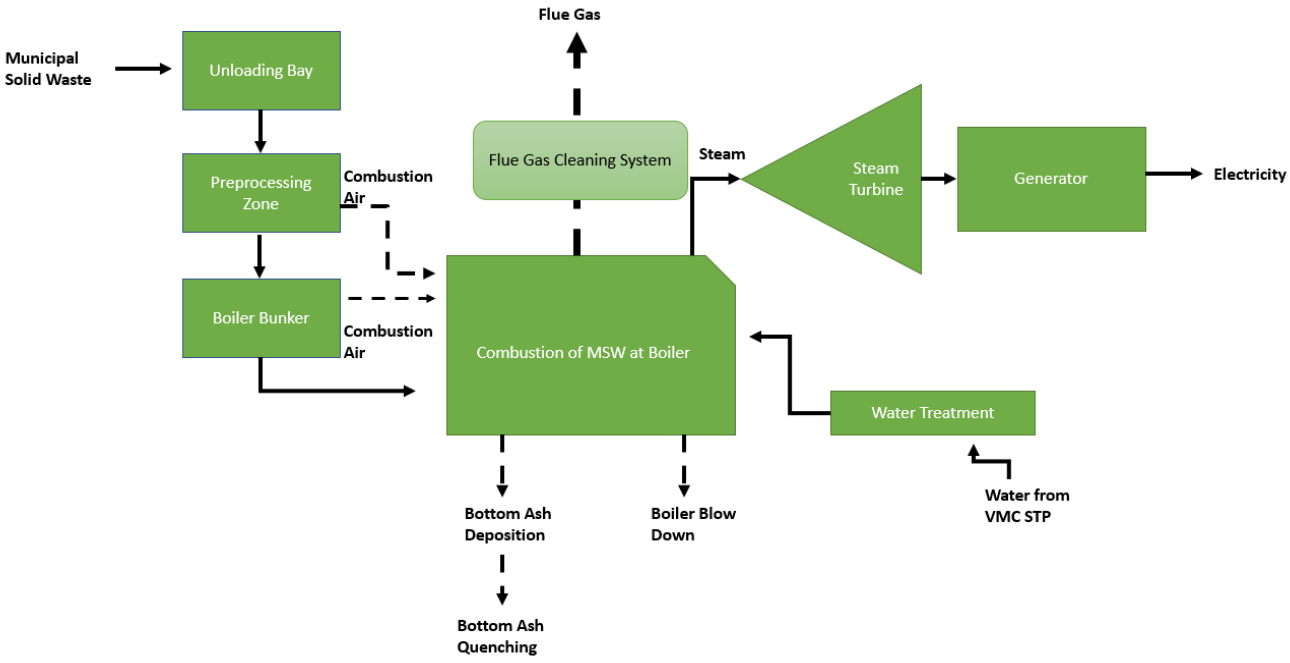
22	Project' Area of Influence considered as part of the ESIA	• **Ecological Parameters: Based on identified sensitivity during desk-based review and previous experiences, the study area for ecological assessment was demarcated as,**
		  ○ **Core Area:** Boundary of the project, and
		  ○ **Buffer Area:** 10 km radius from the project boundary.
		• **Environmental Parameters:** The area of up to 10 km radius from the Project boundary has been demarcated as study area or Area of Influence for the Project by considering the extent of project 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 facilities. For the purpose of environmental baseline assessment:
		  ○ **Core Area:** 0 – 2 km from project site
		  ○ **Buffer Area:** Beyond 2km – 10km of project site.

[4] https://vai.bmtpc.org/
[5] https://vmc.gov.in/ApplicationFormsPdf/Disaster/CDMP%202022-23.pdf
[6] https://timesofindia.indiatimes.com/city/vadodara/heavy-rains-lash-vadodara-city-many-areas-water-logged/articleshow/70467738.cms
[7] https://indianexpress.com/article/india/vadodara-rains-marooned-residents-caught-unawares-call-for-help-5870803/

Sr. No.	Components	Description
		• **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 zone -** The core zone is defined as the radius extending from the Project footprint area which would have majority of the impacts (during mobilization, construction, operation and decommissioning phase). The core zone area for the study is project footprint area i.e. WtE Plant, Water Pipeline and Transmission Line and adjacent area within 500 m radius. • **Buffer Zone -** An AoI of 10 km radius from the location of WTE Plant, transmission line and the water pipeline is considered for socioeconomic consultations to determine perceived impacts due to the Project including employment opportunities, loss of livelihood and increased vehicular activity in remote areas. **Study area:** Project footprint = Core zone (500 meters) + buffer zone (10 km).

Source: GWVPL & Site visits undertaken

Figure 2-1 Process Flow



2.1.1 Proposed Use of Industrial Waste

Type of industrial waste identified to be handled in the plant is as below.

S. No	Type of Industry	Waste Name
1	Paper	Pulp & Paper Waste
2	Textiles	Silk Waste/ Fiber Waste
3	Automobiles	Oily Rags, Cotton rags
4	Pharmaceuticals	Date expired goods

S. No	Type of Industry	Waste Name
5		Off specifications goods
6		Spent Carbon
7		Process Wastes and residues
8	Heavy Engineering	Used Oil
9		Waste residues containing Oil

Source: GWVPL

Industrial waste from only the above type of industries will be handled after proper screening. Screening of the waste will be undertaken prior to approval for use /incineration of the waste within the Plant. Screening of waste will include the following:

- Check & confirm the industry type
- Obtain waste categorization report from the industry
- Conduct test to identify and confirm hazardous content in the waste
- Assess suitability of incineration of the waste within the Plant including disposal mechanism of the hazardous ash
- Identify need for any additional Air Pollution Control Device due to incineration of any such waste, also identify need for any additional waste handling and storage requirement.
- All the applicable permits required for incineration of the identified waste including amendment in the existing legal permits, if required, will be obtained. All the conditions in the legal permits will be complied with
- Ash generated from the plant will be examined for hazardous content. If found hazardous, to be disposed of as per the provisions of Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, as amended.

2.2 Project Location & Site Setting

The 14.90 MW under construction waste to energy plant is located at Makarpura village, Vadodara tehsil and district, Gujarat, India. The project is situated adjacent to municipal solid waste (MSW) landfill operated by Vadodara Municipal Corporation towards east direction. The project in north and west direction is surrounded by agricultural land whereas a cremation ground is located towards the south direction. Based on historical images available on google earth and discussion with project team, it is understood that the land proposed for the project site was part of VMC's MSW landfill which was cleared by GWVPL for establishment of the WTE plant.

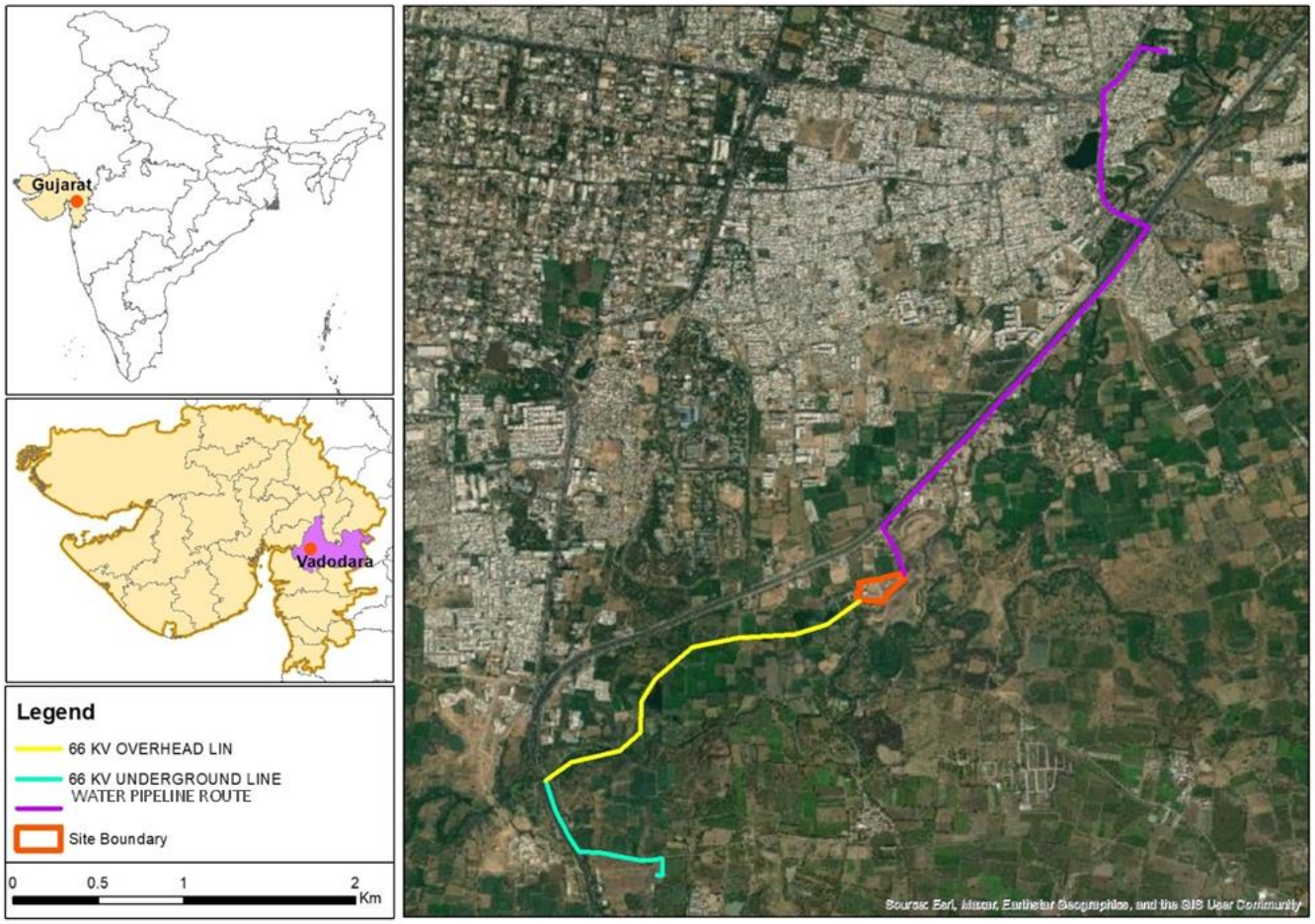
There is no protected areas/Ramsar/Important Bird Areas within the 5 km radius. The nearest protected area is Vadhavana Ramsar site located approximately 30 km away from the project location in South-east direction. A natural perennial water pond is located ~ 140 m (aerial distance) from site towards southwest direction. Vishwamitri river is flowing is flowing ~ 180 m (aerial distance) from site towards south and east direction and Tarsali lake is located 2.5 km (aerial distance) from site towards northeast direction. There are food outlets along the NH-64 and granite and marble shops located ~ 200 m (aerial distance) from site towards north and west directions. The project is accessible through Vora-Gamdi road which gets connected to National Highway (NH)-64 at an aerial distance of 400 m towards west direction.

The 52 MLD Tarsali STP is located at ~ 3.5 km (aerial distance) from the WTE plant towards north direction. Additionally, GETCO Jambuva 66kV substation is located ~ 2 km (aerial distance) from the WTE plant towards south direction. The nearest settlement to the project site is Makarpura village located 1 km (aerial distance) from site towards northeast direction and Vora Gomdi village located 1.2 km (aerial distance) towards east direction. There are no hospitals and schools in the near vicinity to the project location.

Nearest airport to the WTE plant is Vadodara airport located at 10 km from the WTE plant towards north direction and nearest commercial railway station is Vadodara railway station located at 9 km towards north direction.

A tentative Project location map has been presented in ***Figure 2-2*** below

Figure 2-2 Project Location Map



Source: Google Earth Imagery

2.3 Project Planning & Strategy

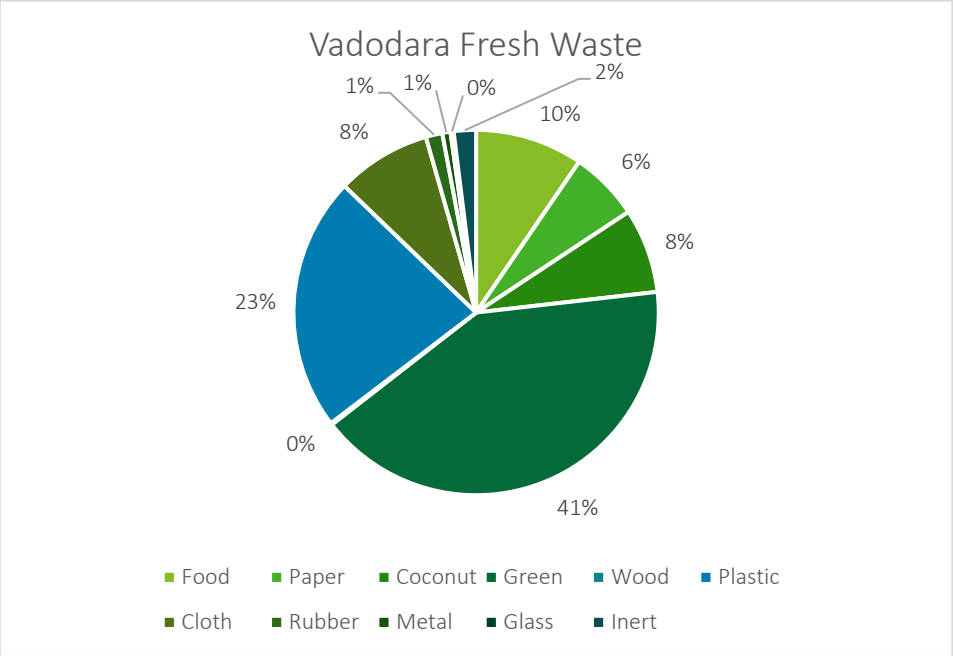
2.3.1 Waste Quantity

At present, Vadodara city is producing 1000 TPD of fresh municipal waste. The waste generation of the city is increasing at a rate of 25% per year.

2.3.2 Waste Characteristics

To understand the waste categorization of the area, the samples of waste were collected from 4 garbage stations (Atladara Transfer Station-West Zone, Atladara Transfer Station-South Zone, Vuda Circle Transfer Station- North Zone, Gadheda Market Transfer Station- East Zone) each of capacity 250 TPD. Total 198 tests were performed on the samples collected between 8th September to 15th September 2022. This included qualitative tests like bulk density, moisture, ash, GCV along with quantitative sieve analysis for 8-inch, 4-8 inch, 2-4 inch and below 2 inch size. Waste characterization for the fresh waste (sampled from the 4 transfer stations) for Vadodara has been presented in ***Figure 2-3*** . The Municipal Solid waste collected from these 4 locations reveals that green waste comprises the largest proportion, standing at 41%, whereas rubber and metal waste make up the smallest proportion, merely 1%. Additionally, other waste categories include food waste at 10%, paper waste at 6%, coconut waste at 7%, plastic waste at 23%, cloth waste at 8%, and inert waste at 2%.

Figure 2-3 Waste characterization for Fresh waste for Vadodara



Source: GWVPL, Abellon

Waste categorization was also undertaken separately by Abellon for the four-transfer station to assess the moisture content ash %, Gross Calorific Value (GCV), Heating value etc, details have been presented in Table below. The waste samples collected Atladara Transfer Station-South Zone recorded to have 43% moisture, which was the highest among the 4 Transfer Stations. The percentage of dry ash was recorded more in highest in Atladara Transfer Station-South Zone (21%) and the lowest at Vuda Circle Transfer Station (16%). Gross Calorific Value of dry waste at Vuda Circle Transfer Station-North Zone (4630 kcal/kg) was recorded as the highest among 4 transfer stations. Gross Calorific Value of wet waste was lowest at Atladara Transfer Station-West Zone due to its high moisture content. The low heating value (LHV) value of wet waste at Gadheda Market-East Zone was recorded as the highest (2707 kcal/kg).

Table 2-2 Transfer Station specific waste characterization.

	Weighted Average values					Derived Composition		
Vadodara Transfer Station	Moisture (%)	Ash_{dry} (%)	GCV_{dry} (kcal/kg)	GCV_{wet} (kcal/kg)	LHV_{wet} (kcal/kg)	Organic matter (%)	Moisture (%)	Ash + Inert (%)
Atladara Transfer Station-West Zone	42%	19%	4274	2580	2197	47%	42%	12%
Atladara Transfer Station-South Zone	43%	21%	4332	2658	2273	45%	43%	12%
Vuda Circle Transfer Station-North Zone	41%	16%	4630	2890	2499	50%	41%	9%
Gadheda Market-East Zone	34%	17%	4539	3078	2707	55%	34%	11%
Average	40%	18%	4443	2801	2419	49%	40%	11%

Source: GWVPL Project Parameter Booklet, Abellon

2.4 Waste Collection and Transportation

The project will obtain the total required 1000 TPD MSW to operate the power at full capacity of 14.9 MW from waste transfer stations located across Vadodara city. At present, the project is under construction and will be in operation by March 2024.

2.4.1 Door to door waste collection

The fresh waste collected from households will be transferred at the transfer stations which will then be transported to the project site through VMC owned trucks. Approximately 150-200 trucks and tippers will be required at the WTE plant for transportation of MSW from the transfer stations. Currently, the MSW arriving at the operational transfer stations are disposed at the VMC MSW landfill. The process adopted by Vadodara Municipal Corporation (VMC) for door-to-door waste collection involves following steps:

1. **Segregation:** Waste generated by households is segregated into different categories like biodegradable (organic) waste, recyclable waste, and non-recyclable waste. This step is not universally followed by all households; however, some households has adopted the practice of segregation of waste at the household level.
2. **Collection Schedule:** VMC has set a collection schedule for each area or locality of the Vadodara city. The schedule specifies the time for waste collection from the area/ locality.
3. **Collection Staff:** Waste collection staff, often known as waste collectors or sanitation worker, are responsible for going from house to house to collect waste. They may be employed by the municipality or contracted through private companies.
4. **Collection Process:** Waste collectors go to each household during the designated collection hours and collect the waste. They use trolleys, bins, or sacks to collect and transport the waste from individual houses to the collection vehicle.
5. **Collection Vehicles:** Dedicated waste collection vehicles, such as compartmentalized mini trucks, are deployed to collect segregated dry and wet waste from door to door.
6. **Collection Centers:** The door-to-door collected waste through mini-trucks is dumped at collection centers from where the collected waste will be loaded in compactors or big trucks to transport it to the Waste to Energy project site.

During the door-to-door collection process, the collection staff collect the recyclable waste from the household produced waste. After the collection, the recyclable waste is then sold by the collection staff to private buyers or at the Material Recovery Facility (MRF) owned by Vadodara Municipal Corporation (VMC). The MRF serves as a centralized facility where recyclable materials are sorted, processed, and prepared for further recycling or sale to recycling industries.

Currently, the collected waste is loaded in compactors or big trucks to transport from collection centers to the landfill. After the dumping of freshly collected waste at the landfill, Ragpickers further collect recyclable waste from the dumped waste. The process of collection of recyclable waste by ragpickers from freshly dumped waste at the landfill is generally an informal process

2.5 Waste Handling and Treatment Process

GWVPL will receive 1000 TPD MSW (when both the boilers will be in operation) directly from Vadodara Transfer stations (collected from households) which is proposed to be transported through trucks and tippers owned by VMC on daily basis. Nearly 100-120 trucks and tippers are anticipated to arrive at the WTE plant with MSW.

Each truck carrying the municipal solid waste (MSW) will be visually inspected before going to a weighbridge. MSW vehicle containing high percentage of unwanted materials, will not be accepted in the WTE plant and returned post communication with the municipality. After visual inspection and weighment, the municipal solid waste will be unloaded at the unloading bay in the pre-processing bunker of capacity 590 Ton from where it will be fed into the pre-processing zone. At the pre-processing zone, splitters, shredders, star screen and metal removing equipment are proposed to be installed to:

- Removal of unwanted particles size from MSW
- Remove big size stones as much as possible
- Remove metal (mostly Fe) to the extent possible

- Remove content like glass bottles, big tin and other large size cubes to the extent possible
- Processing of all incoming waste will be undertaken as fast as possible to minimize waiting time of vehicles bringing material to WTE Plant.

The rejected waste/ inert waste generated at the preprocessing unit will be transferred back into VMC trucks which will dispose the inert waste at Vadodara MSW landfill. Glass and metal will be collected and stored within the WTE plant and further will be disposed of through local scrap vendors.

Post preprocessing waste will be transferred at the boiler bunker proposed to be constructed to store prepared fuel for boiler. Bunker of capacity (~1400 Ton) will be built to accommodate approximately waste requirement of 2+ days of prepared RDF to ensure round the clock availability of the fuel for the two boilers.

Boiler is proposed to be fed with RDF (also termed as "fuel") with the help of fuel feeding system. The WTE plant at GWVPL is equipped with two boilers of capacity of 40 TPH (Tons per Hour) each with steam pressure and temperature of of 42 kg/cm^2(g) and 410+-10^{0}C and a stack height of 50 meters and stack diameter of 2.1 m. Fuel is proposed to enter the boiler at an elevated height of 5.5 m above travelling grate which will help in partial combustion of about 40% in suspension and remaining combustion will take place on grate[8]. As proposed, the incineration process will take place in Boiler itself. Combustion of Fuel or RDF is proposed to be undertaken at a temperature more than 900°C. A special radiation zone without heat recovery is provided in the boiler after the last injection point of secondary air into furnace. As the air goes higher, the temperature of the boiler will decrease, however it will remain at 850 °C at least for about two seconds. This higher temperature will help in achieving complete combustion and ensure destruction of harmful emission before flue gas enters heat recovery area. A rapid cooling zone (400° C to 200° C) is provided for the flue gas post combustion to avoid formation of carcinogenic compounds.

A comprehensive flue gas cleaning system is proposed to be installed after boiler exhaust to control emissions. The flue gas cleaning system will include Dry ESP, Activated Carbon Injection System and Bag Filters to control emission in the atmosphere as per EU Norms 2010.

2.6 Project Components

Total site area for the project is 34,426 sqm (8.54 Acre), Total Footprint area of construction is 17,065 sqm and building construction area is 7,371 sqm. Component wise area details are as presented below in ***Table 2-3*** and ***Figure 2-4***.

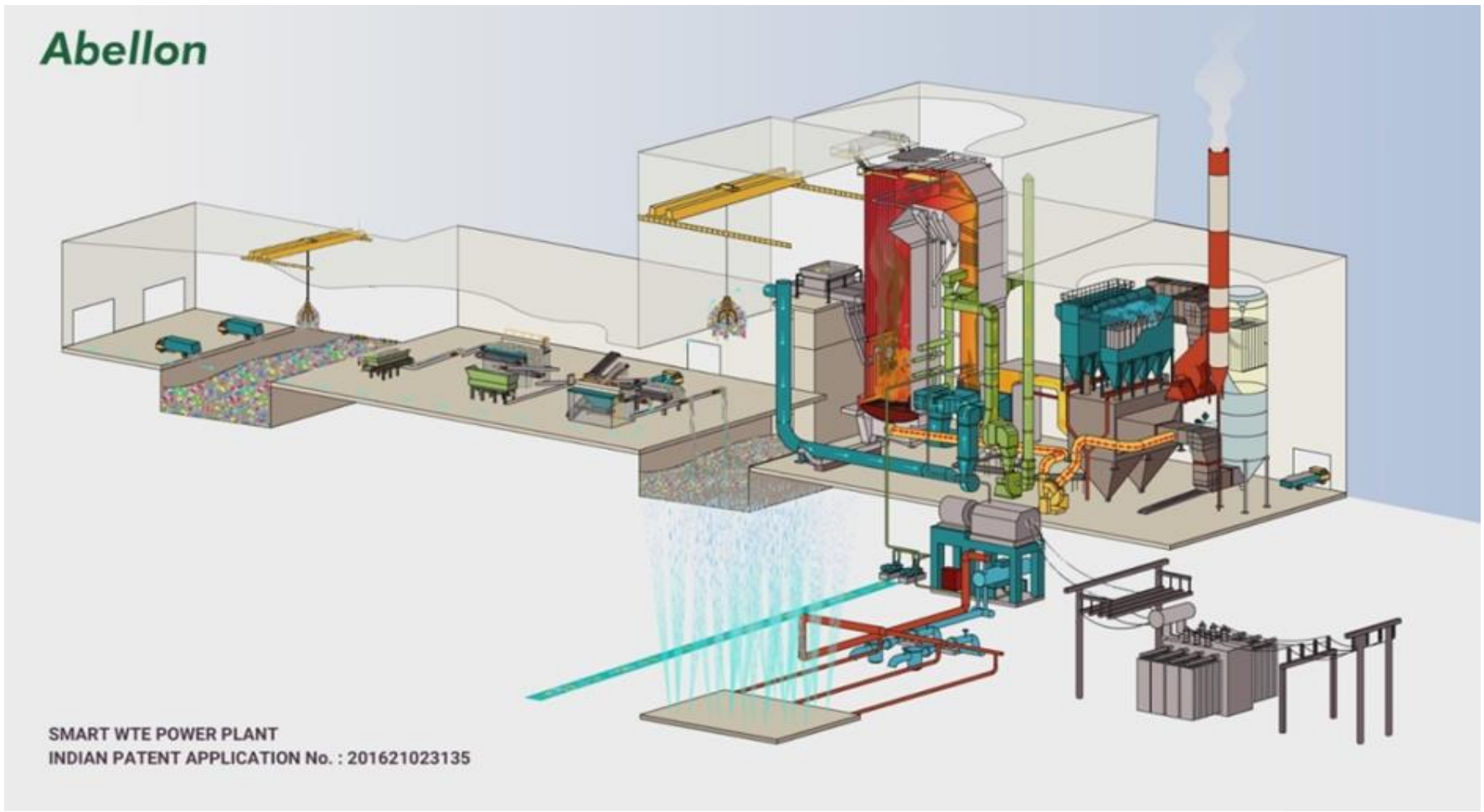
Table 2-3 Project Component Area Details

Component	Area (in sqm)
Worker and Visitor Entrance Area	300 sqm
Two-Wheeler Parking Area	186 sqm
Four-Wheeler Parking Area	130 sqm
Admin + Cafeteria Area	730 sqm
Boiler + FGCS Area	2285 sqm
Switchyard Area	520 sqm
Pre-Treatment Area	200 sqm
Mist Cooling Area	445 sqm
Panel Room Area	260 sqm
Turbine Area	300 sqm
Main Bunker Area	635 sqm
Pre-processing Area	1,320 sqm
OTS Toilet Area	60 sqm
Total	**7,371 sqm**

Source: GWVPL Project Parameter Booklet, Abellon

[8] The primary air required for combustion is proposed to be drew from boiler bunker area and preprocessing zone.

Figure 2-4 Project Site Overview & Layout



Source: GWVPL, Abellon

2.6.1 Weighbridge

Weigh Bridge is a platform where the trucks carrying waste from transfer stations will stop to record the quantum of waste entering the Waste to Energy facility. The Project has setup a weighbridge at the entrance dedicated for material movement and will be used to weigh trucks loaded with waste as well as empty trucks.

2.6.2 Pre-processing

Pre-processing is a PLC based control system with operating station in which operator controls and monitors the operation of splitters, shredders, star screens and belt conveyors. The entire system has auto start/stop for all the equipment and can be operated by the operator sitting in the operation station with a processing capacity of 60TPH. Only 4-5 personnel will be required to be present within the area to overlook the overall processing.

Pre-processing will include:

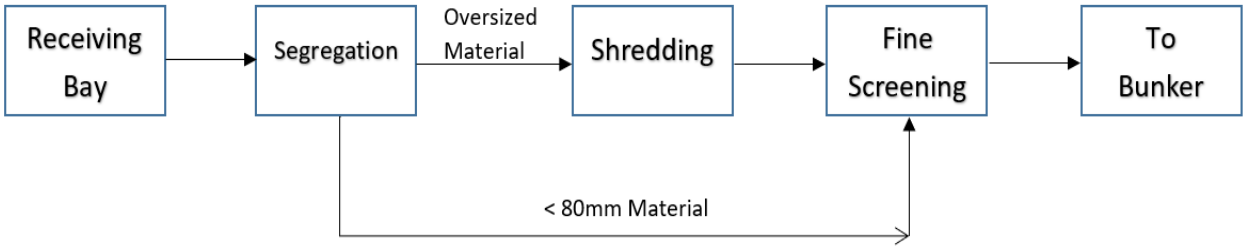
Waste segregation: Waste from the receiving area will be fed into splitter machine through grabbers. The splitter will segregate the in-feed material in 3 streams:

- 3D cubical heavy parts (size >80mm, rejected)
- 2D long material (size >80 mm)
- Fine/ under size material (size < 80 mm)

Waste shredding: The oversized material from the splitter will be passed through a single shaft shredder. The 90% of output material will be the size of <80mm.

Waste screening: The fine material of size < 80 mm from both splitter and shredder will then be passed through star screen unit for the segregation of the material. The screened material will mostly be inert and of the size of <20 mm and is considered as reject. Process flow diagram for pre-processing is as presented ***Figure 2-5*** below.

Figure 2-5 Process Flow Diagram for Pre-Processing



Vadodara WTE plant is proposed to be equipped with two boilers, hence the WTE Plant will have two separate pre-processing areas and equipment for the boilers.

2.6.3 Fuel Feeding System

The fuel feeding system consists of feeders for both primary fuel (RDF) and auxiliary fuel (biomass). The Project will have two separate boilers with common steam turbine.

Fuel feeding system will consist of the following components:

- **Boiler bunker along with storage of auxiliary fuel**: The boiler bunker will have a partition to store auxiliary fuel (Biomass Pellets/briquettes, saw dust, wood chips). Separate unloading access point will be provided to the auxiliary fuel area of capacity 590 ton. The auxiliary fuel will be used to ignite boiler and achieve target furnace temperature. Fuel will feed in the boiler only after achieving the target temperature.
- **Orange Peel Grab Crane**: orange peel grab crane will be provided to lift the required quantity of boiler fuel from bunker and deliver the same on fuel pushing mechanism and to tumble stored Boiler Fuel (RDF) in bunker to achieve better homogeneity.
- **Fuel Pushing Mechanism (FPM) & Fuel feeding chute system**: 2 fuel pushing mechanism per boiler will be available to supply fuel to the boiler. Each FPM will be connected to hydraulic push with a vibro feeder to increase the better waste flowability. Four Fuel feeding chutes will be provided per boiler. Inlet for each feeding

chute will be inside boiler area. The portion present within the boiler will be made of stainless steel material and will be water jacketed.

2.6.4 Boiler

Boiler of output 40 TPH has been installed to convert water to steam. Technical specification of boiler is as presented in *Table 2-4*.

Table 2-4 Boiler Specification

Design Parameters	Unit	Value
No. of Boiler	2	Two
Boiler output – Maximum Continuous Rating	TPH	40
Boiler type		Traveling Grate
Installation		Indoor, Field erected
Steam Pressure at Super heater outlet	Kg/cm2(g)	42
Steam temperature at Super heater outlet	^{o}C	410±10
Feed water temperature inlet to economizer	^{o}C	130
Feed water temperature inlet of Deaerator	^{o}C	35
Fuel Feeding Capacity	TPH	Required 16 (can feed upto 20)
Fuel Required quantity	Kg/Hr	16.168
Type of firing		Travelling Grate (Air cooled) with Pneumatic Spreader
RDF Fluff		Top size not to exceed 100 mm in length for a Micro Cross Section of 2.0 mm2

Source: GWVPL Project Parameter Booklet, Abellon

2.6.5 Power Generation & Evacuation

Boiler will generate superheated steam which will expand in steam turbine which in turn will rotate alternator and generated electricity will be evacuated through 66KV transmission line at GETCO substation. Steam turbine is proposed to be equipped with condenser with cooling water circulation. Process of generation of electricity from turbo-generator is as described below.

2.6.5.1 Steam Turbine

Turbo-generators convert the thermal energy of steam into mechanical work (Turbine) & then convert the mechanical energy to the electricity (alternator). Depending upon the size of the machine and operating parameters, the alternator can be either directly coupled with the turbine or mechanically connected through a gear box in between. This coupling is connected through reduction gearbox and is of pinbush/shear pinbush type, latter is mostly in case of smaller capacity machines such as the ones for WTE projects.

High pressure steam is admitted into the turbine and then expanded in fixed and moving nozzles depending upon the turbine configuration. During the process of expansion, the nozzles/blades thermal energy is converted into mechanical work. Low pressure steam at the end of the expansion can be either extracted for processes and/or preheating of feed water for improving the overall thermodynamic efficiency of the plant or condensed directly at lowest possible pressure (related to the absolute atmospheric pressure) for generating maximum power from the available steam. Steam is required in the WTE plant for the HP-heater as well as feed water de-aerator& SCAPH. This steam can be extracted from the turbine under different modes.

Table 2-5 Technical Specification of Turbine

Description	Value
Type	Multistage, impulse/reaction, nozzle governed bleed cum condensing

Description	Value
Casing split	Horizontal
Rotor type	Solidly forged & machined rotor with integral disks
No of Stage	16
Shaft seal	Labyrinth
No. of governing valves	Three (Inlet)
Bearing support	Double pedestal
Rated power	15000 KW
Power Generation Capacity (MW)	14.9
Generation Voltage (kV)	11
Frequency (Hz)	50±5%

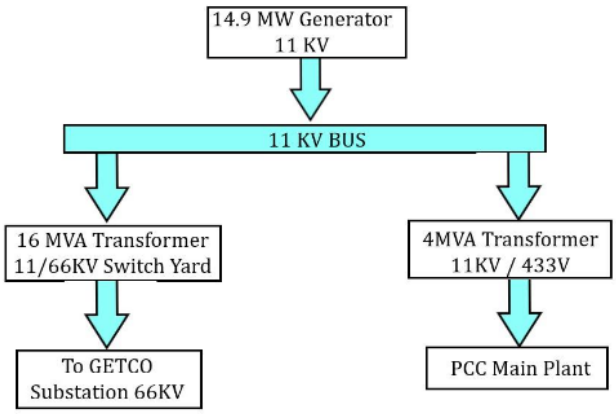
Source: GWVPL Project Parameter Booklet, Abellon

2.6.5.2 Power Evacuation

GWVPL will setup a switchyard within the project premises, where the Power Transformer (16 MVA, 66/11 KV) will be used to step up voltage from 11 KV to 66 KV. 66 KV power from the switchyard will be further evacuated to Jambua 66 KV Substation through transmission line.

Project will also use the generated power within the premises for various project components. The auxiliary power transformer will step down the voltage from 11KV to 433 Volt and further distributes power through the panels to be used in various locations within the WtE Plant.

Figure 2-6 Power Flow Diagram



Source: GWVPL Project Parameter Booklet, Abellon

Project will also use the 17% of the generated power within the premises for various project components. The Auxiliary power transformer will step down the voltage from 11KV to 433 Volt and further distributes power through the panels to be used in various locations within the WtE Plant.

2.6.5.3 Transmission Line

The total length of the 66 kV transmission line from the project location to nearby Gujarat Energy Transmission Corporation Limited (GETCO) Substation is 3.8 kilometres out of which 2.2 km is overhead and 1.6 km is underground. The overhead transmission line will install 14 towers. Provided below the details of the overhead and underground transmission line:

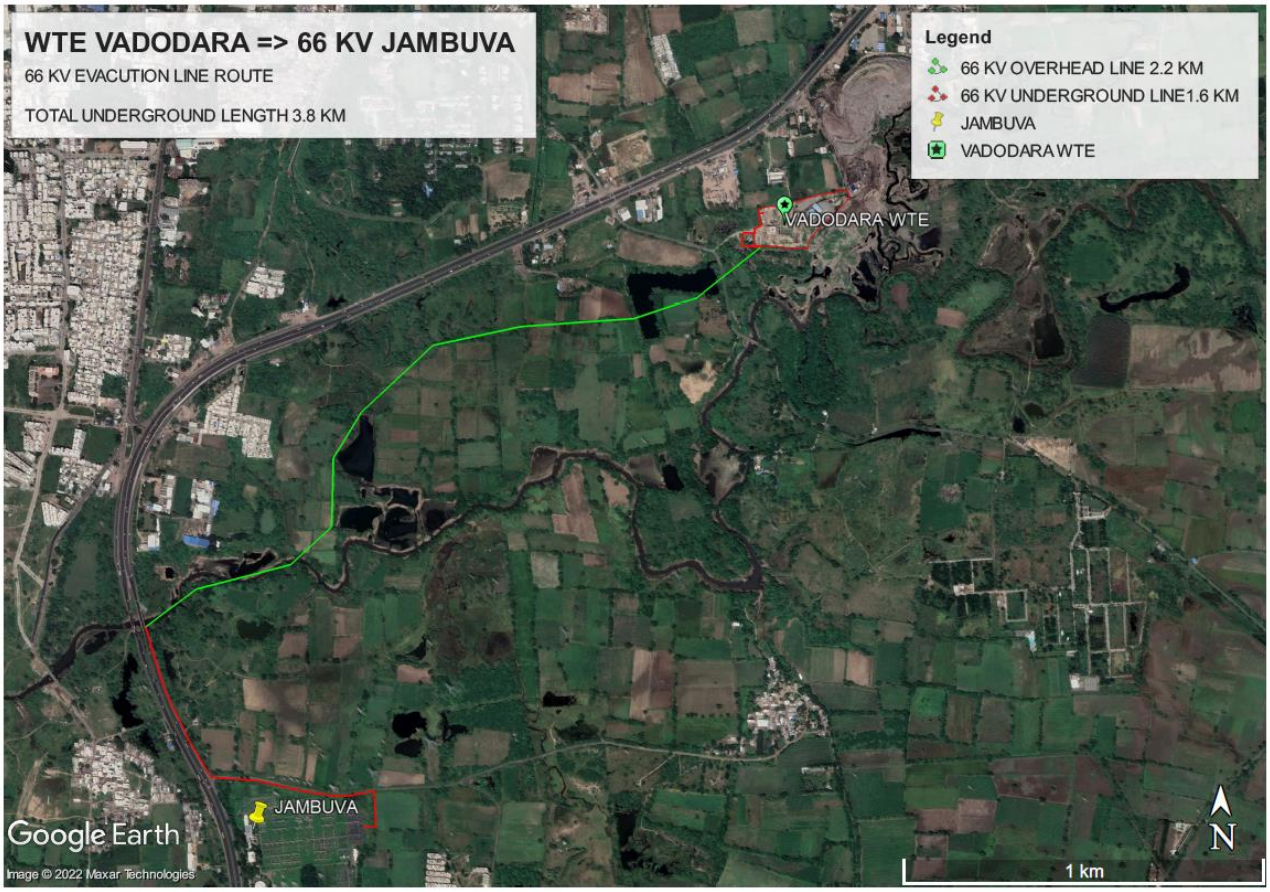
Table 2-6 Details of the overhead and underground transmission line

Type of transmission line	Details
Overhead transmission line	o Total length: 2.2 KM o Total of 14 towers with 66 KV D/C tower with ACSR Dog conductor. o The Overhead Transmission line will be crossing the IOCL pipe line and a 400 KV D/C transmission line
Underground transmission line	o Total Length of 1.6 km o Underground line length from GWVPL substation to Tower no 1 is 1.735 Km o Underground line length across the railway line is 0.19 Km o Underground line length from Tower no 48 to Jambuva Substation is 1.065 Km

The transmission line is not associated facilities[9] as per the IFC PS, 2012, because it is part of the project and funded by the Project. It is not a separate facility that relies on the project or provide essential goods or services to the project. Therefore, Transmission line do not fall under the scope of the definition of associated facilities.

The Transmission line is shown in ***Figure 2-7.***

Figure 2-7 Transmission Line Route



Source: Project Parameter Booklet, GWVPL

[9] As per the International Finance Corporation's (IFC) performance standard (PS), associated facilities are defined as facilities that are not funded as part of the project and that would not have been constructed or expanded if the project did not exist and without which the project would not be viable.

2.6.6 Cooling Water System

Cooling system is required for cooling of hot condensate, coming from turbine, oil cooler of turbine, air cooler of generator, feed pump gland cooling and steam samplers. To cool about 30.83 TPH of condensate and to meet total cooling requirement, circulation of about 4200 m^3 of water being done in condenser unit. Condensate cooling system ensures an approach of reduction in 3˚C to WBT (wet bulb temperature) with a temperature drop of 8˚C. i.e., from 40˚C to 32˚C.

2.7 Air Pollution Control Devices

Air pollution control devices proposed to be installed are as presented in subsequent sections.

2.7.1 Stack Height

The flue gas is proposed to be released through stack at a height of 50 m in compliance to CPCB guidelines (national requirements), Consent to Establish (CTE) obtained from GPCB as well as requirements of WBG EHS guidelines.

As per the Environment (Protection) Amendment Rules, 2023, published on 16th May 2023[10], for boilers, minimum stack height (in meter) shall be as per the formula,

- $H=14Q^{0.3}$ (where Q is SO_2 emission rate in kg/hr); or
- $H=74Q^{0.27}$ (where Q is PM emission rate in tonnes/hr), whichever is more.

However, in no case the stack height shall be less than 11 m for boilers of < 2 ton/hour steam generation capacity and 30 m for boilers of higher steam generation capacity.

GWVPL will be setting up two boilers with 40 TPH steam generation capacity and will be using waste as primary fuel for the boiler, Stack height as calculated as per the above-mentioned formula should be 48.75m. GWVPL is developing a stack height of 50m for each boiler.

Table 2-7 Stack height calculation as per The Environment Protection Rule-1986

Particulars	Units	Value	Remark / Formula
Fuel Feeding Rate (F)	Kg/hr	16000	--
Sulphur Content in Fuel (S)	%	0.20	--
Emission Rate of SO_2 (Q)	Kg/hr	64	Q = (F*S%*2)/ 100
Stack Height (H)	metre	48.75	H = 14*(Q^0.3)

Stack Design for both the boilers

- **Top Part of Stack:** The Height of the Top Part of the Chimney will be 14.50 meters
- **Bottom Part of Chimney**: The Height of the Bottom Part of the Chimney is proposed to be 22.70 meters
- The Bottom part of chimney will start at elevation of 12.80 meters. So, total height of the chimney will be 50 meters from the Ground Level at the WTE plant.

As per the IFC EHS[11] guidelines the stack height should be as per the following formula:

Hg= H+1.5L,

H is the height of the nearby structures above the base of the stack (stack is set on ground level)

Where L is the lesser dimension, height(h) or width(w) of nearby structure, wherein Nearby structures are structures within or touching a radius of 5L, but less than 800 m (in this case, during construction phase (scenario-1) nearest residential structure[12] is present at a distance of 501m from GWVPL plant in north west direction, however post completion of construction of the project (scenario-2) nearest structure present will be the admin building present adjacent to the stack with a height of 14 m and width of 23 m approx.)

[10] https://cpcb.nic.in/displaypdf.php?id=SW5kdXN0cnktU3BlY2lmaWMtU3RhbmRhcmRzL0VmZmx1ZW50LzQ1OS0xLnBkZg==
[11] Air Emissions and Ambient Air Quality (Environmental, Health & Safety Guidelines: General EHS Guidelines: Environmental))
[12] This is a standalone residential structure in the midst of the agricultural fields.

Scenario 1: Hg is calculated as ~19.2 m(considering H= 5.5m, L= 9.15m)

Scenario 2: Hg is calculated to be ~35 m (considering H= 14m, L= 14m).

Since the stack height will be 50 m which is higher than the minimum stack height requirement for the project, therefore the stack height of the boilers is compliant to WBG EHS guidelines as well.

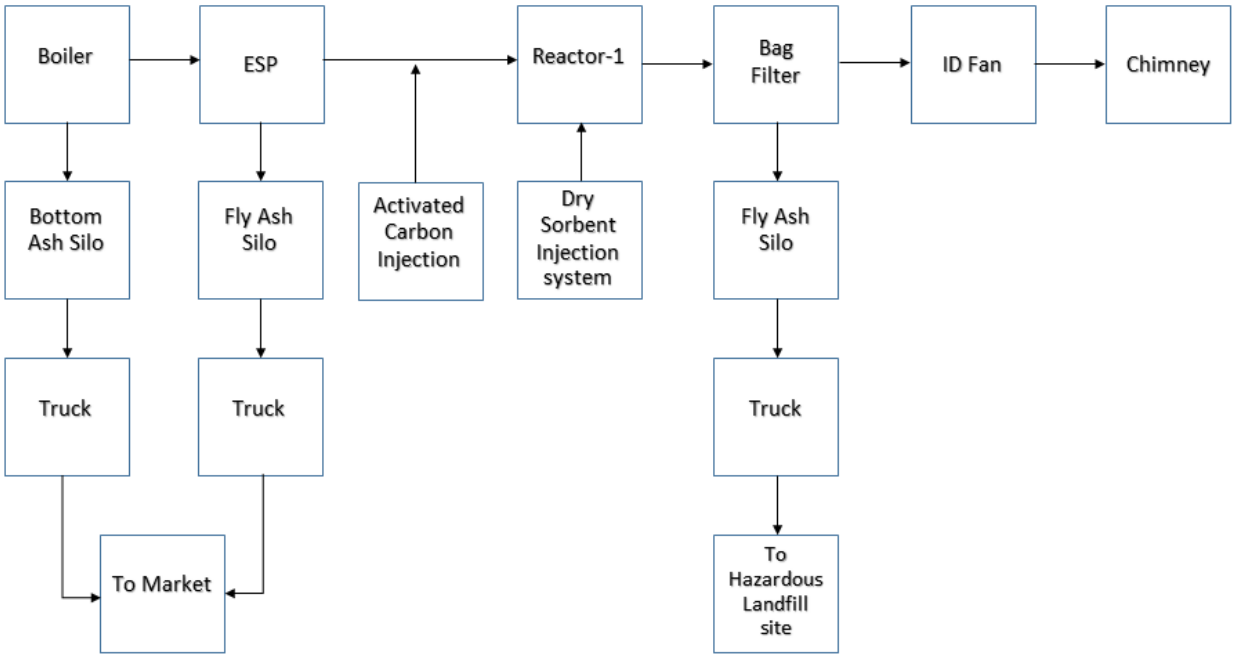
Stack height as per CTE obtained from GPCB dated 21.03.2020 is 40 m. Hence the proposed stack height is also in complaint to CTE.

2.7.2 Flue Gas Cleaning Mechanism

GWVPL's flue gas cleaning system has been designed to control emission of dioxin, furan and heavy metals i.e., Sc (Scandium), As (Arsenic), Pb (Lead), Co (Cobalt), Cr (Chromium), Cu (Copper), Mn (Manganese), Ni (Nickel) and V (Vanadium), acidic gases like HCl (Hydro-Chloric Acid), SOx (Sulfur Oxides), NOx (Nitrogen Oxides) and suspended particulate matter (SPM).

The dust extraction system will be equipped with bag filters and Electrostatic Precipitator (ESP). The bag filters will enhance the acid removal process by forming cake and minimize SPM emission. Air will be purged on the Deferential Pressure (DP) basis within the bag house system. The bag house system will be designed in a way that whenever there will be increase in differential pressure to certain limit, the air will be purged automatically. The ESP helps in controlling emission of particle size of less than 100 micron and enhance efficiency of hydrated lime and activated carbon powder used in Dry Sorbent Injection System (DJIS)[13]. There will be two units of flue gas cleaning trains (one train per boiler) within the dust extraction system where one train of flue gas cleaning system will comprise of an ESP, Injection of Activated Carbon, reaction tower, DSIS and bag filter. Refer ***Figure 2-8*** below for details.

Figure 2-8 Flue Gas Circuit



Technical details and design parameters for ESP, Activated Carbon Injection, Acid Control Reactor Tower, Dry Sorbent Injection (DSIS) system, Filter bag house have been added as ***Annexure 3***

2.7.3 Dioxin and Furan Control Mechanism

Dioxins and furans are typically formed in a temperature zone of 200-400°C and are minimized/destroyed in a temperature zone of 800-900°C. Therefore, the boiler system will be designed to help in achieving complete combustion

[13] Dry Sorbent Injection Systems involve the injection of a dry sorbent into the flue gas ductwork following the boiler to reduce concentrations of acid gases like Sox and HCl. These acid gases react directly with the dry sorbent, which are collected in a downstream particulate control device.

and ensuring destruction of harmful emissions before flue gas enters heat recovery area. Factors promoting formation of Dioxins and Furan are presence of Chlorine in vapor phase, presence of oxygen, resident time of flue gas between 400^{0}C to 200^{0}C, presence of pre-cursors for Dioxin and Furan, presence of large surface area of Fly ash, presence of metallic catalyst like copper (Cu) and Lack of online cleaning mechanism for minimizing fouling on heat transfer area.

GWVPL aims to ensure that the formation of dioxins and furans does not takes place. In that approach, suspension firing will be undertaken for at least 50% of the waste and rest combustion will take place on travelling grate where average temperature is around 1000 ^{0}C.

2.7.4 Ash Handling System

Each boiler of capacity 40 TPH will have Suspended Firing Combustion System, therefore, about 20% of total cash generated during incineration process will be "Fly Ash". The estimated fly ash quantity generated at the WTE plant will be about 70 TPD (per Boiler) which will be collected at different points i.e., 8 collection points for Bank Zone ash[14], 4 collection points for ESP ash and 2 collection points for bag filter.

The bottom ash received from the boiler will be disposed in the water submerged belt conveyor to reduce high temperature of bottom ash and avoid unwanted air ingression in the boilers. The bottom ash temperature at the boiler will be about 350 ^{0}C which will be reduced to 100 ^{0}C at the submerged water belt conveyor. The bottom ash will be transported to the sludge dying area for natural drying prior to its disposal to the VMC landfill via VMC trucks[15]. The fly ash generated will be stored in silos before it is sent to cement plant or as per conditions stipulated in the consent to operate to be obtained prior to operation phase. Technical specifications of Ash conveying system are shown in ***Table 2-8***.

Table 2-8 Technical Specification of Ash Conveying System

Bank zone Ash conveying system	ESP Ash conveying system	Bag Filter Ash/Residue Conveying system
• Conveying capacity: 600 kg/hr. • Conveying distance: 25 ± 5% Metre • Storage silo capacity: 22.5 Cubic Metre • No. of Silos: 1 per boiler (2 total)	• Conveying capacity: 800 kg/hr. • Conveying distance: 40 ± 5% Metre • Storage silo capacity: 22.5 Cubic Metre • No. of Silos: 1 per boiler (2 total)	• Conveying capacity: 600 kg/hr. • Conveying distance: 25 ± 5% Metre • Storage silo capacity: 22.5 m3 • No. of Silos: 1 per bag house (2 total)
Source: ESP discharge Hopper 1 & 2	Source: Bank Zone Ash, Vertical Economizer zone, PAPH-II, ESP inlet duct	Source: Bag Filter Discharge

Source: Project Parameter Booklet, GWVPL

[14] Bank zone is an area between boiler super heater and economizer area. It is horizontally laid immediately after end of furnace. There are three fly ash collector pipeline which are connected in bank zone area at three different location. This provision is required to drain any fly ash deposition in this area. With help of common RAV (rotary airlock valve) they are connected to flash silo located adjoining boiler house. Fly ash generated from bank zone and ESP area collected in same silo and from there same is transferred out of the campus in closed transport vehicle.

[15] As reported by GWVPL, the inert waste and ash disposal does not fall within the purview of GWVPL and the same will be disposed by VMC at designated landfill through VMC owned trucks.

Figure 2-9 Ash Sources

1). Boiler ash :- Collection point - 8 Nos (Bank zone, economizer zone, primary air preheater zone and ESP inlet)
2). ESP ash :- Collection point - 4 nos (ESP Discharge Hopper 1 & 2)
3). Bag filter ash :- Collection point - 2 Nos (Bag filter Discharge hopper 1 & 2)

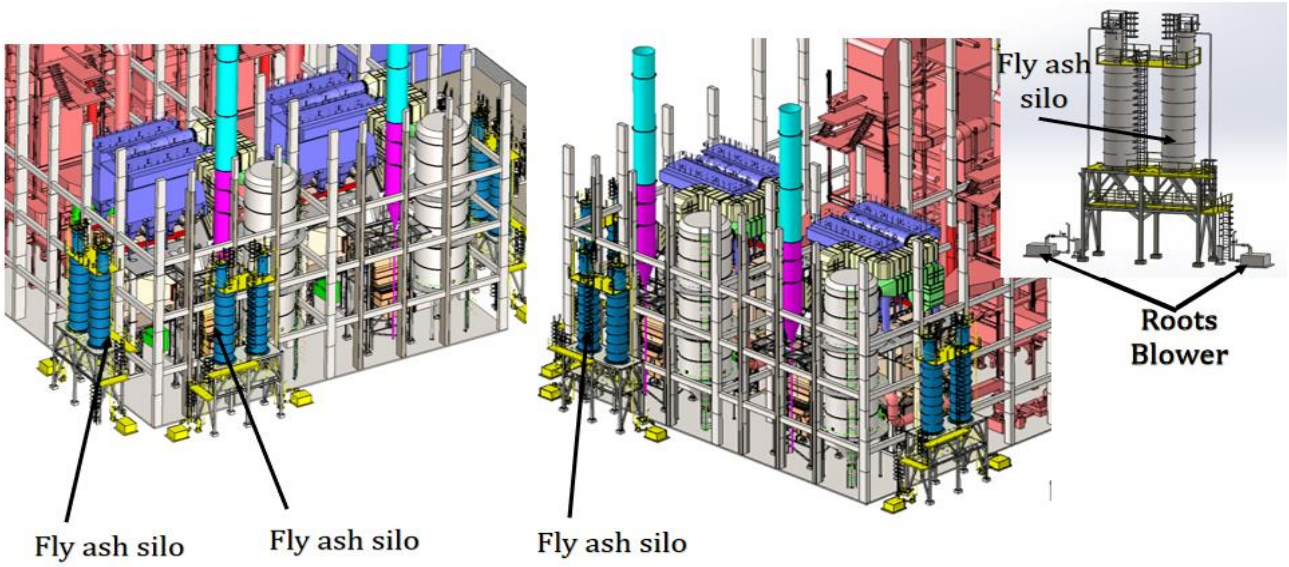


Table 2-9 Ash Balance- Per Boiler

Ash Type	Ash Quantity (TPD)	% Ash composition	Proposed Disposal Mechanism	Potential Ash Use[16]
Total Ash	70	20% of the total fuel	--	--
Bottom Ash	56	80% of Total Ash, contains 0.25% ferrous material and 0.012% Nonferrous material	Submerged belt conveyer post which disposed in sludge drying bed area for natural drying Metal Scrap recovery	Most of It can be used as void material for construction purpose subject to proper screening and drying process. There are other ingredients like metal pieces, glass material, some portion of unburnt needs scientific separation and its disposal.
Bank Zone Ash	2.80	4% of Total Ash	Sent to market as replacement @1000INR/Ton	It can be utilized in place of river sand in construction due to its larger course size.
ESP Fly Ash	7.70	11% of Total Ash	Can be sent for Pavor Production	it can be utilized to produce concrete pavers, aerated concrete blocks, etc.
Bag Filter cake ash	3.50	5% of Total Ash	Hazardous Landfill site	Most of It can be used as void material for construction purpose subject to proper screening and drying process
Bag Filter Residue due to hydrated lime reacted with HCL and	7.30	--	Hazardous Landfill site	--

[16] Please note, the ash uses are potential uses and the ash is not currently used. The Ash generated are currently disposed.

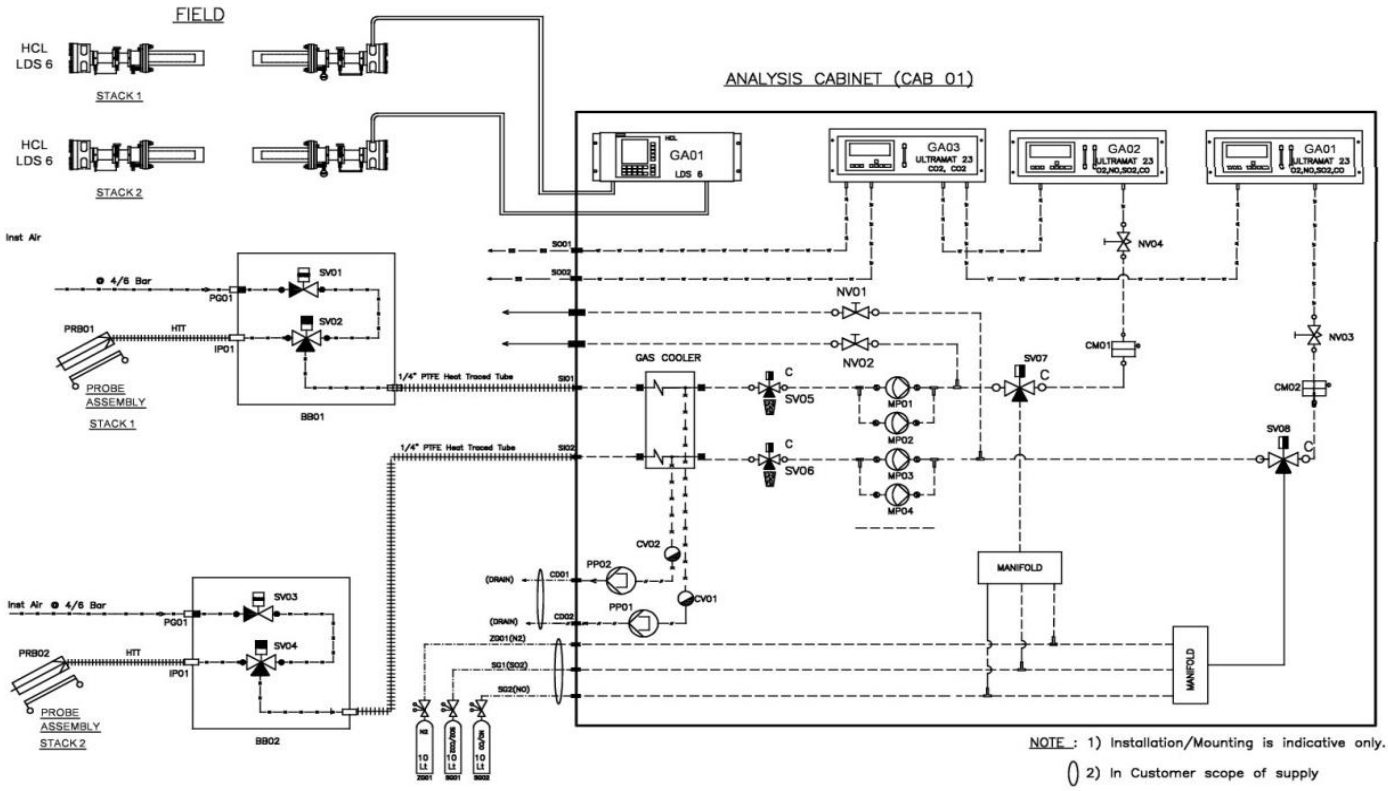
Ash Type	Ash Quantity (TPD)	% Ash composition	Proposed Disposal Mechanism	Potential Ash Use[16]
activated carbon injection				
Metal Scrap Recovery	0.14	@0.25% of the bottom ash	--	--

Source: Project Parameter Booklet, GWVPL

2.7.5 Continuous Emission Monitoring System (CEMS)

CEMS will include a PLC-based control system with an operating station that communicates with DCS for centralized monitoring, data archiving, and report generation. Data from this system will be directly communicated with the government body (CPCB). Flue gas emission data for SOx, NOx, CO, CO_2, O_2, HCl, and SPM will be measured.

Figure 2-10 Continuous Emission Monitoring System (CEMS)



Source: GWVPL Project Parameter Booklet, Abellon

2.7.6 Odour Control Mechanism

Primary air required for combustion will be sucked from boiler bunker area and pre-processor area. This will result into negative draft inside boiler bunker. Thus, there will be a control on spread of pathogens and odor in surrounding region. In addition, Project will also install fragrance sprinkler as well as fogging system in the pre-processing area for odour management.

Retention time of the waste in the bunker and pre-processing area is proposed to be around 10 hours, which will give less time for disintegration of the waste which results in odor.

2.8 Water Requirement & Treatment Process

2.8.1 Water Requirement

GWVPL will lay two underground pipeline of 9 inches diameter (1.5 m below natural ground level), 4 km length each connecting the Tarsali Sewage Treatment Plant (STP) Vadodara to the project site. Project will undertake secondary treatment of the water received from STP prior to its use within the WTE plant. The underground water pipeline will facilitate the supply of water to various components of the project infrastructure.

The underground water pipeline is not considered as associated facilities[17] as per the IFC PS, 2012, because it is part of the project and funded by the Project. It is not a not separate facility that relies on the project or provide essential goods or services to the project. Therefore, underground water pipeline do not fall under the scope of the definition of associated facilities.

According to the water utilization diagram (refer ***Figure 2-11***) the daily water requirement for industrial purpose within the WTE plant for project operations will be 1387 m3/day which will be sourced from STP. 2216 m3/day of treated wastewater from STP will be further treated at the STP of which only 1387 m3/day of treated water will be transported to the WTE site and the reject water (~829 m3/day) will be returned to the STP inlet and the project has received permission for receiving 2 MLD of secondary treated water from the Tarsali STP. Refer ***Section 2.8.2.1*** for details on Pre-Treatment of treated STP water.

Approximately, 66 m3/day of water is used for boiler feed and 1267 m3/day is used as mist make up water. As reported, rejected water after secondary treatment within the WTE plant will be utilized for bottom ash quenching. Any excess water will be diluted within campus with makeup water (treated wastewater from STP) to bring down TDS level to less than or equal to 2100 PPM, which will further be used for gardening on premise[18].

For domestic purpose, approximately 7.5 m3/day water will be abstracted from the borewell within the WTE plant and permission for use of 7.5 m3/day groundwater has been obtained from Central Groundwater Authority (CGWA). The project has obtained permission to developed 1 borewell within the project premises via application no 21-4/6522/GJ/IND/2020 valid upto 1st Nov 2023 for abstraction of fresh water. As per the CGWB categorization 2017, Vadodara falls in an area categorized as semi-critical in terms of availability of ground water. Phase II analysis reports indicates that groundwater should not be used for any portable purpose such as drinking or any other domestic purposes due to arsenic contamination level above tap water requirements. Recommendation on use of groundwater has been presented in ***7.4.2.4***

Bottled water from a third-party vendor will be sourced for drinking purposes.

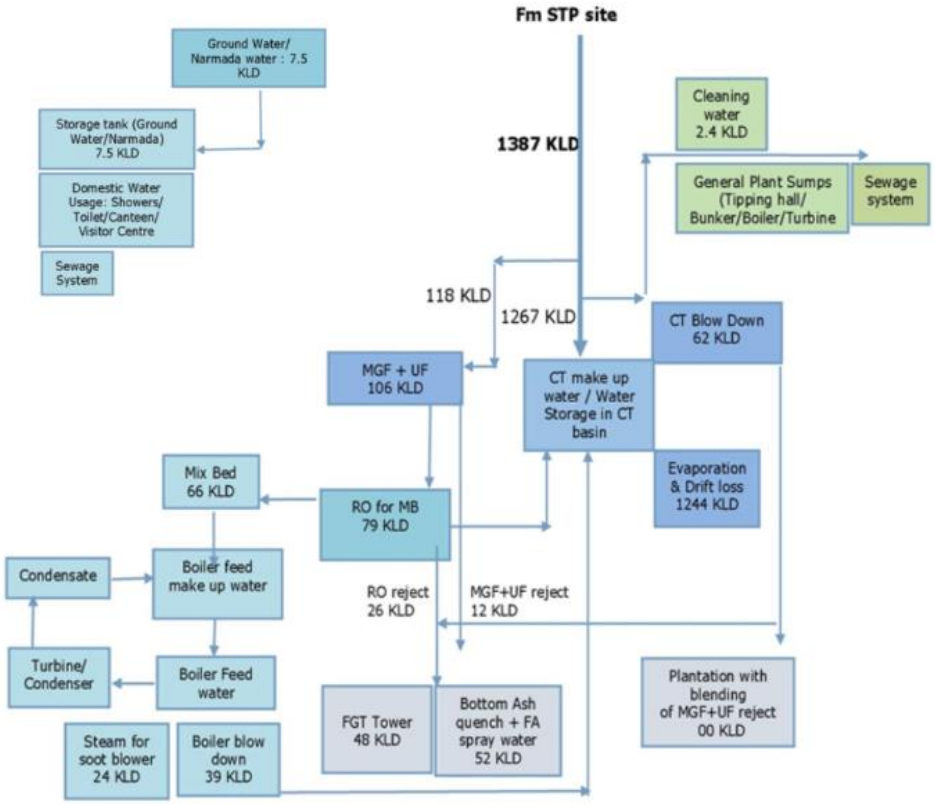
Water balance diagram for project operations and Ground water usage has been presented in ***Figure 2-11***. Wastewater generated from toilets, showers, canteen within the WTE plant premises (domestic stream) is proposed to be drained to sewage system. Also the water quantity generated from cleaning of office area, tipping hall, bunker area, boiler area and Turbine hall will be drained to Sewage System.

GWVPL will also storage water in cooling tower basin of capacity 1490 m^3. This water storage area will be utilized for storage of pre-treated RO water from the STP site & Fire reservoir. GWVPL plans to store 100 KL DM water in 4 water tanks of 25 KL storage capacity. Reject water of high TDS, from RO is proposed to be used for Flue-gas Reactor tower.

[17] As per the International Finance Corporation's (IFC) performance standard (PS), associated facilities are defined as facilities that are not funded as part of the project and that would not have been constructed or expanded if the project did not exist and without which the project would not be viable.

[18] Water for gardening will meet the GPCB requirement and the TDS of the water is less than or equal to 2100 PPM.

Figure 2-11 Water Balance for project operations and ground water usage



Source: Project Parameter Booklet, GWVPL

2.8.2 Water Treatment Process

2.8.2.1 Pre-Treatment Process (Water Treatment of treated water at STP)

GWVPL will setup a treatment plant ("Pre-Treatment" at STP) within the vicinity of the Tarsali 52 MLD STP area and further treat the treated STP water within the premises.

To meet the water requirement for WTE plant operations, GWVPL has obtained permission vide letter dated 17th February 2023 via letter no from the Vadodara Municipal Corporation, Solid Waste Management Branch, WOW cell for lease of land within the existing STP Premises, laying of pipeline network for plant and pumping house and for further treatment of water (Pre-Treatment) at Tarsali STP for sourcing 2 MLD secondary treated water from Sewage Treatment Plant (STP) located at ~ 4 km (aerial distance) from site towards north east direction.

As understood, treated STP water from the existing 52 MLD plant at Tarsali is currently discharged in open fields and drains in the vicinity through river basin. The project will source water from Trasali STP as primary source of water requirement for the project operations.

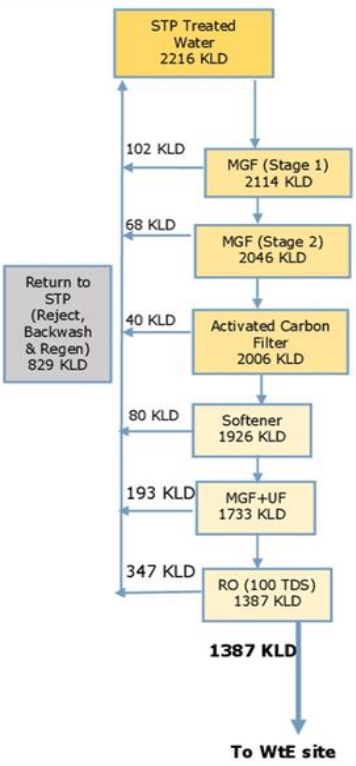
GWVPL will setup a treatment plant ("Pre-Treatment" at STP) within the vicinity of the Tarsali 52 MLD STP area and further treat the treated STP water within the premises. The Pre-treatment will comprise three stage process,

- Stage 1: Removal of TSS, color and odor via Multi Grade Filter & Activated Carbon Filter (ACF)
- Stage 2: Water softening
- Stage 3: Reduction of TDS and sediments/suspended particulate via Multi-grade filter (MGF), Ultra- Filtration (UF), and Reverse Osmosis (RO)

Flow diagram of the Pre-treatment process has been presented as ***Figure 2-12.*** The project will treat 2216 m3/day of treated STP water and all reject water (829 m3/day) in the form of backwash/regeneration/reject from MGF, ACF, Softener & RO etc. will sent back to STP Inlet for further treatment at the STP plant itself. This treated water i.e. 1387

m3/day will be transported via underground water pipeline of ~4 km length to the WTE plant. GWVPL proposes to undertake the Pre-Treatment process at the STP as the treated water from the Tarsali STP does not meet the quality requirement. Details of the inlet parameters and outlet parameters of the water for the per-treatment process has been presented in ***Table below.***

Figure 2-12 Pre Treatment Process



Source: Project Parameter Booklet, GWVPL

Table 2-10 Inlet and Outlet water quality for the Pre-Treatment Process

Parameters	Inlet water quality	Outlet water quality
Appearance	Turbid	Clear
pH	7-7.5	-
Total dissolved solid (ppm)	600 to 1200	100
Total suspended solid (ppm)	≤ 70	≤ 5
Alkalinity (mg/L)	≤ 550	-
Sulphate as SO4 (ppm)	≤ 52	-
Chloride as Cl (ppm)	≤ 250	< 8
Sodium (ppm)	≤ 250	-
Potassium (ppm)	≤ 25	-
Calcium (ppm)	≤ 75	-
Total Hardness (ppm)	≤ 500	< 5
Silica (ppm)	≤ 32	-
Conductivity (µS/cm)	≤ 1.83	< 30-40
Biological Oxygen Demand (mg/l)	≤ 250	-

Parameters	Inlet water quality	Outlet water quality
Chemical Oxygen Demand (mg/l)	≤ 750	-
Dissolved Oxygen Demand (mg/l)	≤ 3.5	-

Source: Project Parameter Booklet, GWVPL

The sewage treatment plant, which has been established by VMC, is not considered an integral component of the associated facility for the Project. Nevertheless, it is crucial to acknowledge that the project is reliant on the provision of water from the STP. It is worth noting that the STP's financing and operational status differ significantly from that of the main Project. It is essential to emphasize that the sewage treatment plant (STP) was constructed independently and is not funded as part of the current Project. The STP's existence predates the inception of the project, and it remain operational irrespective of whether the Project is not executed or not. This underscores that the STP is a pre-existing municipal infrastructure facility to treat the Vadodara city sewage water and is not specifically tailored to the needs or financing of the Project.

2.8.2.2 Secondary Water Treatment

The Pre-treated water will be further treated prior to use in the boiler. The secondary water treatment system comprise of the following:

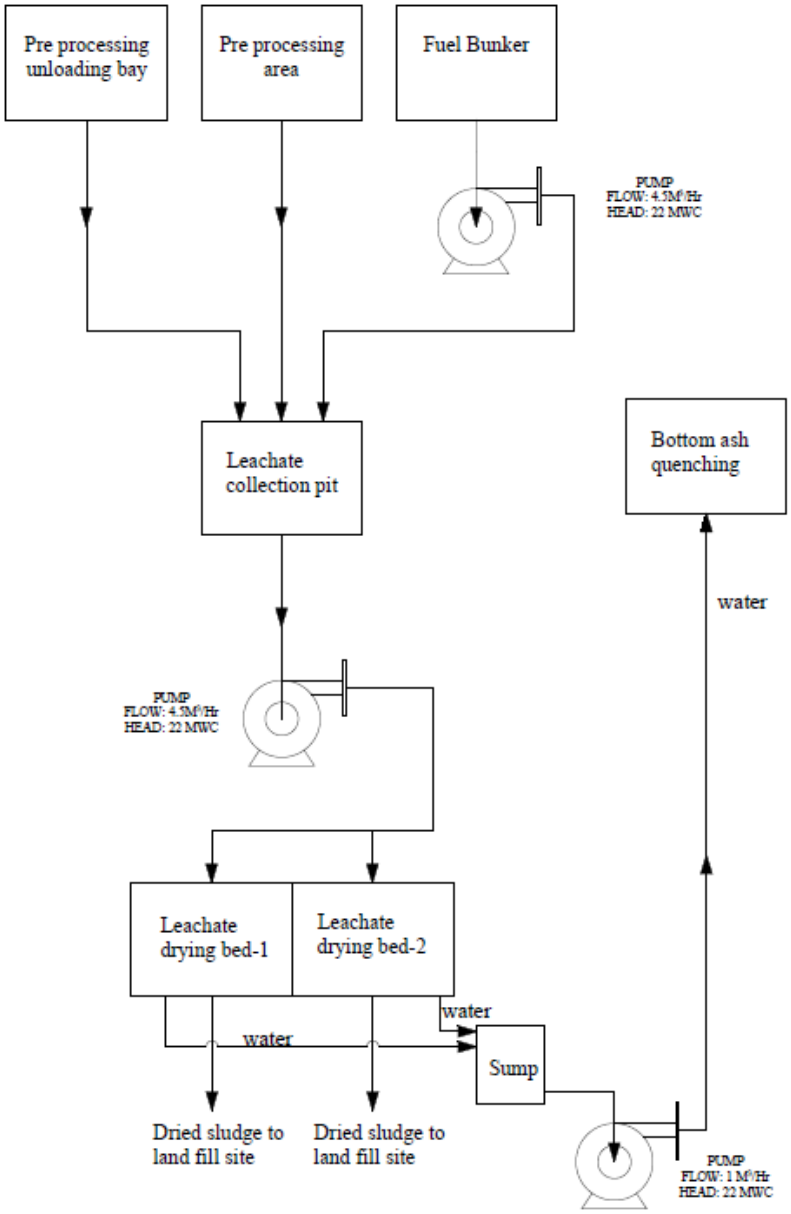
- Boiler Feed Water Treatment Plant will comprise of De-mineralization Plant, Reverse Osmosis and Mix Bed.
- Water used for Mist Cooling will be further treated via MGF & Water Softener and further used within the mist cooling system.

Domestic sewage at site will be managed using soak pit-septic tank system. The septic tanks will be cleaned as required.

2.8.3 Leachate Management

Leachate will be collected from pre-processing unit and main bunker. This leachate will be pumped to sludge drying beds and in SMBC. Dried leachate sludge is proposed to be disposed at nearest sanitary landfill. Also, Project plans to use of leachate for bottom ash quenching or alternatively inject it into the boiler. Proposed leachate management plan is as presented in ***Figure 2-13*** below.

Figure 2-13 Leachate Management Plan

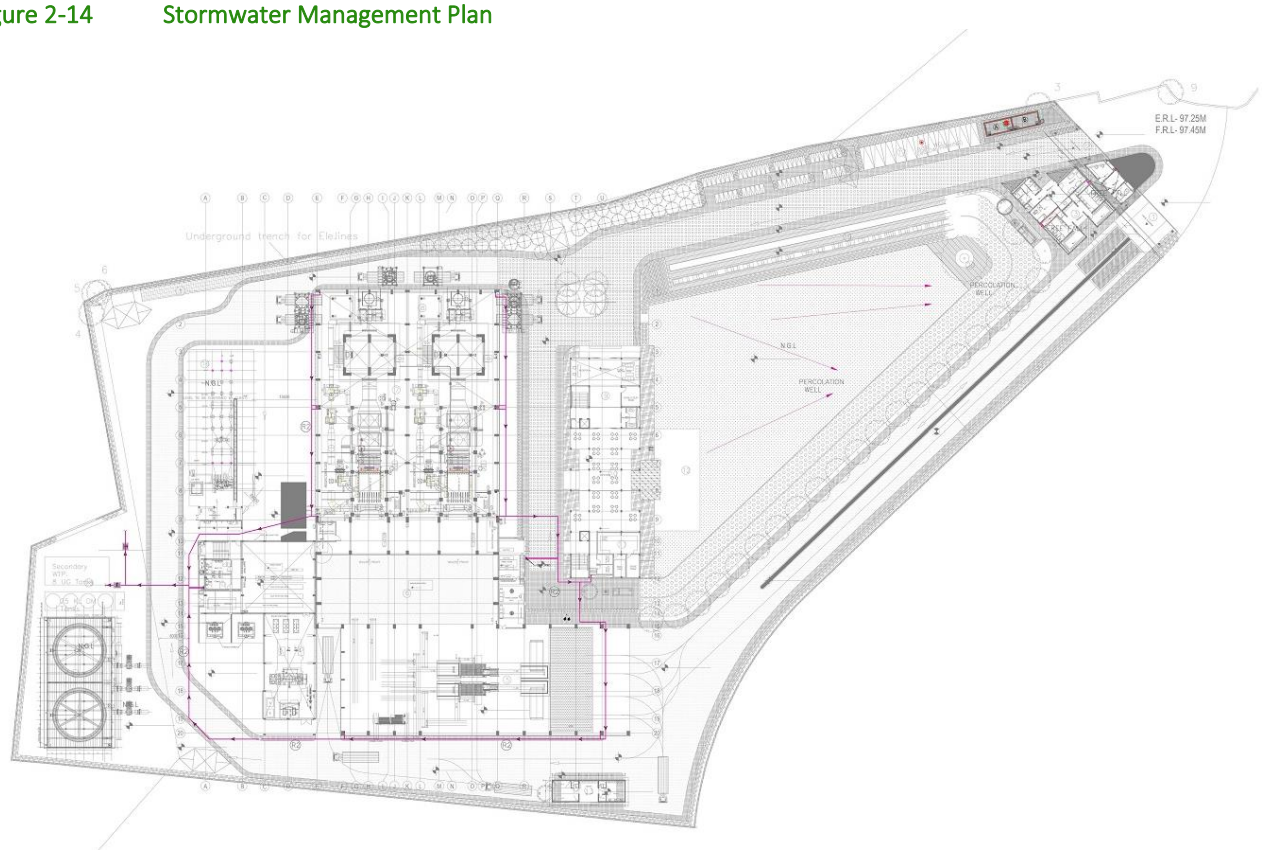


Source: Project Parameter Booklet, GWVPL

2.8.4 Storm Water Control & Management

Based on the master planning and contours, Plant area has been segregated in such a way to prevent crisscross movement of storm water drainage between operations area, ash handling area and landscape area. Site is sloped predominately towards south-west. Water collected in the catch pits installed within the Project site is collected through rain water pipe and is discharged into the percolation wells (proposed in north-east). Total 2 no. of percolation wells are present within the Project for recharging 11000 m^3/annum of ground water. Layout plan showing location of the catch pits and percolation wells is presented in ***Figure 2-14*** below.

Figure 2-14 Stormwater Management Plan



Source: Project Parameter Booklet, GWVPL

2.9 Fire Fighting Requirement

Proposed firefighting system will consist of fire hydrant comprising of Jockey Pump and main pump. Jockey Pump and main pump will be installed in Cooling Tower Basin. Fire Hydrant System is also connected with cooling tower water pumps which ensure pressurized line whenever plant is in working.

As per latest notification of Urban Development and Urban Housing Department Sachivalaya, Gandhinagar dated 8th July 2021, separate Fire NOC for construction phase is not required and will be a part of Building Approval Plan.

Fire and life safety arrangement will be as per the requirements of the Gujarat Fire Prevention and Life Safety Act and Fire NOC will be obtained prior to start of operations.

Fire Detection System proposed at Control Panel includes:

- Conventional Fire Alarm Control Panel
- Multi Sensor (Smoke and Heat combination) Detector
- Manual Pull Station
- Conventional Sounder cum strobe with 24V DC, Audible Sound 75 dB @ 1 metre range (16 V DC) – to be used Fire, Burglar & Emergency Alarm System.

Details of fire extinguishers proposed is as presented below.

Table 2-11 Details of proposed fire extinguishers

S. No	Details	Qty	UOM
1	ABC 6 Kg Fire Extinguisher Mono Ammonium Phosphate Powder 50, Stored Pressure Type, Pressure Gauge, Controllable discharge mechanism Class A Rating 3A & Class B rating 21B as per IS 15683	11	Nos

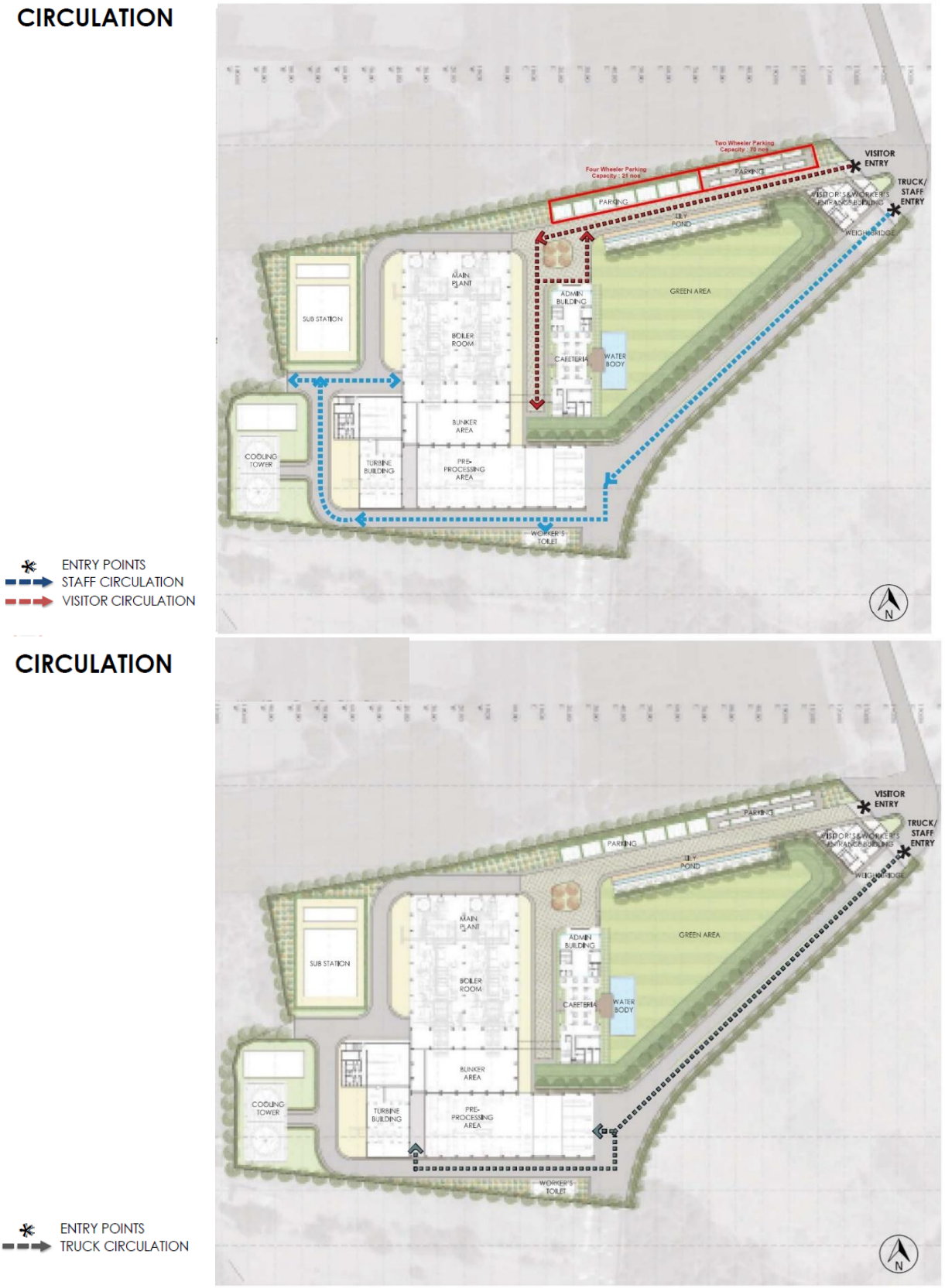
S. No	Details	Qty	UOM
2	CO2 type Fire Extinguisher of capacity 4.5 kg filled with Co2 Gas as per IS 15222 with control discharge mechanism, fitted with Hose & Horn applicable on Class B fire rating 21B confirms to IS 15683 bearing ISI mark. Co2 cylinder as per IS 7285	20	Nos
3	CO2 type Fire Extinguisher with trolley of capacity 22.5 kg filled with Co2 Gas as per IS 15222 with control discharge mechanism, fitted with Hose & Horn applicable on Class B fire rating 21B confirms to IS 15683 bearing ISI mark. Co2 cylinder as per IS 7285	1	No.
4	Nitrogen Injection Fire Protection System for 4MVA Auxiliary Transformer 11KV/433V	1	No.
5	Nitrogen Injection Fire Protection System for 16MVA Auxiliary Transformer 66/11KV	1	No.

Source: GWVPL

2.10 Traffic Management

To manage the traffic movement within the project site during operational phase, the project plans to separate the entry and exit for staff, vehicle and visitor movement. Circulation within the Plant has been presented in ***Figure 2-15*** below:

Figure 2-15 Proposed route for movement of staff, manpower and material



Source: GWVPL

2.11 Greenbelt & Landscape

Trees proposed to be planted within the premises include Banyan, Neem, Champa, mehndi, etc. Conocarpur will be planted within the Project boundary for making hedge in all directions except entrance. Layout plan showing greenbelt and landscape area and number of trees proposed to be planted within the premises is as presented in **Figure 2-16** below.

Figure 2-16 Layout Plan showing Greenbelt and Landscape area

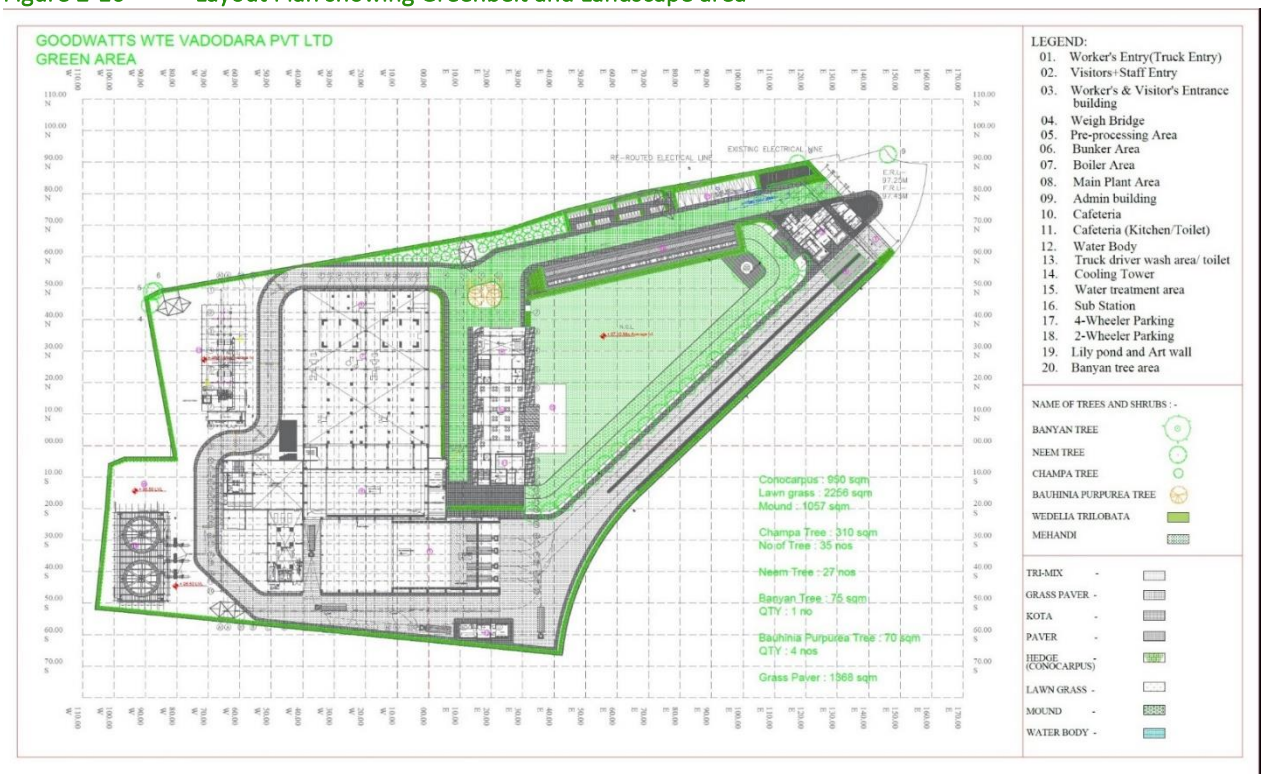


Table 2-12 Indicative no. of trees proposed to be planted.

Sr. No.	Tree	Number	Area (m^2)
1	Neem	27	-
2	Bauhinia purpuria	4	70
3	Champa	35	310
4	Conocarpus	-	950
5	Banyan	1	75

2.12 Land Requirement and Procurement

The land requirement for the proposed project including associated facilities is approximately 17.92 acres. Out of the 6 acres land is required for the WTE plant which taken on lease for 25 years from Vadodara Municipal Corporation. 10.42 acres of land will be obtained for ROW of transmission line including and towers and 1.5-acre land will be required for laying of water pipelines. Details of total land requirement is given in ***Table 2-13.***

Table 2-13 At a Glance Total Land Requirement for the Project

Project Component	Total Leased out Land Size (in acres)	Easement Rights (in acres)	Total land requirement (acres)	Land use category	Remarks
Waste to energy plant	8.5	0	8.5	Government leased out land. The allotted land is a waste landfill, and the ownership of the land was in the name of the Vadodara Municipal Corporation. Furthermore, based on a review of past Google imagery, it was observed that the allotted land was not encroached or squatted on by any person.	The project has obtained a 25-year lease on land from the Vadodara Municipal Corporation.
Overhead transmission line	0	9.77	9.77	**Land Use** / **Area (acres)** Open Scrub Land: 0.32 Agricultural Land: 6.45 Road Land: 0.07 Waterbody: 0.73 Nalla: 2.20 **Total: 9.77**	Total number of private landowners impacted by transmission line is 13.
Underground transmission line	0	0.26	0.26	**Land Use** / **Area (acres)** Road land: 0.25 WTE plant: 0.01 **Total: 0.26**	No land owners is impacted by installing of water pipeline.
Underground water pipeline	0	1.47	1.47	**Land Use** / **Area (acres)** STP Land: 0.05 WTE plant: 1.42 **Total: 1.47**	Based on the site visit, it has been determined that the final route of the water pipeline, which has been shared with the Service Provided, passes through government land or the right-of-way (RoW) of state highways. Additionally, there is no expected impact on any privately owned land
Temporary Workers' accommodation*	0.7	0	0.7	Privately owned land	The appointed contractor has leased out the privately owned land at a rate of INR 56,987 per month ***Note:** the land requirement is temporary and will be handed over to the landowner after the construction phase of the Project. Therefore, same is not included in the total land requirement for the project
Total			**20.7**		

2.12.1 Land Requirement for the Plant

The project has obtained a lease for six (6) acres of land from the Vadodara Municipal Corporation (VMC) for a period of 25 years. As reported, the allotted land is a landfill area and previously was used to dump solid waste of Vadodara city. The land has been leased to GWVPL through the lease deed vide serial number 41624 dated 17.07.2020.

2.12.2 External Transmission Line

The total length of the 66 kV transmission line is 3.82 kilometres out of which 2.2 kilometres is overhead transmission line and the remaining 1.62 kilometres is underground transmission line. The total land requirement for the transmission line is shown in ***Table 2-14***

Table 2-14 Land requirement for overhead and underground transmission line

Transmission Line type	Width of Right of Way (in meters)[19]/area per tower	Total Length (km)/Number	Total Land (acres)
Overhead transmission line	18 meters RoW	2.185 km	9.77
Underground transmission line	1 meter	1.048 km	0.26
	Total		**10.03**

2.12.3 Payment of obtaining RoW for overhead transmission line

The overhead transmission line has impacted 13 private landowners. The project has paid the compensation for obtaining of Transmission's Line RoW and that for tower payment at a minimum as per the "Guideline for payment of compensation towards damages in regard to Right of Way for Transmission Line" issues by the Ministry of Power.

The details of the compensation as per the guideline, are presented below:

- Compensation @ 85% of land value as determined by District Collector, or any other authority based on Circle rate/Guideline value/Stamp Act rates for tower base area (between four legs) impacted severely due to installation of tower/pylon structure.

- Compensation towards diminution of land value in the width of Right of Way (RoW) corridor due to laying of transmission line and imposing certain restriction would be decided by the States as per categorization/type of land in different place of States, subject to a maximum of 15% of land value as determined based on Circle rate/guideline value/stamp rates.

Further, as reported, the compensation taking the baseline as per the provisions of the Guidelines will be voluntary negotiated with impacted landowners, and a uniform rate will not be adopted for payment of compensation.

2.12.4 Determination of rate of payment for overhead transmission line

Reportedly to determine the optimum land rates for the land the project has adopted a specific approach to determine the rate for obtaining the easement right. The baseline rate was initially taken from the district collector's issued land rates of 2011 (circle rate – the latest circle rate issued by the Vadodara district collector[20]) , which was:

Open Plot	Residential flat	Office space	Shops	Industrial	Cultivated agriculture land	Uncultivated Agriculture Land
6,050	6,150	7,600	15,250	6,600	-	3,500

Note: All the price is for square meter and is in INR.

Source: https://garvi.gujarat.gov.in/PDF/Corp/VADODARA.pdf (Accessed on January 30, 2024)

[19] The width of RoW has been taken from Ministry of Power's disclosed "Guidelines for Payment of compensation towards damages in regard to Right of Way for Transmission Line".

[20] https://garvi.gujarat.gov.in/PDF/Corp/VADODARA.pdf (Accessed on January 30, 2024)

However, the circle rate is available for the year 2011 only. Thus, in order to match the current market rate, the project has escalated the base rate by 10% and compounded annually. The easement right of the transmission line has been obtained in the year 2022-23. Therefore, based on the 10% compounding interest the compounded circle rate is provided below:

Open Plot	Residential flat	Office space	Shops	Industrial	Cultivated agriculture land	Uncultivated Agriculture Land
19,987/m^2	19,301/m^2	23,852/m^2	47,861/m^2	20,713/m^2	-	10,984/m^2
7,68,39,645/acre	7,81,09,721/acre	9,65,25,835/acre	19,36,86,708/acre	8,38,25,067/acre	-	4,44,52,687/acre

Note: All the price is for square meter and is in INR.

Further, analysis of secondary data on market rate has been done, based on the secondary data, the market rate of agricultural land in the Vadodara city is in the range of INR 6 crores – 10 crores (INR 1,377.4 – 2295.7/square meter)[21]

As reported by the project site team, the compensation of obtaining the easement rights will be paid to impacted landowners by issuance of cheques or direct bank transfer by the project's appointed contractor. The compensation will be paid in following three (3) compensation stages as shown in ***Table 2-15***.

Table 2-15 Final rate of compensation

Stages	Activities	Percentage of total compensation
1st Stage	Building the foundation of tower	33.33 per cent of the total compensation
2nd Stage	Raising the tower	33.33 per cent of the total compensation
3rd Stage	Stringing of transmission line	33.33 per cent of the total compensation

2.12.5 Payment of compensation to impacted landowners due to installation of transmission line

As reported by the Project, as a process, the Project initiated the process of installing the transmission line by submitting the written application to the Gujarat Energy Transmission Company Limited (GETCO) with information such as WTE plant location, capacity of the transmission and the connecting substation. After receiving the application, GETCO initiate the route survey for the transmission line through its authorised contractors. Further, after finalisation of the survey route, GETCO provide the survey route to the project and provide go ahead for installing the transmission line. However, before installing the transmission line, the Project shall submit an advance amount to GETCO, the advance amount is finalised basis of the total length and capacity of the transmission line.

Further, after finalisation of the route from GETCO, Project hires the installation contractor from GETCO approved contractor list. After finalisation of contractor, the project along with the appointed contractor undertake resurvey of the approved route. And if there is any change in the finalised survey route, the Project inform GETCO and take approval on the change route.

Once the route of the transmission line is finalised, the appointed contractor initiates the installation of transmission line. During, the installation of the transmission line, if there is any impact on the private landowners due to the installation, the contractor pays the compensation amount to the impact landowners based on the Government of Gujarat Circular No. JET-11-2015-GOI-199-K date 14.08.2017 AND 31.12.2021, and negotiation with the landowner. The same has been confirmed during consultation with landowners. However, the information of the total amount of compensation paid is only shared with GETCO and not with the project.

As reported by the Project, the initiation of the transmission line installation process involves the submission of a formal written application by the Project to the Gujarat Energy Transmission Company Limited (GETCO). This application includes essential details such as the WTE plant location, transmission capacity, and the connecting substation. Following

[21] https://www.magicbricks.com/residential-plots-land-for-sale-in-makar-pura-vadodara-pppfs (Accessed on January 30, 2024)

the receipt of the application, GETCO, through its authorized contractors, commences a route survey for the transmission line.

Upon finalizing the survey route, GETCO communicates the approved route to the project and grants authorization for the installation of the transmission line. Prior to the commencement of installation, the Project is required to submit an advance amount to GETCO. The determination of this advance amount is based on factors such as the total length and capacity of the transmission line.

Following the route finalization by GETCO, the Project engages a contractor from GETCO's approved list of contractors for the installation process. Subsequently, the project, in collaboration with the appointed contractor, conducts a resurvey of the approved route. In the event of any modifications to the finalized survey route, the Project informs GETCO and seeks approval for the altered route.

Upon the conclusive determination of the transmission line route, the appointed contractor initiates the installation process. During, the process of installation, it is the responsibility of the contractor to obtain the No Objection Certificate (NOC) from respective government department – in case the transmission line is passing through the government owned land. Additionally, in cases where the installation impacts private landowners, the contractor is responsible for compensating them. The compensation amount is determined in accordance with the guidelines outlined in the Government of Gujarat Circular No. JET-11-2015-GOI-199-K dated 14.08.2017 AND 31.12.2021 and is subject to negotiation with the affected landowners. Importantly, the information pertaining to the total compensation amount paid is solely communicated to GETCO and is not shared with the Project.

2.12.6 Water Pipeline

The project will lay down four (4) kilometres of underground wate pipeline from the location to the Tarshali STP, Vadodara. The total land requirement for the underground water pipeline is provided below ***Table 2-16.***

Table 2-16 Total land requirement for underground water pipeline

Total Length of water pipeline	Width of RoW for underground water pipeline	Total Land (acres)
3.973 km	1 meter	1.47

Based on the site visit, it has been determined that the route of the water pipeline, which has been shared by the GWVPL for review, passes through government land or the right-of-way (RoW) of state and national highway. Therefore, there is no expected impact on any private land. As the land for the pipeline does not involve private land acquisition therefore impacts related to involuntary resettlement and displacement is not foreseen.

2.13 Manpower Requirement

The project has appointed one (1) contractor for providing contractual workers and one (1) private security personnel at the waste to energy power plant. In addition to the contractual workers, GWVPL also has deployed its on-roll employee at the waste to energy power plant. Details of on-roll employees and contractual workers are provided below in ***Table 2-17***

Table 2-17 Manpower Details

Sr. No.	Employer name	Nature of work	Total number of employees/contract workers		
			Male	Female	Total
On-roll employees					
1.	Abellon Staff	Overall project Management	6	0	6
Contractual workers					
2.	(HK, Material Trns., & Maintenance)	Construction Work	65	10	75

Sr. No.	Employer name	Nature of work	Total number of employees/contract workers		
			Male	Female	Total
3.	Security Allied Services	Security	5	0	5
	Operation Phase				
4.	Abellon Staff	Overall Project Operations	100	10	110
5.	Subcontracted Workers	HK, Material Trns., & Maintenance	88	29	117
6.	Security Allied Services	Plant Security	10	1	11

Source: Manpower Summary Abellon 5th June 23

As informed nearly 238 persons shall be employed during operations phases, out these 110 will be permanent staff and 129 contractual workers.

3 Analysis of Alternatives

As per the applicable standards, an analysis of probable alternatives for the chosen technology and location of Project site along with other similar factors that contribute to the Project as a whole has been carried out. This step will ensure all reasonable alternatives or options are taken into account, including the effect of a no project scenario, and that these are examined with an eye towards minimizing impacts to the environment and allowing decision makers to choose the best alternatives to protect and enhance environmental quality.

The following scenarios have been taken into consideration:

- No Project scenario
- Alternative Options for the Management of Waste
- Alternate Source for Power Generation
- Alternate Incineration Technologies
- Suitability for Project Site and associated facilities

3.1 No Project Scenario

The no project option takes the following into consideration:

- Access to energy and increasing energy demand at state level
- Continuation of current practices of dumping of waste in landfill as a method to manage waste in Vadodara.

Access to energy is a fundamental enabler for economic development and prosperity of any region. A survey conducted by the World Energy Council states that as the population increases and as the growing rate of electrification places huge requirements on energy supplies, the total primary energy demand of India is expected to increase by almost 150% by 2035.

As per the Central Electricity Authority (CEA), Gujarat's energy demand upto February 2023 was 139,245 MU with 44 MU supply deficit. The deficit in the entire western region of India was 588 MU. As of July 2023, Gujarat's power demand rose to 16,733 MW.

Table 3-1 Energy Demand Gap – February 2023

State/Region	Requirement (MU)	Availability (MU)	Deficit (MU)	Deficit (%)
Gujarat	139,245	139,201	-44	-0.0
Western Region (India)	474,458	473,870	-588	-0.1

Source: Central Electricity Authority

In order to meet the energy demand, renewable/non-conventional sources of power will be required to supplement the conventional sources. The Project, being renewable source of power generation, will contribute towards bridging the gap between demand and supply. The Project presents an opportunity to utilize the potential for Waste-to-Energy power generation. A "No Project Scenario" will not address the issue of power demand and would be a constraint on economic growth in the future.

In view of the current status of the waste issue in Vadodara, it is evident that the waste management practices need urgent attention. As per Census 2011, Vadodara City has population base 16,70,806. The municipal solid waste management in the city limits is the responsibility of Vadodara Municipal Corporation (VMC). At present, Vadodara city is producing 1000 TPD of fresh municipal waste. The waste generation of the city is increasing at a rate of 25% per year. Waste collected is dumped into the landfill site. Since the Vadodara landfill is an unscientific open landfill, the organic waste matter is subjected to biodegradation resulting into Green House Gas (GHG) emissions in the form of methane, which is a matter of environmental concern. Continuation of such practice will result in increase in GHG emissions. Other adverse impacts of open dumping of waste are:

- Issue of odor in surrounding areas
- Spread of pathogens, and unhealthy microbes with potential health concerns in nearby areas

- Potential for contamination of soil and groundwater due to absence of scientific lining
- Fire hazards resulting in gaseous emissions and safety of worker, ragpickers and nearby community
- Diversion of new land parcels for landfill in long term once city's waste generation increases.

Since the Project not only produces energy, but also provides an environment friendly manner for waste utilization, a no project scenario would not be a preferable option.

3.2 Alternative Options for the Management of Waste

Waste to energy plants hold significant potential for India's sustainable development goals. With the rapidly growing population and increasing urbanization, waste management has become a pressing challenge. Waste to energy plants thus offer a viable solution by converting municipal solid waste into energy. This not only mitigates the burden on waste landfills, but also provides a source of renewable and clean energy.

In order to address the challenges of municipal solid waste management and treatment, there are three primary methods under consideration: sanitary landfill, composting and power generation.

Table 3-2 Advantages and Disadvantages of waste treatment facilities

Type of waste treatment	Advantages	Disadvantages
Sanitary landfill	• Simple in terms of implementation and management • Partial Recycling Potential	• Requirement of larger land area • Very low reduction of waste volume • Uncapped landfills have potential for GHG emissions • Potential for soil and groundwater contamination in case of lack of proper scientific lining due to leachate generation • Potential for spread of airborne microbial load as well as pest infestation • Not aesthetic • Odor and fire issues
Composting	• Partial possibilities of Diversion of waste from the landfill • Uncontrolled methane gas or leachate generation	• Low reduction of waste volume • Odor issues • Lesser market viability • Birds and pest related issues • Time consuming process to treat waste and generate end product • Dependent on weather and temperature conditions • Health risks due to waste handling • Potential for soil and groundwater contamination due to leachate generation • Not Aesthetic • Requirement of larger land area
Waste to energy	• Fast and compact and human friendly process when designed with a higher degree of Automation • Adequate pre-processing infrastructure will may create opportunities for multiple value chains like Biogas, Plastic Recycling, Metal Recycling, Glass Recycling, etc • Diversion of fresh waste from the landfill • Methane avoidance with WTE project • Higher reduction of waste volume	• Larger capital investment • Technology dependent • Ash generation and disposal • Potential for dioxin and furan emissions

Type of waste treatment	Advantages	Disadvantages
	• Lowest possibility of methane gas or leachate generation • Power generation and utilization • Lower health risks due to waste handling	

The waste to energy plant being constructed by Abellon in Vadodara would thus help process approximately 1000 TPD of MSW thereby reducing the quantity of municipal solid waste that would otherwise have collected at the landfill in Vadodara. It will also help meet a portion of the energy requirements for the region via clean energy generated through the plant.

The Government of Gujarat has also accorded a high priority to setting up power projects based on non-conventional energy sources in the State. With a view to promote generation of power from these sources, Gujarat Energy Development Agency (Government of Gujarat) issued a "Waste to Energy Policy" in 2016, amended in 2018, 2021 and 2022. The Gujarat Waste to Energy Policy, 2022 aims to promote Municipal Solid Waste (MSW) utilization as a renewable resource for generation of electricity. The Gujarat Waste to Energy Policy, 2022 emphasizes waste segregation, thus helping operations of an MSW WTE plant. The usage of modern and efficient technology in the WTE plant, coupled with effective waste management practices would help ensure maximum energy recovery while minimizing environmental impacts. Under this policy, any individual company or corporate or association or body of individuals, Urban Local Bodies/ Urban Development Authorities will be eligible for setting up Power Plants utilizing Municipal Solid Waste either for the purpose of captive use or for sale to Obligated Entities. The Vadodara WTE project is also being set up in line with this policy requirement.

3.3 Alternate Source for Power Generation

As per the estimations of World Nuclear Association the grams of carbon-equivalent (including CO2, CH4, N2O, etc.) per kilowatt-hour of electricity (gCO2eq/kWh) for MSW to energy project are low and scores better when compared with other forms of conventional sources of energy. The International Energy Agency (IEA) also estimates municipal solid waste-based energy generation to be lower in life cycle carbon emissions. Table below highlights GHG emissions that each technology possesses.

Table 3-3 GHG Emissions power generation sources

Technology	Average tonnes (CO2e/GWh)
Lignite	1054
Coal	888
Oil	733
Natural Gas	499
MSW[22]	367
Solar PV	85
Biomass	45
Nuclear	29
Hydroelectric	26
Wind	26

Source: World Nuclear Association (WNA), 2011[23]

[22] https://www.ieabioenergy.com/wp-content/uploads/2013/10/40_IEAPositionPaperMSW.pdf
[23] https://www.world-nuclear.org/uploadedfiles/org/wna/publications/working_group_reports/comparison_of_lifecycle.pdf

Carbon capture for a waste to energy plant is simpler than for a coal-fired power station. Issues such as presence of sulphur and generation of particulates is lesser in case of MSW as compared to coal. WTE plant is considered as a better option when compared to other conventional sources of power generation.

3.4 Alternate Technologies for Waste Incineration

3.4.1 Grate technology

Grate incinerators are widely applied for the incineration of mixed municipal wastes and can be used for untreated, non-homogenous, and low calorific municipal waste. An overhead crane feeds waste into the hopper, where it is transported via the chute to the grate in the furnace. On the grate, the waste is dried and then burned at high temperature with supply of air. The ash, including non-combustible fractions of waste, leaves the grate as slag or bottom ash through the ash chute. Different grate systems can be distinguished by the way the waste is conveyed through the different zones in the combustion chamber. The type of grate system determines the efficacy of primary air feeding, conveying velocity and raking, as well as mixing of the waste.

Grate incinerators are of two types:

- Reciprocating Grate: Waste enters from one end and ash is discharged at other end. Generally there are three zones in series. These are drying, combustion, and burnt out zone.
- Travelling Grate: Prepared RDF from fresh MSW is fed into furnace in suspended mode. Partial Combustion takes place during suspension and balance combustion take place on top of travelling grate. Travelling grate moves from rear end to front end and therefore RDF feeding and bottom ash discharge are in the front side of the boiler.

Advantages of grate incinerators	• This technology is most widely tested and meets the standards of technical performance. • It accommodates large variations in waste composition and calorific value. • One can achieve complete combustion with better control on harmful emissions.
Disadvantage of grate incinerators	• Capital and maintenance costs are high

3.4.2 Gasification

Gasification is a partial combustion of organic or fossil based carbonaceous material, plastics, etc. into carbon monoxide, hydrogen, carbon dioxide, and methane. This is achieved at high temperature (650°C and above), with a controlled amount of air, oxygen, or steam. The process is largely exothermic, but some heat may be required to initialize and sustain the gasification process. The main product is syngas, which contains carbon monoxide, hydrogen, and methane and solid residue of non-combustible material (ash).

MSW should be pre-processed before it can be used as feedstock for the gasification process. The pre-processing comprises of manual and mechanical sorting, grinding, blending with other material, drying, and pelletization.

Gasification technology is selected on the basis of available fuel quality, capacity range and gas quality conditions. The main reactors used for gasification of MSW are fixed beds and fluidized beds.

- Fixed Bed: typically have a grate to support the feed material and maintain a stationary reaction zone. They are relatively easy to design and operate, and are therefore useful for small and medium scale power and thermal energy uses.
- Fluidized Bed: In this, a stream of gas (typically air or steam) is passed upward through a bed of solid fuel and material (such as coarse sand or limestone). The gas acts as the fluidizing medium and also provides the oxidant for combustion and tar cracking. Waste is introduced either on top of the bed through a feed chute or into the bed through an auger. The sand with the pre-treated waste and/or fuel is kept suspended on pumped air currents and takes on a fluid-like character. The bed is thereby violently mixed and agitated keeping small inert particles and air in a fluid-like state. This allows all of the mass of waste, fuel and sand to be fully circulated through the furnace.

Fluidized beds have the advantage of extremely good mixing and high heat transfer, resulting in very uniform bed conditions and efficient reactions.

However, during gasification, tars, heavy metals, halogens, and alkaline compounds are released within the product gas and can cause environmental and operational problems. Further, it requires specific feedstock quality, that is, high calorific value waste, which has a direct impact on the efficiency and commercial viability of the product. To achieve this pre-processing including source segregation and on-site sorting is essential which makes it not viable.

3.4.3 Pyrolysis

Pyrolysis involves an irreversible chemical change brought about by the action of heat in an atmosphere devoid of oxygen. Pyrolysis is an endothermic reaction and heat must be applied to waste to distil volatile components. The converting of plastic to fuels through pyrolysis is possible, but it is yet to be proven to be a commercially viable venture.

Pyrolysis is carried out at 500°C – 1,000°C and produces a mixture of combustible gases such as hydrogen, carbon monoxide, methane, carbon dioxide, and some hydrocarbons. Liquid consisting of tar, pitch, light oil, and low boiling organic chemicals like acetic acid, acetone, methanol, etc. and char consisting of elemental carbon along with the inert material in the waste feed are also end products of the process.

It is required that feedstock for pyrolysis should have high calorific value with very limited moisture content and should be homogenous in nature. For mixed MSW, pre-processing is necessary to bring homogeneity to increase efficiency. As a result of combustion of organic matter in an oxygen-deficient environment, various products such as char (ash), pyrolysis oil, and syngas are produced. Syngas can be further refined to remove particulates, hydrocarbons, and soluble matter, and is then combusted to generate electricity. One key issue for use of syngas in energy recovery is tarring. The deposition of tars can cause blockages and other operational challenges and has been associated with plant failures and inefficiencies at some pilot and commercial scale facilities.

Given the requirements of achieving specified size and consistency of MSW before it can be used as feed, pyrolysis and gasification processes are not viable options under the project. Therefore the grate incineration technology has been selected by Abellon.

3.5 Suitability for Project Site and associated facilities

The Project is proposed to be set up adjacent to the existing landfill in Vadodara city. The location of the Project site was finalized by VMC, on land already owned by VMC and is provided on lease to Abellon for development of WTE plant. The waste will be collected on daily basis by VMC from door to door and supplied to the WTE plant. Since the project site is located adjacent to the landfill, the VMC trucks will follow the same transportation route once the plant is operational. This will ensure that no new route plan has to be prepared or implemented by VMC, thus minimizing any additional community disturbance issues.

The proposed project land was thus finalized due to the following factors:

- Proximity to Landfill site.
- No economic displacement due to construction of WTE plant
- No reported legacy issues related to waste dumping & contamination
- No physical structures or houses on the land
- Good connectivity to village roads and state highways.

Therefore, considering the above no other alternate locations for this project have been considered.

The project has proposed 66 kV transmission line of length 3.82 km (1.61 km underground and 3.82 km overhead) having 14 towers connecting to GETCO Jambuva Substation. The project will also lay down two 4 km of underground water pipeline from the project location to the Tarshali Sewage Treatment Plant (STP) Vadodara.

The TL and pipeline routes identified follows all the below-mentioned points.

- TL route minimise passing through human settlement.
- TL route does not affect/ minimum affect any archaeological/ cultural monument.

- TL route avoids forest area.
- TL route avoids passing through any protected area such as National Park/ Wildlife Sanctuary.
- TL routes avoid disturbance to public utility services such as school, playground, bus depots etc.
- Both underground TL and underground treated water pipeline are proposed on government land and ROW of state highways to minimize construction related disturbances to community.

Furthermore, as reported, the project has determined the identified route as the optimal path for the transmission line and pipeline, taking into account environmental and social sensitivities. This conclusion is drawn by mitigating the aforementioned sensitivities related to impacts on human settlements, cultural monuments, forest areas, national parks/wildlife sanctuaries, and public utilities.

4 Applicable Legislative, Regulatory and Administrative Regime

The following reference framework is applicable to the project:

- Applicable local, National and International environmental and social legislations including Solid Waste Management Rules, 2016
- Applicable technical guidelines on waste to energy including revised guidelines of waste-to-energy Programme, Ministry of New and Renewable Energy (MNRE), Government of India
- Applicable guidelines/legislations on waste pickers and recycling
- IFC Performance Standards on Social and Environmental Sustainability (2012)
- IFC/World Bank Group EHS General and relevant Sector Specific Guidelines as applicable
- WB General EHS Guidelines, 2007
- WBG EHS Guidelines for Waste Management Facilities, 2007
- WBG EHS Guidelines Water and Sanitation, 2007
- IFC/WBG EHS Guidelines for Power Transmission & Distribution, 2007
- The International Labour Organization (ILO) conventions covering core labour standards and the basic terms and conditions of employment - Declaration of Fundamental Principles and Rights to Work, 1998
- IFC/ERBD Guidance on Worker Accommodation, 2009
- UN Voluntary Principles on Security and Human Rights, 2000
- Addressing Gender-Based Violence and Harassment - Emerging Good Practice for the Private Sector, 2020

4.1 Permitting Status of the Project

As per the EIA Notification (2006) and its amendments, dated 14.07.2022, the thermal Power plant up to 25MW, based on non-hazardous municipal waste and using auxiliary fuel such as coal / lignite / petroleum products up to 15% are exempted from prior environmental clearance. Additionally, Thermal Power plants using waste heat boiler without any auxiliary fuel are exempted from prior environmental clearance. Since the capacity of the project is 14.9 MW and MSW will be used as fuel for the boiler, therefore, environmental clearance is not applicable to the project.

As per latest notification from the CPCB, dated 07/03/2016 (Ref No: B-29012/ ESS (CPA)/2015-2016[24], "Waste to Energy Power Generation Project" have been classified as "Red category" and therefore "there shall be necessity in obtaining 'Consent to Establish & Operate" for Red category of industries". The project has received Consent to Establish (CTE) under Air Act 1981 and Water Act 1974 dated 21.03.2020 valid till 19.01.2027. According to the conditions of the CTE, the project is entitled to use 800 TPD Refuse Derived Fuel (RDF) as fuel for the WTE plant. However, based on discussion with GWVPL, it is understood that approximately 1000 MT/day of fresh waste will be delivered by VMC at the project site and will be required for the operation of the WTE plant.

The project will generate, store and handle hazardous wastes such as used oil from operating equipment and DG sets, fly ash from Bag House during operational phase which shall require hazardous waste authorization under Hazardous and other Wastes (Management and Transboundary Movement) rules,2016. According to Clause 2(ii) of the Hazardous and other Wastes (Management and Transboundary Movement) Amendment rules,2019, industrial sectors /projects which are not required to obtain Consent to Establish (CTE) or Consent to Operate (CTO) from the State Pollution Control Board or Pollution Control Committee under The Water (Prevention and control of pollution) Act,1974 (25 of 1974) and Air (Prevention and control of pollution) Act 1981 (21 of 1981) shall also be exempted from obtaining Hazardous Waste Authorization from SPCB. Since the project requires CTE and CTO, hence, the project does not fall within the aforesaid exemption and is required to obtain hazardous waste Authorization.

4.2 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 4-1***.

[24] https://cpcb.nic.in/openpdffile.php?id=TGF0ZXN0RmlsZS9MYXRlc3RfMTE4X0ZpbmFsX0RpcmVjdGlvbnMucGRm

Table 4-1 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 • 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	Ministry of New and Renewable Energy (MNRE)	The Ministry of New and Renewable Energy (MNRE) is the nodal Ministry of the Government of India for all matters relating to new and renewable energy. The broad aim of the Ministry is to develop and deploy new and renewable energy for supplementing the energy requirements of the country. The Ministry facilitate research, design, development, manufacture, and deployment of new and renewable energy systems/devices for transportation, portable and stationary applications in rural, urban, industrial, and commercial sectors.
3	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. Guidelines on the provision of the buffer zone around waste processing and disposal facilities, April 2017; amended in March 2019- Recommends developing buffer zone around waste processing and disposal facilities; development of Green Belt (including species of trees to be planted); responsibilities of various stakeholders
4	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 to prevent the depletion of groundwater levels and deterioration of its quality.

Sr. No	Agency	Function
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	Gujarat Energy Development Agency (GEDA)	Different states have created Energy Development Agency as the designated agency to co-ordinate, regulate and enforce the provisions of the Energy Conservation Act and implement schemes under the said Act within the State. The objective is to undertake development of renewable energy and facilitate energy conservation, as a state nodal agency under the umbrella of the MNRE. The objective of GEDA is: • Undertake or sponsor, techno-economic/socio-economic feasibility studies/cost-benefit analysis. • Formulate and implement a broad-based programme for conservation of energy at all stages, including extraction, conversion, distribution, and consumption in all sectors of the economy. • Study the environmental effects of all energy-related processes. • Establish an Energy Resources Centre that will collect and collate energy and inter-related information. • Develop and support Documentation Services in area of energy in general and renewable energy in particular. • Develop Communication and Education projects for widespread dissemination of energy and environmental issues
7	The Forests & Environment Department, Gujarat	The Forests & Environment Department in the Government of Gujarat has environment wing and forest wing. The environment wing of the Department is the apex body in the Gujarat State for implementation of all the environment related matters including Environment (Protection) Act, 1986, which is an umbrella Act on environment in the country. The main mandate of the Department is to achieve the sustainable development in the State and introducing the sound environmental management practices. The Department has four executing agencies viz Gujarat Pollution Control Board, Gujarat Ecology Commission, Gujarat Institute of Desert Ecology and Gujarat Environmental Management Institute, for discharging its functions.
8	Gujarat Pollution Control Board	The Government of Gujarat constituted the GPCB (Gujarat Pollution Control Board) on 15.10.1974 as per provisions under the Water (Prevention and Control of Pollution) Act, 1974 with a view to protect the environment, prevent and control the pollution of water in the State of Gujarat, that occupies a prominent niche in progressive and industrial development of the country. The Board has been entrusted with the Central Acts and relevant Rules for pollution control as notified thereof from time to time. The function of the Board is to enforce is to provisions of the following Acts, Rules and Directives issued by the Authorities from time to time. • The Water (Prevention and Control of Pollution) Act, 1974 • The Water (Prevention and Control of Pollution) Cess Act, 1977 • The Air (Prevention and Control of Pollution) Act, 1981 • The Environment Protection Act,1986, various relevant Rules notified thereof • The Hazardous and other Waste (Management and Trans boundary Movement) Rules,2016.
9	Labour Department, Government of Gujarat	The Department of Labour is responsible for formulation, implementation, and enforcement of the labour laws in the state of Gujarat. Decent Working Conditions and Improved Quality of Life of Workers, Ensuring India without Child Labour and Enhancing Employability on a Sustainable Basis.

Sr. No	Agency	Function
		Formulating and Implementing Policies / Programmes / Schemes / Projects for Providing Social Security and Welfare, Regulating Conditions of Work, Occupational Health and Safety of Workers, Eliminating Child Labour, Promoting Harmonious Industrial Relations, Ensuring Enforcement of Labour Laws and Promoting Employment Services. • The most important functions of the Commissionerate of Labour include maintaining peaceful atmosphere in the labour sector; ensure co-operation and healthy relation between employers and the employees, systematic implementation of labour legislation, enhancing welfare of workers through better policies and programmes.
10	Private Security Agency, Gujarat	It is a state government body, with the aim to establish providing licenses to the private security agencies under the Private Security Agencies (Regulations) Act, 2015. To provide: • Better services to the PSARA Controlling Authorities, private security agencies as well as to the citizen • Quick implementation of government policies from time to time. • Improved/transparent image of Government & Department • Instant access to information related to private security agencies To improve the quality-of-service delivery to the citizen and the quality of the work environment of the PSARA licensing authorities.
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, 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 workplace. • 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. The main activities Directorate Industrial Safety and Health Department are: • To create awareness for Health & Safety amongst workers and factory management through seminars and other programs. • To update with the latest trend department, arrange the Safety Conference every year. • To encourage and appreciate the workers contribution in the industry by Shram Awards • To facilitate implementation of various welfares schemes for Construction workers. • To conduct required Health & Hygiene Survey in various industrial sectors.
12	State Forest Department	The Forests & Environment Department forms the policy for the conservation of the forest, protection of the Wildlife and the Environment in the State of Gujarat. The main objectives of the policy states that: • Protection, Conservation and development of forests and wildlife, the adoption of measures of soil conservation, moisture conservation and increasing soil fertility. • The utilization of the forest to obtain the maximum yield consistent with their permanent maintenance and the supply of the needs of the people, agriculture, industry and defense. • To conduct research into silviculture, utilization and other problems affecting the regeneration and development of the forests. • To achieve the goals of National Forest policy 1988 and to cover the maximum area under forests. • To create awareness among the people about the forests and environment. • To increase the active participation of the local people in protection and conservation of forest with special emphasis on tribal, poor and women.

4.3 Gujarat Waste to Energy – 2022 Policy

The objectives of the "Gujarat Waste to Energy Policy – 2022" are as enlisted below:

- Help improve efficiency and effectiveness of collection and disposal of MSW, thereby contributing to 'Swachh Bharat Mission'.
- Facilitate and promote disposal of MSW in more environment friendly manner.
- Facilitate and promote utilization of MSW as renewable resource for generation of electricity.
- Reduce the requirement of lands for disposal of MSW, thereby saving precious public resource for alternative public purpose.
- Promote investment, employment generation & skill enhancement in Renewable Energy Sector.
- Lay down rational framework for smooth implementation of policy.

Gujarat Energy Development Agency (GEDA) shall be the state Government Nodal Agency for facilitation and implementation of the Gujarat WTE Policy 2022. The Nodal Agency will facilitate and assist the project developers to undertake the following activities in achieving the objectives of the Policy.

- Registration of projects
- Respond to queries and problems of Project Developers
- Accreditation and recommending WTE Projects for registering with Central Agency under REC Mechanism
- Certifying commissioning of Projects

4.4 Applicable National Environmental and Social Acts and Rules

Table 4-2 below summarizes the key regulations that are relevant to the project across its lifecycle. This table should be used to update/develop a comprehensive legal register for the project that can be regularly monitored for compliance as well as updated to reflect changes/non-applicability of regulations, policies, and standards. Status of applicable permits is presented as ***Appendix 19***.

Table 4-2 Applicability of key E&S regulations in the different phases of Project lifecycle

Sr. No.	Applicable Regulation/Permit	Construction	Operation	Responsible Authority	Applicability to the Project/ Status
	Environment Protection				
1	EIA Notification (2006) and its amendments	×	×	MoEFCC	According to EIA Notification 2006 and amendment dated 25.06.2014, the Thermal Power plant up to 15MW, based on non-hazardous municipal waste and using auxiliary fuel such as coal / lignite / petroleum products up to 15% are exempted from prior environmental clearance. Additionally, Thermal Power plants using waste heat boiler without any auxiliary fuel are exempted from prior environmental clearance. Since the capacity of the project is 14.9 MW and MSW will be used as fuel for the boiler, therefore, environmental clearance is not applicable to the project
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	✓	✓	GPCB CPCB	As per latest notification from the CPCB, dated 07/03/2016 (Ref No: B-29012/ ESS (CPA)/2015-201625, "Waste to Energy Power Generation Project" have been classified as "Red category" and therefore "there shall be necessity in obtaining 'Consent to Establish & Operate" for Red category of industries". The project has received Consent to Establish (CTE) under Air Act 1981 and Water Act 1974 dated 21.03.2020 valid till 19.01.2027. According to the conditions of the CTE, the project is entitled to use 800 TPD Refuse Derived Fuel (RDF) as fuel for the WTE plant. However, based on discussion with GWVPL, it is understood that approximately 1000 TPD MSW will be required for the operation of the WTE plant which is not aligned to the condition of the CTE. The Project should update the existing CTE and ensure future CTO include procurement of 1000 TPD MSW for operation of the project instead of 800 TPD mentioned in the CTE.
3	The Noise (Regulation & Control) Rules, 2000 and as amended up to 2010 Ambient Noise Standards	✓	✓	GPCB CPCB	As per the Act, ambient noise levels are to be maintained as stipulated in the rules for different categories of areas such as residential, commercial, and industrial and silence zones. Considering the location of the Project, the construction and operation activities of the Project and its contractors will need to abide by the limits prescribed for industrial area. 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 night-time 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 WBG and MoEFCC vide gazette notification dated 14th February 2000 Area Code | Category of Area | Day Time limits in d B(A)Leq | Night-time limits in d B(A)Leq A | Industrial Area | 75 | 70 B | Commercial Area | 65 | 55 C | Residential Area | 55 | 45 D | Silence Zone** | 50 | 40 **Silence zone is defined as area up to 100 m around premises of hospitals, educational institutions and courts. Use of vehicle horns, loudspeakers and bursting of crackers are banned in these zones.
4	Guidelines on usage of RDF in various industries (waste management sector included) by Ministry of Housing and Urban Affairs, 2018	×	✓		Criteria for waste to energy process o Non-recyclable waste having calorific value of 1500 Kcal/kg or more shall not be disposed off on landfills and shall only be utilized for generating energy either or through refuse derived fuel or by giving away as feed stock for preparing refuse derived fuel. o High calorific wastes shall be used for coprocessing in cement or thermal power plants. GWVPL will comply with the above requirements during operation phase of the project
5	Solid Waste Management Rules 2016 as amended	×	✓	GPCB/ local municipal body	The Solid Waste Management Rules applies to solid or semi-solid domestic waste, sanitary waste, commercial waste, institutional waste, catering and market waste and other non-residential wastes, street sweepings, silt removed or collected from the surface drains, horticulture waste, agriculture and dairy waste, treated bio-medical waste excluding industrial waste, bio-medical waste and e-waste, battery waste, radio-active waste generated in the area under the local authorities. It provides specifications for generators, manufacturers, industrial units, local authorities and other entities regarding the various treatment methods and disposal mechanisms to be utilised. *Clause 19 of Solid Waste Management* Criteria for Duties regarding setting-up solid waste processing and treatment facility: • The operator of the facility shall design and set up the facility as per the technical guidelines issued by the Central Pollution Control Board in this regard from time to time and the manual on solid waste management prepared by the Ministry of Urban Development. • The operator of the facility shall obtain necessary approvals from the State Pollution Control Board or Pollution Control Committee. • The operator of the facility shall be responsible for the safe and environmentally sound operations of the solid waste processing and or treatment facilities as per the guidelines issued by the Central Pollution Control Board from time to time and the Manual on Municipal Solid Waste Management published by the Ministry of Urban Development and updated from time to time. • The operator of the solid waste processing and treatment facility shall submit annual report in Form III each year by 30th April to the State Pollution Control Board or Pollution Committee and concerned local body. *Clause 21: Criteria for Waste to Energy Process*

[25] https://cpcb.nic.in/openpdffile.php?id=TGF0ZXN0RmlsZS9MYXRlc3RfMTE4X0ZpbmFsX0RpcmVjdGlvbnMucGRm

Sr. No.	Applicable Regulation/Permit	Construction	Operation	Responsible Authority	Applicability to the Project/ Status
					• Non-recyclable waste having calorific value of 1500 K/cal/kg or more shall not be disposed of on landfills and shall only be utilised for generating energy either or through refuse derived fuel or by giving away as feed stock for preparing refuse derived fuel. • High calorific wastes shall be used for co-processing in cement or thermal power plants. • The local body or an operator of facility or an agency designated by them proposing to set up waste to energy plant of more than five tonnes per day processing capacity shall submit an application in Form-I to the State Pollution Control Board or Pollution Control Committee, as the case may be, for authorisation. All types of waste received at the facility will be pre-processed and processed and will be managed by GWVPL in accordance with the relevant provision of this Rule
6	Indian Boilers Act-1923	×	✓	Chief Inspector of Boilers	The Indian Boilers Act-1923 was enacted with the objective to provide mainly for the safety of life and Property of persons from the danger of explosions of steam boilers and for achieving uniformity in registration and inspection during operation and maintenance of boilers in India. As the WTE project will require boilers for producing energy, this act is applicable. According to the Indian Boilers Act, 1923, every boiler owner who purchases a new boiler • Submit an application to the Chief Inspector of Boilers along with the inspection fees as per regulation 385 of IBR-1950 and the certificates of the manufacture in form of II, III & IV issued by the Chief Inspector of Boilers of the state, for the registration of the boiler. • The Boiler is inspected and its M.B along with (Memorandum of Inspection Book) is prepared. All calculations for the pressure parts of the boiler are made as per IBR-1950 and a P.O. (Provisional Order) is issued for a maximum period of six months to operate the boiler at the maximum working pressure as calculated. • The boiler is offered for the STEAM TEST by the boiler owner within the validity of PO and if found satisfactory, a certificate for a period of 12 months is issued. GWVPL will comply with the above requirements during operation phase of the project
7	Fly Ash Utilization Notification, 2022	×	✓	GPCB CPCB	The project will generate 140TPD of Bottom ash from the waste combustion. Fly Ash generated will be managed as per the Fly ash utilization notification 2022
8	Construction and Demolition Waste Management Rules 2016	✓	×	Local authority	Construction waste generated at site will be handled as per the provisions of Construction and Demolition Waste Management Rules, 2016.
9	Manufacture, Storage and Import of Hazardous Chemicals (MSIHC) Rules, 1989 and as amended	✓	✓	GPCB	Rules will be applicable during construction and operation phases if chemicals stored at site satisfy the criteria laid down in the Rules
10	The Batteries (Management and Handling) Rules 2022	✓	✓	GPCB	Batteries waste, if any generated in construction and operation phase to be disposed of as per Batteries (Management and Handling) Rules 2022.
11	E-waste (Management) Rules, 2016	✓	✓	GPCB	E waste generated on site to be collected, stored, and disposed of as per E waste Management Rules.
12	Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 as amended till date	✓	✓	GPCB CPCB	Hazardous waste estimated to be generated from the plant includes organic residue, salts, spent solvents, used oil from operating equipment and DG sets, fly ash from ESP, waste effluent, empty drums, etc., therefore the WtE plant 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.
13	Plastic Waste Management Rules 2016	✓	✓	GPCB CPCB	The WtE plant 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.
14	Bio-Medical Waste Management Rules, 2016 as amended 10.05.2019	✓	✓	GPCB CPCB	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.
15	Ground water extraction permission will be required if the project plans to abstract groundwater for fulfilling water demand.	✓	✓	GPCB CPCB	As per the information provided by Aquifer Mapping and Ground Water Management Plan for Vadodara, 2022, the Vadodara block where the under construction Project fall is categorised as *Semi-critical* in terms of ground water extraction.All industries/mining/ infrastructure projects drawing ground water in safe, semi-critical and critical assessment units will have to pay ground water abstraction charges based on quantum of ground water extraction and category of assessment unit as per details given in this guideline. GWVPL has obtained No Objection Certificate (NOC) from CGWA which is valid up to 01.11.2023. As per the NOC, the project can abstract 7.5 m3/day water from one existing borewell within the project premises. However as per the conditions of the NOC, Proponents shall install roof top rainwater harvesting in the premise as per the existing building bye laws in the premise. Based on discussion with GWVPL, no rainwater harvesting system is planned for the project. Additionally, as per the conditions, the firm shall report compliance of the NOC conditions online on the website (www.cgwa-noc.gov.in) within one year from the date of issue of this NOC
Land					
16	The Indian Telegraph Act, 1885	✓	×	Department of Telegraphic – Communication, Government of Gujarat	**Section 10** Power for telegraph authority to place and maintain telegraph lines and posts. The telegraph authority may, from time to time, place and maintain a telegraph line under, over, along, or across, and posts in or upon, any immovable property subject to the following conditions: • The telegraph authority shall not exercise the power conferred by this section except for the purpose of a telegraph established or maintained by the Central government of India. • The central government shall not acquire any right other than that for use of the property for placing telegraph lines passing either under, over, along or across the property.

Sr. No.	Applicable Regulation/Permit	Construction	Operation	Responsible Authority	Applicability to the Project/ Status
					• The central authority shall not exercise its powers with respect to any property which is under the control or management of any local authority, without permission of that authority. • given the powers under this section, the telegraph authority shall minimize/avoid damage to the property to the extent possible and shall pay full compensation to all persons interested in any damage sustained by them due to the powers exercised by the telegraph property with respect to the land.
17	The Electricity Act, 2003	✓	✓	Gujarat Energy Transmission Corporation Limited	**Section 67** Section 67 of the Electricity Act 2003 (along with Section 68 discussed below) deal with the powers of the central/state authority on the use of land for Right of Way (RoW), erection of transmission towers/electric poles. However, the provisions of Electricity Act under Section 67 apply on the licensee (as appointed by the government) who has not been granted the powers of the Telegraph Authority under the Telegraph Act, 1885. The licensee, subject to the terms and conditions of the license, as awarded by the government, may carry out work to lay down supply lines, that includes: • To open/break the soil and pavement of any street, railway. • To open/break any sewer, drain or tunnel in or under any street, railway. • To lay down and place electric lines, electrical plant, and other works • To repair existing electrical supply lines In order to carry out works, as incidental to, and required for the laying of electrical supply lines, the appropriate government (central/state), may specify the conditions and grant the necessary permissions, particularly on matters relating to – • Consent of the local authority, owner, or occupier of the land parcel on which work is to be carried out, as required. • The duration of the contract of the licensee, and the nature of work • Determining the compensation amount, procedure of deposit of compensation amount payable by the licensee and payment process to the persons affected by the work to be carried out. • The rights of the owner/occupier of the land parcels that is being utilized for the works to be carried out by the licensee. • The procedure for fencing, guarding, and other safety measures relating to work on streets, railways and for alteration of the position of pipes, electric lines, telegraph lines. • The manner of restoration of property affected by such works and maintenance of the same. • Matters relating to disputes on compensation amount shall be determined by an “appropriate commission”. the execution of works, involving erection of towers and connection of overhead lines, are done, only after a detailed field study, by identifying a feasible route of the proposed transmission line and by selecting a suitable corridors, by avoiding densely populated residential areas, span length, the angle of deviation, the extent of damage, likely to be caused, while erecting towers, maintenance cost of electric lines and towers and more particularly, the public interest in providing electricity to a large section of people and industrial establishments, **Section 68** The section provides for process of approval from the appropriate government for stringing of overhead lines, and/or maintenance of existing overhead lines. While section 67 contains provisions granted to the licensee by the government regarding erection of towers, this section deals with structures under the transmission line (TL) RoW • Any tree, or any structure standing near overhead line, or has been placed near an overhead line after the approval of the RoW, and erection of towers, can be removed or dealt with as accordingly by the licensee, after obtaining necessary approvals from appropriate government. • In case of any tree, structure in existence prior to the approval of the RoW and subsequent construction activities in the RoW, compensation shall be awarded to such persons with ownership of the trees/structures by the licensee. (Tree includes shrub, jungle, hedge). Section 68 of the Act contemplates that the appropriate government may, by rules made in this behalf, delegate the powers for carrying out over headline tower works and such power cannot be delegated by anyone else especially without prior permission from the appropriate government. Section 68 (2) (c) of the Indian Electricity Act prescribe the period of notice to be given prior to carrying out the works. **Section 164** This section grants the equivalent powers as vested to the telegraph authority through the Telegraph Act of 1885 to the private licensee (electricity generation and Distribution Company) for placing/erecting TL towers, and procurement of easement rights for RoW (Ministry of Power, Procedure for Obtaining Authorization U/s 164 of the Electricity Act, 2003, 2016). The appropriate government may elevate the status of a private company to the status of a public body and confer the powers as prescribed in the Telegraph Act upon the licensee, upon the submission of request from the company. In the submission of request, the licensee will furnish the following details: • Newspaper publication of the scheme (dissemination of information in public domain) • Authenticated maps showing the details of the selected route alignment, along with justification.
18	Guidelines on Payment of Compensation for the Right of Way (RoW) for Transmission Lines, Ministry of Power, October 2015	✓	x	Gujarat Energy Transmission Corporation Limited	In order to address the inadequacy of rules and statutes contained in Section 16 of the Telegraph Act and Section 68 of the Electricity Act regarding payment of compensation for loss of trees/structures, the Ministry of Power formulated guidelines for determining the compensation towards "damages" as stipulated in the Electricity Act, 2003 along with Indian Telegraph Act, 1885. These guidelines take into account losses that were not described in the two Acts. The guidelines are applicable for construction activities related to electricity lines of 66 kV and above (Ministry of Power, Guidelines for payment of compensation towards RoW damages, 2015). These are: • For tower base area impacted by erection activities, compensation at 85% of land value based on Circle rate/Stamp Act rates for tower base area. • For deterioration in value of land caused due to stringing of overhead lines and demarcation of the RoW corridor, compensation will be decided by the States as per the land category s.t a maximum of 15% of the land value based on Circle rate
	Labour				
19	Contract Labour (Regulation & Abolition) Central Act 1970 and Contract Labour (Regulation And Abolition) Rules, 1972 Gujarat	✓	✓	Labour Department	The Act applies to: • To every establishment in which twenty or more workmen are employed or were employed on any day of the preceding twelve months as contract labour • To every contractor who employees or who employed on any day of the preceding twelve months twenty or more workmen

Sr. No.	Applicable Regulation/Permit	Construction	Operation	Responsible Authority	Applicability to the Project/ Status
					The Act details out conditions of licensing of contractors[26] and ensure basic welfare measures to be made available to the contract workers by the employer, which includes: • Canteens • Restrooms • First aid facilities • Liability of principal employer • Responsibility for payment of wages • Penalties and procedure • Registers and other records to be maintained[27] **Applicability** **Applicable on Dave Construction & Engineering Company** Dave Construction & Engineering Company has obtained the contract labour license vide license number CLRA/License/CLRA/BRD/2023/CLL/90 dated 13.03.2023. The license is valid till 31.03.2024. **Not Applicable on Golden Crown Security Allied Services** The number of security personnel employed (which is 5) by the agency are below the mandatory applicability limit of 50 workers as per the Act. Therefore, as per the section 4 of the Act, the contractor labour license is not applicable on the agency. **Note: A**ccording to the Contract Labour (Regulation and Abolition) (Gujarat Amendment) Act, 2020, the Contract Labour (Regulation and Abolition) Act, 1970 in Gujarat is now apply to establishments and contractors which employ 50 or more workmen as opposed to the earlier threshold of 20. Therefore, the contractor labour license is not applicable on Dave Construction and Engineering Company
20	The Gujarat Factory Rule, 1963	×	✓	Chief Inspector of Factories	According to the act, an application for obtaining permission for the site on which the factory is to be situated and for the construction or extension of a factory shall be made to the Chief Inspector of Factories, Application for such permission shall be made in Form No. 1 which shall be accompanied by the following documents • a flow chart of the manufacturing process supplemented by a brief description of the process in Its various stages. • plans in duplicate drawn to scale showing: - o the site of the factory and Immediate surroundings including adjacent buildings and other structures, roads, drains, etc. o the plan elevation and necessary cross-sections of the various buildings, indicating all relevant details relating to natural lighting, ventilation and means of escape in case of fire. The plans shall also clearly indicate the position of the plant and machinery, aisles and passageways; and • such other particulars as the Chief Inspector may require, If the Chief Inspector is satisfied that the plans are in consonance with the requirements of the Act he shall, subject to such conditions as he may specify, approve them by signing and returning to the applicant one copy of each plan or tie may call for such approval to be given. **Applicability** **Not Applicable** The project is still in the construction phase.
21	Minimum Wages Act 1948	✓	✓	Labour Department	The act ensures minimum wages for each category of workers. Per the provision of the Act, the employer shall pay to every employee engaged in a schedule employment under them, wages at a rate not less than the minimum wages fixed by such notification of by the state government for that class of employees in that employment without any deductions except as may be authorised within such time and subject to such conditions as may be prescribed. Further, the Act also detailed out provisions on key aspects, such as: • fix the working hours for a normal working day • overtime payment • wages of worker who works for less than normal working days • Minimum time rate wages for piecework • Maintenance of registers and records • Penalties on offences to the Act • General provision for punishment of offences • Payment of undisbursed amounts due to employees **Overtime Payment** The employer shall pay to every employee engaged in a scheduled employment under him wages at a rate not less than the minimum rate of wages fixed by the appropriate Government Authority for that class of employees in that employment without any deductions except as may be authorized within such time and subject to such conditions as may be prescribed. **Applicable** It has been confirmed through consultation and a review of the wage register that all workers and security personnel at the project are receiving wages equivalent to the minimum wages prescribed by the Gujarat state notification[1], it indicates the compliance with the provisions of the Minimum Wages Act, 1948. The review of sample of wages received by the workers are provided below:

Workers	Employment	Wages Received	Class of employee	Wages as per notification
Workers 1	Construction workers	700/day	Skilled	474

[26] No contractor to whom this Act applies, shall undertake or execute any work through contract labour except under and in accordance with a license issued in that behalf by the licensing officer.
[27] Every principal employer and every contractor shall maintain such registers and records giving such particulars of contract labour employed, the nature of work performed by the contract labour, the rates of wages paid to the contract labour and such other particulars in such form as may be prescribed.

Sr. No.	Applicable Regulation/Permit	Construction	Operation	Responsible Authority	Applicability to the Project/ Status

					Workers 2	Helper in construction activities	500-600/day	Semi-skilled and unskilled	462
					Workers 3	Security personnel	15,000/month and 577/day	Skilled	474

[1] https://col.gujarat.gov.in/Portal/News/998_3_minimum_wages_46_Schedule_Employment_27.03.2023.pdf (Accessed on May 27, 2023)

22	Equal Remuneration Act 1976	✓	✓	Labour Department	Puts in place rules and regulations governing the remuneration payable to workers and employees
23	The Payment of Wages Act, 1936, amended in 2005 and 2017	✓	✓	Labour Department	• This Act was passed with the aim of regulating the payment of wages but excluding bonus/pension/PF/gratuity etc. to persons employed in any factory, either directly or indirectly through a sub-contractor. • The Act holds the employer solely responsible for the payment of wages to the employees. • The Act also specifies the need for a timeline for the wage payment, and the provisions for fines and deductions amongst other details pertaining to wages • No wage period shall exceed one month **Applicability** **Applicable** As per the review of wage register and consultation with workers it was observed that the workers working at same level is receiving equal remuneration irrespective of their gender
24	Maternity Benefit Act, 1961 & The Maternity Benefit (Amendment) Act, 2017	✓	✓	Labour Department	• Every woman shall be entitled to, and her employer shall be liable for, the payment of maternity benefit at the rate of the average daily wage for the period of her actual absence the period immediately preceding the day of her delivery, the actual day of her delivery and any period immediately following that day. • Increases the duration of the maternity leave from 12 to 26 weeks which can be availed prior to 8 weeks from the date of expected delivery (earlier it was 6 weeks prior). • From third child onwards, maternity leave to be for 12 weeks which can be availed 6 weeks prior. • Employer to permit a woman to work from home, if the nature of work permits her to do so and the same can be availed after the completion of her maternity leave for a duration mutually decided. Woman to be informed at the time of appointment, of the maternity benefits available, either in writing or electronically. **Applicability** **Applicable** As reported, the project is providing benefits to female workers as per the Act.

25	The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013	✓	✓	Labour Department	• No woman shall be subjected to sexual harassment at any workplace
					• The following circumstances, among other circumstances, if it occurs or is present in relation to or connected with any act or behaviour of sexual harassment may amount to sexual harassment:-
					  • Implied or explicit promise of preferential treatment in her employment: or
					  • Implied or explicit threat of detrimental treatment in her employment; or
					  • Implied or explicit threat about her present or future employment status: or
					  • Interference with her work or creating an intimidating or offensive or hostile work environment for her; or
					  • Humiliating treatment likely to affect her health or safety.
					Applicability
					Applicable
					Based on consultation with female workers it is confirmed that there is no sexual harassment at the project level. Sexual harassment refers to unwelcome sexual advances, requests for sexual favours, or any other verbal, non-verbal, or physical conduct of a sexual nature that creates an intimidating, hostile, or offensive working environment.

26	The E.P.F. and Miscellaneous Provisions act, 1952	✓	✓	Labour Department	• This Act is applicable to every factory or establishment employing 20 or more persons. • This Act requires the employer to provide for provident fund as under the scheme to the general public The contribution which shall be paid by the employer to the Fund shall be ten percent. Of the basic wages, dearness allowance and retaining allowance, if any, for the time being payable to each of the employees whether employed by him directly or by or through a contractor, and the employee's contribution shall be equal to the contribution payable by the employer in respect of him and may, if any employee so desires, be an amount exceeding ten percent of his basic wages, dearness allowance and retaining allowance if any. **Applicable** The applicability and status of the registration of contractor and security personnel are provided below:

Contractor/Project SPV	Applicability	Status
Dave Construction & Engineering Company	Not Applicable on the contractor	As per the Act, an employee whose salary applicable for PF is more than INR 15,000 per month and first time covered under the Act, is an Excluded employee. Note: All the workers employed by the contractor are earning more than INR 15,000 per month and have not been covered under the Act before employing at the Project.
Golden Crown Security Allied Services	The Act is applicable on the contractor	The security agency has obtained the PF registration vide establishment code GJAH1910947000.

Sr. No.	Applicable Regulation/Permit	Construction	Operation	Responsible Authority	Applicability to the Project/ Status
					Further, based on the consultation with security personnel, they are receiving benefits as per the Act.
27	Payment of Bonus Act, 1965 and rules and subsequent amendment	✓	✓	Labour Department	Every employee shall be entitled to be paid by his employer in an accounting year, bonus, in accordance with the provisions of this Act, provided he has worked in the establishment for not less than thirty working days in that year. Further, every employer shall be bound to pay to every employee in respect of the accounting year commencing on any day in the year 1979 and in respect of every subsequent accounting year, a minimum bonus which shall be 8.33 per cent. of the salary or wage earned by the employee during the accounting year or one hundred rupees, whichever is higher, whether the employer has any allocable surplus in the accounting year. An employee shall be disqualified from receiving bonus under this Act, if he is dismissed from service for • fraud; or • riotous or violent behaviour while on the premises of the establishment; or • theft, misappropriation, or sabotage of any property of the establishment
28	Payment of Gratuity Act, 1972	✓	✓	Labour Department	Gratuity shall be payable to an employee on the termination of his employment after he has rendered continuous service for not less than five years, • on employee's superannuation, or • on his retirement or resignation, • on his death or disablement due to accident or disease Provided that the completion of continuous service of five years shall not be necessary where the termination of the employment of any employee is due to death or disablement. The gratuity amount will be calculated as follows: • Employees are entitled to get the salary of 15 days for every completed year as gratuity. • Only the basic pay and DA (if any) are considered while accounting for the salary. It means any bonus, special allowance and HRA are not taken for the gratuity calculation. **Note** Gratuity calculation: Gratuity = (Salary / 26) x 15 x Number of years in service Where; Salary is "Last drawn basic pay + DA" 26 is the average working days in a month (As per Gratuity rules – 26 days not 30 days calculated) 15 is the actual days considered for gratuity in a year
29	ESI Act, 1948 (Employees State Insurance Act, 1948)	×	✓	Labour Department	• It applies to all non-seasonal factories • To provide benefits in case of sickness, maternity, and employment injury' and to make provision for certain other matters in relation thereto. • all employees in factories or establishments to which this Act applies shall be insured in the manner provided by this Act. The contribution payable under this Act in respect of an employee shall comprise contribution payable by the employer (hereinafter referred to as the employer's contribution) and contribution payable by the employee (hereinafter referred to as the employee's contribution) and shall be paid to the Corporation. **Not Applicable – construction workers** Based on Hon'ble Supreme Court of India order dated 06.07.2018, ESIC is not applicable on the construction workers during the stay order. However, till date the stay order is applicable across India. Further, Employees State Insurance Corporation through its letter no. T.11/13/03/2015 Rev.II dated 26.09.2018 – also clarifies that no ESIC contribution may be collected from construction site workers. **Applicable – Security personnel** Golden Crown Security and Allied Services has obtained the ESIC registration, and the employee code of the agency is 37001136390001018.
30	Workmen's Compensation Act, 1923	✓	✓	Labour Department	Payment of compensation amount as applicable at the time of the accident resulting in a temporary or a permanent disablement such that it reduces the earning potential of workman in any employment. Or contracts an occupational disease peculiar to that employment. **Applicable** The project has reported that they will pay the compensation amount as applicable at the time of the accident resulting in a temporary or a permanent disablement.
31	Child Labour (Prohibition and Regulation) Act, 1986 and subsequent amendments	✓	✓	Labour Department	The Act intends to: • Ban the employment of children, i.e., those who have not completed their fourteenth year, in specified occupations and processes • Lay down a procedure to decide modifications to the schedule of banned occupations or processes • Regulate the conditions of work of children in employments where they are not prohibited from working • Lay down enhanced penalties for employment of children in violation of the provisions of this Act and other Acts which forbid the employment of children **Applicability** **Applicable** During the site visit, it was observed that the project has not employed any child labour.
32	The Bonded Labour System (Abolition) Act 1976;	✓	✓	Labour Department	Abolition of Bonded Labour System: (i) The bonded labour system is abolished and every bonded labourer stands free and is discharged from any obligation to render any bonded labour; (ii) (a) No person is to make any advance of bonded labour, (b) No person is to compel any person to render any bonded labour or other form of forced labour. **Applicability** **Applicable** Based on the consultation with workers and information reviewed, it is confirmed that there is no bonded labour at the project level. Bonded labour refers to a situation where a person is compelled to work in order to repay a debt, often through exploitative and coercive practices. It is a form of forced labour and is considered a violation of human rights.

Sr. No.	Applicable Regulation/Permit	Construction	Operation	Responsible Authority	Applicability to the Project/ Status
33	The Protection of Civil Rights Act, 1955	✓	✓	Labour Department	A person shall be deemed to boycott another person who - (a) refuses to let to such other person or refuses to permit such other person, to use or occupy any house or land or refuses to deal with, work for hire for, or do business with, such other person or to render to him or receive from him any customary service, or refuses to do any of the said things on the terms on which such things would be commonly done in the ordinary course of business; or (b) abstains from such social, professional or business relations as he would ordinarily maintain with such other person. **Applicable** The project is in compliance with the requirement of the Act.
34	The building and other Construction Workers Act, 1996	✓	×	Labour Department	Ensure safety measures at construction work site and other welfare measures such as canteens, first-aid facilities, ambulance, housing accommodation for Workers near the Workplace etc. **Overtime Payment** Wages for overtime work: 1) Where any building worker is required to work on any day more than the number of hours constituting a normal working day, he shall be entitled to wages at the rate of twice his ordinary rate of wages; 2) The ordinary rate of wages means the basic wages plus such allowances as the worker is for the time being entitled to but does not include any bonus. **Workers' Accommodation** (1) The employer shall provide, free of charges and within the work site or as near to it as may be possible, temporary living accommodation to all building workers employed by him for such period as the building or other construction work is in progress. (2) The temporary accommodation provided under sub-section (1) shall have separate cooking place, bathing, washing and lavatory facilities. (3) As soon as may be, after the building or other construction work is over, the employer shall, at his own cost, cause removal or demolition of the temporary structures erected by him for the purpose of providing living accommodation, cooking place or other facilities to the building workers as required under sub-section (1) and restore the ground in good level and clean condition. **Creches** (1) In every place wherein, more than fifty female building workers are ordinarily employed, there shall be provided and maintained a suitable room or rooms for the use of children under the age of six years of such female workers. (2) Such rooms shall— (a) provide adequate accommodation; (b) be adequately lighted and ventilated; (c) be maintained in a clean and sanitary condition; (d) be under the charge of women trained in the care of children and infants. **Applicable** GWVPL has obtained BOCW registration with registration number JDISH/BRD/BOCW/106/2022 dated 11.05.2022. The registration is valid till 31.12.2023.
35	The Industries Disputes (Amendment) Act, 2010	✓	✓	Labour Department	• Every industrial establishment employing twenty or more workmen shall have one or more Grievance Redressal Committee for the resolution of disputes arising out of individual grievances. • The Grievance Redressal Committee shall consist of equal number of members from the employer and the workmen. • The chairperson of the Grievance Redressal Committee shall be selected from the employer and from among the workmen alternatively on rotation basis every year. • The total number of members of the Grievance Redressal Committee shall not exceed more than six: Provided that there shall be, as far as practicable, one-woman member if the Grievance Redressal Committee has two members and in case the number of members are more than two, the number of women members may be increased proportionately. • Notwithstanding anything contained in this section, the setting up of Grievance Redressal Committee shall not affect the right of the workman to raise industrial dispute on the same matter under the provisions of this Act. • The Grievance Redressal Committee may complete its proceedings within forty-five days on receipt of a written application by or on behalf of the aggrieved party. • The workman who is aggrieved of the decision of the Grievance Redressal Committee may prefer an appeal to the employer against the decision of Grievance Redressal Committee and the employer shall, within one month from the date of receipt of such appeal, dispose off the same and send a copy of his decision to the workman concerned. • Nothing contained in this section shall apply to the workmen for whom there is an established Grievance Redressal Mechanism in the establishment concerned. **Applicability** **Applicable** The project has established a grievance redressal mechanism depicting grievance redressal committee, and the process of redressing the grievances.
36	Trade Union Act, 1926	✓	✓	Labour Department	Any seven or more members of a Trade Union may, by subscribing their names to the rules of the Trade Union and by otherwise complying with the provisions of this Act with respect to registration, apply for registration of the Trade Union under this Act. The admission of ordinary members who shall be persons actually engaged or employed in an industry with which the Trade Union is connected, and the admission of the number of honorary or temporary members to form the executive of the Trade Union> **Applicability** **Applicable** The project has reported that they are not stopping any workers to join or form trade union.
37	Persons with Disabilities Act, 1995 and Persons with Disability Rules 1996	✓	✓	Labour Department	• Give effect to the proclamation on the full participation and equality (equal opportunities) of people with disabilities and protection of rights • The employer in every establishment shall furnish such information or return as may be prescribed in relation to vacancies appointed for person, with disability that have occurred or are about to occur in that establishment to such Special Employment Exchange as may be prescribed and the establishment shall thereupon comply with such requisition. • Every employer shall maintain such record in relation to the person. With disability employed in his establishment in such form and in such manner as may be prescribed by the appropriate Government • Every appropriate Government shall appoint in every establishment such percentage of vacancies not less than three per cent. for persons or class of persons with disability of which one per cent. Each shall be reserved for persons suffering from-

Sr. No.	Applicable Regulation/Permit	Construction	Operation	Responsible Authority	Applicability to the Project/ Status
					○ Blindness or low vision; ○ Bearing impairment; ○ Loco motor disability or cerebral palsy, in the posts identified for each disability: Provided that the appropriate Government may, having regard to the type of work carried on in any department or establishment, by notification subject to such conditions, if any, as may be specified in such notification, exempt any establishment from the provisions of this section. **Applicability** Based on the consultation with workers it is confirmed that there is no discrimination at the project level. Discrimination refers to the unfair or unequal treatment of individuals or groups based on certain characteristics such as race, gender, religion, nationality, or disability. It is a violation of human rights and can create a hostile and unequal working environment.
38	Ancient Monuments and Archaeological Sites and Remains Act 1958	✓	×	Labour Department	This Act places restrictions on the destruction, alteration, defacement, or removal of monuments and on construction on or near the site of any protected monument. No person, including the owner or occupier of a protected area, shall construct any building within the protected area or carry on any mining, quarrying, excavating, blasting or any operation of a like nature in such area, or utilise such area or any part thereof in any other manner without the permission of the Central Government
39	Private Security Agencies (Regulation) Act, 2005	✓	✓	Managing Director, Gujarat Police Academy, General Administrative Department	An Act to provide for regulations of private security agencies and for matters connected therewith or incidental thereto. Per the provision of the Act – No person shall carry on or commence the business of private security agency, unless he/she holds a license issued under this Act. **Applicable** Golden Crown Security and Allied Services – the private security providing agency has obtained the PSARA license vide license number 19083828 and is valid till 19.08.2024.
40	Factories Act, 1948 and Gujarat Factories Rules, 1963	×	✓	Factories Inspector from Labour Department	The occupier or manager of every factory to which the Act applies shall submit to the Chief Inspector an application in triplicate in Form No. 2 for the registration of the factory accompanied by an application in Form No. 3 for the grant of a license therefore: Provided that the occupier manager of a place to which the provisions of the Act are made applicable by a notification under Sec. 15 of the Act shall submit an application within 30 days of the date of the notification. **Not Applicable** The project is in the construction phase, thus, the Act is not applicable.
	Ecology				
41	Wildlife (Protection) Act, 1972	✓	✓	Wildlife Warden, State Forest Department	If any protected/ endangered flora or fauna (as listed in Schedules of Wildlife Protection Act, 1972) are found in the project area, the proponent should implement conservation measures for their protection.

Table 4-3 Applicability of IFC Performance Standards to the Project

Sr. No.	IFC Performance Standards	Applicability/ Compliance/Details
1)	Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts	**Applicable** This PS aims to assesses the existing social and environmental management systems of ACEL and to identify the gaps with respect to their functioning, existence and implementation of an environmental and social management plan (ESMP), a defined EHS Policy, organization chart with defined roles and responsibilities, risk identification and management procedures as well as processes like stakeholder engagement and grievance management. This ESIA is being conducted as part of the "identification of risks and impacts" requirement under the IFC PS 1. The management measures prescribed in this ESIA report will be implemented for mitigation of impacts identified.
2)	Performance Standard 2: Labour and Working Conditions	**Applicable** This PS is guided by a number of international conventions and instruments on labour and workers' rights. It recognizes that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of fundamental rights of workers. The PS covers following themes: human resource policy and management, workers' organization, non-discrimination and equal opportunity, retrenchment, protecting the workforce and occupational health and safety. This PS helps to assess the status of the employees and workers at the Project as well as any contractors. The construction and operation phase for the Project will include employment of labor 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)	Performance Standard 3 Resource Efficiency and Pollution Prevention	**Applicable** PS-3 covers the use of resources and materials as inputs and wastes that could affect human health. The objective of PS-3 is to avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities; to promote more sustainable use of resources, including energy and water, etc. Key themes covered under PS-3 are pollution prevention, resource conservation and energy efficiency, wastes, hazardous materials, emergency preparedness and response, greenhouse emissions, pesticide use and management. This PS will assess how the SPV intends to minimize pollution related impacts, what management plans and systems are in place, and what measures it plans to take to conserve and use resources more efficiently. The Project involves air emissions and pollution discharge during both construction and O&M phases. The following activities fall under the purview of the PS3: Use of groundwater and treated water from STP in project activities, impact on soil and water, wastewater discharge, use of MSW as fuel, air emissions, leachate collection & management, ash handling from the site, generation, and disposal of hazardous waste etc.
4)	Performance Standard 4: Community Health, Safety & Security	**Applicable** PS-4 anticipate and avoid adverse impacts on the health and safety of the affected community during the project life from both routine and non-routine circumstances. It also requires ensuring that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the affected Communities. Key areas of compliance screened under PS-4 includes infrastructure/equipment safety, hazardous material safety, natural resource issues, exposure to disease, emergency preparedness and response, and security personnel requirements. The project may impact the health and safety of the communities adjacent to its boundary during construction phase. PS 4 is applicable to the project as the Project use access roads for transportation of construction materials to site which may have potential impact on the health and safety of the commuters and communities located along the access road. The same access roads will be used for transportation of MSW during operation phase at the project site.
5)	Performance Standard 5 Land acquisition and involuntary resettlement	**Not Applicable**

Sr. No.	IFC Performance Standards	Applicability/ Compliance/Details
		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 for the project is taken on lease and prior to the project land was classified as barren. Since, the land procurement does not involve involuntary resettlement therefore the applicability of the PS 5 is scoped out.
6)	Performance Standard 6	**Applicable** The project is surrounded by natural (water bodies, seasonal water streams) and Modified (agricultural lands) habitats are present in the surrounding 5 km radius of the project location. Especially, there is pond at 115m in west and a tributary of Vishwamitri River at 130m in south, consequently, it is anticipated that there may be potential impact on aquatic and terrestrial avifauna movement because of project activities. Thus PS-6 is applicable here.
7)	Performance Standard 7 Indigenous People	**Not Applicable** there is no direct potential adverse impact on the Schedule Tribes (Indigenous People) therefore PS-7 is not getting triggered
8)	Performance Standard 8 Cultural Heritage	**Not Applicable** As per the available data 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.

4.5 Applicable National and International Standards

4.5.1 Ambient Air Quality Standards

4.5.1.1 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 4-4***.

Table 4-4 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
Cadmium ng/m^3	Annual*	5***	-

Pollutant	Time Weighted Avg.	Concentration in Ambient Air	
		Industrial, Residential, Rural & Other Areas	Ecologically Sensitive Areas (notified by Central Government)
Mercury[28] mg/l	-	0.1	-

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.

*** WHO air quality guideline for cadmium of 5 ng/m3 has been recommended in order to prevent any further increases in cadmium levels in agricultural soils

4.5.1.2 WBG EHS Ambient Air Quality Standards

According to the WBG General 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 WBG General EHS guidelines has been presented in ***Table 4-5.***

Table 4-5 WBG Ambient Air Quality Standards

Pollutant	Averaging Period	Guideline Value in µg/m3
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)

[28] https://cpcb.nic.in/uploads/News_Letter_Mercury_2017.pdf

Pollutant	Averaging Period	Guideline Value in µg/m3
		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 Maximum	160 (Interim target-1)
		100 (guideline)

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

Therefore, as per ***Table 4-4*** and ***Table 4-5,*** the ambient air quality as per WBGEHS standards are more stringent as compared to NAAQS Standards and the stringent standards are to be followed.

4.5.2 Ambient Noise standards

4.5.2.1 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 4-6.***

Table 4-6 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
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone**	50	40

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, loudspeakers and bursting of crackers are banned in these zones.

4.5.2.2 WBG Ambient Noise Standards

As per the WBG General EHS Guidelines on noise management, noise impacts should not exceed the levels presented in ***Table 4-7*** or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

Table 4-7 WBG Ambient Noise Standards

Receptor	One Hour Leq (dBA)	
	Daytime 07:00 - 22:00	Night time 22:00 - 07:00
Residential; Institutional; Educational	55	45
Industrial, commercial	70	70

Since the project is be set up Industrial Area, the noise limits of industrial area has been considered for the project. Based on Table 4 6 and Table 4 7, the ambient noise levels as per MoEFCC are different for industrial and commercial areas, however, WBG noise guidelines provide same ambient noise standards for commercial and industrial areas. Therefore, the ambient noise standards as per WBG is more stringent as compared to MOEFCC for industrial areas and the stringent standards are to be followed.

4.5.3 Incineration Standards

4.5.3.1 Incineration standards (National and International)

As per MSW Rules 2016, The emission from incinerator / thermal technologies in solid waste treatment/ disposal facility shall meet the following standards and as per the WBG, the waste management facilities shall meet the EU Directive 2000/76/EC as mentioned in the guidelines. The same has been presented below:

Table 4-8 Air Emission Standards for MSW Incinerators as per SWM Rules 2016 and WBG Waste Management Facilities EHS guidelines

Sr.	Parameters	UOM	India MSW Rules 2016	MSW Incinerators, WBG EHS Guidelines[29] (EU Directive 2000/76/EC)
1	Total Dust/PM	mg/Nm^3	50	10 (24-hr average)
2	Hydrogen chloride(HCL)	mg/Nm^3	50	10
3	Sulphur dioxide (SO_2)	mg/Nm^3	200	50 (24-hr average)
4	Carbon monoxide (CO)	mg/Nm^3	50-100	50 – 150
5	Total Organic Carbon (TOC)	mg/Nm^3	20	--
6	Hydrogen fluoride (HF)	mg/Nm^3	4	1
7	Nitrogen oxide (NOx)	mg/Nm^3	400	200 – 400 (24-hr average)
8	Cadmium (Cd) + Thorium (Th) + Their compounds	mg/Nm^3	0.05	0.05 – 0.1 [0.5 – 8 hr average]
9	Mercury (Hg) and Its compound	mg/Nm^3	0.05	0.05 – 0.1 [0.5 – 8 hr average]
10	**Total Metals** Scandium (Sc) + Arsenic (As) + Lead (Pb) + Cobalt (Co) +	mg/Nm^3	0.5	0.5 – 1 [0.5 – 8 hr average]

[29] https://www.ifc.org/content/dam/ifc/doc/2000/2007-waste-management-facilities-ehs-guidelines-en.pdf

Sr.	Parameters	UOM	India MSW Rules 2016	MSW Incinerators, WBG EHS Guidelines[29] (EU Directive 2000/76/EC)
	Chromium (Cr) + Copper (Cu) + Manganese (Mn) + Nickel (Ni) + vanadium (V) + Their compounds			
11	Dioxins and furans	mg TEQ/Nm^3	0.1	0.1 ng TEQ/m3 [6 – 8 hr average]

Since the Incineration emission norms are more stringent as per WBG EHS waste management facilities, the stringent standards are to be followed.

4.6 Other Relevant International Guidelines and Standards

- **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 considered.

- **World Bank EHS Guidelines for Electric Power Transmission and Distribution (2007):** The EHS Guidelines for Electric Power Transmission and Distribution include information relevant to power transmission between a generation facility and a substation located within an electricity grid, in addition to power distribution from a substation to consumers located in residential, commercial, and industrial areas. The guidelines cover the following aspects:
  - Industry specific environmental, occupational health and safety, community health and safety impacts and management
  - EHS Performance Indicators
  - General Description of Power Transmission and Distribution Industry

- **World Bank EHS Guidelines for Waste Management Facilities, 2007:** 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 EHS Guidelines for Waste Management cover facilities or projects dedicated to the management of municipal solid waste and industrial waste, including waste collection and transport; waste receipt, unloading, processing, and storage; landfill disposal; physico-chemical and biological treatment; and incineration projects. Industry-specific waste management activities applicable, for example, to medical waste, municipal sewage, cement kilns, and others are covered in the relevant industry-sector EHS Guidelines, as is the minimization and reuse of waste at the source.

- **World Bank EHS Guidelines on Air Emissions and Ambient Air Quality:** This guideline applies to facilities or projects that generate emissions to air at any stage of the project life cycle. It complements the industry-specific emissions guidance presented in the Industry Sector Environmental, Health, and Safety (EHS) Guidelines by providing information about common techniques for emissions management that may be applied to a range of industry sectors. Emissions of air pollutants can occur from a wide variety of activities during the construction, operation, and decommissioning phases of a project. Where possible, facilities and projects should avoid, minimize, and control adverse impacts to human health, safety, and the environment from emissions to air. Where this is not possible, the generation and release of emissions of any type should be managed through a combination of: Energy use efficiency, Process modification, Selection of fuels or other materials, the processing of which may result in less polluting emissions, Application of emissions control techniques.

- World Bank EHS Guidelines on Noise Management: This guideline addresses the impacts of noise beyond the property boundary of the facilities. Worker exposure to noise is covered in Section 2.0 on Occupational Health and Safety. Noise prevention and mitigation measures should be applied where predicted or measured noise impacts from a project facility or operations exceed the applicable noise level guideline at the most sensitive point of reception. The preferred method for controlling noise from stationary sources is to implement noise control measures at source. Methods for prevention and control of sources of noise emissions depend on the source and proximity of receptors.

5 Environmental and Social Baseline Conditions

This section describes the existing environmental and social sensitivities of the study area (as described below). 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

5.1 Study Area

The area of up to 10 km radius from the Project boundary (14.9 MW) of the Waste to Energy plant including the associated transmission line) and water pipeline from STP has been demarcated as study area (as presented in ***Figure 5-1***) for the Project by considering the extent of Project impact in terms of air quality, noise, water resources, human settlement, cultural heritage sites, location of the access roads besides considering the actual land area which has been procured for the Project and its utilities footprints.

5.1.1 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 for the Project include land used for setting up the Waste to Energy Plant, , transmission line infrastructure and water pipeline from STP installed for the Project. The footprint area also includes the RoW of the associated transmission line.

5.1.2 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 several factors, including:

- Nature of the activity
- Specific resource or receptor
- Vulnerability
- 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 to a larger area in its immediate vicinity. This includes the footprint of the project components, such as access road as well as the immediate surroundings that will see increase movement of vehicles, personnel, and land-use change. Most of the impacts will occur within the project footprint area as identified above. However, certain impacts can be further reaching in terms of expected impacts.

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

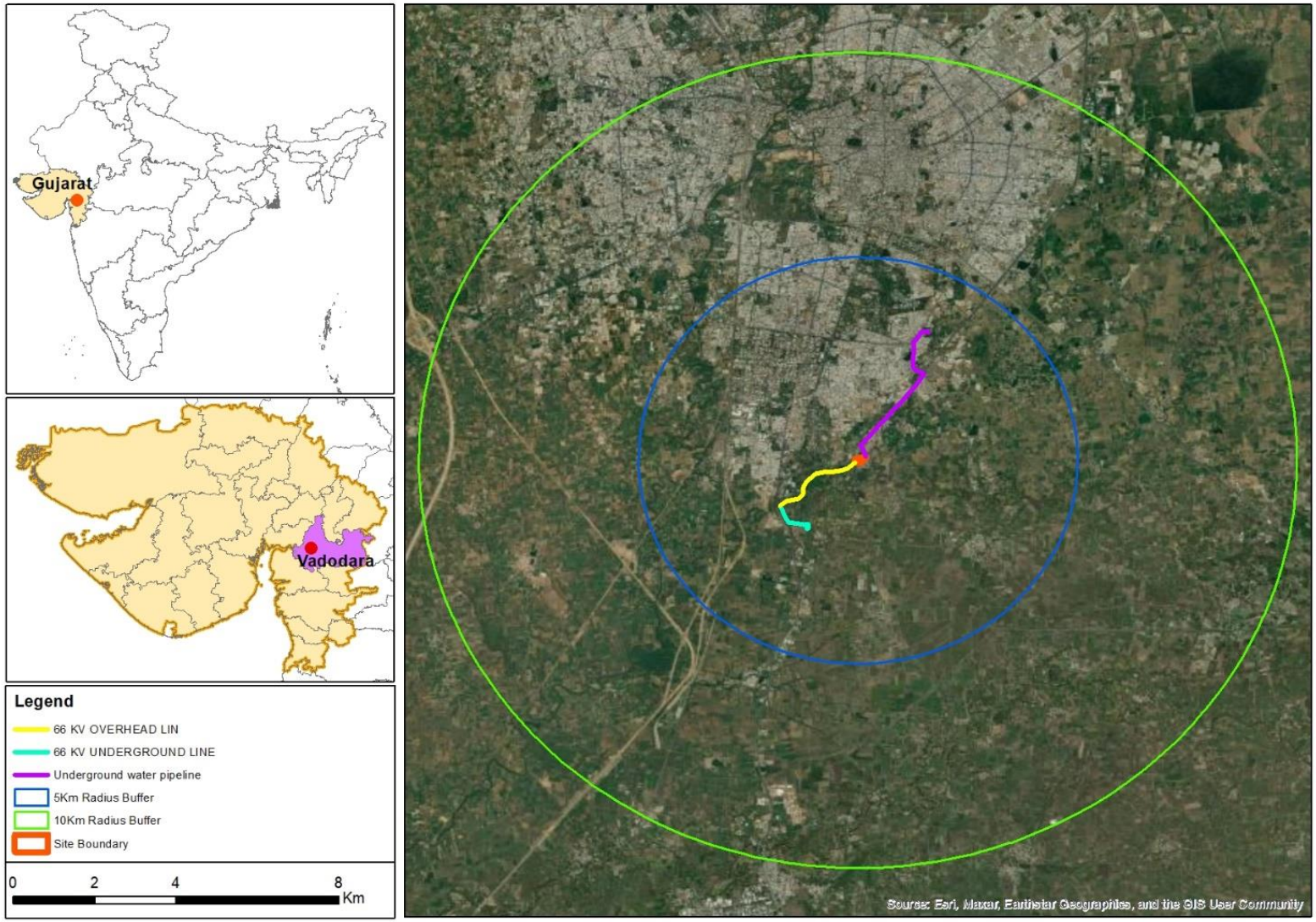
- Ecological Parameters: Based on identified sensitivity during desk-based review and previous experiences, the study area for ecological assessment was demarcated as,
    - ***Core Area:*** Boundary of the proposed project
    - ***Buffer Area:*** 10 km radius from the project boundary.
- Environmental Parameters: The area of up to 10 km radius from the Project boundary has been demarcated as study area or Area of Influence for the Project by considering the extent of project 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 facilities. For the purpose of environmental baseline assessment,
    - ***core (0 – 2km from project site) and***
    - ***buffer zones (beyond 2km – 10km of project site).***

- **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 zone -** The core zone is defined as the radius extending from the Project footprint area which would have majority of the impacts (during mobilization, construction, operation and decommissioning phase). The core zone area for the study is project footprint area i.e. WtE Plant, Water Pipeline and Transmission Line and adjacent area within 500 m radius.
  - **Buffer Zone -** An AoI of 10 km radius from the location of WTE Plant, transmission line and the water pipeline is considered for socioeconomic consultations to determine perceived impacts due to the Project including employment opportunities, loss of livelihood and increased vehicular activity in remote areas.

  Study area: Project footprint = Core zone (500 meters) + buffer zone (10 km).

Figure 5-1 Identified Study area for the Project



Source: Developed by E&S Advisor

5.2 Primary Environmental Baseline Monitoring

Primary environmental baseline monitoring was conducted within the study area 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 project study area. Monitoring locations considered for the project has been presented in *Table below*. Map showing monitoring locations has been presented in ***Figure 5-2***. Sampling for Air, Noise, Surface water Ground Water, Soil was undertaken during the months of May-June 2023.

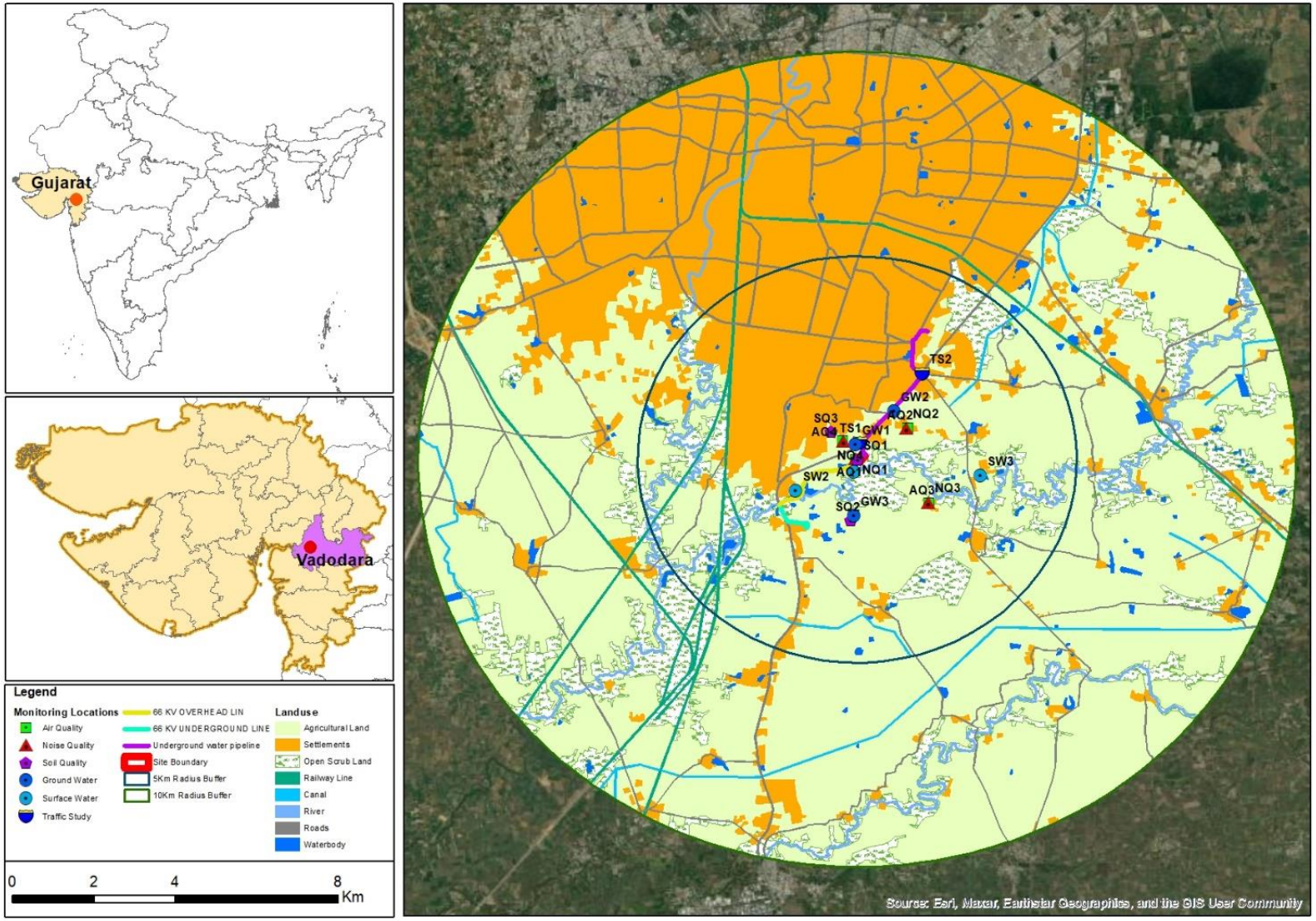
Table 5-1 Environment Monitoring Locations

Parameter	Location Code	Name of the Location	Coordinates	Distance and Direction from Project Site	Location Criteria
Ground Water	GW 1	Himmat Nagar	22°14'00.7"N 73°12'15.5"E	0.35 Km towards North direction	Physical, chemical, and biological parameters as per IS 10500:2012 drinking water standards were assessed for the collected samples Once during the monitoring period in May 2023
	GW 2	Golden quadrilateral road, Tarsali	22°14'27.4"N 73°12'46.6"E	1.44 Km towards Northeast direction	
	GW 3	Mujar gamdi ,Alamgir	22°13'04.3"N 73°12'14.5"E	1.39 Km towards South direction	
Surface Water	SW 1	Vishwamitri River	22°13'39.6"N 73°12'14.3"E	0.31 Km towards South direction	Once during the monitoring period in May 2023
	SW 2	Pond near Ideal school Naman Hostel,	22°13'24.5"N 73°11'28.0"E	1.59 Km towards South West direction	
	SW 3	Pond near Chikhodara Village.	22°13'36.2"N 73°13'55.4"E	2.85 Km towards East direction	
Ambient Air	AQ 1	Project Site	22°13'48.9"N 73°12'15.7"E	Project Site	Twice a week for 4 weeks from the nearest residential receptors covering all directions within 3km radius of the project site from 18th May to 14th June as impacts from Project are anticipated to be up to 3 km from the Project site.
	AQ 2	Dasha Maa Mandir, Mani Nagar (Residential Area)	22°14'14.4"N 73°12'57.6"E	1.40 Km towards Northeast direction cross wind in the month of May and downwind in the month of June.	
	AQ 3	Primary School, Vora Gamdi (Residential Area)	22°13'14.9"N 73°13'14.0"E	1.95 Km towards South East direction downwind in the month of May and cross wind in month of June.	
	AQ 4	Parvati Nagar (Residential Area)	22°14'04.3"N 73°12'05.3"E	0.57 Km towards North direction cross wind in month of May and June.	
Ambient Noise	NQ 1	Project Site	22°13'49.5"N 73°12'15.9"E	Project Site	Once for 24 hours from the nearest residential receptors covering all directions in the 3 km radius of the project site as per MoEFCC guidelines Leq Noise Levels in dB(A), day and night for 48 hour, once at the selected locations in June 2023.
	NQ 2	Dasha Maa Mandir, Mani Nagar (Residential Area)	22°14'13.7"N 73°12'56.4"E	1.36 Km towards East direction	
	NQ 3	Mosque, Vora Gamdi	22°13'14.8"N 73°13'13.8"E	1.95 Km towards Southeast direction	
	NQ 4	Air Force Pre Primary School, Himmat Nagar	22°14'03.6"N 73°12'06.2"E	0.57 Km towards North direction	
Soil	SQ 1	Project Site	22°13'36.2"N, 73°13'55.4"E	Project Site	Sample were assessed for parameters such as

Parameter	Location Code	Name of the Location	Coordinates	Distance and Direction from Project Site	Location Criteria
	SQ 2	Mujar Gamdi, Alamgir	22°13'00.6"N 73°12'12.2"E	1.51 Km towards South direction	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 in June 2023
	SQ 3	Air Force Pre-Primary School, Himmat Nagar	22°14'11.2"N 73°11'56.5"E	0.89 Km towards Northwest direction	
Traffic Survey	TS 1	Junction of NH-64 & Makarpura Road	22°14'02.2"N 73°12'19.6"E	1.59 Km towards South West direction	Access Road used for the project site in June 2023
	TS 2	Near, Signature Gym & Fitness Hub, Gymnasium school in Vadodara	22°14'57.1"N 73°13'08.7"E	2.85 Km towards East direction	
Dioxin and Furan	D&F 1 & 2	Project Site	22°13'49.1"N 73°12'15.6"E	Project Site	To assess the presence of D&F in the ambient air

Source: Site Visit by Independent E&S Advisor May 2023

Figure 5-2 Monitoring Location Map



Source: Developed by E&S Advisor

5.3 Physical Environmental Sensitivities

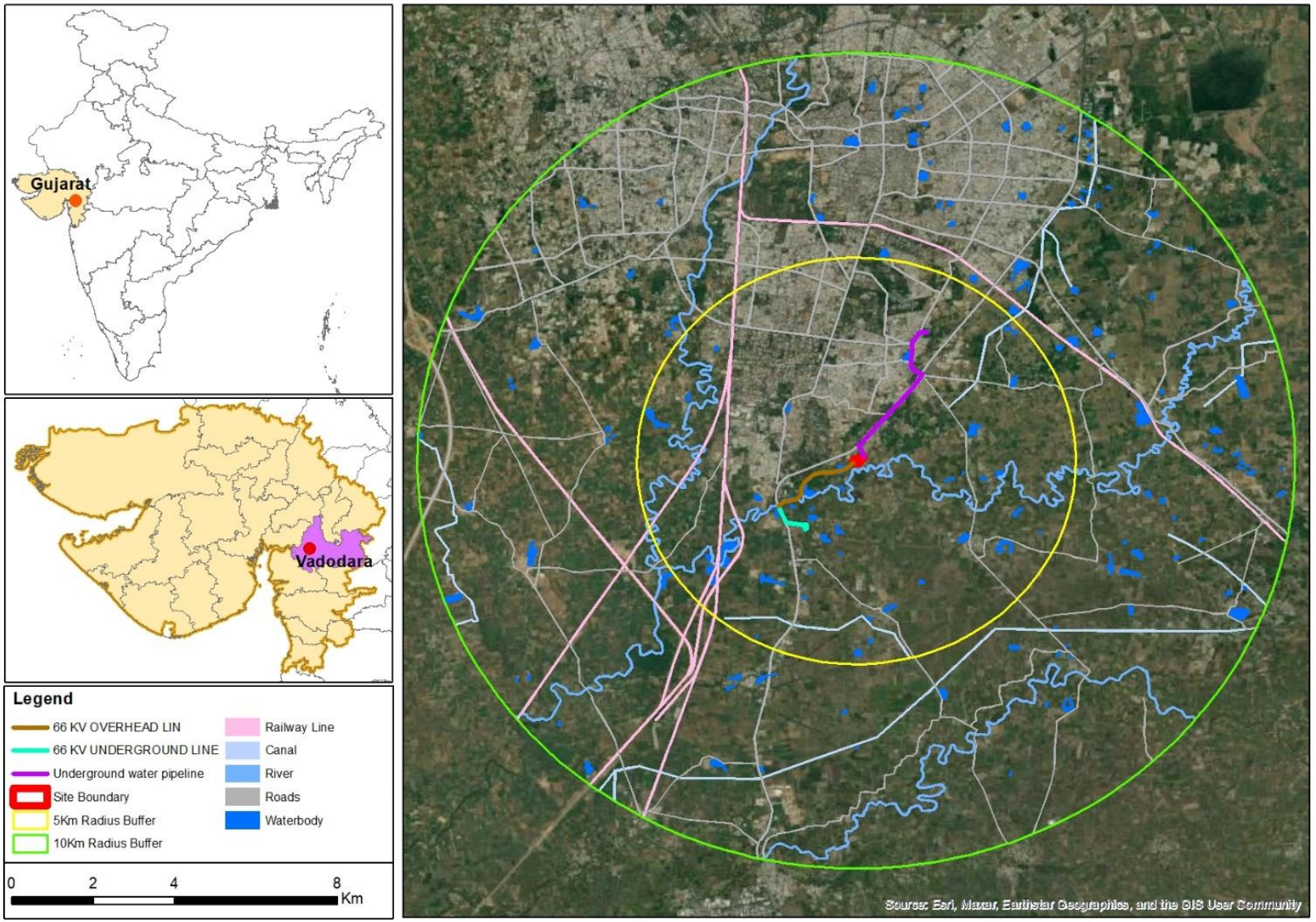
5.3.1 Physical Features

The physical features map of the study area is showcased in ***Figure 5-3.***

The map displays the following features that are located within 10 km radius from the Project site:

- The location of the Project site and transmission line route (underground and above ground),
- Water pipeline route from Sewage Treatment Plant
- Settlements within 10 km radius of the Project
- Road network around the site
- Railway Track
- Water bodies located within 10 km radius

Figure 5-3 Physical Feature Map for study area



Source: Developed by E&S Advisor

5.3.2 Climatology & Meteorology

The district of Vadodara has a moderate climate, and the Tropic of Cancer passes about 100 kilometers to the north of the project location. According to the Groundwater scenario for Vadodara District, 2020 by Central Ground Water Board (CGWB), the climate of the Vadodara is characterized by hot summer and general dryness except during the southwest monsoon seasons. The year can be divided into four seasons:

- March to May is the hot season (summer)
- June to September (southwest monsoon)
- October and November (post monsoon or retreating monsoon season)
- December and ends in February (winter)

Table 5-2 Metrological Data for Vadodara District from IMD (1991-2020)

Month	Temperature (°C)				Relative Humidity (%)		Rainfall		Mean wind speed (m/s)	Predominant direction from
	Mean Max	Mean Min	Highest	Lowest	Max	Min	Monthly (mm)	No of rainy days		
Jan	29.4	13.2	33.7	9.0	70%	38%	4.4	0.3	7.9	NW
Feb	32.1	15.4	36.6	10.8	64%	31%	0.0	0.0	7.7	NW
Mar	36.5	19.7	41.1	15.3	55%	26%	0.1	0.0	7.5	NW
Apr	39.3	24.2	42.7	20.5	56%	24%	1.3	0.1	8.4	W
May	40.1	27.4	43.2	25.1	65%	32%	3.6	0.2	12.2	W
Jun	37.3	27.6	41.6	24.2	75%	52%	128.8	4.2	13.1	SW
Jul	32.6	26.1	36.5	23.9	86%	74%	363.7	13.8	11.5	SW
Aug	31.7	25.5	34.5	23.9	88%	74%	316.1	12.2	10.4	SW
Sep	33.2	25.2	36.7	23.5	84%	65%	163.0	6.8	8.2	SW
Oct	35.8	22.7	38.2	18.5	72%	46%	20.5	1.2	6.1	NE
Nov	33.8	18.0	36.2	14.2	67%	41%	3.7	0.3	6.5	NE
Dec	30.8	14.3	33.9	10.5	70%	42%	2.0	0.2	7.3	N

Source: https://www.imdpune.gov.in/library/public/Climatological%20Tables%201991-2020.pdf

Temperature: According to **Table 5-2**, the coldest month in Vadodara is January, with a mean maximum and lowest temperature range of 29.4°C to 13.2°C respectively. The mean maximum and lowest temperatures in Vadodara vary from 40.1 °C to 27.4 °C in the month of May which is the hottest month.

Wind: According to National Renewable Energy Laboratory, the seasonal cycle leads to strong winds from March through August and relatively weak winds from November through March. Because Gujarat has a long coastline, sea breezes also influence the wind characteristics in this region. From the **Table 5-2** it is established that June month experiences the fastest wind i.e. 13.1m/s from south west direction which bring the south west monsoon to Vadodara. The wind speed decreases gradually in the month of October to about 6.1m/s from the Northeast direction.

Rainfall: According to the above ***Table 5-2*** from Metrological Data for Vadodara District from IMD (1991-2020), the months of June, July, August and September constitute the monsoon season (refer ***Table 5-2***). This is the main rainy season for most part of India. Frequent rainfall, thunderstorms, heavy rains are characteristics features of these months of the year. According to IMD report, July month has received the maximum rainfall of 363.7mm in the last 30 years with at least 13 rain days. During this month the relative maximum and minimum average relative humidity over 3 decades has been recorded as 86% and 74% respectively.

5.3.3 Land Use

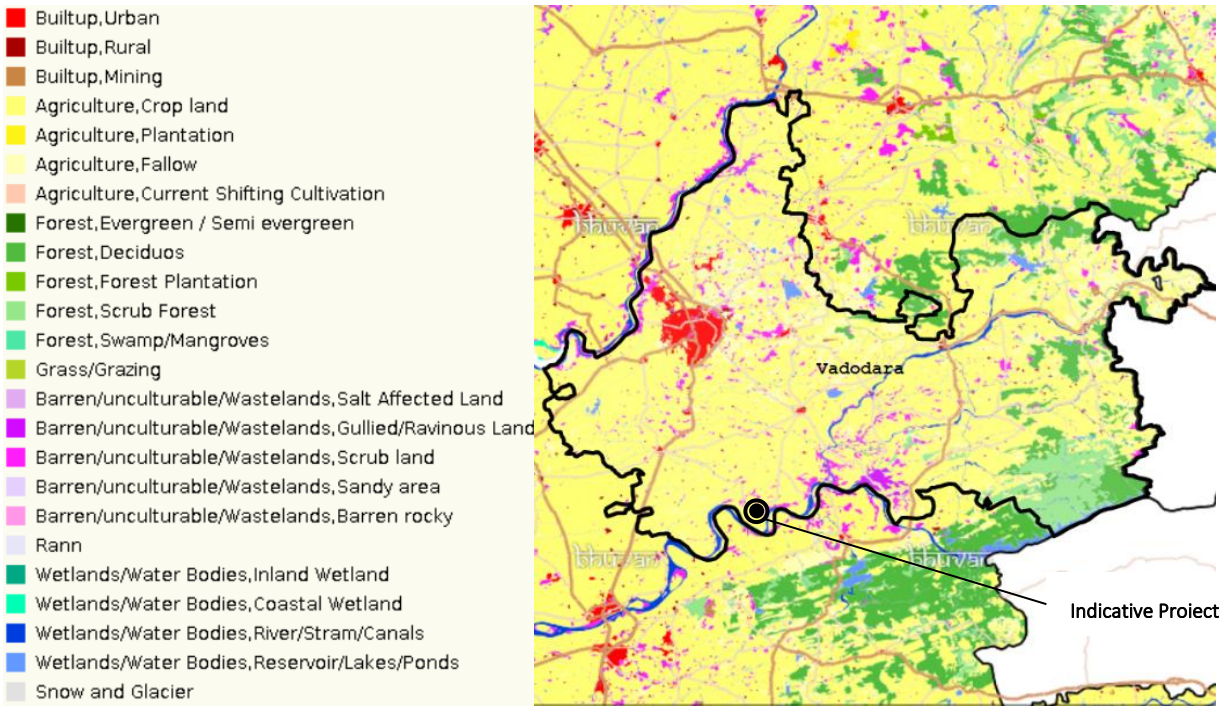
According to District and category wise distribution of Land Use / Land Cover in Gujarat (2015-2016), the dominant land use in the Vadodara district is Agricultural land (refer **Table 5-3*).*** The current land use of the Vadodara City majorly falls under Agricultural crop land category and fallow land (***refer*** **Figure 5-4**. About 200 hectares of area within the district falls under urban built-up category. As observed during site visit, the site area and vicinity are categorized as agricultural, settlements and open scrub land. Land use map showing the land use pattern of the Project study area has been presented in **Figure 5-5**.

Table 5-3 District and category wise distribution of Land Use / Land Cover in Vadodara (2015-2016)

LU Category (Level 1)	LU Category (Level 2)	Area (in Hectares)
Agriculture	Crop land	5,407.08
	Fallow	507.15
Barren/unculturable/ Wastelands	Plantation	2.24
	Gullied / Ravinous Land	52.09
	Salt Affected Land	1.54
	Scrub Land	373.81
Built-up	Mining	12.94
	Rural	140.70
	Urban	191.95
Forest	Deciduous	452.89
	Scrub Forest	310.77
Wetlands / Water Bodies	Inland Wetland	0.63
	Coastal Wetland	0.05
	River/Stream/Canals	250.15
	Water bodies	90.03

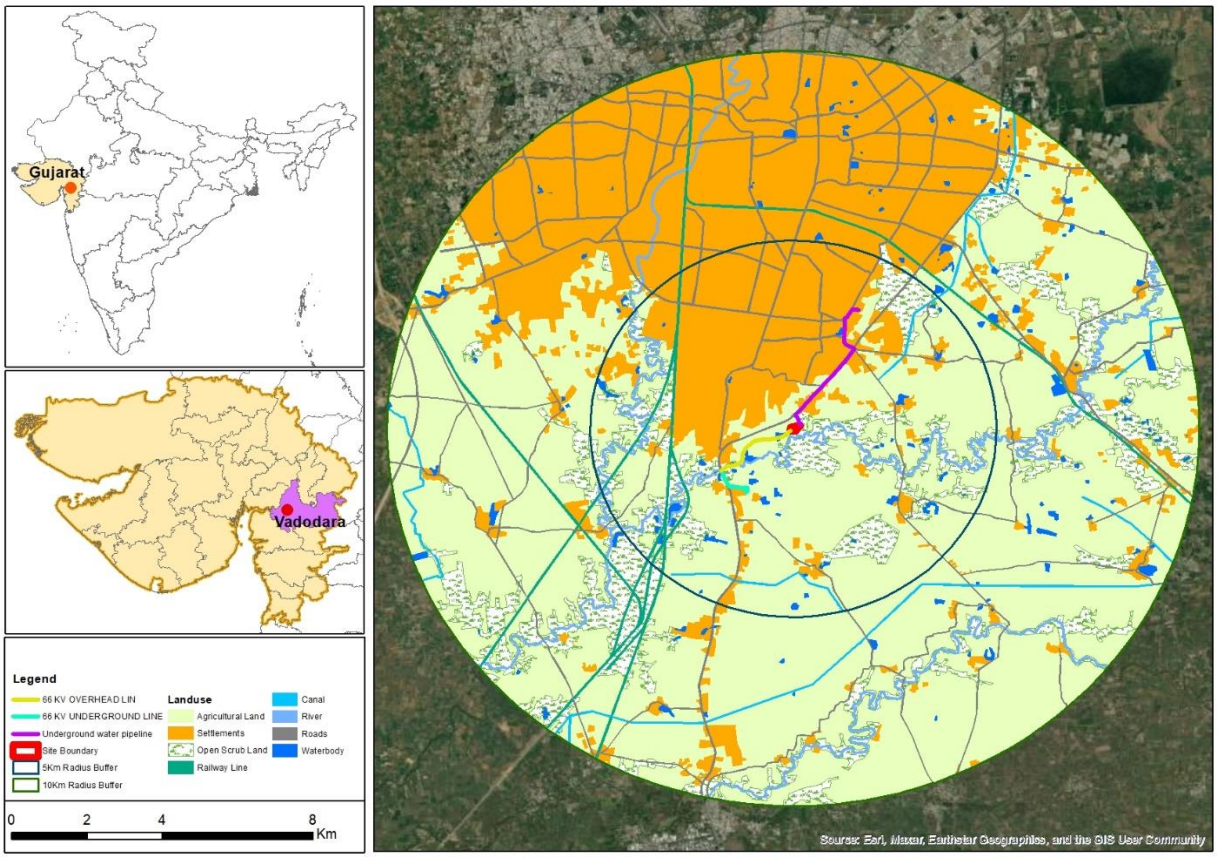
Source: District and category wise distribution of Land Use/Land Cover in Gujarat (2015-2016)

Figure 5-4 Land Use Pattern for the district



Source: Bhuvan Indian Geo Platform of ISRO

Figure 5-5 Land use Pattern of the Project Study Area



Source: Developed by E&S Advisor

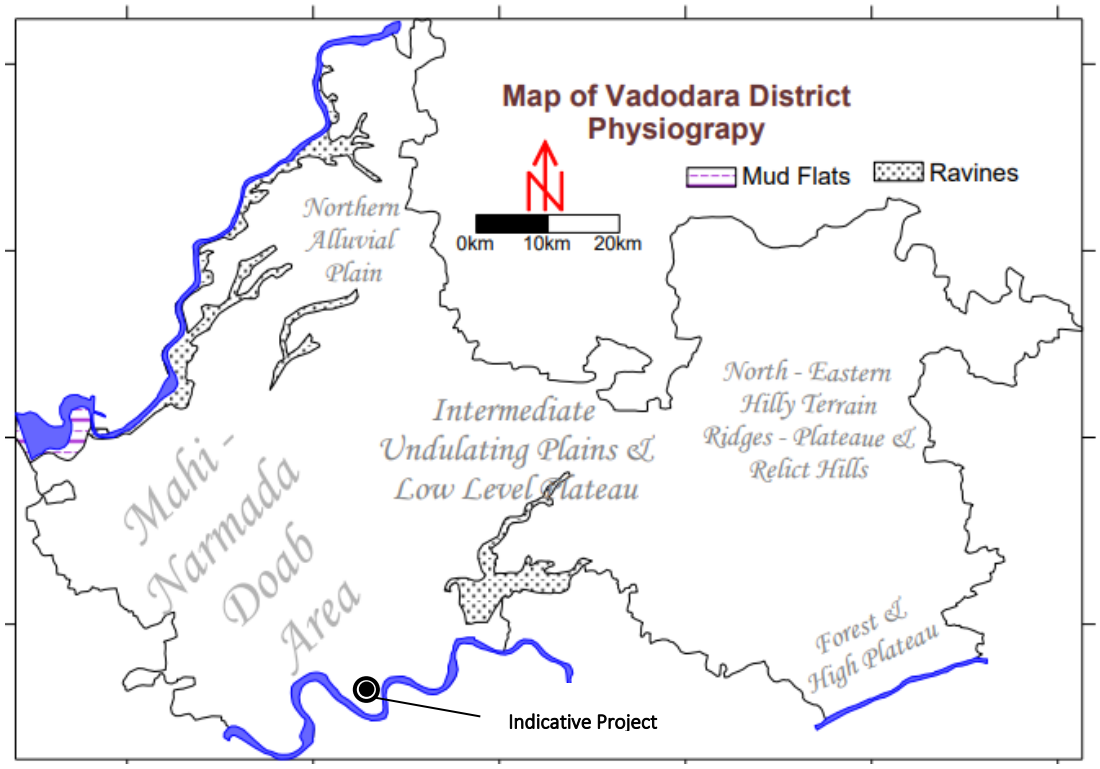
5.3.4 Topography

According to Groundwater scenario for Vadodara district 2021 in CGWB, Vadodara district lies on the banks of the Vishwamitri river and is characterized by diverse topography. Vadodara district forms a part of the great Gujarat plain.

- The eastern portion of the district comprising the Chhota Udepur, the Kavant, the Jambughoda and the Naswadi taluka is hilly terrain with several ridges, plateaus and isolated relict hills have elevation in range of 150 to 481 m amsl.
- The southeastern plateau has the highest peaks of the district – Amba Dungar & Mandai Dongar 637 m amsl.
- The rest of the district, the western & southern part, comprising of Mahi & Narmada Doab, is a level plain with gentle undulating terrain have elevation in range of 120 to 20 m (where the proposed project site lies).

Vadodara district forms a part of the great Gujarat plain. The overall elevation ranges from 610m in east to 20 m amsl in south-west. Most of the western part, comprising of Mahi – Narmada Doab and northern alluvial plain is level terrain. There are some linear tracts, along Mahi, Viswamitre, Dhadahar and Orsang rivers, have ravine landforms, with typical head ward erosional featured gully formation in soft alluvium. The banks of the Mahi have high vertical cliff, 10 to 25 m height, generally on left bank; same way left bank of the Narmada also has high cliff of 10 to 20 m.

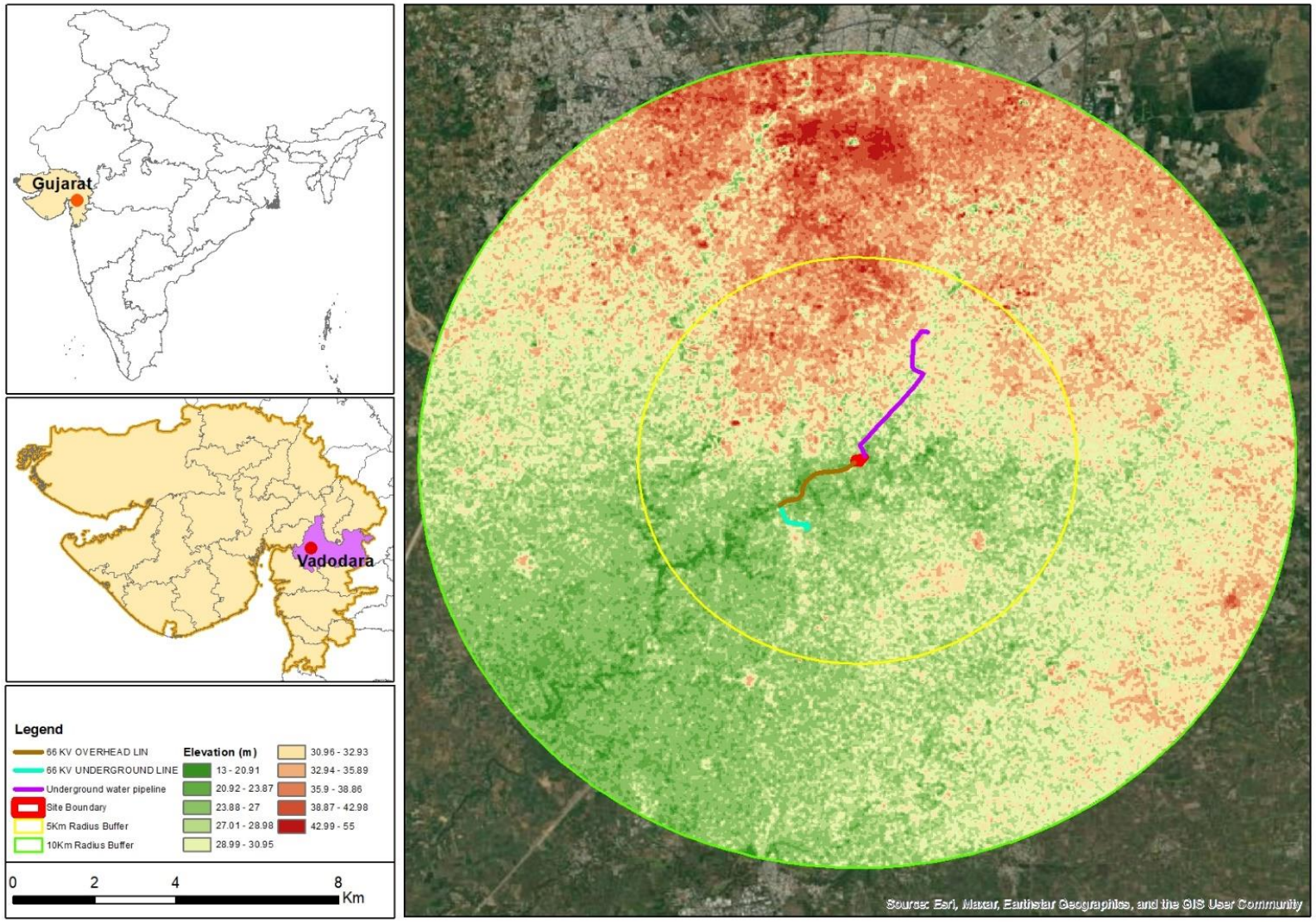
Figure 5-6 Physiographic map of Vadodara District



Source: District Ground Water Brochure: Vadodara

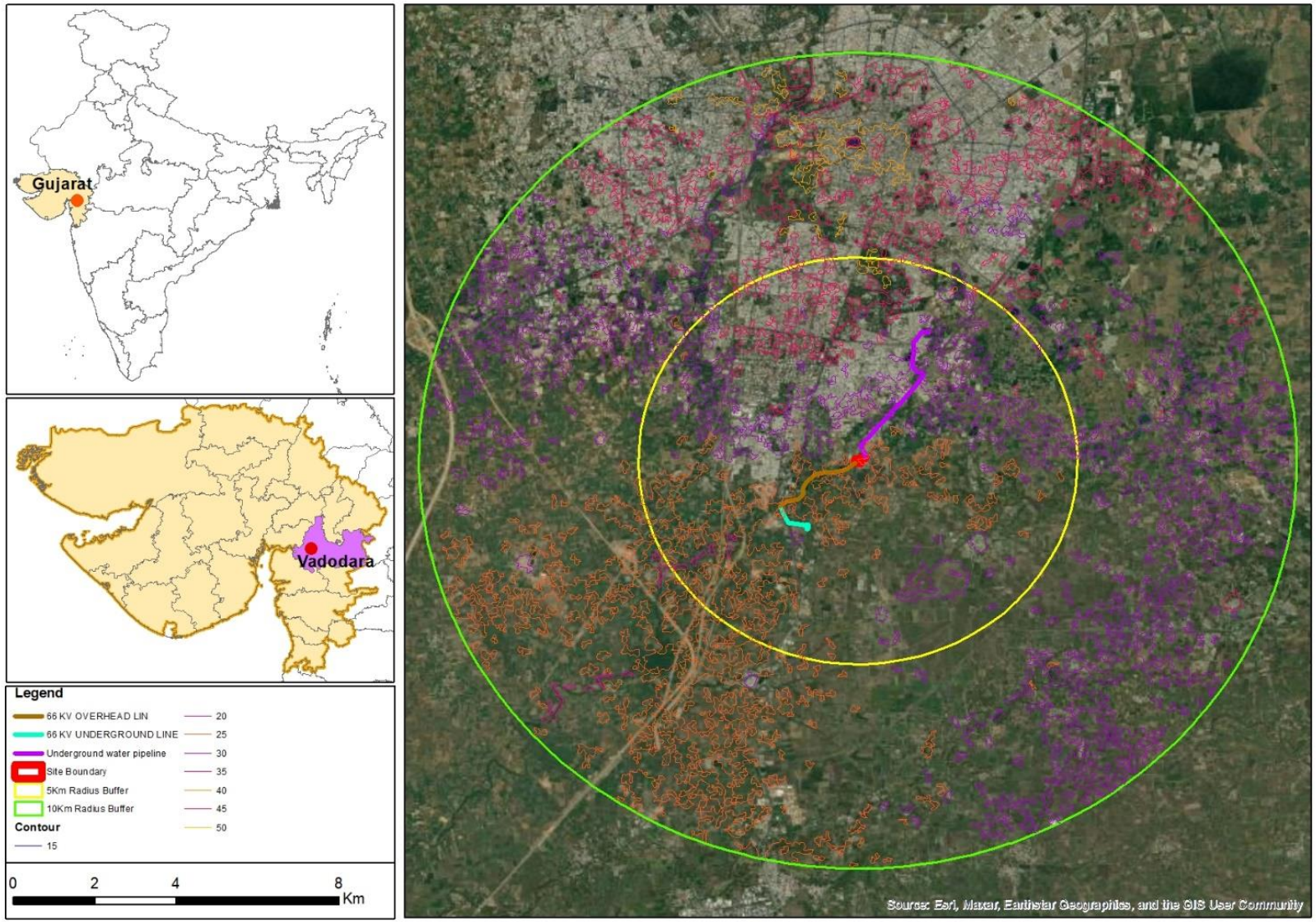
Based on satellite imagery dated 11.04.2022 and site visit, it was observed that the project site is located at an elevation of 20-27m above mean sea level with almost flat surface. Analysis of digital elevation map presented in ***Figure*** below for Project shows a trend in elevations ranging from 20-32m amsl for the project components which is indicative of flat to undulating land in Project AoI. The below ***Figure 5-8***, shows the contour map which represents the elevation of the project area lies in l40m above mean sea level.

Figure 5-7 Digital Elevation Map of Study Area



Source: Developed by E&S Advisor

Figure 5-8 Contour Map of the Study area



Source: Developed by E&S Advisor

5.3.5 Geology and Geomorphology

Geology

According to CGWB report, the rocks in Vadodara district range in age from Proterozoic to recent, with the absence of Paleozoic rocks being a notable feature. The eastern and northeastern parts of the district contain the oldest rocks, which are part of the southwesterly extended Precambrian basement of Peninsular India. Overlying these basement rocks are Post Cretaceous sediments and significant volcanic rocks. The sediments can be found in scattered inliers, while the volcanic rocks, known as the Deccan trap, are well represented. The district also features Tertiary and Quaternary rocks, although the Tertiary records are not fully exposed or complete.

Table 5-4 Stratigraphic outline of the Vadodara District

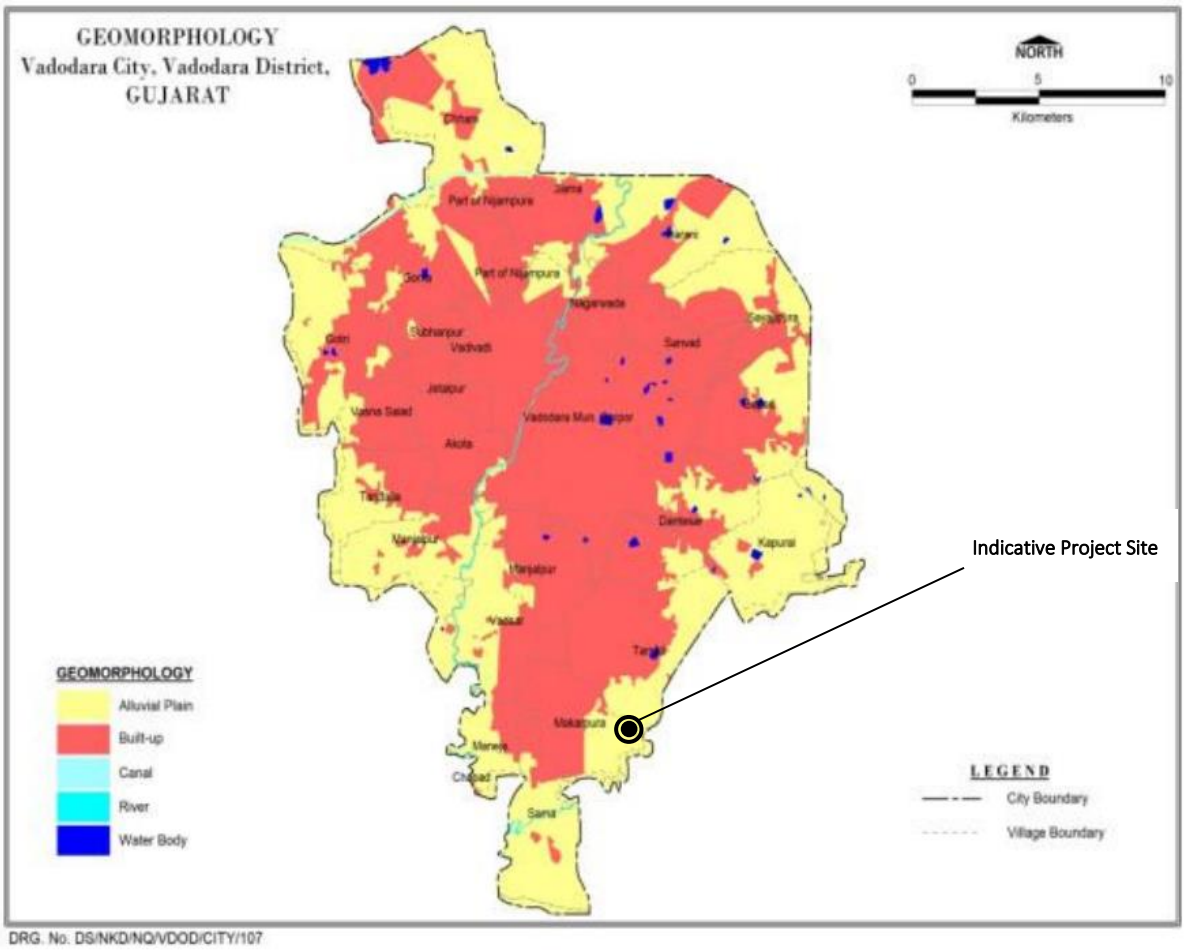
Continental sediments- – fluvio-marine, fluvial and aeolian Marine and fluvio-marine sediments	Quaternary Tertiary
Basalts of the Deccan Trap with associated differentiates and intrusive bodies	Upper Cretaceous to Lower Eocene
Marine, fluvio-marine and fluvial sediments	Cretaceous
Crystalline rocks -Metasediments associated with granite, igneiss, and other mafic rocks	Precambrian (Aravalli)

Source: District Ground Water Brochure: Vadodara

Geomorphology

Vadodara district is in the Gujarat plain and exhibits diverse topography. The eastern part of the district, including Chhota Udepur, Kavant, Jambughoda, and Naswadi taluka, consists of hilly terrain with various ridges, plateaus, and isolated hills ranging in elevation from 150 to 481 meters above mean sea level (amsl). The southeastern plateau features the highest peaks in the district, Amba Dungar and Mandai Dongar, reaching 637 meters amsl. The remaining western and southern parts of the district, which encompass the Mahi and Narmada Doab, are characterized by a flat plain with gently undulating terrain, ranging in elevation from 120 to 20 meters amsl. The elevation across the district varies from 610 meters in the east to 20 meters amsl in the southwest. The western part, including the Mahi-Narmada Doab and the northern alluvial plain, is mostly level terrain with elevations ranging from 20 to 80 meters amsl. Certain areas along the Mahi, Viswamitre, Dhadahar, and Orsang rivers feature ravine landforms, characterized by erosional gully formations in soft alluvium. The banks of the Mahi and Narmada rivers have high vertical cliffs, reaching heights of 10 to 25 meters and 10 to 20 meters, respectively. These features, such as ravines, high cliffs along the riverbanks, and entrenched meandering courses, indicate a mature river stage and recent tectonic uplift in the Doab portion. As per the below ***Figure 5-9*** the project site lies in the alluvial plain .

Figure 5-9 Geomorphology Map of Vadodara District



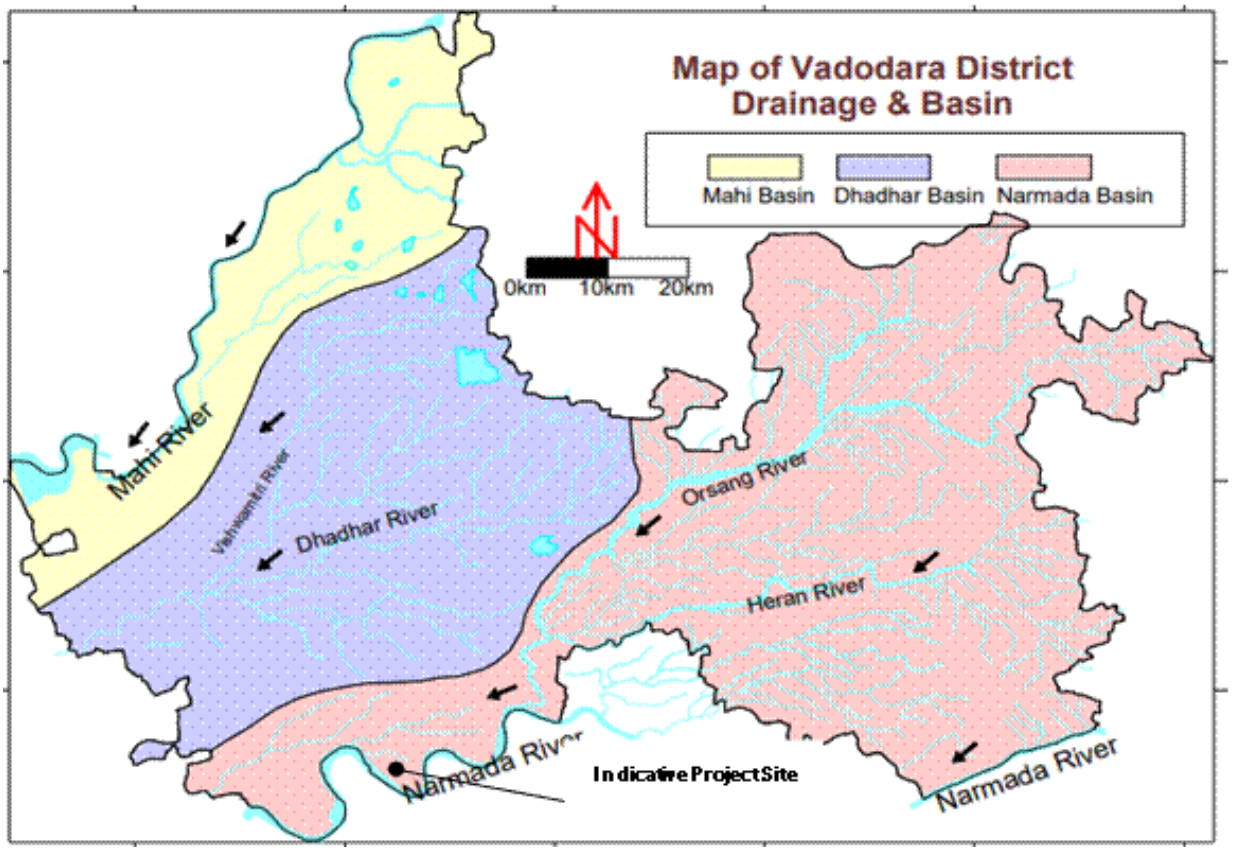
Source: CGWB Aquifer Mapping and Management Of Ground Water Resources Vadodara District

5.3.6 Water Resources

5.3.6.1 Surface Water

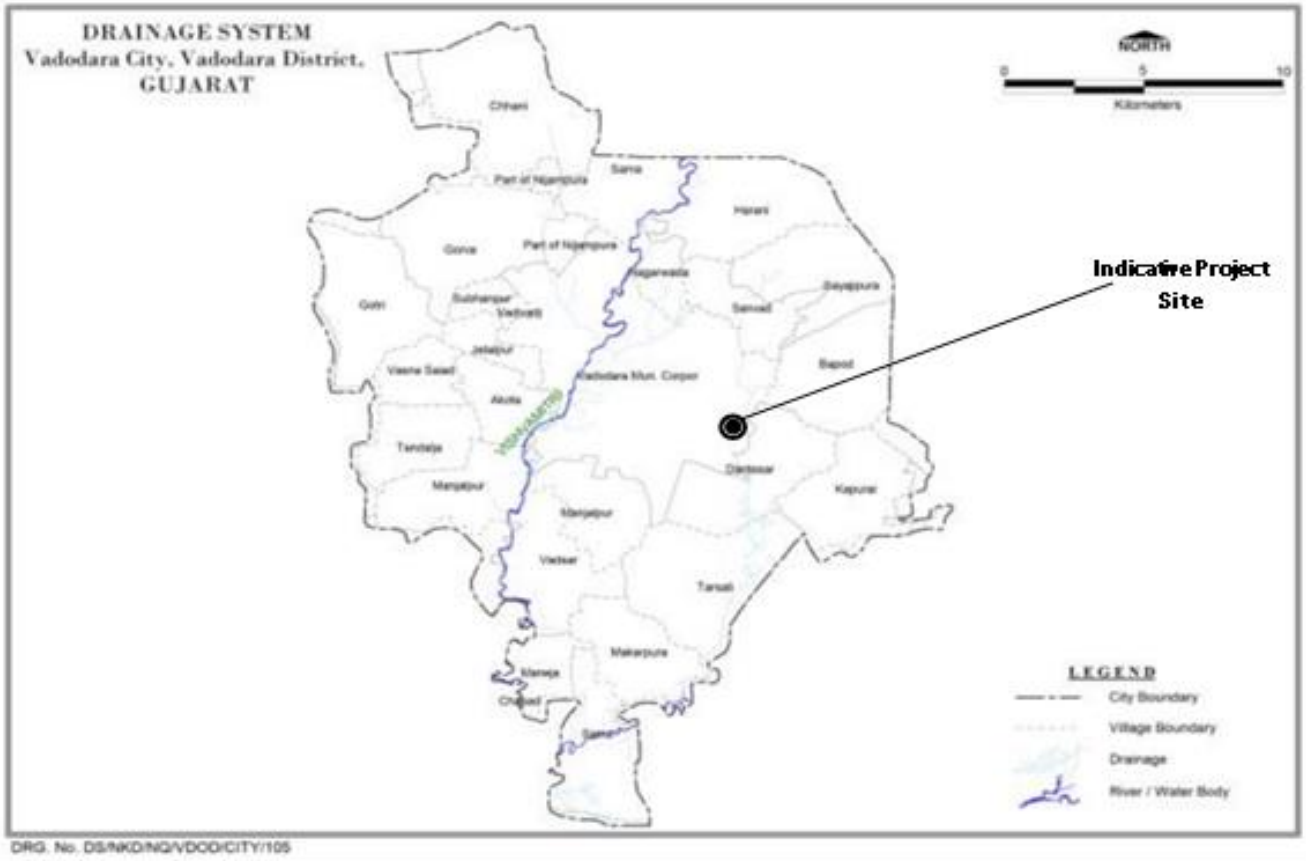
The district is divided into three river basins (***refer Figure 5-10).*** Narmada and Mahi are the main rivers of the district, flowing along the northwestern and southern boundaries, respectively. The Dhadhar basin is in the south-central part of the district, with small rivers like Mesari, Goma, and Karad as its tributaries. In the northwest part, the Mahi River has tributaries like Mesari, Goma, and Karad. In the central part, the Dhadhar basin consists of rivers like Jambuva, Surya, Viswamitre, and Dhadhar, which empty into the Gulf of Khambat. The eastern and southern regions of the district fall under the Narmada basin, encompassing rivers like Unch, Heran, Dev, Orsang, Karjan, Aswan, and Bhukhi, with the project site located in this area.

Figure 5-10 Vadodara District – Drainage and Basin



Source: Vadodara NAQUIM Report 2021

Figure 5-11 Drainage system of Vadodara City

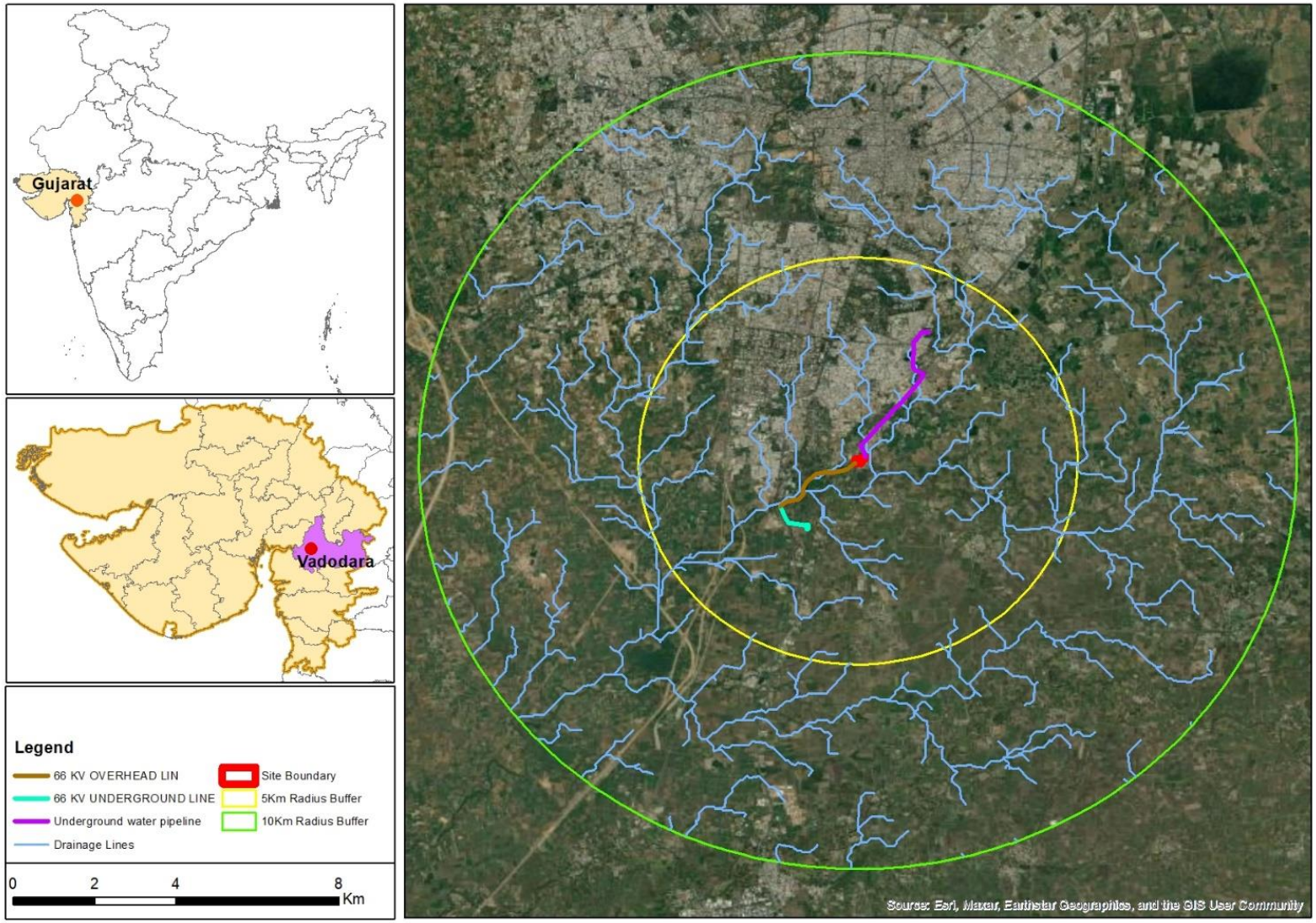


Source: CGWB Aquifer Mapping and Management Of Ground Water Resources Vadodara District

As a result of the Sardar Sarovar Dam's utilization of the Narmada River's water, a significant portion of the district has come under the jurisdiction of the Narmada Canal Command. To meet the substantial water requirements of Vadodara City and the nearby Strategic Industrial Units, surface water from the Kadana Dam is supplied via the Wanakbori Weir during the dry season. Apart from these primary sources, the Orsang and Heran rivers in the district continue to maintain some base flow until February or March, which is utilized for supplemental irrigation at specific locations along their paths. The drainage system of Vadodara City is shown in Figure 5-11

The below Figure 5-12 represents the drainage pattern of the proposed project area. Based on observations from drainage map below, there are multiple minor dendritic drainage channels passing through out the project area including the water pipeline as well as the Transmission line route .

Figure 5-12 Drainage Map of Study Area



Source: Developed by E&S Advisor

5.3.6.2 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 May 2023 to understand the surface water quality in the study area. One sample is taken of surface water was collected from tributary of Narmada river, i,e. vishwamitri River , other 2 samples are taken of small ponds surrounding the project site. The location of primary surface water sample has been presented in ***Figure 5-13*** and the results of the assessment has been presented in ***Table 5-5.*** Map showing monitoring locations has been presented in **Figure 5-2.**

Figure 5-13 Surface water test and monitoring conducted in Study Area

SW 1 Location

SW 2 Location

SW 3 Location

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

Sr. No.	Parameters	Unit	Surface Water Sample			Permissible Limit as per IS 2296 Inland surface Water class C	Testing Method
			SW 1	SW2	SW3		
Physical Parameters							
1.	Colour	Hazen	<5.0	<5.0	<5.0	300	APHA (23rd Edition) 2120B : 2017
2.	pH	None	7.79 at 25 deg C	8.03 at 25 deg C	8.01 at 25 deg C	6.5-8.5	APHA (23rd Edition) 4500 - H-B : 2017
3.	Turbidity	NTU	42	25	58	--	APHA (23rd Edition) 2130B : 2017
4.	Total Dissolved Solid (TDS)	mg/l	884	1650	342	1500 max	APHA (23rd Edition) 2540C : 2017
General Parameters							
5.	Calcium (Ca)	mg/l	53	52	34	--	APHA (23rd Edition) 3500 Ca B,2017_(O)
6.	Chloride (Cl)	mg/l	226	384	56	600	APHA (23rd Edition) 4500 - Cl B : 2017

Sr. No.	Parameters	Unit	Surface Water Sample			Permissible Limit as per IS 2296 Inland surface Water class C	Testing Method
			SW 1	SW2	SW3		
7.	Copper (Cu)	mg/l	<0.02	<0.02	<0.02	--	APHA (23rd Edition) 4500 - Cl B : 2017
8.	Fluoride (F)	mg/l	0.58	1.2	0.37	1.5	APHA (23rd Edition) 4500 - FC/ D: 2017
9.	Iron (Fe)	mg/l	3.6	2.1	3.4	50	APHA (23rd Edition) 3500 Fe B: 2017
10.	Magnesium (Mg)	mg/l	31	56	12	--	APHA (23rd Edition) 3500 Mg B,2017_(O)
11.	Manganese (Mn)	mg/l	<0.02	<0.02	<0.02	--	APHA (23rd Edition) 3120 B :2017
12.	Nitrate (NO_3)	mg/l	<0.5	23	1.4	50	APHA (23rd Edition) 4500 - NO3 - E : 2017
13.	Phenolic Compounds (C_6H_5OH)	mg/l	<0.001	<0.001	<0.001	--	APHA (23rd Edition) 5530C : 2017
14.	Sulphate ($SO_{4)}$	mg/l	51	64	14	400	APHA (23rd Edition) 4500 - SO42- E : 2017
15.	Total Alkalinity	mg/l	392	844	196	--	APHA (23rd Edition) 2320B 2017_(O)
16.	Total Hardness	mg/l	260	360	132	--	APHA (23rd Edition), 2340 C : 2017
Toxic Substances							
17.	Cadmium (Cd)	mg/l	<0.001	<0.001	<0.001	0.01	APHA (23rd Edition)3120B 2017_(O)
18.	Lead (Pb)	mg/l	<0.005	<0.005	<0.005	0.1	APHA (23rd Edition) 3120 B : 2017
19.	Mercury (Hg)	mg/l	<0.001	<0.001	<0.001	--	IS 3025 (Part 48): 1994
20.	Nickel (Ni)	mg/l	<0.02	<0.02	<0.005	--	APHA (23rd Edition) 3120 B : 2017
21.	Arsenic (As)	mg/l	<0.005	<0.005	<0.001	0.2	APHA (23rd Edition)3120B 2017 (ICP OES) _(O)
22.	Zinc (Zn)	mg/l	<0.02	<0.02	<0.02	15	APHA (23rd Edition) 3120 B : 2017
23.	Cobalt (Co)	mg/l	<0.05	<0.05	<0.05	---	APHA (23rd Edition)3120B 2017 (ICP OES) _(O)
24.	Total Suspended Solid (as TSS)	mg/l	96	58	52	--	APHA (23rd Edition) 2540D: 2017
25.	Temperature	Deg/C	25	25	25	---	APHA (23rd Edition), 2550B: APHA 23rd EDITION,2550 B_(O) 2017
26.	Conductivity	Us/cm	1499	2872	592	--	APHA (23rd Edition) 2510B: 2017

Sr. No.	Parameters	Unit	Surface Water Sample			Permissible Limit as per IS 2296 Inland surface Water class C	Testing Method
			SW 1	SW2	SW3		
27.	Biochemical Oxygen Demand (as BOD)	mg/l	21	14	8.8	3	APHA (23rd Edition) 5210B : 2017
28.	Chemical Oxygen Demand (COD)	mg/l	76	52	36	---	APHA (23rd Edition) 5220B : 2017
29.	Oil and Grease	mg/l	<5.0	<5.0	<5.0	0.1	APHA (23rd Edition) 5520B : 2017
30.	Salinity	None	0.90 In respect to KCl equivalent salinity 35	1.78 In respect to KCl equivalent salinity 35	0.34 In respect to KCl equivalent salinity 35	---	APHA (23rd Edition)2520B, 2017_(O)
31.	Phosphate (as PO4)	mg/l	6.6	<0.15	0.24	---	APHA (23rd Edition) 4500-P D, 2017_(O)
32.	DO	mg/l	5.7	6.1	6.3	4 minimum	APHA 23rd Ed. 2017-4500-OC/G_(O)
33.	Chromium as Cr	mg/l	<0.01	<0.01	<0.01	0.05	APHA (23rd Edition)3120B 2017 (ICP OES)_(O
Bacteriological Parameters							
34	Faecal coliform	MPN/100ml	7.9	13	7.8	--	APHA 23rd Edition 9221 B_(O)
35	Total coliform	MPN/100ml	21	27	14	5000	APHA 23rd Edition 9221 B_(O)

Source: Monitoring conducted by NABL accredited lab in May 2023

Represents value exceeding the permissible limit

5.3.6.2.1 Analysis of Surface Water Quality Monitoring

As per the results from above table, the parameters like Total Dissolved Solids (TDS) (1500 max), Chloride (600), Fluoride (1.5), Iron(50), Nitrate (50), Sulphate (400), Cadmium (0.01), Lead (0.1), Arsenic (0.2), Zinc (50) are found to be within the permissible limits as prescribed by IS 2296 Inland surface Water class C. But, however, the following parameters are found to be exceeding

- **Total Dissolved Solids (TDS):** The TDS level in SW1 (884 mg/l) and SW3 (342 mg/l) are within the permissible limit however SW2 (16500 mg/l) exceeds the permissible limit (1500 mg/l). This may be due to rapid urbanization, industrial growth around Vadodara City.
- **Dissolved oxygen:** DO level for SW1 (5.7 mg/l), SW2 (6.1 mg/l) and SW3 (6.3 mg/l) exceed permissible limits (4 mg/l). Dissolved oxygen is affected by both anthropogenic (human activities) and natural factors. Naturally, water conditions such as salinity and temperature, and too many aquatic organisms can affect DO levels. Humans also have an impact on DO levels in water from clearing land, runoff, and sewage waste.
- **Biochemical Oxygen Demand (BOD):** The BOD levels of SW1 (21 mg/l), SW2 (14 mg/l), SW3 (8.8 mg/l) are exceeding the permissible level (3 mg/l). The reason could be uncontrolled chemical wastes dumping nearby the industries, industrial effluent mixed with sewage and runoff water has arguably turned the local rivers into big sewer, which ultimately leads to contaminate the ground water after leaching.

5.3.6.3 Groundwater Resources

In Vadodara district, groundwater exists in both unconfined and confined conditions.

- Unconsolidated shallow alluvium, weathered zones, and fractured rocks form unconfined aquifers. The unconfined aquifers have a depth of occurrence ranging from 0 to 40 meters below ground level (mbgl).
- The confined aquifer (Confined Aquifer I) is found at depths between 51 to 83 mbgl. It is made of impervious clay horizons in alluvium formations and interflow zones of basalts, inter-trappean beds, and deep-seated fracture zones in basalts, granites (refer ***Table 5-6***).

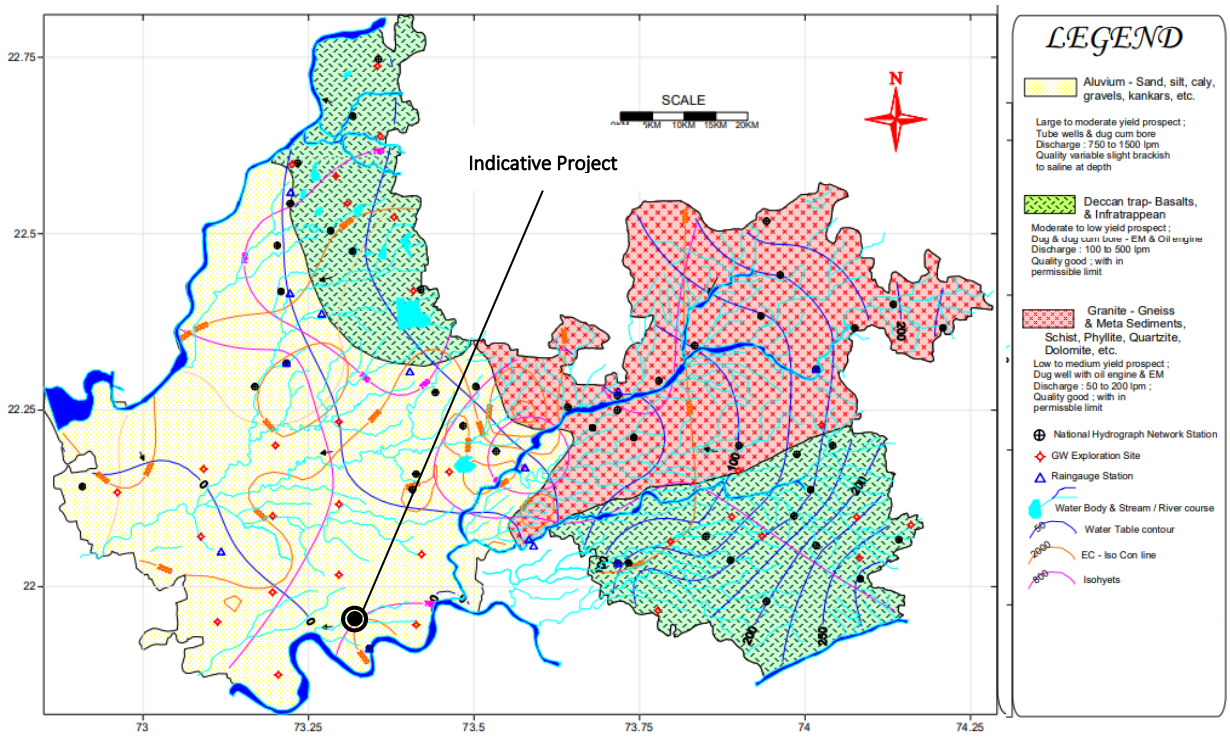
The northern and eastern parts of the district consist mainly of hard rocks such as phyllite, schist, granite, gneiss, basalt, and sediments like sandstone and limestone, which form aquifers. The central, south-central, and western areas have an aquifer system primarily composed of multi-layered alluvium deposits. Weathered basalts, granite, gneiss, and other deposits covered by soil, as well as valley fill and piedmont deposits, create potential aquifers near rivers and on vast undulating plains adjacent to hilly terrain. The principal aquifer system is the Quaternary Alluvium

Table 5-6 Aquifer Characterisation and Disposition

Stratigraphy	Formation	Aquifer Nomenclature	Nature of Aquifer	Depth of occurrence	Thickness	Water Level (mbgl)	Quality (TDS)	Discharge	Transmissivity
				Aquifer	Range	Range	Range	Range	Range
				(mbgl)	(m)	(mbgl)	mg/l	lps	m²/day
Quaternary	Alluvium	Unconfined Aquifer	Phreatic	0 to 40	35 to 40	5 to 28	392 to 4490	2 to 50	1.67 to 1067
		Confined Aquifer I	Confined	51 to 83	10 to 20	5 to 35	360 to 5370	1.2 to 60	38 to 2665

Source: CGWB Aquifer Mapping and Management Of Ground Water Resources Vadodara District

Figure 5-14 Hydrogeological Map of Vadodara District



Source: NAQUIM Report

According to the NAQUIM report for Vadodara district, the project site has Alluvium soil with varied ground water extraction structures. Various types of dug wells (DW) are common to both alluvial / soft rock areas and in hard rock areas. According to the latest CGWD report for Vadodara in 2022, following are some highlights of ground water quality around project site:

- Both the phreatic and confined aquifers are considered potable and suitable for domestic use, drinking, irrigation, and other industrial purposes.

In the central part of Mahi-Narmada Doab, where the thickness of alluvium is limited (14-40 meters) and underlain by Tertiary sediments, the groundwater quality exhibits relatively high electrical conductivity (more than 3000 µS/cm). This refers to the quality of shallow water in that area.

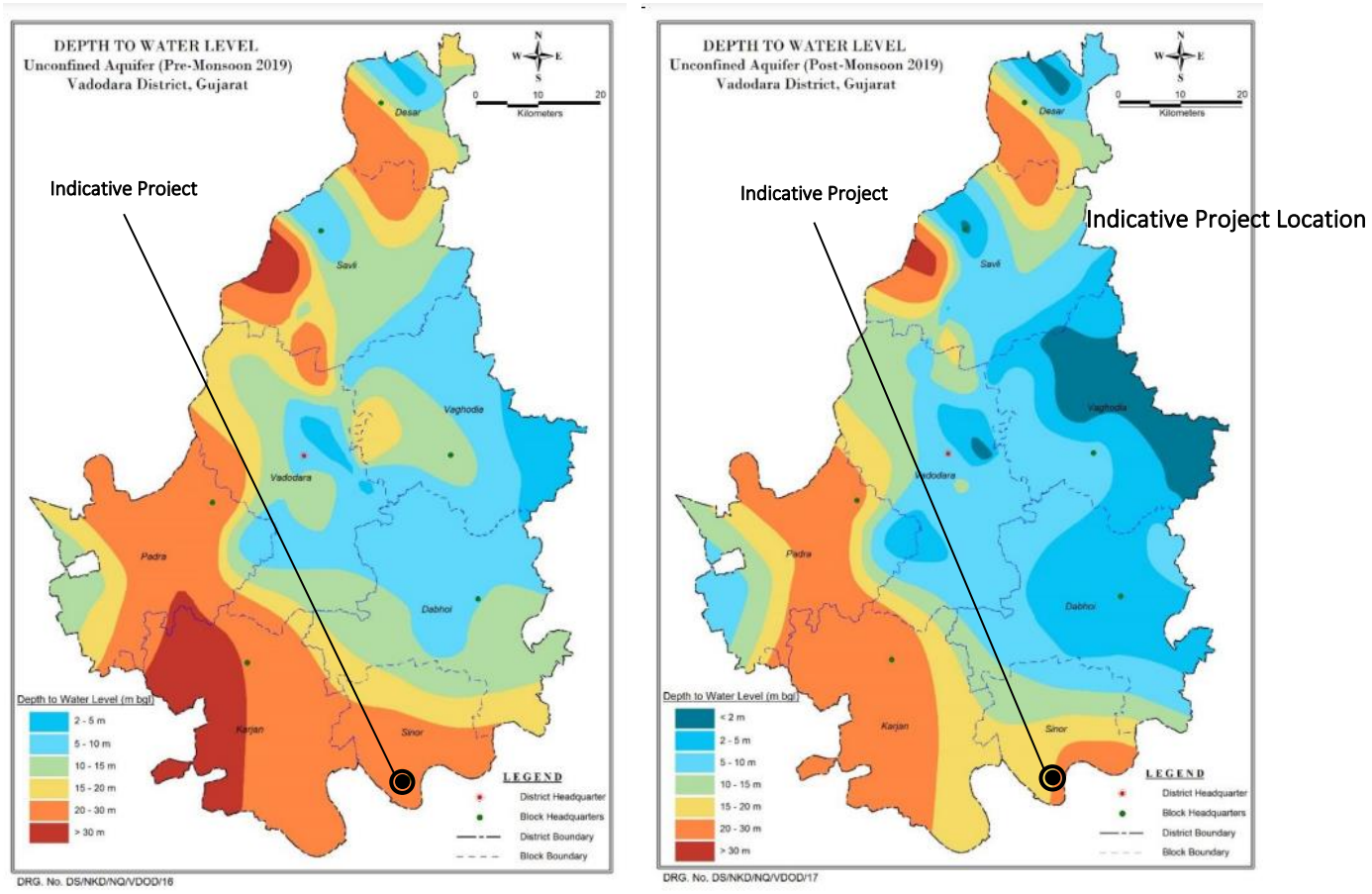
According to the below ***Table 5-7*** presented below, the stage of ground water development for the project taluka at year 2017, is 78.11 % and have been categorized as ***Semi-critical***, based on the stages of ground water development and the long-term trend of pre and post monsoon ground water levels.

Table 5-7 Taluka Wise Ground Water Resources, Availability, Utilization and Stage of Ground Water Development (2017) District: Vadodara

Assessment Unit Name	Total Ground Water Recharge (Ham)	Total Natural Discharges	Annual Extractable Ground Water Recharge (Ham)	Current Annual Ground Water Extraction (Ham)	Net Ground Water Availability for future use	Stage of Ground Water Extraction (%)	Categorization
Vadodara	16354.06	817.70	15536.36	12136.00	4378.36	78.11	Semi critical

Source: NAQUIM Report -2022

Figure 5-15 Depth to Water Level for Unconfined Aquifer (Pre and Post Monsoon 2019)



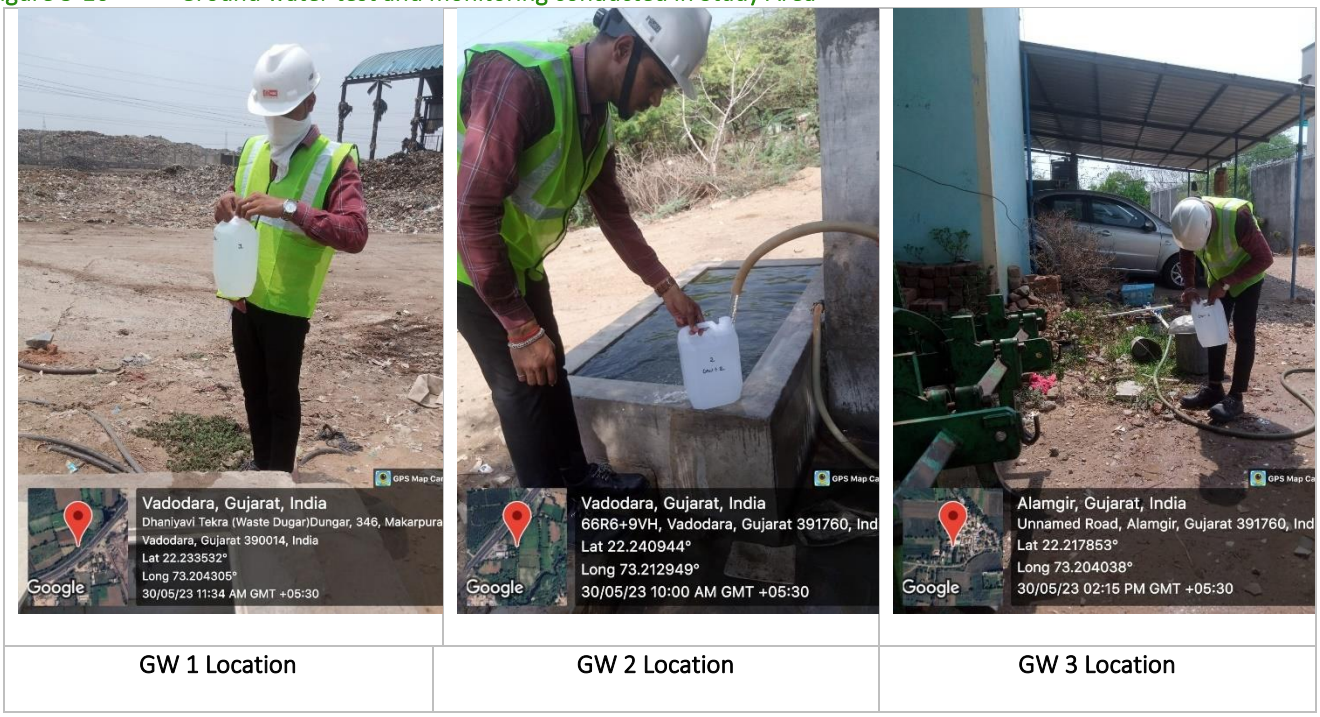
Source: NAQUIM Report -2022

According to the above Figure 5-15, the project site lies in region where the depth of water level for unconfined aquifer for Vadodara district during pre-monsoon was in between 20-30 m and between 15-20m during post monsoon in 2019.

5.3.6.4 Primary Groundwater Quality Assessment in Project Area

As part of the ESIA, groundwater quality assessment was conducted to understand the groundwater quality in the study area. Three 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). Map showing monitoring locations has been presented in ***Figure 5-2***, the results of the assessment has been presented in ***Table 5-8*** and The location of primary surface water sample has been presented in ***Figure 5-16.***

Figure 5-16 Ground water test and monitoring conducted in Study Area



GW 1 Location | GW 2 Location | GW 3 Location

Table 5-8 Results of Primary Groundwater Quality

Sr. No.	Parameters	Unit	Ground Water Sample			Desirable Limit	Permissible Limit	Standard limits as per WHO guidelines (mg/L)	Test Method
			GW 1	GW2	GW3				
Physical Parameters									
1.	Colour	Hazen	1.0	1.0	1.0	5	15	No visible colour	3025 (Part 4)-1983; Rffm:2002
2.	Odor	None	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	--	3025 (Part 5)-1983; Rffm:2002
3.	pH	None	6.90	6.92	6.99	6.5-8.5	No Relaxation	--	3025 (Part 11)-1983; Rffm:2002
4.	Turbidity	NTU	1.0	1.0	1.0	1	5	--	IS 3025 (Part 10)-1984 Rffm:2012
5.	Total Dissolved Solid (TDS)	mg/l	140	130	138	500	2000	--	IS 3025 (Part 16) : 1984
General Parameters									

Sr. No.	Parameters	Unit	Ground Water Sample			Desirable Limit	Permissible Limit	Standard limits as per WHO guidelines (mg/L)	Test Method
			GW 1	GW2	GW3				
6.	Aluminum (Al)	mg/l	0.01	0.01	0.01	0.03	0.2		IS 3025 (Part 2) :2004
7.	Ammonia (N)	mg/l	0.1	0.1	0.1	0.5	No Relaxation	1.5	IS 3025 (Part 34): 1988
8.	Anionic Detergent	mg/l	0.05	0.05	0.05	0.2	1		IS 13428 (ANNEX _ K): 2005
9.	Boron (B)	mg/l	0.3	0.3	0.3	0.5	1.0	0.5	IS 3025 (Part 2) :2004
10.	Calcium (Ca)	mg/l	23.76	19.80	19.80	75	200	--	IS 3025 (Part 40) : 1991
11.	Chloramines (Cl2)	mg/l	0.1	0.1	0.1	4	No Relaxation	0.5-1.5	IS 3025 (Part 26) : 1986
12.	Chloride (Cl)	mg/l	29.29	29.39	34.29	250	1000	200-300	IS 3025 (Part 32) : 1988
13.	Copper (Cu)	mg/l	0.02	0.02	0.02	0.05	1.5	2.0	IS 3025 (Part 2) :2004
14.	Fluoride (F)	mg/l	0.2	0.28	0.26	1	1.5	1.5	IS 3025 (Part 60) : 2008
15.	Free Residual Chlorine	mg/l	0.1	0.1	0.1	0.2	1	--	IS 3025 (Part 26) : 1986
16.	Iron (Fe)	mg/l	0.05	0.08	0.05	0.3	No Relaxation	--	IS 3025 (Part 53) : 1988
17.	Magnesium (Mg)	mg/l	9.50	9.50	7.13	30	100	--	IS 3025 (Part 46) : 1994
18.	Manganese (Mn)	mg/l	0.02	0.02	0.02	0.1	0.3	0.4	IS 3025 (Part 2) :2004
19.	Mineral Oil	mg/l	0.5	0.5	0.5	0.5	No Relaxation	--	IS 3025 (Part 39) : 1991
20.	Nitrate (NO_3)	mg/l	0.87	0.86	0.91	45	No Relaxation	50	IS 3025 (Part 34) : 1988
21.	Phenolic Compounds (C_6H_5OH)	mg/l	0.001	0.001	0.001	0.001	0.002	--	IS 3025 (Part 43) : 1992
22.	Selenium (Se)	mg/l	0.005	0.005	0.005	0.01	No Relaxation	0.01	IS 3025 (Part 2) :2004
23.	Silver (Ag)	mg/l	0.005	0.005	0.005	0.1	No Relaxation	--	IS 3025 (Part 2) :2004
24.	Sulphate ($SO_{4)}$	mg/l	1.0	2.86	2.36	200	400	--	IS 3025 (Part 24) : 1986
25.	Hydrogen Sulphide (H_2S)	mg/l	0.02	0.02	0.02	0.05	No Relaxation	--	IS 3025 (Part 29) : 1986
26.	Total Alkalinity	mg/l	71.4	61.2	71.4	200	600	--	IS 3025 (Part 23) : 1986
27.	Total Hardness	mg/l	99	89.10	79.20	200	600	--	IS 3025 (Part 21) :2009
28.	Zinc (Zn)	mg/l	0.02	0.02	0.02	5	15	--	IS 3025 (Part 2) :2004

Sr. No.	Parameters	Unit	Ground Water Sample			Desirable Limit	Permissible Limit	Standard limits as per WHO guidelines (mg/L)	Test Method
			GW 1	GW2	GW3				
Toxic Substances									
29.	Cadmium (Cd)	mg/l	0.001	0.001	0.001	0.003	No Relaxation	0.003	IS 3025 (Part 2) : 2004
30.	Cyanide (CN)	mg/l	0.01	0.01	0.01	0.05	No Relaxation	0.07	IS 3025 (Part 27) : 1986
31.	Lead (Pb)	mg/l	0.005	0.005	0.005	0.01	No Relaxation	0.01	IS 3025 (Part 2) :2004
32.	Mercury (Hg)	mg/l	0.002	0.002	0.002	0.001	No Relaxation	0.006	IS 3025 (Part 48) : 1994
33.	Molybdenum (Mo)	mg/l	0.05	0.05	0.05	0.07	No Relaxation	0.07	IS 3025 (Part 2) :2004
34.	Nickel (Ni)	mg/l	0.01	0.01	0.01	0.02	No Relaxation	0.07	IS 3025 (Part 2) :2004
35.	Polychlorinated Biphenyl (PCB)	mg/l	0.005	0.0005	0.005	0.0005	No Relaxation	--	USEPA 8082: 2007
36.	Polynuclear Aromatic Hydrocarbons (PAH)	mg/l	0.001	0.0001	0.001	0.0001	No Relaxation	--	APHA (23rd Edition) 6440C:2017
37.	Arsenic (As)	mg/l	0.005	0.005	0.005	0.01	0.05	0.01	IS 3025 (Part 2) :2004
38.	Total Chromium (Cr)	mg/l	0.01	0.01	0.01	0.05	No Relaxation	0.05	IS 3025 (Part 2) :2004
Trihalomethanes									
39.	Bromoform	mg/l	0.01	0.01	0.01	0.1	No Relaxation	0.1	APHA (23rd Edition) 6232 B:2017
40.	Dibromochloromethane	mg/l	0.01	0.01	0.01	0.1	No Relaxation	--	APHA (23rd Edition) 6232 B: 2017
41.	Bromodichloromethane	mg/l	0.01	0.01	0.01	0.06	No Relaxation	0.06	APHA (23rd Edition) 6232 B: 2017
42.	Chloroform	mg/l	0.01	0.01	0.01	0.2	No Relaxation	0.3	APHA (23rd Edition) 6232 B: 2017
Pesticides Residues									
43.	Alachlor	µg/l	0.02	0.02	0.02	20	20		USEPA 525.2
44.	Atrazine	µg/l	0.02	0.02	0.02	2	2		USEPA 8141A: 2007
45.	Aldrin	µg/l	0.01	0.01	0.01	0.03	0.03		AOAC (21st edition), 990.06: 2019
46.	Dieldrin	µg/l	0.01	0.01	0.01	0.03	0.03	--	AOAC (21st edition), 990.06: 2019

Sr. No.	Parameters	Unit	Ground Water Sample			Desirable Limit	Permissible Limit	Standard limits as per WHO guidelines (mg/L)	Test Method
			GW 1	GW2	GW3				
47.	Alpha-HCH	µg/l	0.01	0.01	0.01	0.01	0.01	0.002	AOAC (21st edition), 990.06: 2019
48.	Beta-HCH	µg/l	0.01	0.01	0.01	0.04	0.04	0.00003	AOAC (21st edition), 990.06: 2019
49.	Butachlor	µg/l	0.02	0.02	0.02	125	125	0.00003	USEPA 8141AOAC (21st edition), 990.06: 2019A: 2007
50.	Chlorpyrifos	µg/l	0.02	0.02	0.02	30	30	--	USEPA 8141 A
51.	Delta-HCH	µg/l	0.01	0.01	0.01	0.04	0.04	--	AOAC (21st edition), 990.06: 2019
52.	2,4-Dichlorophenoxyacetic acid	µg/l	0.01	0.01	0.01	30	30	--	USEPA 515: 1981
53.	o,p-DDT	µg/l	0.01	0.01	0.01	1	1	0.03	AOAC (21st edition), 990.06: 2019
54.	p,p-DDT	µg/l	0.01	0.01	0.01	1	1	--	AOAC (21st edition), 990.06: 2019
55.	o,p-DDE	µg/l	0.01	0.01	0.01	1	1	0.03	AOAC (21st edition), 990.06: 2019
56.	p,p-DDE	µg/l	0.01	0.01	0.01	1	1	0.01	AOAC (21st edition), 990.06: 2019
57.	o,p-DDD	µg/l	0.01	0.01	0.01	1	1	0.01	AOAC (21st edition), 990.06: 2019
58.	p,p-DDD	µg/l	0.01	0.01	0.01	1	1	0.01	AOAC (21st edition), 990.06: 2019
59.	Alpha -endosulfan	µg/l	0.01	0.01	0.01	0.4	0.4	0.01	AOAC (21st edition), 990.06: 2019
60.	Beta-Endosulfan	µg/l	0.01	0.01	0.01	0.4	0.4	0.01	AOAC (21st edition), 990.06: 2019
61.	Endosulfan sulfate	µg/l	0.01	0.01	0.01	0.4	0.4	0.01	AOAC (21st edition), 990.06: 2019
62.	Ethion	µg/l	0.02	0.02	0.02	3	3	--	US EPA 8141A: 2007
63.	Gama-HCH(Lindane)	µg/l	0.01	0.01	0.01	2	2	--	AOAC (21st edition), 990.06: 2019

Sr. No.	Parameters	Unit	Ground Water Sample			Desirable Limit	Permissible Limit	Standard limits as per WHO guidelines (mg/L)	Test Method
			GW 1	GW2	GW3				
64.	Isoproturon	µg/l	0.02	0.02	0.02	9	9	--	USEPA 532: 2000
65.	Malathion	µg/l	0.02	0.02	0.02	190	190	--	USEPA 8141A: 2007
66.	Methyl parathion	µg/l	0.02	0.02	0.02	0.3	0.3	--	USEPA 8141A: 2007
67.	Monostrophes	µg/l	0.02	0.02	0.02	1	1	0.009	USEPA 8141A: 2007
68.	Phorate	µg/l	0.02	0.02	0.02	2	2	--	USEPA 8141A: 2007
Bacteriological Parameters									
69.	Total coliform bacteria	/100ml	Not Detected	Not Detected	Not Detected	Not Detectable	Absent	--	IS 15185:2016
70.	E.coli	/100ml	Not Detected	Not Detected	Not Detected	Not Detectable	Absent	--	IS 15185:2016

Source: NABL Accredited Lab

Represents value exceeding the desirable limit

Represents value exceeding the permissible limit

5.3.6.4.1 Analysis of Ground water Quality Results

As pe the above ***Table 5-8***, all the parameter for Groundwater samples is within the permissible, desirable limit and WHO Guidelines.

5.3.6.4.2 ESA Phase II Ground water quality Results

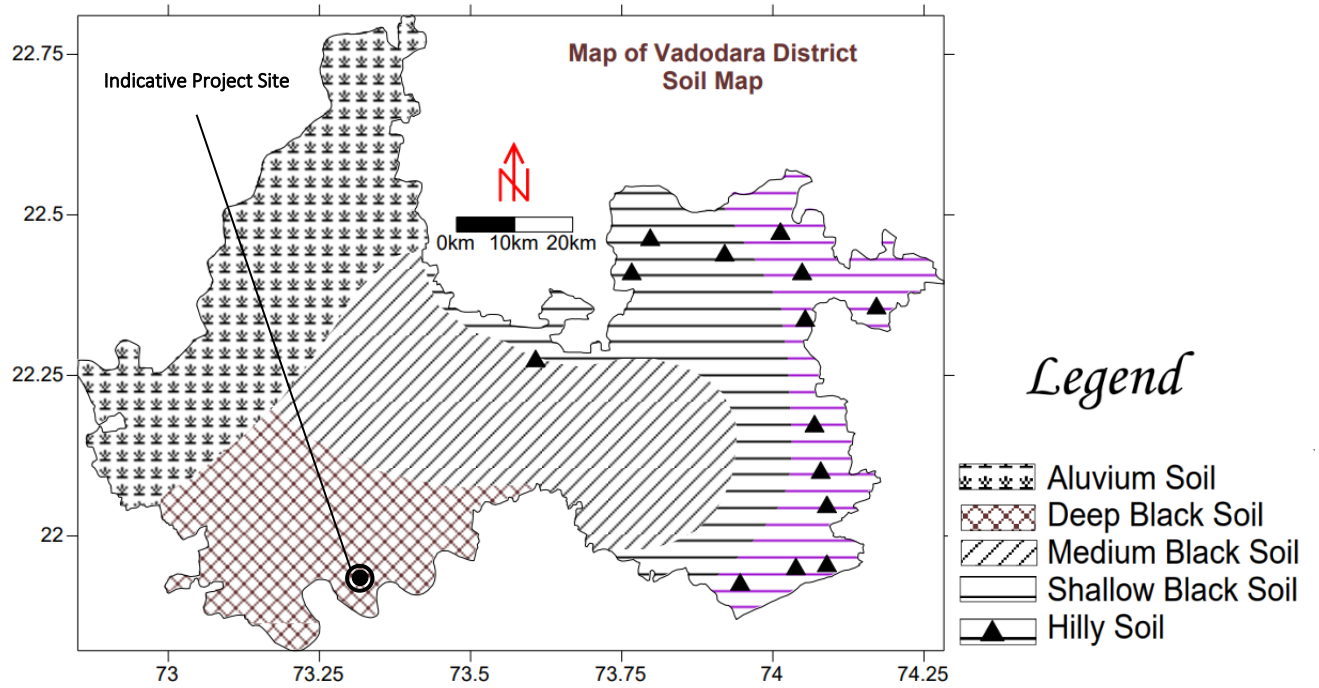
ESA Phase II assessment (undertaken separately) for ground water was undertaken for the facility for which groundwater samples across the Site were undertaken to assess the ground water quality as well as groundwater flow direction.

As per the Phase II report, as per the analytical results of groundwater samples, collected during the current investigation Copper was reported in concentration exceeding the Dutch Intervention Values (DIVs) standards. In addition, Lead/Nickel exceeds MOEF (Indian standards for drinking water) and Arsenic exceeds the USEPA RSLs. The presence of heavy metal in groundwater samples exceeding LOR may be attributed to natural reason that's geogenic. Based on secondary literature heavy metals can be geologically present with in soil formation and geogenic concentrations in soil can leach into shallow groundwater.
The Site was historically used for dumping municipal non-hazardous waste (mostly food & domestic waste). Groundwater level is below 25m; hence it is unlikely that groundwater will be contaminated based on past practices. It may be concluded, based on field visual observation and laboratory analytical results that groundwater at site is currently not impacted adversely due to past or current practices at site. However, we recommend that the facility should conduct one more round of groundwater investigation for analyzing all 13 priority metals and VOCs/SVOCs.

5.3.7 Soil Type

The soils of Vadodara district can be broadly classified into five groups. They are Alluvium Soil, Deep Black soil, shallow black soil, medium black soil and hilly soil. The project site lies in the region which has got deep black soil (***refer Figure 5.17***).

Figure 5-17 Soil Texture of the Vadodara District



Source: District ground water brochure (Vadodara)

5.3.7.1 Soil Quality Assessment

Soil characteristics within the study area, especially the physical quality and fertility of the soil have been characterized by analyzing soil samples collected from three (03) locations under the supervision of a NABL accredited Lab in May 2023. Soil sampling locations are shown in ***Table 5-1***. Soil analysis and results have been presented in ***Figure 5-18.*** Map showing monitoring locations has been presented in ***Figure 5-2.*** The results of the soil samples are presented in ***Table 5-9.***

Figure 5-18 Soil test and monitoring conducted in Study Area

S 1 Location

S 2 Location

S3 Location

Source: Monitoring conducted by NABL accredited lab in May 2023

Table 5-9 Results of Soil Sampling in Study Area

Sr no	Parameter	Unit	Method	Values for S1 Location	Values for S2 Location	Values for S3 Location
1	Arsenic (as As)	mg/kg	EPA 6010D_(O)	<0.25	<1.25	<0.25
2	Bulk Density	g/cc	IS 2720(Part 29) 1975 RA 2015_(O)	1.19	1.17	1.34
3	Cadmium (as Cd)	mg/kg	EPA 6010D_(O)	<2.0	<2.0	<2.0
4	Chloride (as Cl)	mg/kg	TPM/MSK/P&E/1/10_(O)	160	100	110
5	Clay	%	TPM/MSK/P&E/1/36A_(O)	24	49	15
6	Conductivity	Micro S/cm	IS 14767:2000,RA 2016_(O)	1241 (1:2) at 25 deg C	352 (1:2) at 25 deg C	439(1:2) at 25 deg C
7	Copper (as Cu)	mg/kg	EPA 6010 D (ICP-OES)	39	40	27
8	Heavy metals	mg/kg	TPM/MSK/P&E/3/60_(O)	16682	21894	18287
9	Lead (as Pb)	mg/kg	EPA 6010D_(O)	6.9	4.5	5.2
10	Mercury (as Hg)	mg/kg	USEPA 245.5	<0.1	<0.1	<0.1
11	Moisture	%	TPM/MSK/P&E/1/17_(O)	34	41	24
12	Nickel (as Ni)	mg/kg	EPA 6010 D (ICP-OES)	23	27	22
13	Organic Matter	%	IS 2720 (Part 22): 1972	0.75	1.7	0.51
14	Particle Size Distribution	%	TPM/MSK/P&E/1/36A_(O)	Sand : 48% Silt: 28% Clay 24%	Sand:36% Silt:15% Clay:49%	Sand:64% Silt: 21% Clay: 15%
15	Sand	%	TPM/MSK/P&E/1/36A_(O)	48	36	64
16	Silt	%	TPM/MSK/P&E/1/36A_(O)	28	15	21
17	Sulphate (as SO_4)	mg/kg	IS 2720 (Part 27) 1977,RA 2015_(O)	<15	<15	<15
18	Texture	None	TPM/MSK/P&E/1/36A, Issue date- April 02 Issue no-03: 2018	Loam	Clay	Sandy Loam
19	Total Chromium (as Cr)	mg/kg	EPA 6010D_(O)	26	36	29
20	Total Nitrogen (as N)	mg/kg	IS 14684 : 1999	683	1098	375
21	Total Petroleum Hydrocarbon (as TPH)	mg/kg	IS 3025 (Part 39)-1991 Rffm 2014_(O)	<1.0	<1.0	<1.0
22	Zinc (as Zn)	mg/kg	EPA 6010 D (ICP-OES)	50	45	44
23	pH Value	None	IS 2720 (Part 26) - 1987	8.19 (1:2.5) at 25 deg C	8.53 (1:2.5) at 25 deg C	8.93 (1:2.5) at 25 deg C

Source: Monitoring conducted by NABL accredited lab in May 2023

Table 5-10 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

S.No.	Soil Test Parameters	Classification
		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) (1 ppm = 640 mhos/cm)	Up to 1.00 Average 1.01-2.00 harmful to germination 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

5.3.7.1.1 Analysis of Soil Quality Monitoring

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

- ***pH:*** The pH value of the three soil samples were found to be 8.19 (S1), 8.53 (S2) and 8.93 (S3). As per the standard soil classification, S1 is moderately alkaline and S2 and S3 are strongly alkaline.
- ***Texture:*** The texture of all the soil samples were found to be loam, clay and sandy loam in nature.
- ***Electrical Conductivity (EC):*** EC is used to estimate the concentration of nutrients in soil. The electrical conductivity of S1, S2 and S2 was found to be 1241 µs/cm, 352 µs/cm and 439 µs/cm respectively. This indicates low concentration of nutrients in the soil whereas the value of S1 indicates the harmful nature for germination.
- ***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. The concentration of copper in the soil samples were found to be 39 mg/kg, 40 mg/kg and 27 mg/kg. The level of zinc in the soil samples were found to be 50 mg/kg (S1), 45 mg/kg (S3) and 44 mg/kg (S2) which indicated low level of micronutrients in soil.

Phase II ESA Results

- Among the eighteen (18) soil samples (including two QA/QC sample) that were collected and analysed from eight on-site locations, no analyte in any of the samples were reported in concentration exceeding the Dutch Intervention Values (DIVs) expect marginal copper exceedance at SBV07A (204.9mg/kg).Copper concentration is marginally exceeding the MOEF Guidance document for assessment and remediation of contaminated sites in India (screening and response levels) at SBV03B (155.3 mg/kg). Arsenic concentration is marginally exceeding USEPA RSLs across most of the Site with maximum value of 5.2 mg/kg however, arsenic levels are less than RMLs. Heavy metals (Arsenic, Barium, Beryllium, Cadmium, Chromium, Cobalt, Copper, Lead, Molybdenum, Mercury, Nickel, Antimony and Zinc), TPH (C10-C40) and Polyaromatic Hydrocarbon (Benz[a]anthracene, Benzo[a]pyrene, Chrysene, Fluoranthene, Pyrene and Phenanthrene) exceeds the Limit of Detection (LOD). The presence of heavy metal in soil samples exceeding LOR may be attributed to natural reason that's geogenic and do not seem anthropogenic in nature. The TPH observed in soil exceeding the LOR maybe attributed due to oil spills of frequent truck and JCB movement inside the plant[30].

5.3.8 Ambient Air Quality

The Gujarat Pollution Control Board is actively monitoring ambient air quality in the state, including Vadodara, at 62 strategic locations as part of the Ambient Air Quality Monitoring program (AAQM) all over the state.***Table 5-11*** represents the collection of ambient air samples follows standard norms for monitoring ambient air quality. The parameters analysed during this process include sulphur dioxide (SO_2), nitrogen oxides (NOx), particulate matter with a diameter of 10 micrometres or less (PM_{10}), and particulate matter with a diameter of 2.5 micrometres or less ($PM_{2.5}$). The nearest monitoring site to the project site is Dandiya Bazar (about 8 km from project site), and the locations considered were within 15 km of the project site.

Table 5-11 Vadodara Air Quality Annual Average (From April-2017 To March-2018)

Name of location	Distance from Project Site (km)	PM_{10} µg/m3	$PM_{2.5}$ µg/m3	SO_2 µg/m3	NOx µg/m3
GPCB office	10.25 Km	97	33	16	22
Dandiya bazar	7.86 Km	117	39	17	24
Bapod	8.82 Km	105	36	18	24
Chhani	15.24 Km	109	39	16	22
Gotri	11.67 Km	107	36	18	25
National Ambient Air Standards (Annual)	--	**60**	**40**	**50**	**40**

Source: GPCB

Based on the ***Table 5-11*** provided above, the concentration of PM_{10} in the air exceeds the National Ambient Air Standards set by the Central Pollution Control Board (CPCB). This is mainly attributed to various factors such as the resuspension of road dust, emissions from vehicles and diesel generators (D.G. sets), construction activities, burning of fossil fuels in households, open burning of solid waste, transportation of building materials without proper covering, and emissions from

30

https://www.researchgate.net/publication/288602103_Study_of_some_heavy_metals_Arsenic_Cadmium_chromium_lead_and_mercury_in_the_ponds_water_of_Vadodara_Gujarat_state_India

https://www.worldwidejournals.com/paripex/recent_issues_pdf/2014/June/June_2014_1403953078__20.pdf

https://www.academia.edu/28485739/Heavy_Metal_Content_of_Foods_and_Health_Risk_Assessment_in_the_Study_Population_of_Vadodara

https://www.sciencedirect.com/science/article/abs/pii/S0147651311001266?via%3Dihub

brick kilns in the Vadodara area. These sources contribute to the elevated levels of PM_{10} in the local air quality. Also, Vadodara has been categorized as non-Attainment[31] city as per National Clean Air Program (NCAP)

5.3.8.1 Ambient Air Quality Monitoring

Existing ambient air quality of the study area was monitored. at four (04) locations twice a week for four weeks Air quality samples were collected by NABL accredited lab by installation of air quality monitoring device. under the supervision of E&S Advisor. The monitoring parameters, including Respirable Particulate Matter (RPM) i.e. PM_{10} (particulate matter of particle size less than 10 micrometers) and $PM_{2.5}$ (particulate matter of particle size less than 2.5 micrometers), Sulphur Dioxide (SO_2), Oxides of Nitrogen (NO_X) and Carbon Monoxide (CO), Cadmium, Lead, Mercury (Hg), Nickel (Ni), Arsenic (Ar), Hydrogen Fluoride (HF), Hydrochloric Acid (HCL) and Dioxin and Furan. All the parameters were monitored on 24 hourly bases, while CO was monitored on 8 hourly basis- twice a week for four weeks in the study area, except dioxin and furan which can twice in one week for 24 hours within the plant premises.

The locations of the ambient air quality monitoring has been presented in **Table 5-1** and results of the air quality monitoring has been presented in **Table 5-12** and ***Figure 5-19.*** Map showing monitoring locations has been presented in **Figure 5-2.**

Figure 5-19 Ambient Air Quality Monitoring conducted in Study Area

AAQ 1 Location

AAQ 2 Location

[31] Cities that have fallen short of the National Ambient Air Quality Standards (NAAQS) for over five years of 131 cities that have been covered under NCAP.

	
AAQ 3 Location	AAQ 4 Location

Source: Monitoring conducted by NABL accredited lab in May 2023

Table 5-12 Results of Ambient Air Quality Monitoring

S.N.	Date of Monitoring	Sample no	PM 10	PM 2.5	SO2	NOx	CO	Cadmium as Cd	Lead (Pb)	Mercury (Hg)	Nickel (as Ni)	Arsenic as As	Hydrogen fluoride (HF)	Hydrochloric Acid (HCl)
AAQ-1	18.05.2023 to 19.05.2023	Sample 1	50.0	29.2	10.1	30.8	0.61	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.20
	23.05.2023 to 24.05.2023	Sample 2	54.2	27.5	8.9	26.6	0.61	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.18
	25.05.2023 to 26.05.2023	Sample 3	58.1	28.8	9.9	21.2	0.98	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.25
	30.05.2023 to 31.05.2023	Sample 4	83.2	47.9	8.8	23.5	0.93	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.30
	01.06.2023 to 02.06.2023	Sample 5	77.0	41.3	10.2	18.5	1.02	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.19
	06.06.2023 to 07.06.2023	Sample 6	79.0	35.0	9.6	34.5	0.93	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.21
	08.06.2023 to 09.06.2023	Sample 7	57.4	33.3	8.8	32.7	0.78	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.24
	13.06.2023 to 14.06.2023	Sample 8	54.4	31.3	7.6	26.6	1.05	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.20
	Values for AAQ-1	**Min**	**50.02**	**27.50**	**7.60**	**18.50**	**0.61**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.18**
		Max	**83.23**	**47.92**	**10.20**	**34.50**	**1.05**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.30**
		Average	**64.17**	**34.28**	**9.24**	**26.81**	**0.86**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.22**
		Percentile 98%	**82.64**	**46.99**	**10.19**	**34.25**	**1.05**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.29**

S.N.	Date of Monitoring	Sample no	PM 10	PM 2.5	SO2	NOx	CO	Cadmium as Cd	Lead (Pb)	Mercury (Hg)	Nickel (as Ni)	Arsenic as As	Hydrogen fluoride (HF)	Hydrochloric Acid (HCl)
AAQ-2	19.05.2023 to 20.05.2023	Sample 1	56.5	46.3	9.8	21.2	0.42	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.24
	22.05.2023 to 23.05.2023	Sample 2	84.5	37.5	9.8	20.8	0.59	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.20
	26.05.2023 to 27.05.2023	Sample 3	98.9	37.1	7.8	24.0	0.68	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.17
	29.05.2023 to 30.05.2023	Sample 4	68.3	22.1	8.6	35.0	0.66	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.22
	02.06.2023 to 03.06.2023	Sample 5	63.0	23.4	9.5	26.0	0.62	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.18
	05.06.2023 to 06.06.2023	Sample 6	52.5	22.9	<6.0	19.0	0.78	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.15
	09.06.2023 to 10.06.2023	Sample 7	67.1	38.3	9.8	32.0	0.86	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.31
	12.06.2023 to 13.06.2023	Sample 8	80.0	41.3	7.8	18.8	0.68	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.19
	Values for AAQ-2	**Min**	**52.49**	**22.09**	**7.80**	**18.80**	**0.42**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.15**
		Max	**98.87**	**46.26**	**9.80**	**35.00**	**0.86**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.31**
		Average	**71.35**	**33.61**	**9.01**	**24.60**	**0.66**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.21**
		Percentile 98%	**96.86**	**45.56**	**9.80**	**34.58**	**0.85**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.30**
AAQ-3	19.05.2023 to 20.05.2023	Sample 1	74.3	37.9	9.6	18.5	0.87	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.30

S.N.	Date of Monitoring	Sample no	PM 10	PM 2.5	SO2	NOx	CO	Cadmium as Cd	Lead (Pb)	Mercury (Hg)	Nickel (as Ni)	Arsenic as As	Hydrogen fluoride (HF)	Hydrochloric Acid (HCl)
	22.05.2023 to 23.05.2023	Sample 2	75.8	30.8	<6.0	21.5	0.75	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.20
	26.05.2023 to 27.05.2023	Sample 3	89.9	45.8	7.5	36.6	0.69	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.18
	29.05.2023 to 30.05.2023	Sample 4	54.7	21.3	6.8	32.2	0.85	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.24
	02.06.2023 to 03.06.2023	Sample 5	57.5	24.6	8.9	29.6	0.94	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.14
	05.06.2023 to 06.06.2023	Sample 6	58.4	27.9	9.5	34.5	0.58	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.19
	09.06.2023 to 10.06.2023	Sample 7	82.6	45.4	9.8	38.5	0.65	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.23
	12.06.2023 to 13.06.2023	Sample 8	98.1	40.0	<6.0	21.8	0.48	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.17
	Values for AAQ-3	**Min**	**54.69**	**21.25**	**6.80**	**18.50**	**0.48**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.14**
		Max	**98.08**	**45.85**	**9.80**	**38.50**	**0.94**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.30**
		Average	**73.91**	**34.23**	**8.68**	**29.15**	**0.73**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.21**
		Percentile 98%	**96.94**	**45.79**	**9.78**	**38.23**	**0.93**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.29**
AAQ-4	18.05.2023 to 19.05.2023	Sample 1	46.7	27.5	<6.0	19.9	0.75	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.20
	23.05.2023 to 24.05.2023	Sample 2	44.4	23.3	7.5	24.5	0.52	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.19

S.N.	Date of Monitoring	Sample no	PM 10	PM 2.5	SO2	NOx	CO	Cadmium as Cd	Lead (Pb)	Mercury (Hg)	Nickel (as Ni)	Arsenic as As	Hydrogen fluoride (HF)	Hydrochloric Acid (HCl)
	25.05.2023 to 26.05.2023	Sample 3	52.6	26.3	<6.0	28.5	0.65	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.19
	30.05.2023 to 31.05.2023	Sample 4	66.5	27.7	8.5	29.3	0.48	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.23
	01.06.2023 to 02.06.2023	Sample 5	58.0	23.4	9.4	31.2	0.52	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.18
	06.06.2023 to 07.06.2023	Sample 6	48.3	22.1	<6.0	34.5	0.39	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.23
	08.06.2023 to 09.06.2023	Sample 7	66.8	36.3	12.5	29.6	0.84	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.32
	13.06.2023 to 14.06.2023	Sample 8	78.1	35.0	13.3	37.5	0.58	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.15
	Values for AAQ-4	Min	44.40	22.09	7.50	19.90	0.39	0.00	0.00	0.00	0.00	0.00	0.00	0.15
		Max	78.10	36.26	13.30	37.50	0.84	0.00	0.00	0.00	0.00	0.00	0.00	0.32
		Average	57.69	27.69	10.24	29.38	0.59	0.00	0.00	0.00	0.00	0.00	0.00	0.21
		Percentile 98%	76.52	36.08	13.24	37.08	0.83	0.00	0.00	0.00	0.00	0.00	0.00	0.31
	--	NAAQS, Standards (24 hours)	100	60	80	80	02 (8 hours)	--	1	--	20 (Annual)	6 (Annual)	--	--
	--	WBG (24 hours)	150 (Interim target-1) 100 (Interim target-2)	75 (Interim target-1) 50 (Interim target-2)	125 (Interim target-1) 50 (Interim target-2)	1 year: 40 (WBG EHS guideline)	--	--	--	--	--	--	--	--

S.N.	Date of Monitoring	Sample no	PM 10	PM 2.5	SO2	NOx	CO	Cadmium as Cd	Lead (Pb)	Mercury (Hg)	Nickel (as Ni)	Arsenic as As	Hydrogen fluoride (HF)	Hydrochloric Acid (HCl)
			75 (Interim target-3) 50 (WBG EHS guideline)	37.5 (Interim target-3) 25 (WBG EHS guideline)	20 (WBG EHS guideline)	1 hour: 200 (WBG EHS guideline)								

Source: Monitoring conducted by NABL accredited lab in May 2023

Table 5-13 Results of Dioxin and Furan in the study Area

Parameter	Units	Method	D&F1	D&F 2	SWM Rules, 2016 (Stack Monitoring)	WBG EHS guidelines for Waste Management facilities (Stack Monitoring)
			Dioxin			
--	--	--	Ambient Temp:29°C Wind Direction: SW Date: 17.06.2023	Ambient Temp:29°C Wind Direction: SW Date: 18.06.2023	--	0.1
1 2 3 4 6 7 8-Heptachlorodibenzo-p-dioxin	ng.TEQ/N m³	Method TO-9A /QA.16.4.73	<0.00024	<0.00024	0.1	
1 2 3 4 7 8-Hexachlorodibenzo-p-dioxin	ng.TEQ/N m³	Method TO-9A /QA.16.4.73	<0.0024	<0.0024	0.1	
1 2 3 7 8 9-Hexachlorodibenzo-p-dioxin	ng.TEQ/N m³	Method TO-9A /QA.16.4.73	<0.0024	<0.0024	0.1	
1 2 3 7 8-Pentachlorodibenzo-p-dioxin	ng.TEQ/N m³	Method TO-9A /QA.16.4.73	<0.024	<0.024	0.1	
1 2 3 7 8-Pentachlorodibenzo-p-dioxin	ng.TEQ/N m³	Method TO-9A /QA.16.4.73	<0.005	<0.005	0.1	
1 2 3 6 7 8-Hexachlorodibenzo-p-dioxin	ng.TEQ/N m³	Method TO-9A /QA.16.4.73	<0.0024	<0.0024	0.1	

Parameter	Units	Method	D&F1	D&F 2	SWM Rules, 2016 (Stack Monitoring)	WBG EHS guidelines for Waste Management facilities (Stack Monitoring)
Octachlorodibenzo-p-dioxin	ng.TEQ/N m^3		<0.000015	<0.000015	0.1	
			Furan			
2 3 4 7 8-Pentachlorodibenzofuran	ng.TEQ/N m^3	Method TO-9A /QA.16.4.73	<0.0072	<0.0072	0.1	0.1
1 2 3 4 6 7 8-Heptachlorodibenzofuran	ng.TEQ/N m^3	Method TO-9A /QA.16.4.73	<0.00024	<0.00024	0.1	
1 2 3 4 7 8 9-Heptachlorodibenzofuran	ng.TEQ/N m^3	Method TO-9A /QA.16.4.73	<0.00024	<0.00024	0.1	
1 2 3 4 7 8-Hexachlorodibenzofuran	ng.TEQ/N m^3	Method TO-9A /QA.16.4.73	<0.0024	<0.0024	0.1	
1 2 3 6 7 8-Hexachlorodibenzofuran	ng.TEQ/N m^3	Method TO-9A /QA.16.4.73	<0.0024	<0.0024	0.1	
1 2 3 7 8 9-Hexachlorodibenzofuran	ng.TEQ/N m^3	Method TO-9A /QA.16.4.73	<0.0024	<0.0024	0.1	
1 2 3 7 8-Pentachlorodibenzofuran	ng.TEQ/N m^3	Method TO-9A /QA.16.4.73	<0.00072	<0.00072	0.1	
2 3 4 6 7 8-Hexachlorodibenzofuran	ng.TEQ/N m^3	Method TO-9A /QA.16.4.73	<0.0024	<0.0024	0.1	
2 3 7 8-Tetrachlorodibenzofuran	ng.TEQ/N m^3	Method TO-9A /QA.16.4.73	<0.0005	<0.0005	0.1	
Octachlorodibenzofuran	ng.TEQ/N m^3	Method TO-9A /QA.16.4.73	<0.000015	<0.000015	0.1	
Total Dioxins & Furans	ng.TEQ/N m^3	Method TO-9A /QA.16.4.73	<0.01	<0.01	0.1	

Source: NABL Accredited Lab

5.3.8.1.1 Analysis of Ambient Air Quality Monitoring

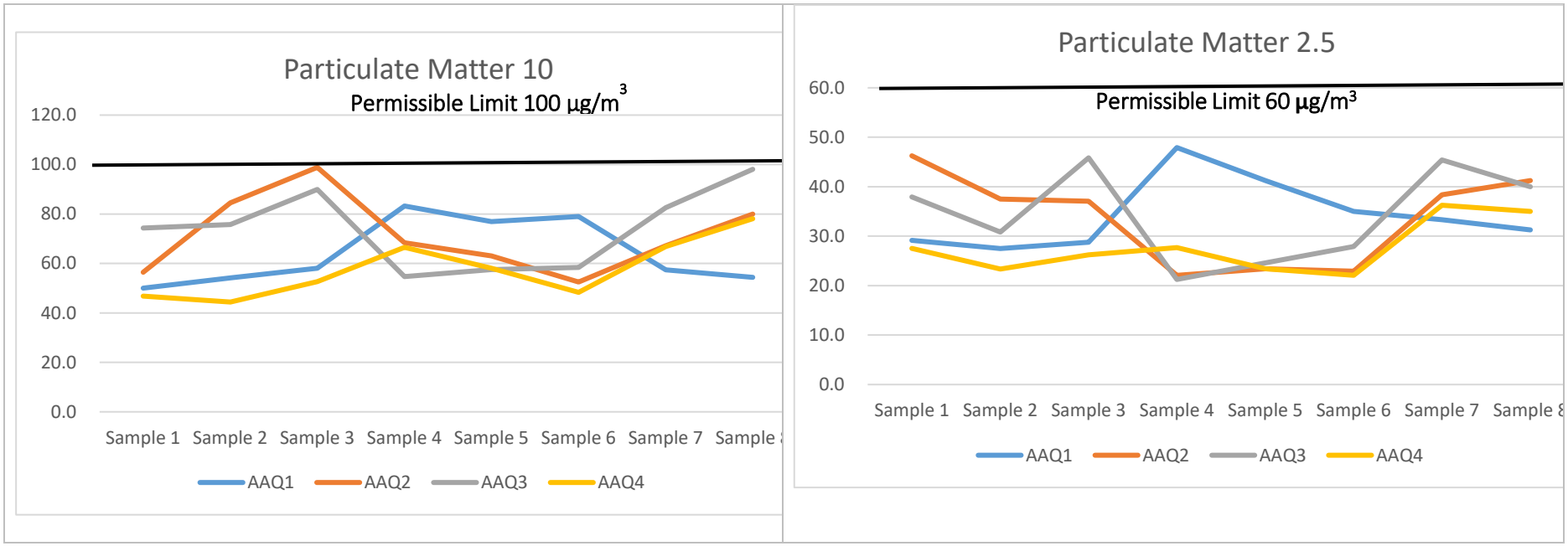
As per the above results, all the parameters such as Dioxin, Furan, PM 10, PM 2.5, Sulphur Dioxide (SO_2), Oxides of Nitrogen (NO_X) and Carbon Monoxide (CO), Cadmium, Lead, Mercury (Hg), Nickel (Ni), Arsenic (Ar), Hydrogen Fluoride (HF), Hydrochloric Acid (HCL) were found to be within NAAQS CPCB permissible limits. However, for few of the samples PM10 and PM2.5 was observed to be exceeding the WBG Interim Target 3 and WBG EHS Guideline.

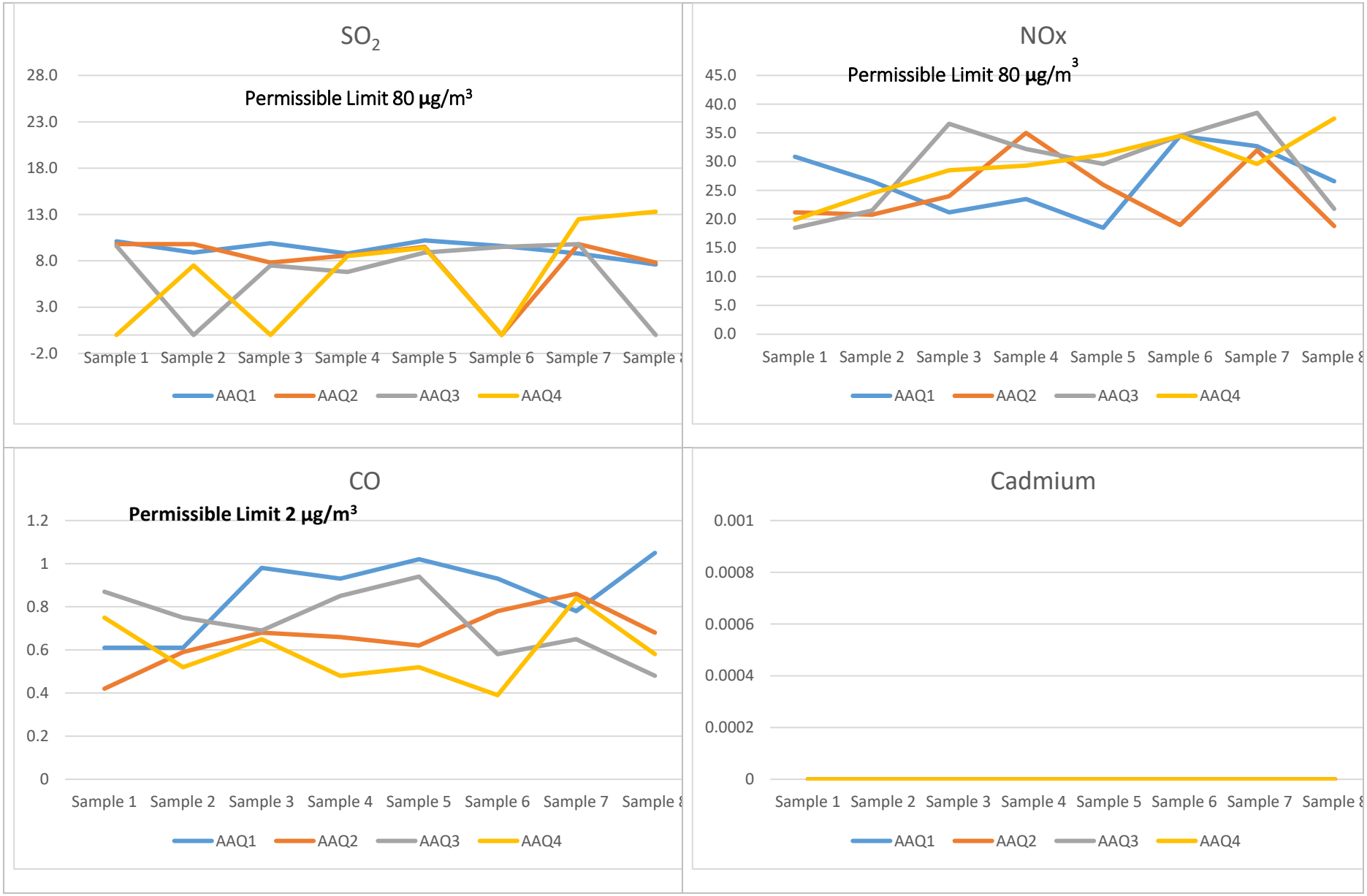
	PM10	PM 2.5
AAQ-1	3 sample are exceeding the WBG Interim Target-3. All samples are exceeding WBG EHS Guideline.	2 Samples are exceeding the WBG Interim Target-3. All samples are exceeding WBG EHS Guideline.
AAQ-2	3 samples are exceeding the WBG Interim Target-3. All samples are exceeding WBG EHS Guideline.	4 Samples are exceeding the WBG Interim Target-3. 5 samples are exceeding WBG EHS Guideline.
AAQ-3	4 samples are exceeding the Interim Target-3. All samples are exceeding WBG EHS Guideline.	4 Samples are exceeding the WBG Interim Target-3. 6 samples are exceeding WBG EHS Guideline.
AAQ-4	Only 1 sample is exceeding WBG Interim Target-3. 5 samples are exceeding WBG EHS Guideline.	All the samples are within WBG Interim Target-3. 5 samples are exceeding WBG EHS Guideline.

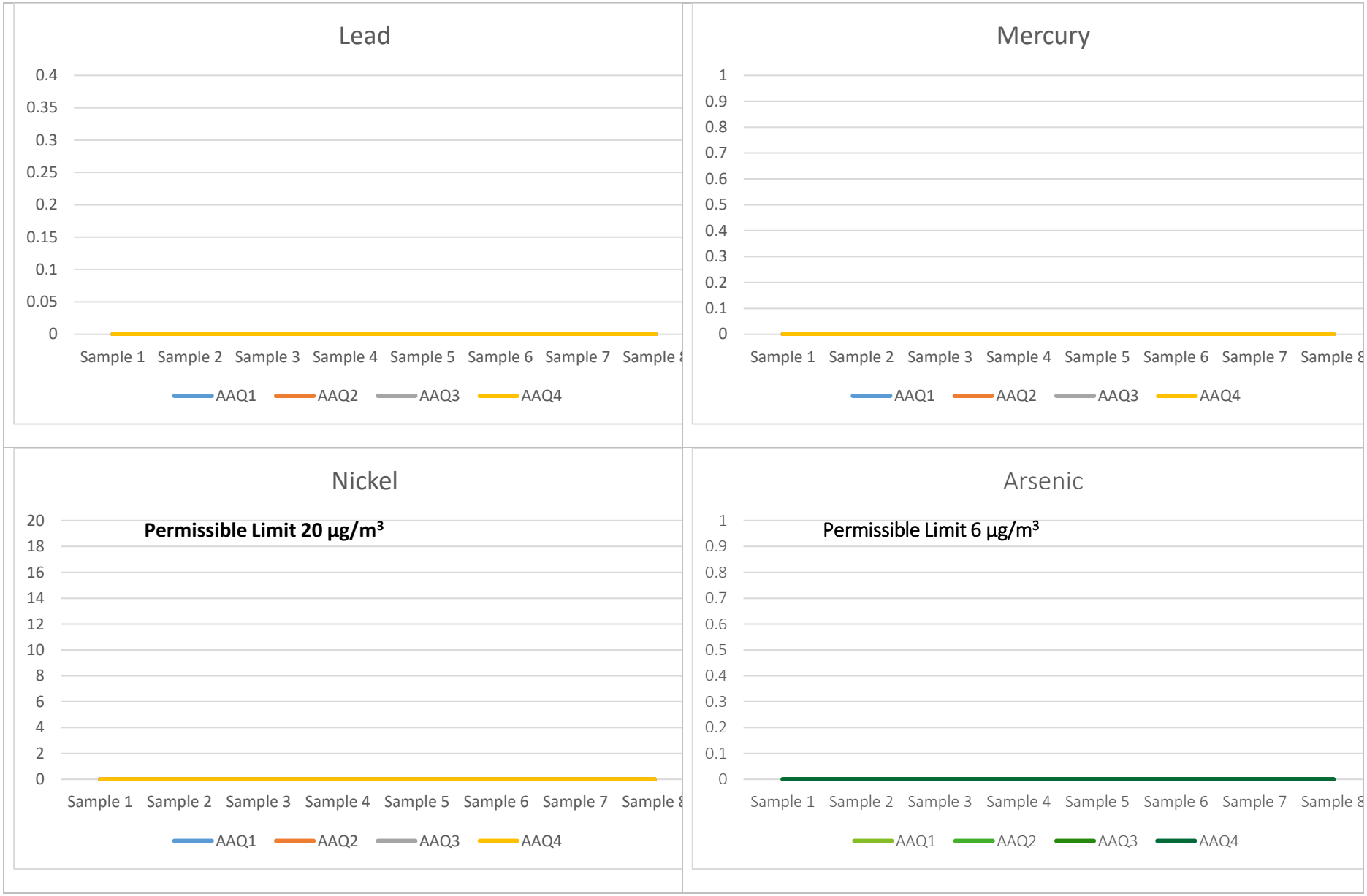
The exceedance in the values for PM10 and PM2.5 for AAQ-1 can be attributed to ongoing construction activities (transportation of construction material, digging, building construction, etc.), bio-mining activities in the landfill (adjoining to the site), waste dumping, waste transportation, presence of dirt roads in the area and other activities along with the moderate wind speeds in that area during the monitoring period. Also, exceedance in the values of AAQ-2, AAQ-3 and AAQ-4 can be attributed to moderate wind speeds in the regions along with presence of dirt roads in area used by all the vehicles leading to increase in the PM 10 and PM2.5 Values along with other anthropogenic activities. Referring to the air quality data (refer ***section 5.3.8***), the values for PM10 are also exceeding the NAAQS values.

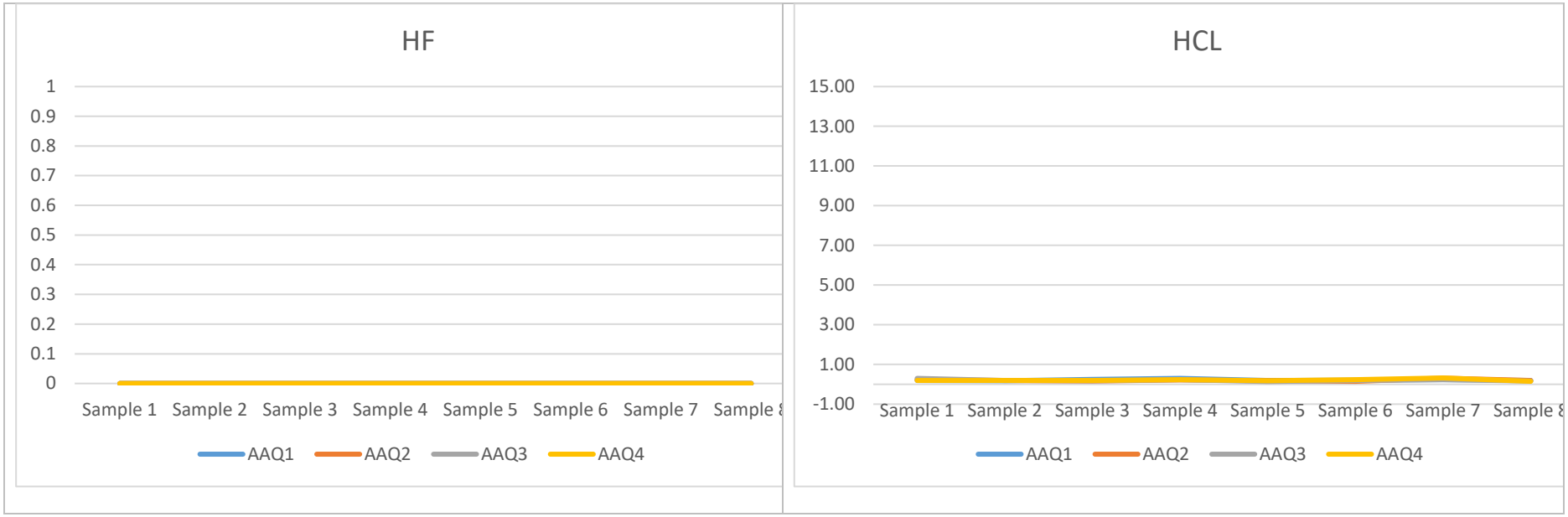
Therefore, the airshed is already degraded for 24 hours mean and annual mean PM10 and PM2.5 levels as per WBG EHS Guideline.

Figure 5-20 Air Quality Analysis Graph









Source: NABL Accredited Lab

5.3.9 Noise Quality Assessment

Noise levels were recorded at four locations once during the study period with the aid of a digital noise level meter. Noise levels were recorded for 48 hours, and the noise quality has been reported as Leq day and Leq night for each of the locations. Daytime is considered from 0600 to 2200 hours and night from 2200 to 0600 hours. The details of noise monitoring locations has been presented in **Figure 5-21** and the results of the ambient noise monitoring has been presented in **Table 5-14.** Map showing monitoring locations has been presented in **Figure 5-2**.

Figure 5-21 Noise Level monitoring conducted in Study Area

N 1 Location

N 2 Location

N 3 Location

N 4 Location

Table 5-14 Ambient Noise Quality Monitoring in Study Area

S.No.	Sampling ID	Results Leq dB(A)	
		Leq Day	Leq Night
1	N1 (Industrial area)	66.2	60.7
2	N2 (Residential area)	55.6	48.0
3	N3 (Residential area)	69.4	51.9
4	N4 (Residential area)	58.4	45.0
Limit As per CPCB (Environment Protection Rules, 1986)			
Receptor			
Industrial Area Leq dB(A)		75	70
Commercial Area Leq dB(A)		65	55
Residential Area Leq dB(A)		55	45
WBG, General EHS Guidelines on noise management			
Receptor		**Daytime 07:00 - 22:00**	**Night time 22:00 - 07:00**
Residential; Institutional; Educational		55	45
Industrial, commercial		70	70

Source: Survey conducted by NABL accredited lab in June 2023

The sampling locations are located in industrial as well as residential area, therefore as per the above results the Leq Day and Leq Night values of N1 is found within the limit prescribed by CPCB and WBG General EHS Guideline. But the values of N2,N3,N4 are found to be exceeding the limit of 55dB(A) and 45 dB(A) for Leq day and Leq night respectively. This can be attributed to the fact that since the monitoring location was in the vicinity of school and religious structures, activities

such as morning assembly or religious prayers and chants and other anthropogenic activities may have led to increase in noise levels.

5.3.10 Traffic Survey

The primary traffic survey was conducted near the access roads for the Vadodara site. Therefore, to understand the existing traffic (up and down) in these roads a primary traffic survey was conducted by a NABL accredited lab for 24 hours. The traffic survey locations have been presented in **Figure 5-22** and **Figure 5-2** the results of the survey has been presented in ***Table 5-15.***

Figure 5-22 Traffic Survey Monitoring conducted in Study Area

Traffic Survey at T1 Location (Down)

Traffic Survey at T2 Location (Up)

Source: Monitoring conducted by NABL accredited lab in June 2023

Traffic monitoring was undertaken at two locations, T1 (UP- Vadodara City -NH-68, Down- NH-68 To site) and T2 (access road to project site). Since T1 is a major road, up and down traffic monitoring was undertaken separately as T1 location is also a three-way road and T1 (up) is the access road which is being used for all the traffic going towards Vadodara city and T1(Down) is the traffic that will be moving towards the site.

Table 5-15 Traffic Density Monitoring Results in Study Area

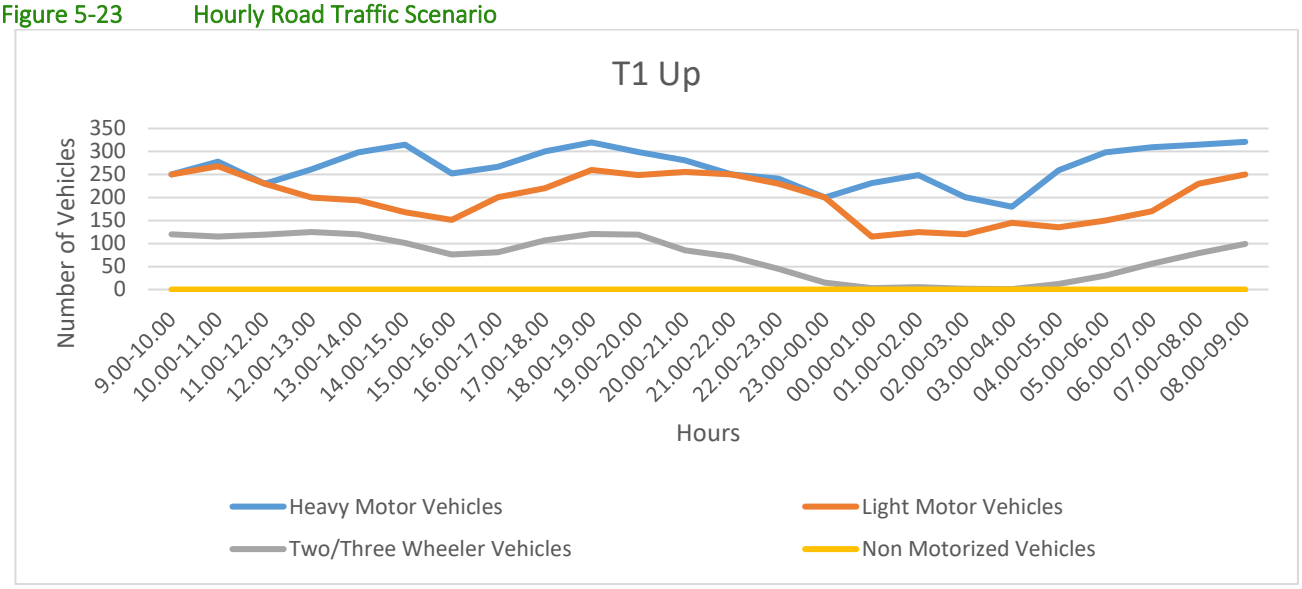
S.No.	Motorised Vehicles			Non-Motorised Vehicles	Total Vehicles
	Heavy Motor Vehicles (Truck, Bus, Dumper, Tanker, Trailer)	Light Motor Vehicles (Car, Jeep, Van, Metador, Tractor, Tempo)	Two/Three Wheelers (Scooter, M. Cycle, Auto, Moped)	Bicycle, Tricycle	
T1 (Up)					
1.	6,405	4767	1,707	0	12,879
T1 (Down)					
1	529	167	303	0	999
T2 (Up and Down)					
2.	2,498	3,465	650	0	6,613

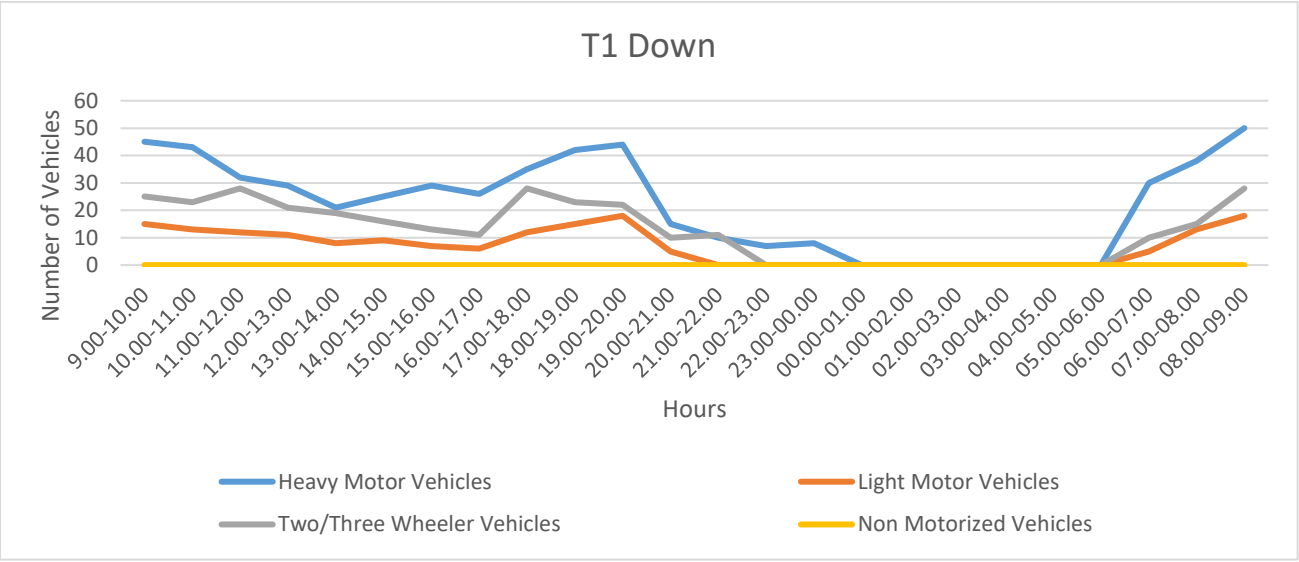
Source: Survey conducted by NABL accredited lab in June 2023

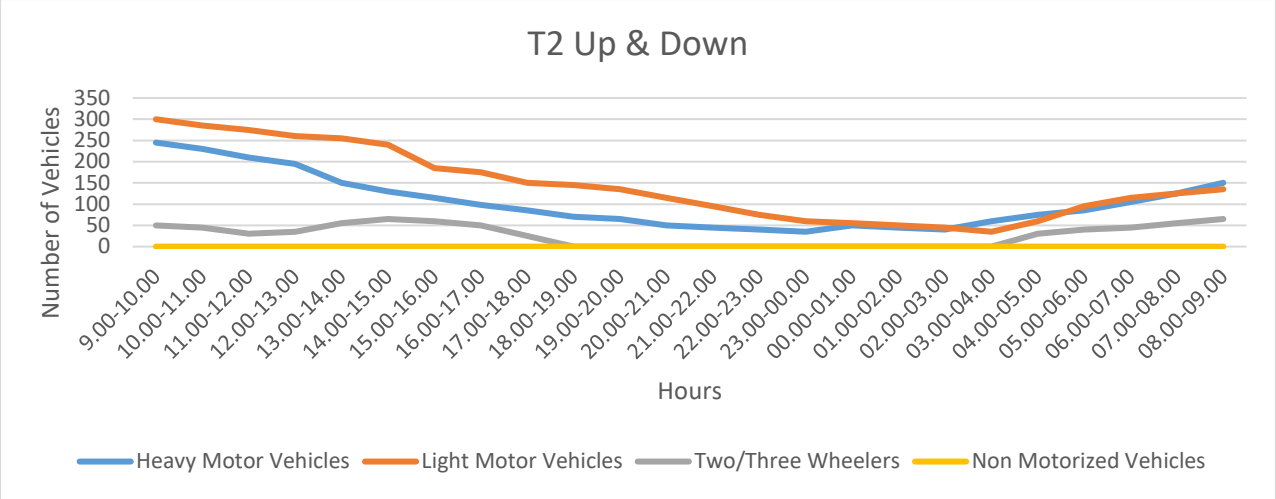
5.3.10.1 Analysis of Traffic Survey

Based on the traffic survey data presented in ***Table 5-15*** and hourly traffic scenario presented in ***Figure 5-23*** it is observed that T1 Up is busier than T1 Down with daily traffic accounting for 12,879 vehicles over 999 vehicles respectively, as the T1 Down traffic is majorly used by four wheeler heavy trucks that are carrying the waste to the dumping site and also the vehicles used by other contractors engaged for other activities at the dumping area. The hourly traffic scenario depicted that the majority of traffic in the T2 road is due to movement of Light Motor vehicles (3,465) travelling up and down the roads comprising of car, jeep, van, matador, tempo and tractors. This is followed by heavy motor vehicles (2,498) comprising of Truck, Bus, Dumper, Tanker, Trailer. The movement of Heavy Motor vehicles in T1 location paves for majority of the traffic near proposed project site as it is a National Highway.

Figure 5-23 Hourly Road Traffic Scenario







Source: Survey conducted by NABL accredited lab in June 2023

5.3.11 Natural Hazards

.

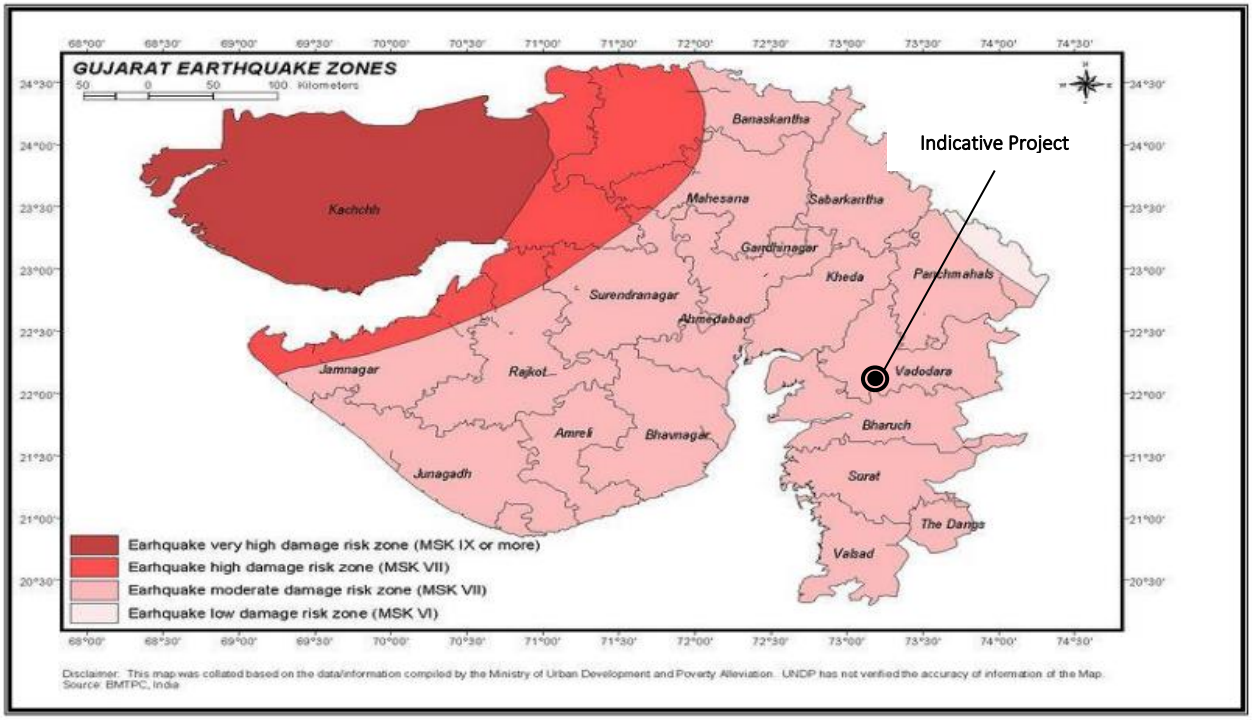
Building Materials & Technology Promotion Council (BMTPC), Government of India, have published hazard maps of Gujarat. According to the BMTPC, floods, wind and earthquake are the main natural hazards that can cause damage to life and property in Vadodara district, where the Project site falls. According to District Disaster Management Plan of Vadodara 2021, Vadodara city is prone to multiple hazards such as Floods, Cyclone, Earthquake, Fires and Epidemics/Pandemics and have experienced & witnessed too on several occasions in the past. Project level details with respect to natural hazards have been presented in below:

Earthquake: The project site falls under seismic zone 3 (Moderate Damage Risk Zone) as shown in **Figure 5-24** Vadodara District is located over a fault line so it may possible that the magnitude of the earthquake can be of 7 on the Richter scale. Thus, there is high possibility of failure of various infrastructures and chances of risk of loss of live, properties too in certain highly populated areas of the city. Mostly the high-rise buildings and constructions which are not made as per the earthquake resistant technology in the urban area, old / defective constructed buildings, huts with the mud walls etc. has the most danger of earthquakes. Certain areas which have less open space in surroundings probably are more affected at the time of earthquake. Vadodara city have experienced the effects of devastating earthquake of year 2001.

Cyclone: The project site lies in the Moderate damage risk zone (V_b= 39m/s) as shown in **Figure 5-25**. There are possibilities of strong winds before monsoon, majorly in the river prone areas and city areas as well. As per the City Disaster Management Plan 2022-23, the months of May to November are for advance preparation against cyclone. The main reason behind the loss to the properties is the loss due to weak construction (especially weak & connected roofs or ceilings). Vadodara city have experienced the effects of cyclone in the year 1998. In the month of June 2023, Biparjoy cyclone stuck Porbandar (the western coast of Gujarat) resulting in increased wind velocity from southwest direction and unexpected rainfall patterns impacting the weather conditions of Vadodara city.

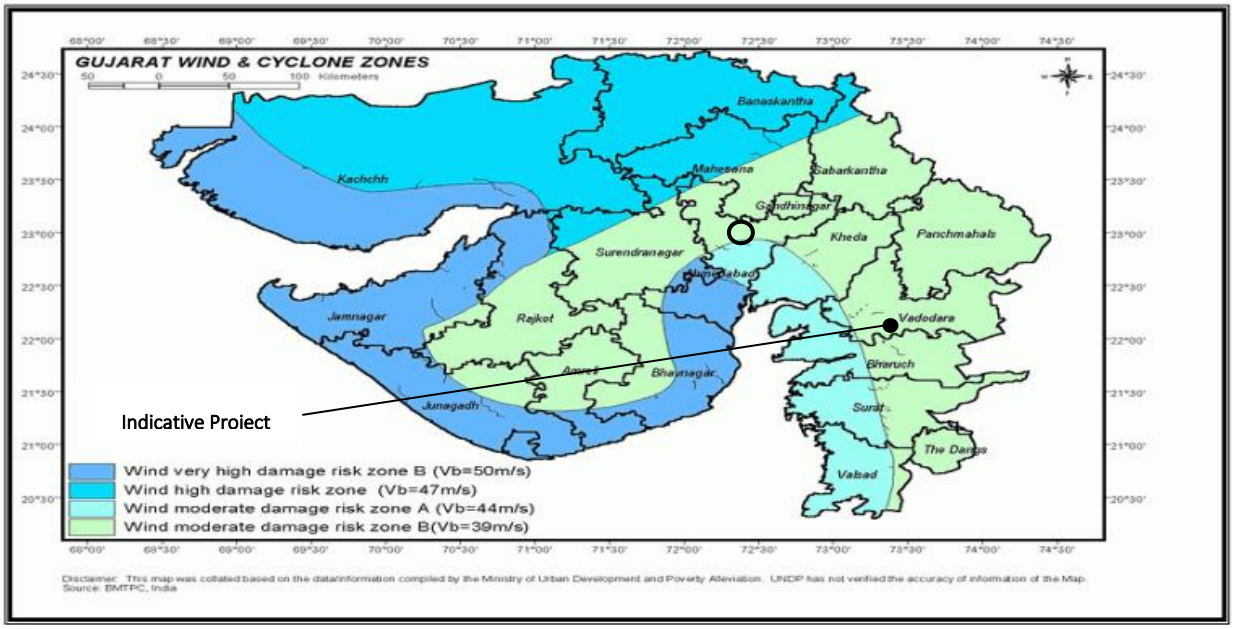
Flood: As shown in **Figure 5-26** Vadodara city has many low-lying areas. Vishwamitri River passes through its centre. Rainwater drains to this river from the upstream areas as well as the city thus increasing the water levels. Also, when Ajwa Sarovar surpasses its level, it starts emptying excess water in the river, which carries it to the downstream areas in the city. Both low lying areas, congested areas and poorly drained areas become waterlogged in the city. Vadodara has faced the impact of major floods once in every three-year period. The city was severely affected by the floods of 1978, 1994, 2005, 2006, 2013, 2014 and 2019.

Figure 5-24 Map showing Earthquake Hazard of the Gujarat State



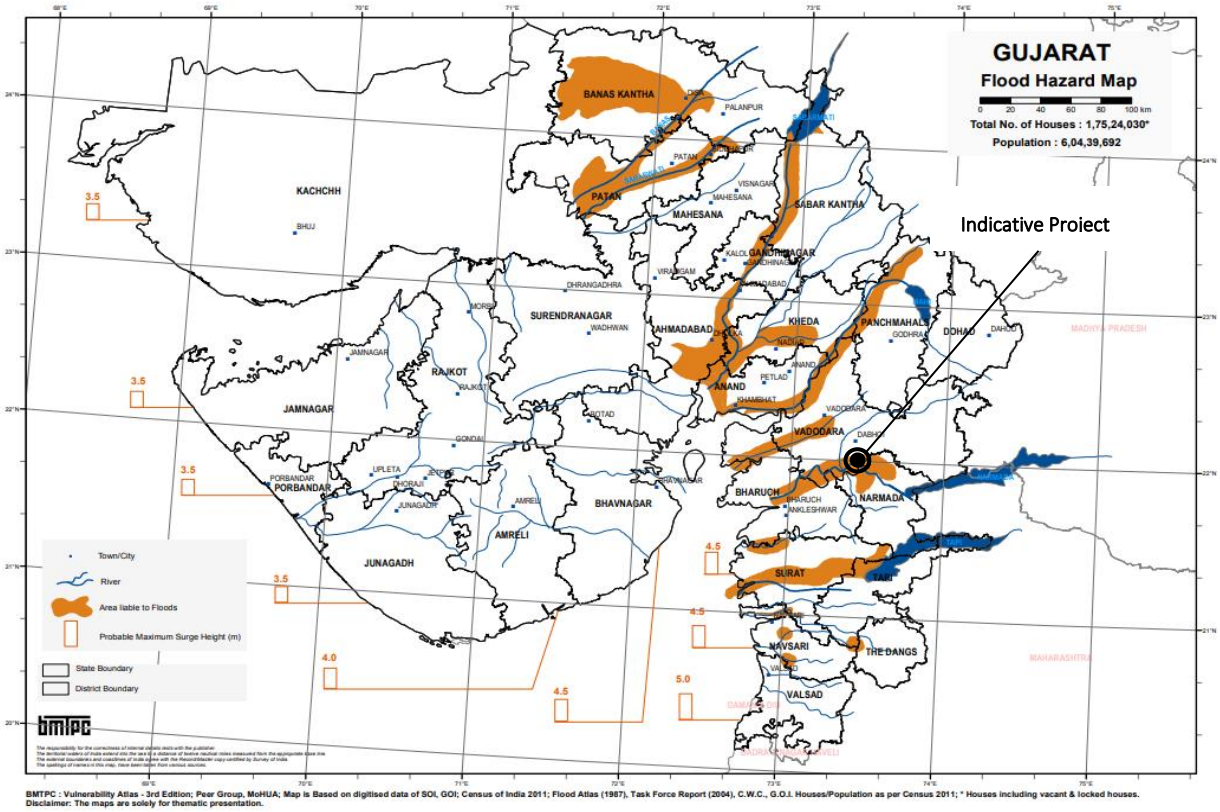
Source: District Disaster Management Plan - Vadodara 2021

Figure 5-25 Map showing Cyclone Hazard of the Gujarat State



Source: District Disaster Management Plan - Vadodara 2021

Figure 5-26 Map showing Flood Hazard of the Gujarat State



Source: Vulnerability Atlas of India Third Edition 2019

5.4 Socio-Economic Sensitivity

5.4.1 Approach

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

5.4.2 Study Area[32]

In order to establish the social baseline for the project, data with respect of social development indicators was collected at three levels that is District , Sub district (Tehsil) and the villages / habitations falling under the study area. And for the better understanding and spread of the social development indicators the study area was further divided into core and buffer respectively:

- **Core zone -** The core zone is defined as the radius extending from the Project footprint area which would have majority of the impacts (during mobilization, construction, operation and decommissioning phase). The core zone area for the study is project footprint area i.e. WtE Plant, Water Pipeline and Transmission Line and adjacent area within 500 m radius.
- **Buffer Zone -** An AoI of 10 km radius from the location of WTE Plant, transmission line and the water pipeline is considered for socioeconomic consultations to determine perceived impacts due to the Project including employment opportunities, loss of livelihood and increased vehicular activity in remote areas.

Study area: Project footprint = Core zone (500 meters) + buffer zone (10 km).

5.4.3 Primary data/ information collection/ site consultation

As part of the baseline collection process, consultations were undertaken with the local stakeholders identified for the project. The provides list of the consultation undertaken as part of the site visit

Table 5-16 Consultation Undertaken during the site visit

Sr. no.	Stakeholders' details	Objective of the consultation
1	Discussion with the Project site team	• To understand the project design • Progress of construction • Labour & HR welfare policy • Deployment of contractors • Construction schedule • Stakeholder engagement process and grievance handling mechanism
2	In-depth interview with Ragpickers	• Understand the number of families engaged in waste collection. • Waste collection process • Social development indicators such as education, Income and livelihood dependence of ragpickers on waste collection

[32] Note: As the transmission line (TL) and the Water pipeline line route located within in AOI hence separate core and buffer area was demarcated for TL and water pipeline

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.

5.4.4 Review of Secondary data

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 used is as follows (but not limited to):

- District Census Handbook, Vadodara
- District Human Development Report, 2016
- Primary Census Abstract data of India, 2011
- Village Directory Census Data of India, 2011, and
- Agriculture Contingency plan for Vadodara
- Performance Grading Index for Districts in India (PGI-D)
- Gender Profile Gujarat

The project falls in the state of Gujarat in Vadodara district. The snapshot of the state and project affected district/ subdistrict is given in the subsequent sections below:

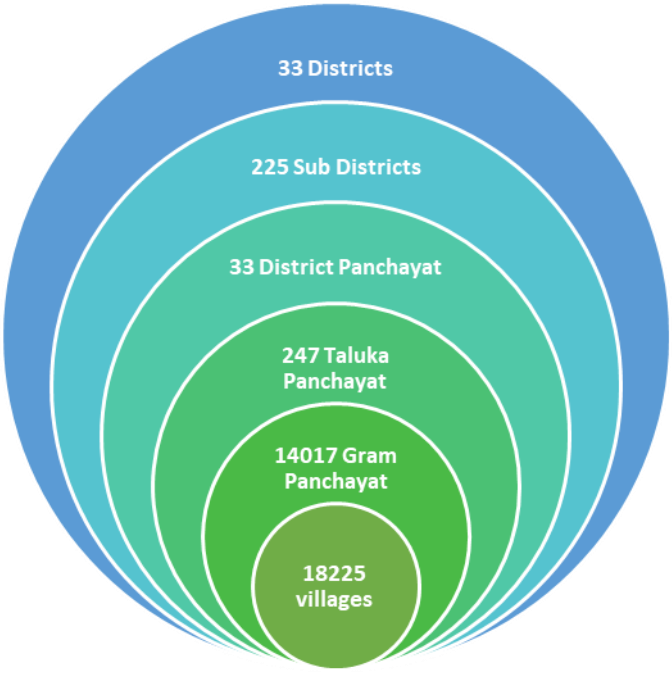
5.4.5 State profile: Gujarat

Gujarat covers an area of 1,96,024 square kilometers (75,685 sq. mile) or 5.96 per cent of the total geographical area of India. The state is the largest Indian state by area and the seventh largest by population. Located on the western coast of India, has the longest coastline of 1,600 Km. It is bordered by Rajasthan to the northeast, Dadra and Nagar Haveli and Daman and Diu to the south, Maharashtra to the southeast, Madhya Pradesh to the east, and the Arabian Sea and the Pakistani province of Sindh to the west.

Gujarat has total 33 district, 225 tehsil, 33 district panchayats, 247 taluka panchayat, 14,017 Gram Panchayat and 18,225 Villages.

Figure 5-27 Administrative Structure of Gujarat

There are 33 districts, 225 sub districts, 33 district panchayat, 247 taluka panchayats, 14017-gram panchayat and 18225 villages in Gujarat according to 2011 Census of India.



Source: Primary Census Abstract data of India, 2011

The state comprises of a population of 6,04,39,692 individuals and 1,22,48,428 households. Compare to the total 120 household pre-dominate households (55.3 per cent of the total household) living in rural area. The sex ratio in the state is 919, which is significantly lower than that of India which stands at 943 females per 1000 males.

The literacy rate of Gujarat is nearly 67.99 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 74.5 per cent and female literacy rate is 60.8 per cent are also lower than the national literacy rate of 82.14 % and 65.46%, respectively.

Table 5-17 Demographic Profile of Gujarat

Variables	Gujarat State
Area (sq. km)	1,96,244
Total Population	6,04,39,692
Males	3,14,91,260
Females	2,89,48,432
Population Growth (percentage)	19.2
Total Households	1,22,48,428
Rural Households	67,73,558
Urban Households	54,74,870
Average Household Size	5
Sex Ratio[33]	919
Child Sex Ratio	890
Population density (sq. km)	308
Total Child Population (0-6 Age)	14,81,748
Male Population (0-6 Age)	7,79,166
Female Population (0-6 Age)	7,02,582
Total Literacy Rate (percent)[34]	78.03
Male Literacy Rate (percentage)	85.75
Female Literacy Rate (percentage)	69.68

Source: Census of India 2011 data

5.4.6 District Profile: Vadodara

Per the census 2011, Vadodara had a population of 41,65,626 of which male and female were 21,53,736 and 20,11,890 respectively. In 2001 census, Vadodara had a population of 36,41,802 of which males were 18,97,368 and remaining 17,44,434 were females. Vadodara district population constitutes 6.89 per cent of total Gujarat population.

There was a change of 14.38 per cent in the total population compared to population as per 2001.

[33] It is the number of females per 1000 males.
[34] It denotes ability to write a letter in any language.

Table 5-18 District Profile

Variables	Vadodara District
Area (sq. km)	7,546
Total Population	41,65,626
Males	21,53,736
Female	20,11,890
Population Growth (percentage)[35]	14.38
Sex Ratio[36]	934
Child Sex Ratio (0-6 age)	897
Population density[37] (sq. km)	552
Total Child Population (0-6 Age)	499811
Male Population (0-6 Age)	263506
Female Population (0-6 Age)	236305
Total Literacy Rate[38] (percent)	78.92
Male Literacy Rate (percentage)	85.39
Female Literacy Rate (percentage)	72.03

5.4.6.1 Vadodara District Density

Per the census 2011, the density of the district for 2011 is 552 people per sq. km. In 2001, the district density was at 482 people per sq. km.

5.4.6.2 Vadodara Literacy Rate

Average literacy rate of the district in 2011 was 78.92 compared to 61.17 of 2001. The male and female literacy were 85.39 and 72.03, respectively. For 2001 census, the literacy rate stood at 69 and 52.66 in the district. Total literates in the district in 2011 were 28,93,080 of which male and female were 16,14,087 and 12,78,993 respectively.

5.4.6.3 Vadodara Sex Ratio

With regards to sex ratio in Vadodara, it stood at 934 per 1000 male compared to 2001 census figure of 919. The average national sex ratio in India is 940 as per the census 2011 directorate.

5.4.6.4 Vadodara District urban/rural

According to the Census 2011, out of the total population of the district 50.41 percent lives in rural areas while 49.59 percent lives in urban areas. The total urban population in the district is 20,65,771 persons comprising 10,75,793 males and 9,89,978 females. The total rural population in this district comes to 20,99,855 persons comprising 10,77,,943 males and 10,21,912 females. The sex ratio for rural and urban areas of the district is 948 and 920 respectively, showing the higher sex ratio in rural areas. The sex ratio for the children of 0-6 years of age is 897 for the district. In rural areas this ratio is 926 while in urban areas the sex ratio of child population is 858 females per 1,000 males. The literacy rates of rural and urban areas are 67.84 and 89.74 percent respectively. The proportion of male and female literates in rural area is 77.14 and 58.07 percent. In urban areas this proportion is 93.35 and 85.85 percent.

As per the 2001 Census, out of the total population of the district, 54.79 percent lives in rural areas while 45.21 percent lives in urban areas. The total urban population in the district is 16,46,222 persons comprising 8,63,030 males and 7,83,192 females. The total rural population in this district comes to 19,95,580 persons comprising 10,34,338 males and 9,61,242 females. The sex ratio for the children of 0-6 years of age is 885 for the district. In rural areas this ratio is 920 while in urban areas the sex ratio of child population is 833 females per 1,000 males. The literacy rates of rural and urban areas are 48.93

[35] Population Growth from year 2001 to 2011
[36] It is the number of females per 1000 males.
[37] Population Density is a measurement of population per square kilometer.
[38] It denotes ability to write a letter in any language. Literacy status assessment made for population 7 years and over.

and 76.02 per cent respectively. The proportion of male and female literates in rural area is 59.59 and 37.46 per cent. In urban areas this proportion is 80.28 and 71.32 per cent.

5.4.6.5 Profile of the Subdistricts

As per the review of secondary data it was understood that 3 tehsils namely Vadodara, Dabhoi , Padra are falling under project area of influence. Most of the area under core zone is falling within Vadodara Tehsil and Vadodara Municipal Corporation. Further 24 villages are failing in Vadodara tehsil , 5 villages in Dabhoi tehsil and 1 village in Padra Tehsil within the project are of influence. A brief profile of the tehsils coming under AOI is presented in the sub heading given below.

5.4.7 Tehsil Profile Vadodara

Vadodara tehsil of the Vadodara district has a total population of 20,09,434 as per the Census 2011. Out of which 10,47,054 are males while 9,62,380 are females. There were a total 4,47,490 families residing in the Tehsil. The average sex ratio of the tehsil is 919 females per 1000 males.

The population of children of age 0-6 years in the tehsil is 2,06,387 which is 10.27% of the total population. There were 1,11,280 male children and 95,107 female children between the age of 0-6 years. Thus, as per the Census 2011, the child sex ratio of the tehsil is 855 which is lower than average sex ratio (897) of the district.

The total literacy rate of the tehsil was 80.62% in 2011. The male literacy rate was 83.59% and the female literacy rate is 77.39% in the tehsil in 2011.

Table 5-19 Tehsil Profile

Variables	Vadodara Tehsil
Total Population	20,09,434
Males	10,47,054
Female	9,62,380
Sex Ratio[39]	919
Total Literacy Rate[40] (percent)	80.62
Male Literacy Rate (percentage)	83.59
Female Literacy Rate (percentage)	77.39

Source: Primary Census Abstract data of India, 2011

5.4.7.1 Working Population – Vadodara Tehsil

In the tehsil out of the total population, 6,90,453 (34.36 per cent of the total population) were engaged in work activities. 91.98% of workers describe their work as main work (employment of earning more than 6 months) while 8.01% were involved in marginal activity providing livelihood for less than 6 months. Of 6,35,083 workers engaged in main work, 18,789 were cultivators (owner or co-owner) while 31,689 were agricultural laborer.

Table 5-20 Vadodara Tehsil - Working Profile

Variables	Total	Male	Female
Main Workers	6,35,083	5,42,265	92,818
Cultivators	18,789	17,280	1,509
Agriculture Laborer	31,689	23,489	8,200
Household Industries	6,357	4,852	1,505
Other Workers	5,78,248	4,96,644	81,604
Marginal Workers	55,370	33,325	22,045
Non-Working	13,18,981	4,71,464	8,47,517

[39] It is the number of females per 1000 males.
[40] It denotes ability to write a letter in any language. Literacy status assessment made for population 7 years and over.

Source: Primary Census Abstract data of India, 2011

5.4.8 Tehsil Profile Dabhoi

Dabhoi tehsil of the Vadodara district has a total population of 1,80,518 as per the Census 2011. Out of which 93,335 are males while 87,183 are females. There were a total 38,972 families residing in the Tehsil. The average sex ratio of the tehsil is 934 females per 1000 males.

The population of children of age 0-6 years in the tehsil is 19,957 which is 11.05% of the total population. There were 10,383 male children and 9,574 female children between the age of 0-6 years. Thus, as per the Census 2011, the child sex ratio of the tehsil is 922 which is higher than average sex ratio (897) of the district.

The total literacy rate of the tehsil was 70.62% in 2011. The male literacy rate was 75.85% and the female literacy rate is 63.87% in the tehsil in 2011.

Table 5-21 Tehsil Profile

Variables	Dabhoi Tehsil
Total Population	1,80,518
Males	93,335
Female	87,183
Sex Ratio[41]	934
Total Literacy Rate[42] (percent)	70.62
Male Literacy Rate (percentage)	75.85
Female Literacy Rate (percentage)	63.87

Source: Primary Census Abstract data of India, 2011

5.4.8.1 Working Population – Dabhoi Tehsil

In the tehsil out of the total population, 76,303 (42.26 per cent of the total population) were engaged in work activities. 81.98% of workers describe their work as main work (employment of earning more than 6 months) while 18.01% were involved in marginal activity providing livelihood for less than 6 months. Of 62,554 workers engaged in main work, 14,527 were cultivators (owner or co-owner) while 26,205 were agricultural laborer.

Table 5-22 Working Profile

Variables	Total	Male	Female
Main Workers	62,554	50,128	12,426
Cultivators	14,527	13,128	1,399
Agriculture Laborer	26,205	17,949	8,256
Household Industries	1,085	736	349
Other Workers	20,737	18,315	2,422
Marginal Workers	13,749	6,684	7,065
Non-Working	1,04,215	36,523	67,692

Source: Primary Census Abstract data of India, 2011

[41] It is the number of females per 1000 males.
[42] It denotes ability to write a letter in any language. Literacy status assessment made for population 7 years and over.

5.4.9 Tehsil Profile: Padra

Padra tehsil of the Vadodara district has a total population of 2,65,901 as per the Census 2011. Out of which 1,38,645 are males while 1,27,256 are females. There were a total 55,104 families residing in the Tehsil. The average sex ratio of the tehsil is 918 females per 1000 males.

The population of children of age 0-6 years in the tehsil is 32,393 which is 12.18% of the total population. There were 17,173 male children and 15,220 female children between the age of 0-6 years. Thus, as per the Census 2011, the child sex ratio of the tehsil is 886 which is lower than average sex ratio (897) of the district.

The total literacy rate of the tehsil was 81.02% in 2011. The male literacy rate was 88.28% and the female literacy rate is 73.16% in the tehsil in 2011.

Table 5-23 Tehsil Profile

Variables	Padra Tehsil
Total Population	2,65,901
Males	1,38,645
Female	1,27,256
Sex Ratio[43]	918
Total Literacy Rate[44] (percent)	81.03
Male Literacy Rate (percentage)	88.28
Female Literacy Rate (percentage)	73.16

Source: Primary Census Abstract data of India, 2011

5.4.9.1 Working Population- Padra Tehsil

In the tehsil out of the total population, 1,06,313 (39.98 per cent of the total population) were engaged in work activities. 86.81% of workers describe their work as main work (employment of earning more than 6 months) while 0.95% were involved in marginal activity providing livelihood for less than 6 months. Of 92,297 workers engaged in main work, 18,899 were cultivators (owner or co-owner) while 42,832 were agricultural laborer.

Table 5-24 Padra Tehsil -Working Profile

	Total	Male	Female
Main Workers	92,297	77,448	14,849
Cultivators	18,899	17,788	1,111
Agriculture Laborer	42,832	32,242	10,590
Household Industries	1,511	1,383	128
Other Workers	29,055	26,035	3,020
Marginal Workers	14,016	4,678	9,338
Non-Working	1,59,588	56,519	1,03,069

Source: Primary Census Abstract data of India, 2011

[43] It is the number of females per 1000 males.
[44] It denotes ability to write a letter in any language. Literacy status assessment made for population 7 years and over.

5.4.10 Study Area[45]

The area of up to ten (10) km radius from the Project boundary has been demarcated as the study area. The study area is demarcated based on the potential direct and indirect impact of the project on the local community.
The key terms used for sub-categorization of the Study Area are:

- **Core area of WtE power Plant:** The core zone is defined as the radius extending from the WtE power plant area which would have majority of the impacts (during mobilization, construction, operation, and decommissioning phase). The core zone area for the WtE power plant is 500 meters radius from the plant location.
- **Buffer area of WtE Power Plant:** Buffer area of 10 km radius from WtE power plant's location is considered for socioeconomic baseline to determine perceived impacts due to the Project.
- **Core area of water Pipeline and transmission line:** The core area for the water pipeline and transmission line is 500 meters radius from the footprint of water pipeline and transmission line.
- **WtE power plant's study area:** WtE power plant's village + core area+ buffer area of 10 km radius from the WtE Power Plant.
- **Water Pipeline and transmission line's study area:** water pipeline and transmission line footprint area and core area of water pipeline and transmission line.
  Note: The decision to designate the water pipeline and transmission line footprint area, along with the core area extending to a 500-meter radius, as the study area for socio-economic analysis was made based on several key considerations. Below are the primary reasons behind this selection:
  - **Direct Impact Zone Identification:** The core area within a 500-meter radius of the water pipeline and transmission line represents the immediate vicinity that is most likely to experience direct impacts from the construction and operation of these infrastructures.
  - **Minimization of Buffer Area:** Given the nature of the construction activities and operation of the pipeline and transmission line, it is anticipated that the impact will be most pronounced within the core area.
- Project's study area: WtE power plant's study area + Water pipeline and transmission line's study area.

It must be noted that the water pipeline passes through Ward 19 of VMC, and transmission line passes along Ward 19 of VMC and Jambuva village.
Note: the study area = project village/core zone + buffer zone

Table 5-25 Core Zone

S. No.	Core Zone	Tehsil	District
1	Ward 19, VMC	Vadodara	Vadodara
2	Makarpura Village	Vadodara	Vadodara
3	Jambuva Village	Vadodara	Vadodara
4	Mujhar Gamdi Village	Vadodara	Vadodara
5	Talsat Village	Vadodara	Vadodara

Source: Google Imagery

Table 5-26 Buffer Area

S. No.	Buffer Area	Tehsil	District
Vadodara Municipal Corporation			
1	Ward 3	Vadodara	Vadodara
2	Ward 4	Vadodara	Vadodara
3	Ward 5	Vadodara	Vadodara
4	Ward 6	Vadodara	Vadodara
5	Ward 7	Vadodara	Vadodara

[45] Note: As the transmission line (TL) and the Water pipeline line route located within in AOI hence separate core and buffer area was demarcated for TL and water pipeline

S. No.	Buffer Area	Tehsil	District
6	Ward 8	Vadodara	Vadodara
7	Ward 10	Vadodara	Vadodara
8	Ward 11	Vadodara	Vadodara
9	Ward 12	Vadodara	Vadodara
10	Ward 13	Vadodara	Vadodara
11	Ward 14	Vadodara	Vadodara
12	Ward 15	Vadodara	Vadodara
13	Ward 16	Vadodara	Vadodara
14	Ward 17	Vadodara	Vadodara
15	Ward 18	Vadodara	Vadodara
Villages			
1	Sundarpura	Vadodara	Vadodara
2	Dhaniyavi	Vadodara	Vadodara
3	Chikhodara	Vadodara	Vadodara
4	Varadla	Vadodara	Vadodara
5	Maretha	Vadodara	Vadodara
6	Alamgir	Vadodara	Vadodara
7	Khatamba	Vadodara	Vadodara
8	Shankarpura	Vadodara	Vadodara
9	Ratanpur	Vadodara	Vadodara
10	Tatarpura	Vadodara	Vadodara
11	Kelanpur	Vadodara	Vadodara
12	Alhadpura	Vadodara	Vadodara
13	Hetampura	Vadodara	Vadodara
14	Hansajipura	Vadodara	Vadodara
15	Raghavpura	Vadodara	Vadodara
16	Shahpura	Vadodara	Vadodara
17	Patarveni	Vadodara	Vadodara
18	Mastupur Gamdi	Vadodara	Vadodara
19	Ajitpura	Vadodara	Vadodara
20	Dolatpura	Vadodara	Vadodara
21	Varanama	Vadodara	Vadodara
22	Karali	Vadodara	Vadodara
23	Khalipur	Vadodara	Vadodara
24	Palaswada	Dabhoi	Vadodara
25	Mosampura	Dabhoi	Vadodara
26	Kundhela	Dabhoi	Vadodara
27	Hansapura	Dabhoi	Vadodara
28	Kajapura	Dabhoi	Vadodara
29	Patod	Padra	Vadodara
30	Barliyapura Village	Vadodara	Vadodara
31	Vora Gamdi Village	Vadodara	Vadodara

5.4.11 Demographic profile of Study area

This section looks at demographic key indicators of the households to understand existing population dynamics, and how they may be influenced by the project as well as availability in numbers and quality of human resources.

Table 5-27 Demographic profile of study area

Villages/ Ward	No. of HH	Population	Average HH Size	Sex Ratio	% SC	% ST	% Lit	% F Lit
Ward 16	533	2402	4.51	922	1%	15%	70%	65%
Ward 18	1960	9337	4.76	911	20%	11%	77%	72%
Ward 19	32	159	4.97	963	2%	21%	64%	55%
Mujar Gamdi	114	494	4.33	960	8%	27%	73%	65%
Total core area	**2639**	**12392**	**4.64**	**939**	**8%**	**19%**	**71%**	**64%**
Buffer area								
Vadodara Municipal Corporation								
Ward 3	31083	141314	4.54	919	4.71	5.85	79.87	77.22
Ward 4	37659	160969	4.27	923	4.62	3.98	84.29	82.37
Ward 5	19353	88349	4.56	923	4.26	1.6	83	80.47
Ward 6	29823	130715	4.38	922	3.84	3.03	79.17	75.53
Ward 7	40892	182567	4.46	897.96	9.63	2.96	82.2	79.27
Ward 8	21882	98723	4.51	942	4.65	2.42	81.48	78.84
Ward 10	41732	177287	4.24	934	6.46	3.4	85.38	83.42
Ward 11	28458	122645	4.31	948	6.26	3.06	84.36	82.05
Ward 12	31547	139349	4.42	883	7.67	4.49	80.39	76.73
Ward 13	5789	26495	4.58	902	5.87	6.34	73.27	68.37
Ward 14	1903	9256	4.86	873	8.49	6	79.56	74.53
Ward 15	368	1760	4.78	899	2.95	2.73	66.93	60.26
Ward 16	533	2402	4.51	922	0.87	15.4	70.44	64.67
Ward 17	824	3817	4.63	949	2.52	35	81.06	78.59
Ward 18	1960	9337	4.76	911	20.15	10.93	77.25	72.21
Villages								
Sundarpura	283	1267	4.48	934	11.6	21.23	83.82	82.52
Dhaniyavi	462	2353	5.09	948	8.33	16.57	74.08	70.13
Chikhodara	380	1747	4.6	983	5.72	19.63	70.58	62.93

Villages/ Ward	No. of HH	Population	Average HH Size	Sex Ratio	% SC	% ST	% Lit	% F Lit
Varadla	NA	NA	NA	NA	NA	NA	NA	NA
Maretha	403	1918	4.76	879	4.54	13.66	75.96	69.45
Alamgir	NA	NA	NA	NA	NA	NA	NA	NA
Khatamba	190	920	4.84	1155	9.78	40.65	71.52	65.72
Ratanpur	344	1508	4.38	923	8.49	32.96	68.37	57.73
Tatarpura	233	1046	4.49	974	6.5	39.39	63.58	54.84
Kelanpur	614	2929	4.77	980	8.6	41.86	69.03	60.9
Alhadpura	217	991	4.57	902	0.81	33.2	69.12	63.62
Hetampura	317	1504	4.74	916	0.13	1.06	67.89	63.56
Hansajipura	NA	NA	NA	NA	NA	NA	NA	NA
Raghavpura	176	850	4.83	932	6.12	21.18	75.88	70.49
Shahpura	118	493	4.18	840	20.69	27.79	80.12	73.78
Patarveni	173	721	4.17	897	13.04	43.13	63.8	56.01
Mastupur Gamdi	94	430	4.57	878	2.33	38.84	63.95	54.73
Ajitpura	41	190	4.63	1043	18.95	0	75.79	68.04
Dolatpura	17	82	4.82	1050	0	12.2	71.95	66.67
Varanama	NA	NA	NA	NA	NA	NA	NA	NA
Karali	225	1075	4.78	889	1.58	24	73.95	69.17
Khalipur	226	1054	4.66	985	0.76	42.88	62.9	53.92
Palaswada	325	1447	4.45	961	9.95	51.42	66.21	59.1
Mosampura	66	313	4.74	909	0	54.63	54.63	47.65
Kundhela	566	2513	4.44	899	8.56	42.22	70.87	65.55
Hansapura	97	430	4.43	911	3.26	40.23	75.12	69.76
Kajapura	154	694	4.51	1035	9.22	1.01	77.52	67.99
Patod	532	2479	4.66	925	9.04	7.87	74.22	66.41
Barliyapura Village	NA	NA	NA	NA	NA	NA	NA	NA
Vora Gamdi Village	147	688	4.68	977.01	1.6	19.62	79.07	73.53
Total Buffer area	**300206**	**1324627**	**4.58**	**937**	**6.56**	**19.86**	**74.21**	**68.72**

Villages/ Ward	No. of HH	Population	Average HH Size	Sex Ratio	% SC	% ST	% Lit	% F Lit
Total Study area	302845	1337019	4.61	938	7.28	19.43	76.64	71.13

Source: Census of India 2011 data

(*Note: Data for Makarpura, Jambuva, Tarsali, villages is not available in Census of India 2011, hence data of respective wards have been used for the study. Additiohnally, data for Varadla, Alamgir, Hansajipura, Varanama, and Barliyapura villages is not available in Census of India 2011, hence "NA" has been written)*

The core zone of the Study area comprises of 3 wards and 1 village from Vadodara tehsil belonging to the Vadodara Municipal Corporation, while the buffer zone has 15 wards of the Vadodara Municipal Corporation and 30 villages from 3 tehsils (Vadodara, Dabhoi and Padra). The core zone has 2639 households with a population of 12,392 individuals. An average household comprises of 4.64 individuals in the core area. The buffer zone has 300206 households with a population of 1337019 individuals. An average household comprises of 4.61 individuals in the buffer zone.

The average sex ratio of the core area comes out to be 938 females per 1000 males, while that of the buffer zone is (937), which is higher than the sex ratio of Gujarat state (919), Vadodara district (934), Vadodara tehsil (919), Dabhoi tehsil (934), and Padra tehsil (918).

The average Scheduled Caste population in the core area is about 8% of the population belonging to the community, which is more than the Scheduled caste population of Gujarat state (6.74%). The scheduled Case population of the buffer zone is 6.56%, which is lower than that of Gujarat State. The average Scheduled Tribe population is 19% of the core area, which is higher than that of Gujarat state (14.75%). The Scheduled Tribe population of buffer zone is 19.86%, which is higher than that of Gujarat State.

The average literacy rate in the core area is 71% while that in the buffer area is 74.21%. The average literacy rate in the study area is 76.64%. The female literacy rate in the core zone is 64% and that if the buffer area is 68.72%. the female literacy rate in the study area is 71.13%.

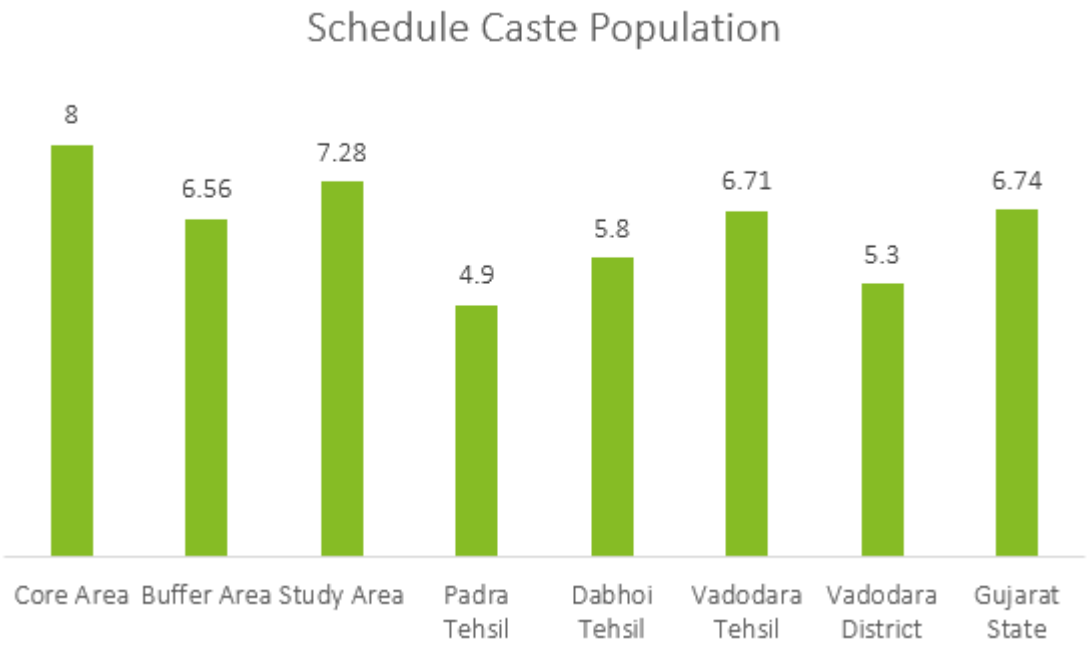
5.4.12 Social stratification

This section provides insights on the social stratification of study area, highlighting the scheduled caste and scheduled tribe populations present.

5.4.12.1 Scheduled Caste

As can be seen from ***Figure 5-28***, the SC population is highest in the core area (8%), followed by study area (7.28%) and lowest in Padra tehsil (4.9%), followed by Vadodara district (5.3%).

Figure 5-28 Proportion of SC population in the Study Area

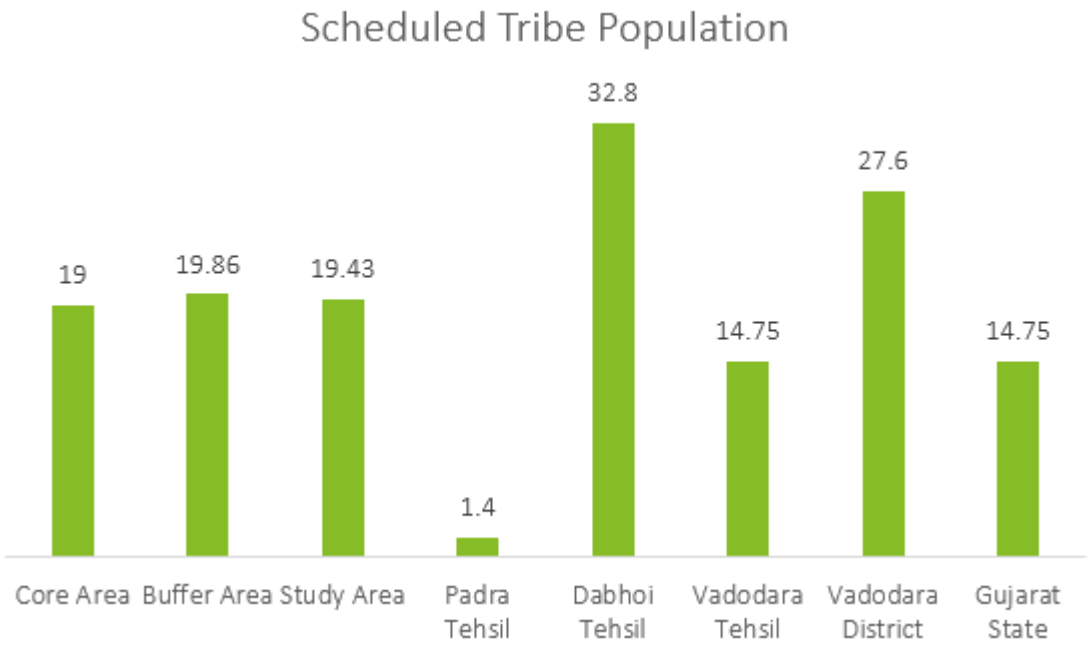


Source: Census of India 2011 data

5.4.12.2 Scheduled Tribes

Vadodara district is partially covered under the designated Scheduled V[46] area as notified by the Government of India. Thus, the provision of Article 244(1) of the Constitution of India, will be applicable to the project location.

Figure 5-29 Proportion of ST population



Source: Census of India 2011 data

[46] In the Article 244(1) of the Constitution, expression Scheduled Areas means such areas as the President may by order declare to be Scheduled Areas. These are areas with high population of Scheduled Tribes that are to be protected by law as stated under Article 244(1).

Dabhoi tehsil has the highest proportion of Scheduled Tribe, with 32.8% of its population belonging to the community, while the lowest proportion of Scheduled Tribes can be found in Padra tehsil, with only 1.4% of its population belonging to the community. The core area has an average scheduled tribe population of 19%, while the buffer zone has 19.86%. Vadodara district has 27.6% of its total population belonging to the Scheduled Tribe community.

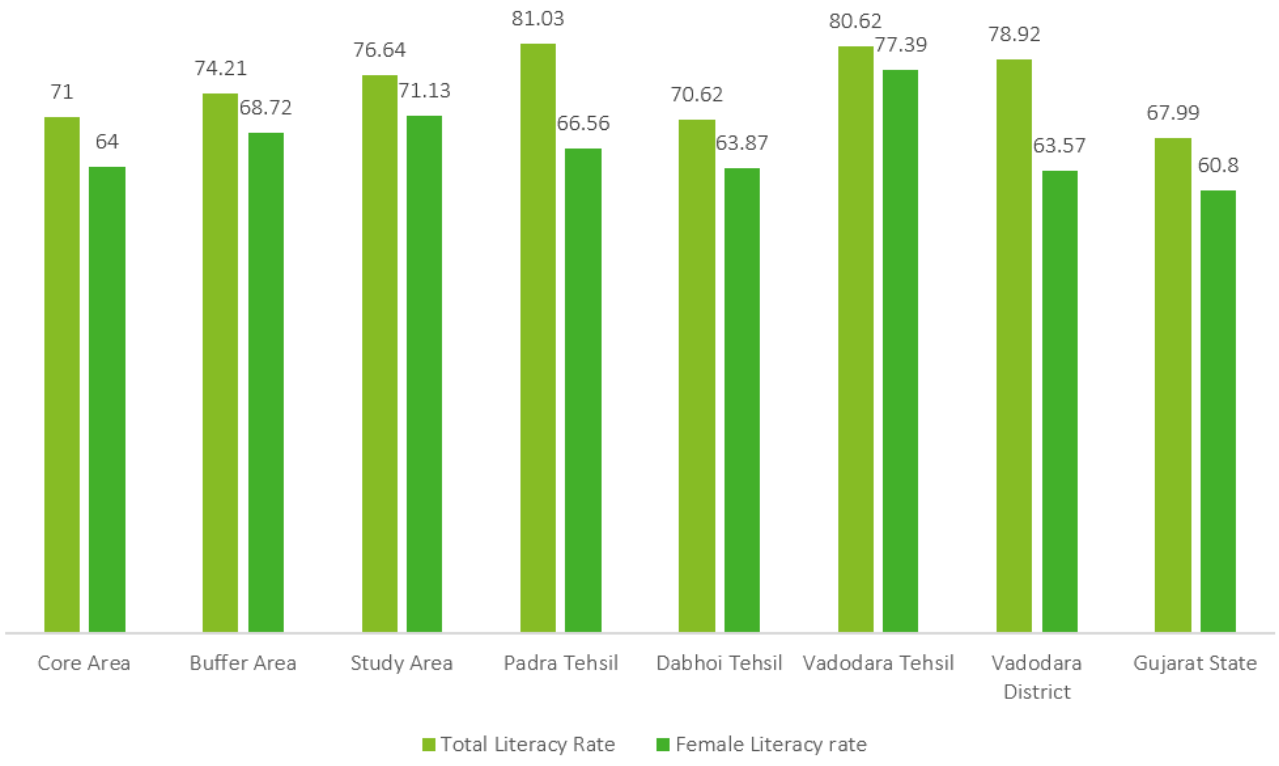
The Dhanka tribe is prevalent in Vadodara district[47]. The Dhanka are a tribe of India, largely found in Rajasthan, Haryana, Uttar Pradesh, Maharashtra, Chhattisgarh, Madhya Pradesh and Gujarat. Historically, the Dhankas have practiced varying occupations, depending on the need of the hour.

5.4.13 Literacy and Education

Out of all the literacy rates represented in the following figure, the total literacy rate is highest in Padra tehsil (81.03%) and lowest in Gujarat state (67.99%). Among the three tehsils, Dabhoi tehsil has the lowest total literacy rate (70.62%), while the total literacy rate of Vadodara tehsil is 80.62%. The core area has an average literacy rate of 71% while the buffer zone has 74.21%.

The female literacy rate is highest in Vadodara tehsil (77.39%) and lowest in Gujarat state (60.8%). Among the three tehsils, Dabhoi tehsil has the lowest female literacy rate (63.87%), while the female literacy rate of Padra tehsil is 66.56%. The core area has an average female literacy rate of 64%, while the buffer zone has 68.72%.

Figure 5-30 Total and Female Literacy Rates in the Core Area



Source: Census of India 2011 data

5.4.14 Land ownership and usage

This section provides an overview of land ownership and usage in the study area, based on the 2011 census. The region has an agrarian economy, and therefore, land is a crucial resource for the local population. The table for land utilization highlights the heavy dependence of the people on agriculture, which is one of the primary sources of their livelihood.

[47] https://tribal.gujarat.gov.in/demographic-fact

At the household level, land holding are arguably the most valuable assets 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.

Table 5-28 Land use pattern in core, buffer and study area

Village/Ward Name	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)
Core area												
Ward 16	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ward 18	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ward 19	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mujhar Gamdi Village	227.2	0	3	10.91	13.3	2.1	0	0	0	197.89	152.89	45
Total core area	**227.2**	**0**	**3**	**10.91**	**13.3**	**2.1**	**0**	**0**	**0**	**197.89**	**152.89**	**45**
Buffer area												
Vadodara Municipal Corporation												
Ward 3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ward 4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ward 5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ward 6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ward 7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ward 8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ward 10	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ward 11	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ward 12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ward 13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ward 14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ward 15	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ward 16	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Village/Ward Name	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)
Ward 17	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ward 18	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Villages												
Sundarpura	376.65	0	1.13	31.21	17.79	0	0	0	0	326.52	174.28	152.24
Dhaniyavi	1356.41	8	18	0	0	6	15	247.47	10	1051.94	971.94	80
Chikhodara	590.98	0	32.13	0	29.33	0	0	0	0	529.52	405.34	124.18
Varadla	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Maretha	240.65	0	2	10.71	13.08	0	5.68	0	1	208.18	108.18	100
Alamgir	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Khatamba	362.75	0	31.02	5.31	44.54	2.88	15	0	0	264	229	35
Ratanpur	294.85	0	1.21	0	14.13	0	30.12	15.18	31.21	203	148	55
Tatarpura	476.74	0	6.85	1.71	20.19	29.45	44.54	0	40	334	254	80
Kelanpur	847.41	2.18	6	4.1	122.95	3	44	0	65	600.18	520.18	80
Alhadpura	506.8	0.29	53.62	22.53	34.36	0	0	0	0	396	276	120
Hetampura	248.95	2	3	2.95	3	0	5	0	5	228	178	50
Hansajipura	253.77	0	2	2	11.77	0	3	5	10	220	215	5
Raghavpura	370.24	0	24.41	1.76	22.07	1	50	64	0	207	107	100
Shahpura	320.44	0	26	0	19	21	26.44	0	2	226	176	50
Patarveni	384.38	0	5	15	11	3	29	5.38	0	316	246	70
Mastupur Gamdi	148.39	2	2	3.25	3	1.25	10	0	10.89	116	56	60
Ajitpura	187.96	0	11	0	7	0	20.96	0	0	149	109	40
Dolatpura	128.45	0	2	2.45	4	1	29	0	0	90	60	30
Varanama	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Karali	317.05	0	7.54	10.46	5	0	3	10	11.05	270	100	170
Khalipur	485.1	5.5	65.32	0	25.08	0	90	17.24	50.96	231	171	60

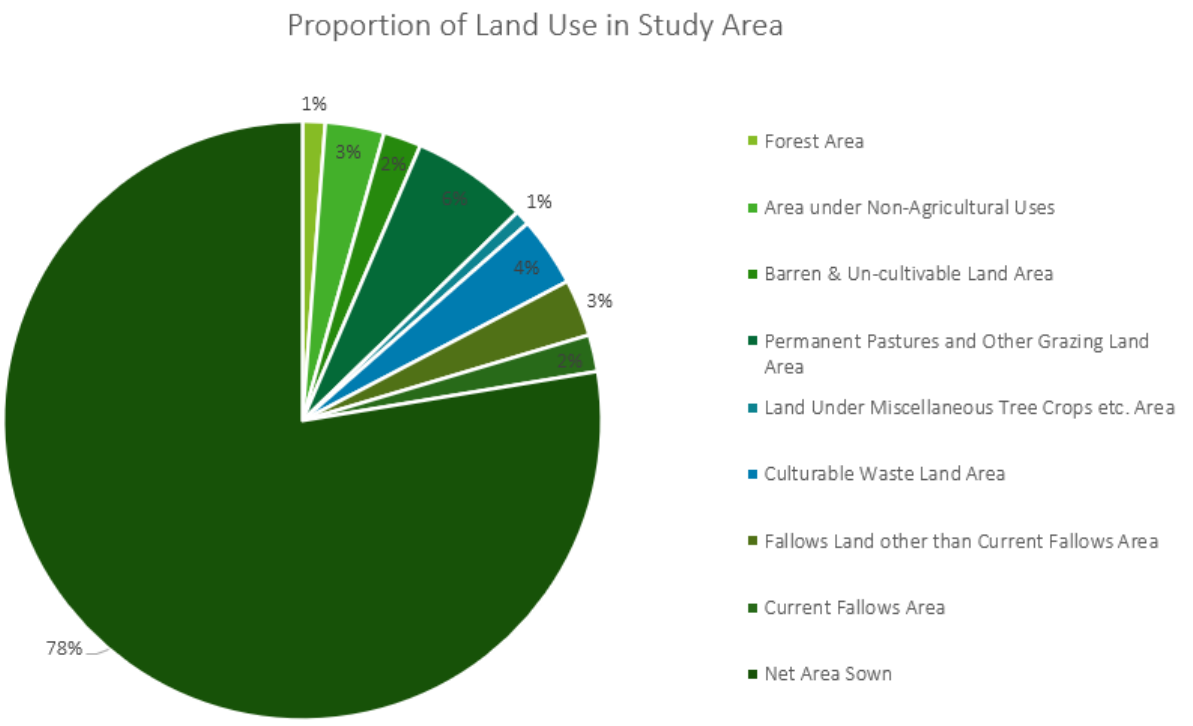
Village/Ward Name	Total Geographical Area (in Hectares)	Forest Area (in Hectares)	Area under Non-Agricultural Uses (in Hectares)	Barren & Un-cultivable Land Area (in Hectares)	Permanent Pastures and Other Grazing Land Area (in Hectares)	Land Under Miscellaneous Tree Crops etc. Area (in Hectares)	Culturable 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)
Palaswada	674.69	0	0	0	109.29	0	0	0	0	565.4	0	565.4
Mosampura	276.47	27.29	0	4.1	6.33	0	0	0	0	238.75	0	238.75
Kundhela	1228.92	98.6	0	40.92	137.47	0	0	0	0	951.93	651.93	300
Hansapura	299.07	0	12.08	33.21	15.48	0	0	0	0	238.3	0	238.3
Kajapura	189.39	0	0	6.02	23.7	0	0	0	0	159.67	0	159.67
Patod	511.33	0	31.17	3.69	7.67	0	16.52	2.87	0	449.41	438.15	11.26
Barliyapura Village	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vora Gamdi Village	392.88	0	5	30.76	19.26	10.86	10	0	0	317	297	20
Total Buffer area	11470.72	145.86	348.48	232.14	726.49	79.44	447.26	367.14	237.11	8886.8	5892	2994.8
Total Study area	11697.92	145.86	351.48	243.05	739.79	81.54	447.26	367.14	237.11	9084.69	6044.89	3039.8

Source: Census of India 2011 data

As can be ascertained from the above table, majority of the land is used for agricultural purposes. 78% of the total geographical area of the Study Area comes under "Net Sown Area"[48]. This shows high dependency on agriculture in the region. 66.52% of the Net Sown Area comes under "total unirrigated land"[49], showing that 33.48% of the Net Sown Area is irrigated by source. The second most widespread usage of land is under "Permanent Pastures and Other Grazing Land Area"[50], with 6% of land being used for the aforementioned. 4% of the total land in study area is used for "Culturable Waste Land Area"[51], while 3% of the land is covered under "Area under Non-Agricultural Use"[52].

[48] This represents the total area sown with crops and orchards. Area sown more than once in the same year is counted only once.
[49] It is the area arrived at by deducting the gross irrigated area from the gross sown area.
[50] This includes all grazing land whether it is permanent pasture/meadows or not. Village common grazing land is included under this category.
[51] This includes land available for cultivation, whether taken up or not taken up for cultivation once, but not cultivated during the last five years or more in succession including the current year for some reason or the other .
[52] This includes all land occupied by buildings, roads and railways or under water, e.g. rivers and canals, and other land put to uses other than agriculture.

Figure 5-31 Portion of land use in core area



Source: Census of India 2011 data

5.4.15 Occupational profile

As understood from the data most of the urban population is engaged in other occupations and main source of livelihood is other than agriculture however statistical information of Vadodara municipal corporation is not available. The following table provides a break-up of working population in the study area. As understood from site consultation

Table 5-29 Proportion and break-up of working population in the study area

Villages /Wards	Total Working Population (% of Total Population)	Main worker (% of total working population)	Main work Male (% of WPR)	Main worker Female (% of WPR)	Marginal (% of total working population)	Marginal worker male (% of WPR)	Marginal worker female (% of WPR)	Non-working population (% of total population)
Core area								
Ward 16	NA	NA	NA	NA	NA	NA	NA	NA
Ward 18	NA	NA	NA	NA	NA	NA	NA	NA
Ward 19	NA	NA	NA	NA	NA	NA	NA	NA
Mujar Gamdi	33.6	34%	93%	91%	8%	8%	100%	0%
Total core area	**33.6**	**34%**	**93%**	**91%**	**8%**	**8%**	**100%**	**0%**
Buffer area								

Villages /Wards	Total Working Population (% of Total Population)	Main worker (% of total working population)	Main work Male (% of WPR)	Main worker Female (% of WPR)	Marginal (% of total working population)	Marginal worker male (% of WPR)	Marginal worker female (% of WPR)	Non-working population (% of total population)
Vadodara Municipal Corporation								
Ward 3	NA	NA	NA	NA	NA	NA	NA	NA
Ward 4	NA	NA	NA	NA	NA	NA	NA	NA
Ward 5	NA	NA	NA	NA	NA	NA	NA	NA
Ward 6	NA	NA	NA	NA	NA	NA	NA	NA
Ward 7	NA	NA	NA	NA	NA	NA	NA	NA
Ward 8	NA	NA	NA	NA	NA	NA	NA	NA
Ward 10	NA	NA	NA	NA	NA	NA	NA	NA
Ward 11	NA	NA	NA	NA	NA	NA	NA	NA
Ward 12	NA	NA	NA	NA	NA	NA	NA	NA
Ward 13	NA	NA	NA	NA	NA	NA	NA	NA
Ward 14	NA	NA	NA	NA	NA	NA	NA	NA
Ward 15	NA	NA	NA	NA	NA	NA	NA	NA
Ward 16	NA	NA	NA	NA	NA	NA	NA	NA
Ward 17	NA	NA	NA	NA	NA	NA	NA	NA
Ward 18	NA	NA	NA	NA	NA	NA	NA	NA
Villages								
Sundarpura	45.07	90.19	76.31	23.69	9.81	25	75	54.93
Dhaniyavi	37.61	92.88	85.64	14.36	7.12	76.19	23.81	62.39
Chikhodara	56.15	63.1	81.91	18.09	36.9	13.54	86.46	43.85
Varadla	NA	NA	NA	NA	NA	NA	NA	NA
Talsat	36.92	84.58	93.45	6.55	15.42	35.94	64.06	63.08
Maretha	38.27	86.78	93.56	6.44	13.22	18.56	81.44	61.73
Alamgir	NA	NA	NA	NA	NA	NA	NA	NA
Khatamba	35	85.09	77.01	22.99	14.91	45.83	54.17	65
Ratanpur	44.16	63.21	82.42	17.58	36.79	65.31	34.69	55.84
Tatarpura	47.23	77.33	87.17	12.83	22.67	6.25	93.75	52.77
Kelanpur	33.46	67.14	90.12	9.88	32.86	78.26	21.74	66.54

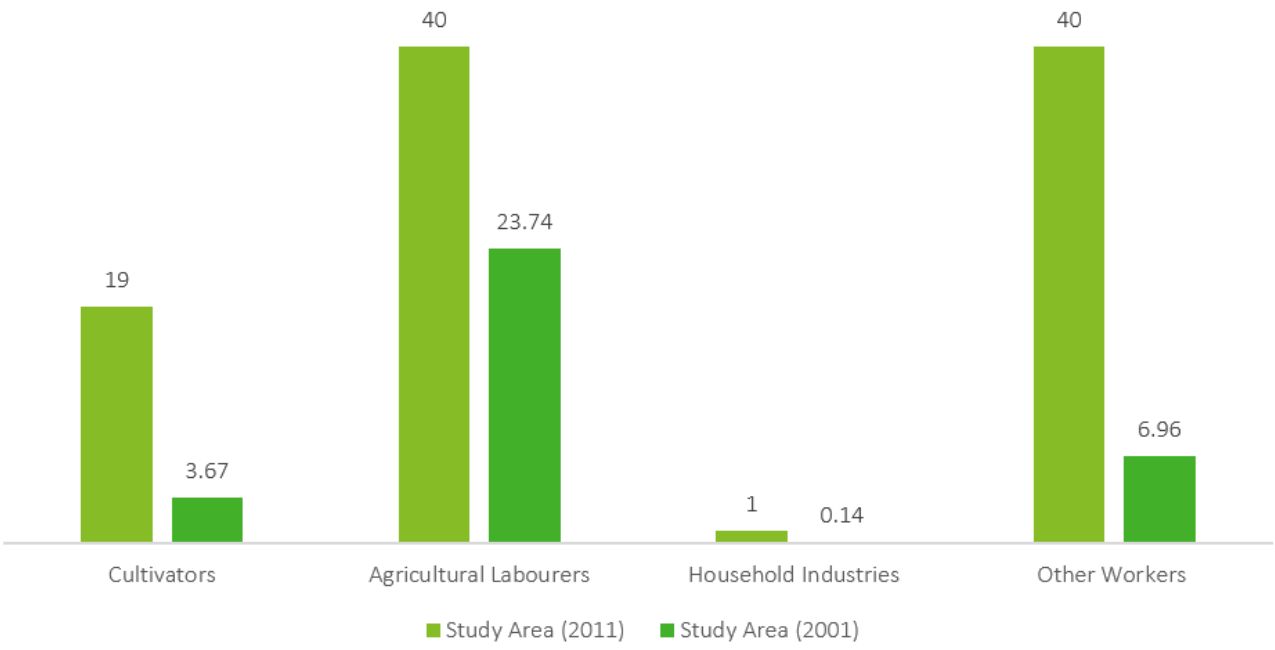
Villages /Wards	Total Working Population (% of Total Population)	Main worker (% of total working population)	Main work Male (% of WPR)	Main worker Female (% of WPR)	Marginal (% of total working population)	Marginal worker male (% of WPR)	Marginal worker female (% of WPR)	Non-working population (% of total population)
Alhadpura	39.96	95.96	78.68	21.32	4.04	56.25	43.75	60.04
Hetampura	35.37	77.44	96.84	3.16	22.56	48.33	51.67	64.63
Hansajipura	NA	NA	NA	NA	NA	NA	NA	NA
Raghavpura	31.41	69.29	93.51	6.49	30.71	84.15	15.85	68.59
Shahpura	35.5	97.71	92.4	7.6	2.29	75	25	64.5
Patarveni	56.45	99.26	64.36	35.64	0.74	33.33	66.67	43.55
Mastupur Gamdi	45.35	99.49	76.29	23.71	0.51	100	0	54.65
Ajitpura	52.11	22.22	100	0	77.78	51.95	48.05	47.89
Dolatpura	58.54	25	75	25	75	58.33	41.67	41.46
Varanama	NA	NA	NA	NA	NA	NA	NA	NA
Karali	60.93	86.56	57.32	42.68	13.44	28.41	71.59	39.07
Khalipur	52.47	82.82	72.49	27.51	17.18	9.47	90.53	47.53
Palaswada	48.17	77.04	76.35	23.65	22.96	42.5	57.5	51.83
Mosampura	65.5	81.95	62.5	37.5	18.05	8.11	91.89	34.5
Kundhela	53.16	88.62	73.06	26.94	11.38	21.05	78.95	46.84
Hansapura	45.58	53.06	94.23	5.77	46.94	53.26	46.74	54.42
Kajapura	39.05	87.45	84.81	15.19	12.55	58.82	41.18	60.95
Patod	37.92	95.96	82.48	17.52	4.04	84.21	15.79	62.08
Barliyapura Village	NA	NA	NA	NA	NA	NA	NA	NA
Vora Gamdi Village	36.77	98.81	79.6	20.4	1.19	33.33	66.67	63.23
Total Buffer area	**44.93**	**78.81**	**81.83**	**18.17**	**21.19**	**46.59**	**53.41**	**55.07**
Total Study area	**39.26**	**39.57**	**41.38**	**9.54**	**10.64**	**23.34**	**27.20**	**27.54**

Source: Census of India 2011 data

An average of 39.26% of the total population in the study area are working. 27.54% of the total population constitute the non-working population.

According to ***Figure 5-32***, out of the main working population, majority of the population is categorized as Other Workers and Agricultural Labourers (both constituting 40% of all main working population each). Cultivators form 19% of the main working population in the study area. The least proportion of main working population is a part of household industries, with only 1% of the main working population.

Figure 5-32 Distribution of main working population in the study area and comparison between 2001 and 2011



Source: Census of India 2011 data

5.4.16 Physical infrastructure

Water Supply and Sanitation:

The Vadodara city gets water from radial wells in River Mahi, tube wells in River Mahi, from Ajwa Lake and also from tube wells scattered in the city. At present the water supply of the city is 270 MLD. The surface water sources supplies almost 30 % of the water supply. The city has two treatment plants, which treats water only from the Sayaji Reservoir (Ajwa). Water from underground sources is not treated but the supplies are chlorinated before supplying. The city has a water distribution network of 700 kms, which covers 75% of the total area.

It can be observed that most people in the study core area living in village are dependent on handpump and tube wells/ boreholes. There are no Tap Water (treated) provisions or springs in any of the villages in the study core area.

Table 5-30 Water Resources availability in study area

Name of the village	Tap Water-Treated	Covered Well	Hand Pump	Tube Wells/Borehole	Spring	River/Canal	Tank/Pond/Lake	Others
Ward 16	-	-	-	-	-	-	-	-
Ward 18	-	-	-	-	-	-	-	-
Ward 19	-	-	-	-	-	-	-	-
Mujar Gamdi	Not Available	Not Available	Available	Not Available	Not Available	Not Available	Not Available	Not Available
Buffer area								

Vadodara Municipal Corporation								
Ward 3	-	-	-	-	-	-	-	-
Ward 4	-	-	-	-	-	-	-	-
Ward 5	-	-	-	-	-	-	-	-
Ward 6	-	-	-	-	-	-	-	-
Ward 7	-	-	-	-	-	-	-	-
Ward 8	-	-	-	-	-	-	-	-
Ward 10	-	-	-	-	-	-	-	-
Ward 11	-	-	-	-	-	-	-	-
Ward 12	-	-	-	-	-	-	-	-
Ward 13	-	-	-	-	-	-	-	-
Ward 14	-	-	-	-	-	-	-	-
Ward 15	-	-	-	-	-	-	-	-
Ward 16	-	-	-	-	-	-	-	-
Ward 17	-	-	-	-	-	-	-	-
Ward 18	-	-	-	-	-	-	-	-
Villages								
Sundarpura	Not Available	Not Available	Not Available	Available	Not Available	Not Available	Available	Not Available
Dhaniyavi	Not Available	Not Available	Available	Available	Not Available	Not Available	Available	Not Available
Chikhodara	Not Available	Not Available	Available	Available	Not Available	Not Available	Available	Not Available
Varadla	-	-	-	-	-	-	-	-
Talsat	Not Available	Not Available	Available	Available	Not Available	Not Available	Not Available	Not Available
Maretha	Not Available	Not Available	Available	Available	Not Available	Available	Available	Not Available
Alamgir	-	-	-	-	-	-	-	-
Khatamba	Not Available	Not Available	Available	Available	Not Available	Not Available	Available	Not Available
Ratanpur	Not Available	Not Available	Available	Available	Not Available	Not Available	Available	Not Available
Tatarpura	Not Available	Not Available	Available	Available	Not Available	Not Available	Not Available	Not Available
Kelanpur	Not Available	Not Available	Available	Available	Not Available	Not Available	Not Available	Available
Alhadpura	Not Available	Not Available	Available	Available	Not Available	Not Available	Available	Not Available
Hetampura	Not Available	Not Available	Available	Available	Not Available	Not Available	Available	Not Available
Hansajipura	Not Available	Not Available	Available	Available	Not Available	Not Available	Available	Not Available

Raghavpura	Not Available	Not Available	Available	Available	Not Available	Not Available	Available	Not Available
Shahpura	Not Available	Not Available	Available	Available	Not Available	Not Available	Available	Not Available
Patarveni	Not Available	Not Available	Available	Available	Not Available	Not Available	Available	Not Available
Mastupur Gamdi	Not Available	Available	Available	Available	Not Available	Available	Available	Not Available
Ajitpura	Not Available	Not Available	Available	Available	Not Available	Available	Not Available	Not Available
Dolatpura	Not Available	Not Available	Available	Available	Not Available	Not Available	Available	Not Available
Varanama	-	-	-	-	-	-	-	-
Karali	Not Available	Available	Available	Available	Not Available	Available	Available	Not Available
Khalipur	Not Available	Not Available	Available	Available	Not Available	Not Available	Not Available	Not Available
Palaswada	Not Available	Not Available	Available	Available	Not Available	Not Available	Available	Not Available
Mosampura	Not Available	Not Available	Not Available	Available	Not Available	Available	Not Available	Not Available
Kundhela	Not Available	Not Available	Available	Not Available	Not Available	Available	Available	Not Available
Hansapura	Not Available	Not Available	Available	Available	Not Available	Not Available	Not Available	Not Available
Kajapura	Not Available	Not Available	Available	Available	Not Available	Not Available	Available	Not Available
Patod	Not Available	Not Available	Available	Available	Not Available	Not Available	Available	Not Available
Barliyapura Village	-	-	-	-	-	-	-	-
Vora Gamdi Village	Not Available	Not Available	Available	Available	Not Available	Not Available	Not Available	Not Available

Source: Census of India 2011 data

The sewerage system consists of an underground piped network, five sewage-pumping stations, 35 auxiliary pumping stations five treatment plants and disposal facilities for the treated sewage. The city is divided into three zones with a total length of 535 km of sewerage network and the total sewerage generated is about 215 MLD. The present area of Vadodara is 149 sq. kms. of which only 82 sq. kms. (55 %) is covered by the sewerage system. This serves around 65% of the total population.

Road and Communication: The city has three flyovers and railways under bridges each. The river Vishwamitri has 11 bridges interconnecting the city areas. The road network within the city is well developed in almost 70% of the area and caters to around 80% of the city's total population. More than 80% of the roads are surfaced of which most of them are black topped while 19% of the roads are earthen. As per the site visit it was understood all the villages / habitations coming under the project is well connected with the all-weather road.

Electrification: All the villages /habitations coming under the study area are electrified and most of the community member are having basic amenities at the household level.

5.4.17 Social infrastructure

Baroda is synonymous with education. The patronage of education started with Maharaja Sayajirao and the city has built further on the academic infrastructure established by him. The present educational foundation rests on over 20 public schools and over 100 private schools. The Maharaja Sayajirao University is the only university in Gujarat with English as the medium of instruction. It has 13 faculties and 17 residential hostels, 4 of them for women students. The university caters to over 30,000 students.

As per the data provided ***Table 5-31***, we can identify that there is only 1 Government Primary school available in core area.

Table 5-31 Educational infrastructure in the study area

Village / Ward	Government Pre - Primary School (Nursery/LKG/KG)	Government Primary School	Government Middle School	Government Secondary School	Government Senior Secondary School
Core area					
Ward 16	NA	NA	NA	NA	NA
Ward 18	NA	NA	NA	NA	NA
Ward 19	NA	NA	NA	NA	NA
Mujar Gamdi	Not Available	Available	Not Available	Not Available	Not Available
Buffer area					
Vadodara Municipal Corporation					
Ward 3	-	-	-	-	-
Ward 4	-	-	-	-	-
Ward 5	-	-	-	-	-
Ward 6	-	-	-	-	-
Ward 7	-	-	-	-	-
Ward 8	-	-	-	-	-
Ward 10	-	-	-	-	-
Ward 11	-	-	-	-	-
Ward 12	-	-	-	-	-
Ward 13	-	-	-	-	-
Ward 14	-	-	-	-	-
Ward 15	-	-	-	-	-
Ward 16	-	-	-	-	-
Ward 17	-	-	-	-	-
Ward 18	-	-	-	-	-
Villages					
Sundarpura	Not Available	Available	Not Available	Not Available	Not Available

Village / Ward	Government Pre - Primary School (Nursery/LKG/KG)	Government Primary School	Government Middle School	Government Secondary School	Government Senior Secondary School
Dhaniyavi	Not Available	Available	Not Available	Not Available	Not Available
Chikhodara	Not Available	Available	Not Available	Not Available	Not Available
Varadla	-	-	-	-	-
Maretha	Not Available	Available	Not Available	Not Available	Not Available
Alamgir	-	-	-	-	-
Khatamba	Not Available	Available	Not Available	Not Available	Not Available
Ratanpur	Not Available	Available	Not Available	Not Available	Not Available
Tatarpura	Not Available	Available	Not Available	Not Available	Not Available
Kelanpur	Not Available	Available	Not Available	Not Available	Not Available
Alhadpura	Not Available	Available	Not Available	Not Available	Not Available
Hetampura	Not Available	Available	Not Available	Not Available	Not Available
Hansajipura	Not Available	Available	Not Available	Not Available	Not Available
Raghavpura	Not Available	Available	Not Available	Not Available	Not Available
Shahpura	Not Available	Available	Not Available	Not Available	Not Available
Patarveni	Not Available	Available	Not Available	Not Available	Not Available
Mastupur Gamdi	Not Available	Available	Not Available	Not Available	Not Available
Ajitpura	Not Available	Available	Not Available	Not Available	Not Available
Dolatpura	Not Available	Not Available	Not Available	Not Available	Not Available
Varanama	-	-	-	-	-
Karali	Not Available	Available	Not Available	Not Available	Not Available
Khalipur	Not Available	Available	Not Available	Not Available	Not Available
Palaswada	Not Available	Available	Not Available	Not Available	Not Available
Mosampura	Not Available	Available	Not Available	Not Available	Not Available
Kundhela	Not Available	Available	Not Available	Not Available	Not Available
Hansapura	Not Available	Available	Not Available	Not Available	Not Available
Kajapura	Not Available	Available	Not Available	Not Available	Not Available
Patod	Not Available	Available	Not Available	Not Available	Not Available
Barliyapura Village	-	-	-	-	-

Village / Ward	Government Pre - Primary School (Nursery/LKG/KG)	Government Primary School	Government Middle School	Government Secondary School	Government Senior Secondary School
Vora Gamdi Village	Not Available	Available	Not Available	Not Available	Not Available

Source: Census of India 2011 data

5.4.17.1 Health facilities and Health seeking Behavior

As per VMC website, Vadodara city is having the following health infrastructure

- Govt. Hospitals - 2
- Urban Health Centers - 17+2
- NGO's Centers – 5+1
- Integrated Health centers & nursing Home - 1
- Staff Dispensaries - 2
- Full Time/Part Time Dispensaries - 15
- Mobile Unit - 4

As per the census 2011 data There are no health facilities present within the village falling under core area. Although in the recent decade there has been a significant growth in heath infrastructure however as the census data is nearly 11 years old hence the recent development in health infrastructure may not be captured in the census data.

5.4.18 Brief profile of ragpickers

The waste generated by Vadodara City is significantly higher than the waste requirement for the operation of the WTE plant. With a waste generation of more than ~2,000 TPD and a requirement of 1,000 TPD for the operation of WTE Plant, there is still a substantial amount of waste that needs to dump at Vadodara landfill site. The waste will continue to be dumped at the Vadodara landfill site where approximately 20 ragpickers are collecting recyclable waste from freshly dumped waste. Given that there is a sufficient waste available at the landfill site, it is envisaged that the ragpickers will continue their activities without being economically displaced due to the development of the WTE plant.

Below is a brief socio-economic profile of the ragpickers involved in this activity at the transfer station:

Aspects	Description
Total Number of Ragpickers involved in rag picking	20 ragpickers (~10 males and ~10 females) The number is based on consultation with ragpickers.
Demography of the family of ragpickers	On average, the household size comprises 4-5 individuals. Ragpicker households typically consist of nuclear families, including a husband, wife, and their children. It is noteworthy that all ragpickers belong to the Other Backward Class (OBC).
Migration	All ragpickers have migrated from Madhya Pradesh, Rajasthan, and Uttar Pradesh to Gujarat in search of better income opportunities. Reportedly, rag picking is not the primary occupations of these ragpickers, all the ragpickers are working as casual labour in the Vadodara city, however, on the day they did not find work as casual labour they come for rag picking.
Literacy among the family	All the family members of ragpickers are illiterate.
Number of year since involved in rag picking	3-4 years
Average income from repicking	The income of ragpickers is primarily derived from the sale of the collected recyclable materials. The value of the recyclables can vary depending on market demand, material type,

	and overall quality. On average, ragpickers earns a daily income ranging from INR 1,200 to INR 1,500 based on the quantity and quality of recyclables they collect. Provide below the selling price of recyclables collected by ragpickers:

Type of Recyclables	Selling Price (INR/kg)
Hair	4,000
Plastic bottles	23
Used milk plastic packets	13
Corrugated box	19-20
Used Cement bags	8
Aluminum	200
Copper	1,000
Iron	27
Shoe soles	14

Process of collection of waste and selling by Ragpickers	Ragpickers collects the recyclable from the freshly dumped waste at the landfill. Once waste collected, ragpickers meticulously segregate the waste based on its nature and composition. This sorting process is essential to ensure that different type of recyclable materials is properly separated, enhancing their value, and facilitating their recycling process. Ragpickers typically classify waste into categories such as plastic, glass, shoe soles, hairs, etc. After segregation, ragpickers take the sorted recyclables to local markets, scrap dealers, or recycling centres to sell them.
Stoppage in rag picking activities	As informed, there is no stoppage of rag picking activities at the landfill.
Accessibility of health infrastructure	All the ragpickers are going to the government owned hospital at the Vadodara to avail the health facilities.

5.5 Ecological Baseline

Between the dates of 16th to 18th May 2023, ecological survey was undertaken with the aim of establishing a baseline understanding of the study area's ecosystem. The primary objective of this endeavour was to assess and determine the potential effects that project-related activities could have on the species and habitats located nearby surroundings of the project site. The information gathered from this survey was used to identify appropriate mitigation and management strategies to minimize any adverse impacts.

5.5.1 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.
- 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.

5.5.2 Ecological Baseline - Data Collection Methods

In order to gain insights into the current ecological conditions of the study area, an ecological baseline was established. This baseline was developed by utilizing information obtained through two key methods: i. Literature Review and ii. Field Data Collection.

5.5.2.1 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.; and for IUCN Threatened and Restricted-range species; and Key Biodiversity Areas (KBAs), which include Important Bird and Biodiversity Areas (IBAs) in and around the proposed project location. Additionally, a comprehensive list of the floral and faunal species was compiled, accompanied by their respective conservation statuses according to the International Union for Conservation of Nature (IUCN) and their designation within the list of scheduled species as outlined in the Wildlife (Protection) Act of 1972. This compilation was based on the analysis of secondary data collected during the literature review phase. Furthermore, the primary habitats within and in the vicinity of the project site were determined through a combination of on-site ground observations, analysis of Google Earth imagery, and examination of other relevant secondary data sources. These efforts aimed to identify the dominant ecological zones and provide a comprehensive understanding of the surrounding habitat composition. Moreover, available information was utilized to identify internationally and/or nationally recognized wildlife migratory corridors as well as avian migratory routes.

5.5.2.2 Field Data Collection

A field survey was undertaken to assess the current ecological conditions, encompassing habitats, flora, and fauna, within the designated study area. This baseline data serves as a crucial foundation for effectively evaluating the potential impacts of the project on the local ecology and enables the formulation of suitable mitigation strategies. During the survey, special attention was given to habitats with the potential to support significant biodiversity, such as forest patches, scrubs, and water bodies.

5.5.2.2.1 Habitat Survey

The various habitats present in the study area, including both natural and modified as identified in the desktop review, were verified during on-site visits. Detailed data pertaining to the type and quality of each habitat, particularly in relation to the flora and fauna it sustains, was systematically collected.

5.5.2.2.2 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.

5.5.2.2.3 Faunal Survey

I. 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.;
II. Consultations 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 was typically obtained from the authentic sources[53,54],

5.5.3 Ecological Baseline – Results

5.5.3.1 Literature Review - eBird Database

Historical data concerning the occurrence of avian species in the region was retrieved from the eBird Database[55,56]. The database revealed the presence of a minimum of 315 avifaunal species within a radius of 10-15 km around the project site. The primary aim of extracting this information was to investigate the prevalence of IUCN threatened birds, including vultures, raptors, and migratory bird species in the designated area.

[53] 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

[54] Menon, V. (2014) Indian Mammals: A Field Guide. Hachette, India
[55] https://ebird.org/region/IN-GJ-VD?yr=all
[56] https://www.inaturalist.org/places/vadodara

The eBird Database indicates the presence of two (2)Critically Endangered **CR** (White-rumped Vulture Gyps bengalensis and Indian Vulture Gyps indicus), Three (3) Endangered **EN** (Black-bellied Tern *Sterna acuticauda*, Egyptian Vulture *Neophron percnopterus* and Steppe Eagle *Aquila nipalensis*), Five (5) Vulnarable **VL** (Greater Spotted Eagle *Clanga clanga*, Indian Spotted Eagle Clanga hastata, River Tern *Sterna aurantia,* Common Pochard *Aythya farina* and Sarus Crane *Antigone antigone*) and Thirteen (13) Near Thretened **NT** (Alexandrine Parakeet *Psittacula eupatria,* Asian Woolly-necked Stork *Ciconia episcopus,* Black-headed Ibis *Threskiornis melanocephalus,* Black-necked Stork *Ephippiorhynchus asiaticus,* Black-tailed Godwit *Limosa limosa,* Eurasian Curlew *Numenius arquata,* Ferruginous Duck *Aythya nyroca,* Great Thick-knee *Esacus recurvirostris, Lesser Flamingo Phoeniconaias minor, Oriental Darter Anhinga melanogaster, Painted Stork Mycteria leucocephala, Dalmatian Pelican Pelecanus crispus,* and Pallid Harrier *Circus macrourus*). 33 Schedule-I species (Amur Falcon, Barn Owl, Black Kite, Black-bellied Tern, Bonelli's Eagle, Booted Eagle, Brahminy Kite, Brown Fish-Owl, Common Buzzard, Common Crane, Common Pochard, Cotton Pygmy-Goose, Demoiselle Crane, Egyptian Vulture, Eurasian Griffon, Eurasian Marsh-Harrier, Eurasian Moorhen, Eurasian Sparrowhawk, Eurasian Spoonbill, Eurasian Wigeon, Ferruginous Duck, Greater Spotted Eagle , Gull-billed Tern, Indian Peafowl, Indian Spotted Eagle, Indian Vulture, Osprey, Pallid Harrier, River Tern, Sarus Crane, Short-eared Owl, Short-toed Snake-Eagle, Steppe Eagle and White-rumped Vulture).

The available secondary data confirms the periodic presence of at least 28 Raptors (Bird of prey) species from the region including, Two Critically Endangred **CR** (Indian Vulture *Gyps indicus* and White-rumped Vulture *Gyps bengalensis*); Two (2) Endangered **EN** (Steppe Eagle *Aquila nipalensis* and Egyptian Vulture *Neophron* percnopterus); and Two (2) Vulnerable **VU** (Greater Spotted Eagle *Clanga clanga* & Indian Spotted Eagle *Clanga hastata*, and one (1) Near Threatened (Pallid Harrier *Circus macrourus*).

As per the database, at least 112 migratory birds including one Endangered **EN** (1) Black-bellied Tern *Sterna acuticauda,* One (1) Vulnerable **VL** Common Pochard *Aythya farina* and Five (5) Near Threatened (*Black-tailed Godwit* Pallid Harrier, Ferruginous Duck, Lesser Flamingo, Dalmatian Pelican, Eurasian Curlew). And 12 Schedule-I species (Eurasian Marsh-Harrier, Eurasian Sparrowhawk, Eurasian Wigeon, Gull-billed Tern, Pallid Harrier, Common Pochard, Ferruginous Duck, Booted Eagle, Black-bellied Tern, Common Crane, Demoiselle Crane and Eurasian Griffon) were reported.

Table 5-32 IUCN threatened birds reported from the region.

S.N.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
1	Black-headed Ibis	*Threskiornis melanocephalus*	R	Near Threatened	Schedule IV
2	Painted Stork	*Mycteria leucocephala*	R	Near Threatened	Schedule IV
3	Asian Woolly-necked Stork	*Ciconia episcopus*	R	Near Threatened	Schedule IV
4	Alexandrine Parakeet	*Psittacula eupatria*	R	Near Threatened	Schedule IV
5	River Tern	*Sterna aurantia*	R	Vulnerable	Schedule I
6	Oriental Darter	*Anhinga melanogaster*	R	Near Threatened	Schedule IV
7	Great Thick-knee	*Esacus recurvirostris*	R	Near Threatened	Schedule IV
8	Black-tailed Godwit	*Limosa limosa*	M	Near Threatened	Schedule IV
9	Sarus Crane	*Antigone antigone*	R	Vulnerable	Schedule I
10	Pallid Harrier	*Circus macrourus*	M	Near Threatened	Schedule I
11	Greater Spotted Eagle	*Clanga clanga*	R	Vulnerable	Schedule I
12	Common Pochard	*Aythya ferina*	M	Vulnerable	Schedule I
13	Ferruginous Duck	*Aythya nyroca*	M	Near Threatened	Schedule I
14	Black-necked Stork	*Ephippiorhynchus asiaticus*	R	Near Threatened	Schedule IV
15	Black-bellied Tern	*Sterna acuticauda*	M	Endangered	Schedule I
16	Lesser Flamingo	*Phoeniconaias minor*	M	Near Threatened	Schedule IV
17	Dalmatian Pelican	*Pelecanus crispus*	M	Near Threatened	Schedule IV

S.N.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
18	Egyptian Vulture	*Neophron percnopterus*	R	Endangered	Schedule I
19	Eurasian Curlew	*Numenius arquata*	M	Near Threatened	Schedule IV
20	Steppe Eagle	*Aquila nipalensis*	R	Endangered	Schedule I
21	Indian Spotted Eagle	*Clanga hastata*	R	Vulnerable	Schedule I
22	Indian Vulture	*Gyps indicus*	R	Critically Endangered	Schedule I
23	White-rumped Vulture	*Gyps bengalensis*	R	Critically Endangered	Schedule I

Table 5-33 Raptors reported from the region

S.N.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
1	Shikra	*Accipiter badius*	R	Least Concern	Schedule IV
2	Black Kite	*Milvus migrans*	R	Least Concern	Schedule I
3	Black-winged Kite	*Elanus caeruleus*	R	Least Concern	Schedule I
4	Indian Scops-Owl	*Otus bakkamoena*	R	Least Concern	Schedule IV
5	Eurasian Marsh-Harrier	*Circus aeruginosus*	M	Least Concern	Schedule I
6	Eurasian Sparrowhawk	*Accipiter nisus*	M	Least Concern	Schedule I
7	Pallid Harrier	*Circus macrourus*	M	Near Threatened	Schedule I
8	Barn Owl	*Tyto alba*	R	Least Concern	Schedule I
9	Greater Spotted Eagle	*Clanga clanga*	R	Vulnerable	Schedule I
10	Short-toed Snake-Eagle	*Circaetus gallicus*	R	Least Concern	Schedule I
11	Booted Eagle	*Hieraaetus pennatus*	M	Least Concern	Schedule I
12	Osprey	*Pandion haliaetus*	R	Least Concern	Schedule I
13	Mottled Wood-Owl	*Strix ocellata*	R	Least Concern	Schedule IV
14	Crested Serpent-Eagle	*Spilornis cheela*	M	Least Concern	Schedule IV
15	Peregrine Falcon	*Falco peregrinus*	M	Least Concern	Schedule IV
16	Red-necked Falcon	*Falco chicquera*	R	Least Concern	Schedule IV
17	Amur Falcon	*Falco amurensis*	R	Least Concern	Schedule I
18	Egyptian Vulture	*Neophron percnopterus*	R	Endangered	Schedule I
19	Steppe Eagle	*Aquila nipalensis*	R	Endangered	Schedule I
20	Brahminy Kite	*Haliastur indus*	R	Least Concern	Schedule I
21	Montagu's Harrier	*Circus pygargus*	M	Least Concern	Schedule IV
22	Indian Spotted Eagle	*Clanga hastata*	R	Vulnerable	Schedule I
23	Bonelli's Eagle	*Aquila fasciata*	R	Least Concern	Schedule I
24	Indian Vulture	*Gyps indicus*	R	Critically Endangered	Schedule I
25	White-rumped Vulture	*Gyps bengalensis*	R	Critically Endangered	Schedule I
26	Short-eared Owl	*Asio flammeus*	R	Least Concern	Schedule I

S.N.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
27	Eurasian Griffon	*Gyps fulvus*	M	Least Concern	Schedule I
28	Rock Eagle-Owl	*Bubo bengalensis*	R	Least Concern	Schedule IV

5.5.3.2 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. The study area consists of natural habitats[57] (open scrub, & water bodies, river), and modified habitats[58] (agricultural lands, & plantations). The distribution of identified habitats within the study area can be seen in ***Figure 5-33***. Photographs of these habitats have been presented in ***Figure 5-34.***

Table 5-34 Area covered by different habitats.

Natural Habitat			Modified Habitat		
Landuse	Area Covered (Sqkm)	%	Landuse	Area Covered (Sqkm)	%
River	4.3733	1.4	Agricultural Land	171.5744	54.75
Open Scrub Land	31.7527	10.13	Settlements	87.4071	27.89
Waterboy	3.53	1.13	Canal	1.7109	0.55
Total	39.656	12.65	Roads	9.683	3.09
			Railway Line	3.345	1.07
			Total	273.7204	87.35
Total area including Natural and Modified habitats =313.3764 Km2					

[57] Natural habitats should not be perceived as completely untouched or pristine environments. It is probable that a significant portion of habitats classified as natural has experienced some level of historical or recent human influence. The crucial consideration is the extent of this impact. If, in the assessment of a qualified professional, the habitat predominantly retains the essential features and functions of native ecosystems, it should be acknowledged as a natural habitat, irrespective of any degree of degradation or the existence of invasive alien species, secondary forests, human settlements, or other alterations induced by human activities.

[58] Modified habitats refer to regions that may encompass a substantial presence of plant and/or animal species not native to the area, and/or locations where human activities have significantly altered the primary ecological functions and species composition. Such habitats may encompass areas designated for agricultural use, forest plantations, reclaimed coastal zones, and reclaimed wetlands.

Figure 5-33 Distribution of habitats in the study area

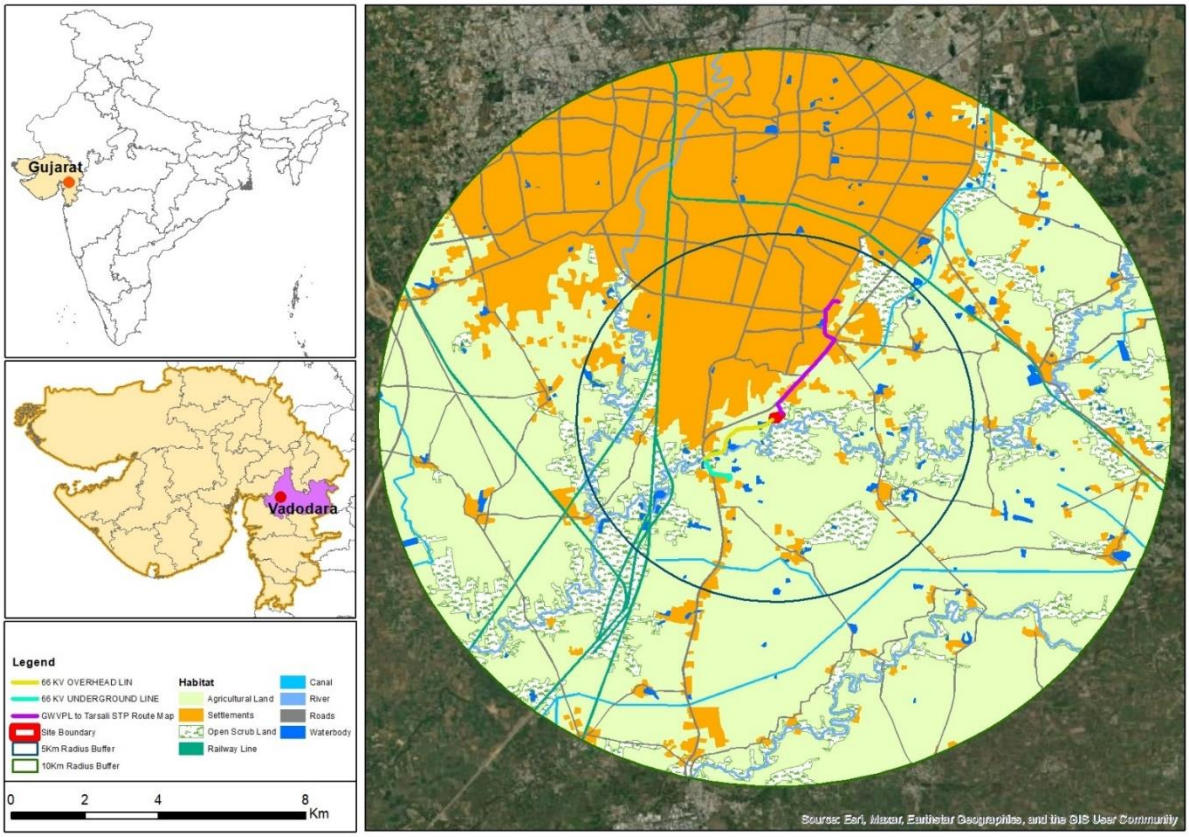
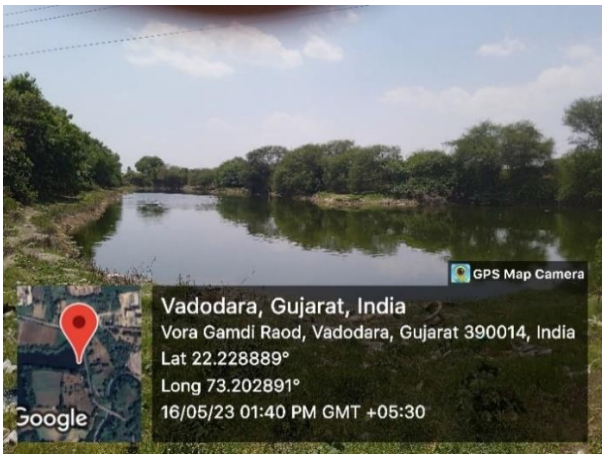
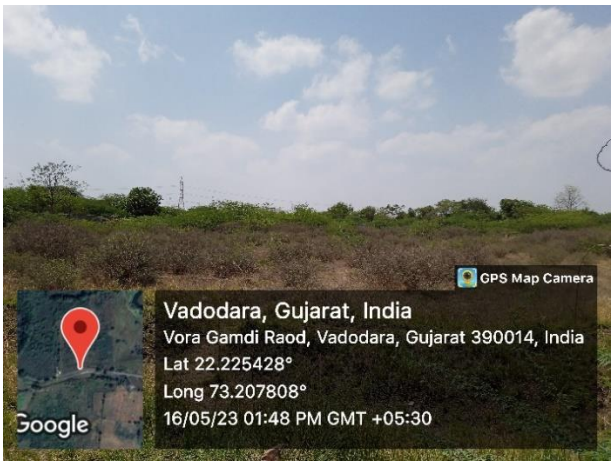


Figure 5-34 Habitats in the study area



Water body



Open Scrub

Timbi Lake, Vadorada.

Agriculture Land

5.5.3.3 Floral Survey

5.5.3.3.1 Vegetation Profile

As per the available information, the selected location for the project falling in the Semi - Arid – Gujarat Rajputana (4B) Biogeographical Province of India comprises of Deccan Plateau (Malwa Plateau, Gujarat plains and Kathiawar peninsula)[59], the Agro-ecological Region is Hot-Semi-arid eco-region with moderately deep black soils[60] and Gujarat plains and hills region (XII) Agro-Climatic Region[61]. The vegetation of the region may be defined as Northern Tropical thorn forest (6B) according to forest classification of Champion and Seth (1968)[62].

5.5.3.3.2 Floral Diversity

The floral diversity present in the 10 km buffer areas was assessed during the site survey. A total of 84 floral species belonging Thirty-Eight (38) families were observed in the study area. Fabaceae was the most dominating family in the area with Twenty-five (25) species, following Apocynaceae, Euphorbiaceae, Solanaceae with each five (5) species. None

[59] Rodgers W.A., Panwar H.S. and Mathur V.B. (2000) Wildlife Protected Area Network in India: A Review (Executive Summary). Wildlife Institute of India, Dehradun, p. 44
[60] Mandal D.K., Mandal C. and Singh S.K. (2015) Delineating Agro-Ecological Regions. ICAR-NBSSLUP technology, p. 8.
[61] http://iasri.res.in/agridata//12data%5Cchapter1%5Cdb2012tb1_2.pdf
[62] Champion, H. G. and Seth, S. K. (1968). A Revised Survey of Forest Types of India. Govt. of India Press, New Delhi, p. 404.

of the species identified in the region is threatened and/or restricted range species. A list of encountered floral species with their families and life forms has been given in Table 5-35.

Table 5-35 Floral diversity of the study area

S.N.	Binomial Scientific Name	Family	Life form	IUCN Red List - Categories
1	*Acacia auriculiformis*	Fabaceae	Tree	Least Concern
2	*Acacia catechu*	Fabaceae	Tree	Least Concern
3	*Acacia farnesiana*	Fabaceae	Tree	Least Concern
4	*Acacia leucophloea (Roxb.) Willd.*	Fabaceae	Tree	Least Concern
5	*Acacia nilotica (L.) Delile*	Fabaceae	Tree	Least Concern
6	*Acacia senegal*	Fabaceae	Tree	Not assessed
7	*Adhatoda vasica*	Lamiaceae	Shrub	Not assessed
8	*Adina cordifolia*	Rubiaceae	Tree	Least Concern
9	*Aerva lanata*	Amaranthaceae	Shrub	Not assessed
10	*Ailanthus excelsa Roxb.*	Simaroubaceae	Tree	Not assessed
11	*Albizia lebbeck (L.) Benth.*	Fabaceae	Tree	Least Concern
12	*Alstonia scholaris (L.) R. Br.*	Apocynaceae	Tree	Least Concern
13	*Alternanthera philoxeroides (Mart.) Griseb.*	Amaranthaceae	Herb	Not assessed
14	*Alternanthera sessilis (L.) R.Br. ex DC.*	Amaranthaceae	Herb	Least Concern
15	*Argemone mexicana L.*	Papaveraceae	Herb	Not assessed
16	*Azadirachta indica A.Juss.*	Meliaceae	Tree	Least Concern
17	*Barleria prionitis*	Acanthaceae	Shrub	Not assessed
18	*Bombax ceiba*	Bombacaceae	Tree	Least Concern
19	*Butea monosperma (Lam.) Taub.*	Fabaceae	Tree	Least Concern
20	*Butea superba Roxb.*	Fabaceae	Climber / Shrub	Not assessed
21	*Calotropis gigantea (L.) Dryand.*	Apocynaceae	Tree	Not assessed
22	*Calotropis procera (Aiton) Dryand.*	Apocynaceae	Shrub	Least Concern
23	*Capparis decidua (Forssk.) Edgew.*	Capparaceae	Shrub	Least Concern
24	*Carissa spinarum*	Apocynaceae	Shrub	Least Concern
25	*Cassia fistula*	Fabaceae	Tree	Least Concern
26	*Cassia tora*	Fabaceae	Herb	Not assessed
27	*Centella asiatica*	Apiaceae	Herb	Least Concern
28	*Ceratophyllum demersum*	Ceratophyllaceae	Submerged	Not assessed
29	*Chrozophora rottleri (Geiseler) A.Juss. ex Spreng.*	Euphorbiaceae	Herb	Not assessed
30	*Cocos nucifera L.*	Arecaceae	Tree	Not assessed
31	*Cordia dichotoma G.Forst.*	Boraginaceae	Tree	Least Concern
32	*Cryptostegia grandiflora Roxb. ex R.Br.*	Apocynaceae	Climber	Not assessed
33	*Cymbopogon citratus*	Poaceae	Grass	Not assessed

S.N.	Binomial Scientific Name	Family	Life form	IUCN Red List - Categories
34	*Dalbergia sissoo DC.*	Fabaceae	Tree	Least Concern
35	*Datura metel*	Solanaceae	Shrub	Least Concern
36	*Datura stramonium*	Solanaceae	Herb	Least Concern
37	*Delonix regia*	Fabaceae	Tree	Not assessed
38	*Digitaria sanguinalis*	Poaceae	Grass	Not assessed
39	*Eichhornia crassipes (Mart.) Solms*	Pontederiaceae	Herb	Not assessed
40	*Eichhornia crassipes*	Pontederiaceae	Emergent	Not assessed
41	*Eucalyptus sp.*	Myrtaceae	Tree	Not assessed
42	*Euphorbia caducifolia Haines*	Euphorbiaceae	Tree	Not assessed
43	*Euphorbia hirta L.*	Euphorbiaceae	Herb	Not assessed
44	*Euphorbia tirucalli*	Euphorbiaceae	Shrub	Not assessed
45	*Ficus benghalensis L.*	Moraceae	Tree	Not assessed
46	*Ficus religiosa L.*	Moraceae	Tree	Least Concern
47	*Ficus virens Aiton*	Moraceae	Tree	Least Concern
48	*Gliricidia sepium (Jacq.) Steud.*	Fabaceae	Tree	Least Concern
49	*Grewia tiliaefolia*	Tiliaceae	Tree	Not assessed
50	*Hardwickia binata Roxb.*	Fabaceae	Tree	Least Concern
51	*Heliotropium indicum L.*	Boraginaceae	Herb	Not assessed
52	*Hydrilla verticillata*	Hydrocharitaceae	Emergent	Not assessed
53	*Imperata cylindrica*	Poaceae	Grass	Not assessed
54	*Indigofera glabra*	Fabaceae	Herb	Not assessed
55	*Ipomoea carnea*	Convolvulaceae	Shrub	Not assessed
56	*Lantana camara*	Verbenaceae	Shrub	Not assessed
57	*Lantana camara L.*	Verbenaceae	Shrub	Not assessed
58	*Lemna minor*	Lemnaceae	Emergent	Not assessed
59	*Leucaena leucocephala (Lam.) de Wit*	Fabaceae	Tree	Not assessed
60	*Madhuca longifolia*	Sapotaceae	Tree	Least Concern
61	*Mangifera indica L.*	Anacardiaceae	Tree	Data Deficient
62	*Mimosa pudica*	Fabaceae	Shrub	Least Concern
63	*Moringa oleifera Lam.*	Moringaceae	Tree	Least Concern
64	*Nelumbo nucifera*	Nelumbonaceae	Floating plant	Least Concern
65	*Nymphaea alba*	Nymphaeaceae	Floating plant	Least Concern
66	*Ocimum tenuiflorum*	Lamiaceae	Shrub	Least Concern
67	*Opuntia elatior Mill.*	Cactaceae	Shrub	Least Concern
68	*Parkinsonia aculeata L.*	Fabaceae	Tree	Least Concern
69	*Peltophorum pterocarpum (DC.) K.Heyne*	Fabaceae	Tree	Not assessed

S.N.	Binomial Scientific Name	Family	Life form	IUCN Red List - Categories
70	*Phoenix sylvestris (L.) Roxb.*	Arecaceae	Tree	Not assessed
71	*Phyllanthus amarus*	Phyllanthaceae	Herb	Least Concern
72	*Pithecellobium dulce (Roxb.) Benth.*	Fabaceae	Tree	Least Concern
73	*Pongamia pinnata (L.) Pierre*	Fabaceae	Tree	Least Concern
74	*Prosopis cineraria (L.) Druce*	Fabaceae	Tree	Least Concern
75	*Prosopis juliflora (Sw.) DC.*	Fabaceae	Tree	Not assessed
76	*Ricinus communis L.*	Euphorbiaceae	Small Tree	Not assessed
77	*Salvadora persica L.*	Salvadoraceae	Tree	Least Concern
78	*Senna auriculata (L.) Roxb.*	Fabaceae	Shrub	Not assessed
79	*Solanum nigrum*	Solanaceae	Herb	Least Concern
80	*Solanum sisymbriifolium Lam.*	Solanaceae	Herb	Not assessed
81	*Solanum virginianum L.*	Solanaceae	Herb	Not assessed
82	*Typha domingensis Pers.*	Typhaceae	Herb	Least Concern
83	*Vallisneria spiralis*	Hydrocharitaceae	Submerged	Not assessed
84	*Ziziphus nummularia (Burm. f.) Wight & Arn.*	Rhamnaceae	Shrub	Not assessed

5.5.3.4 Faunal Survey

5.5.3.4.1 Herpetofauna

As per the literature review[63, 64], local consultation and field survey, 37 species of herpetofauna (reptiles + amphibians) species were reported / observed from the study area. Among them, Three (3) are Vulnerable [Mugger crocodile (Crocodylus palustris), Indian Flapshell Turtle (*Lissemys punctata*) and Indian Roofed Turtle (*Pangshura smithii*)] and One (1) is Near Threatened Bengal Monitor Lizard (*Varanus bengalensis*) as per the category of the IUCN Red List (Online Version 2022-2). Totally ten (10) species falling under the Schedule I category as per the Wildlife (Protection) Act, 1972 - Bengal Monitor Lizard (*Varanus bengalensis*), Checkered Keelback (*Xenochrophis piscator*), Indian Cobra (*Naja naja*), Indian Flapshell Turtle (*Lissemys punctata*), Indian Roofed Turtle (*Pangshura smithii*), Indian Tent Turtle (*Pangshura tentoria*), Oriental Ratsnake (*Ptyas mucosa*), Russell's Viper (*Daboia russelii*), Mugger crocodile (*Crocodylus palustris*) and Pond Slider (*Trachemys scripta*) (***Table 5-36***).

Table 5-36 Herpetofauna diversity from the study area

S.N.	Common English Name	Binomial Scientific Name	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules	Reported / Observed
1	Asian Common Toad	*Duttaphrynus melanostictus*	Least Concern	Not listed	Reported
2	Asiatic Water Snake	*Fowlea piscator*	Not assessed	Schedule II	Observed
3	Banded Kukri Snake	*Oligodon arnensis*	Not assessed	Not listed	Reported
4	Bengal Monitor Lizard	*Varanus bengalensis*	Near Threatened	Schedule I	Reported
5	Bombay Gecko	*Hemidactylus flaviviridis*	Least Concern	Not listed	Reported
6	Checkered Keelback	*Xenochrophis piscator*	Least Concern	Schedule I	Reported
7	Common Krait	*Bungarus caeruleus*	Not assessed	Schedule IV	Reported

[63] https://www.inaturalist.org/places/vadodara#taxon=26036
[64] https://www.inaturalist.org/places/vadodara#taxon=20978

S.N.	Common English Name	Binomial Scientific Name	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules	Reported / Observed
8	Common Sand Boa	*Eryx conica*	Not assessed	Schedule IV	Reported
9	Indian skipper frog	*Euphlyctis cyanophlyctis*	Least Concern	Schedule IV	Observed
10	House Gecko	*Hemidactylus frenatus*	Least Concern	Schedule IV	Observed
11	Indian Bullfrog	*Hoplobatrachus tigerinus*	Least Concern	Schedule IV	Reported
12	Indian Burrowing Frog	*Sphaerotheca rolandae*	Least Concern	Schedule IV	Reported
13	Indian Chameleon	*Chamaeleo zeylanicus*	Least Concern	Schedule IV	Reported
14	Indian Cobra	*Naja naja*	Least Concern	Schedule I	Reported
15	Indian Cricket Frog	*Fejervarya limnocharis*	Least Concern	Schedule IV	Reported
16	Indian Flapshell Turtle	*Lissemys punctata*	Vulnerable	Schedule I	Reported
17	Indian Flying Frog	*Rhacophorus malabaricus*	Least Concern	Schedule IV	Reported
18	Indian Roofed Turtle	*Pangshura smithii*	Vulnerable	Schedule I	Reported
19	Indian Skink	*Eutropis carinata*	Least Concern	Schedule IV	Observed
20	Indian Tent Turtle	*Pangshura tentoria*	Least Concern	Schedule I	Reported
21	Indian Tree Frog	*Polypedates maculatus*	Least Concern	Schedule IV	Reported
22	Marbled Balloon Frog	*Uperodon systoma*	Least Concern	Schedule IV	Reported
23	Oriental Garden Lizard	*Calotes versicolor*	Not assessed	Not listed	Observed
24	Oriental Ratsnake	*Ptyas mucosa*	Not assessed	Schedule I	Reported
25	Russell's Viper	*Daboia russelii*	Least Concern	Schedule I	Reported
26	Saw-scaled Vipers	*Echis carinatus*	Least Concern	Not listed	Reported
27	Brahminy Blind Snake	*Indotyphlops braminus*	Least Concern	Schedule IV	Reported
28	Mugger crocodile	*Crocodylus palustris*	Vulnerable	Schedule I	Reported
29	Indian wolf snake	*Lycodon aulicus*	Least Concern	Schedule IV	Reported
30	Spiny-headed Fan-throated Lizard	*sitana spinaecephalus*	Least Concern	Schedule IV	Reported
31	Pond Slider	*Trachemys scripta*	Least Concern	Schedule I	Reported
32	Golden Tree Snake	*Chrysopelea ornata*	Least Concern	Schedule IV	Reported
33	Buff Striped Keelback	*Amphiesma stolatum*	Least Concern	Schedule IV	Reported
34	Bronze Mabuya	*Eutropis macularia*	Least Concern	Schedule IV	Reported
35	Bark Gecko	*Hemidactylus leschenaultii*	Least Concern	Schedule IV	Reported
36	Trinket Snake	*Coelognathus helena*	Least Concern	Schedule IV	Reported
37	Indus valley toad	*Bufo stomaticus*	Least Concern	Schedule IV	Reported

5.5.3.4.2 Avifauna (Birds)

During the field survey, 77 avifaunal species were observed from the study area, which include one (1) Vulnerable (River Tern *Sterna aurantia*); and Five (5) Near Threatened [Black-headed Ibis (*Threskiornis melanocephalus*), Painted Stork (*Mycteria leucocephala*), Asian Woolly-necked Stork (*Ciconia episcopus*), Alexandrine Parakeet (*Psittacula eupatria*), and Oriental Darter (*Anhinga melanogaster*)] as per IUCN Red List (Online Version 2022-2). Seven (07) Schedule I species (as per the Wildlife (Protection) Act, 1972) – Cotton Pygmy-Goose (*Nettapus coromandelianus*), Indian Peafowl (*Pavo*

cristatus), Eurasian Moorhen (*Gallinula chloropus*), Black Kite (*Milvus migrans*), Black-winged Kite (*Elanus caeruleus*), River Tern (*Sterna aurantia*), Eurasian Spoonbill (*Platalea leucorodia*), Brahminy Kite (*Haliastur indus*) species were also observed in the study area (***Table 5-37***).

Table 5-37 Avifaunal diversity observed from the study area

S.N.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
1	Cotton Pygmy-Goose	*Nettapus coromandelianus*	R	Least Concern	Schedule I
2	Rock dove	*Columba livia*	R	Least Concern	Schedule IV
3	Gray-headed Swamphen	*Porphyrio poliocephalus*	R	Least Concern	Schedule IV
4	Red-wattled Lapwing	*Vanellus indicus*	R	Least Concern	Schedule IV
5	Pheasant-tailed Jacana	*Hydrophasianus chirurgus*	R	Least Concern	Schedule IV
6	Purple Heron	*Ardea purpurea*	R	Least Concern	Schedule IV
7	White-throated Kingfisher	*Halcyon smyrnensis*	R	Least Concern	Schedule IV
8	Asian Green Bee-eater	*Merops orientalis*	R	Least Concern	Schedule IV
9	Rose-ringed Parakeet	*Psittacula krameri*	R	Least Concern	Schedule IV
10	Black Drongo	*Dicrurus macrocercus*	R	Least Concern	Schedule IV
11	Red-vented Bulbul	*Pycnonotus cafer*	R	Least Concern	Schedule IV
12	Common Myna	*Acridotheres tristis*	R	Least Concern	Schedule IV
13	Intermediate Egret	*Ardea intermedia*	R	Least Concern	Schedule IV
14	Cattle Egret	*Bubulcus ibis*	R	Least Concern	Schedule IV
15	Indian Pond-Heron	*Ardeola grayii*	R	Least Concern	Schedule IV
16	Red-naped Ibis	*Pseudibis papillosa*	R	Least Concern	Schedule IV
17	Jungle Babbler	*Argya striata*	R	Least Concern	Schedule IV
18	Common Babbler	*Argya caudata*	R	Least Concern	Schedule IV
19	Bank Myna	*Acridotheres ginginianus*	R	Least Concern	Schedule IV
20	Oriental Magpie-Robin	*Copsychus saularis*	R	Least Concern	Schedule IV
21	Indian Peafowl	*Pavo cristatus*	R	Least Concern	Schedule I
22	Gray Francolin	*Ortygornis pondicerianus*	R	Least Concern	Schedule IV
23	Laughing Dove	*Spilopelia senegalensis*	R	Least Concern	Schedule IV
24	Greater Coucal	*Centropus sinensis*	R	Least Concern	Schedule IV
25	Asian Koel	*Eudynamys scolopaceus*	R	Least Concern	Schedule IV
26	White-breasted Waterhen	*Amaurornis phoenicurus*	R	Least Concern	Schedule IV
27	Black-headed Ibis	*Threskiornis melanocephalus*	R	Near Threatened	Schedule IV
28	White-browed Bulbul	*Pycnonotus luteolus*	R	Least Concern	Schedule IV
29	Large Gray Babbler	*Argya malcolmi*	R	Least Concern	Schedule IV
30	Indian Robin	*Copsychus fulicatus*	R	Least Concern	Schedule IV
31	Purple-rumped Sunbird	*Leptocoma zeylonica*	R	Least Concern	Schedule IV
32	Purple Sunbird	*Cinnyris asiaticus*	R	Least Concern	Schedule IV

S.N.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
33	Indian Silverbill	*Euodice malabarica*	R	Least Concern	Schedule IV
34	Scaly-breasted Munia	*Lonchura punctulata*	R	Least Concern	Schedule IV
35	House Sparrow	*Passer domesticus*	R	Least Concern	Schedule IV
36	Brahminy Starling	*Sturnia pagodarum*	R	Least Concern	Schedule IV
37	Lesser Whistling-Duck	*Dendrocygna javanica*	R	Least Concern	Schedule IV
38	Knob-billed Duck	*Sarkidiornis melanotos*	R	Least Concern	Schedule IV
39	Eurasian Moorhen	*Gallinula chloropus*	R	Least Concern	Schedule I
40	Black-winged Stilt	*Himantopus himantopus*	R	Least Concern	Schedule IV
41	Little Egret	*Egretta garzetta*	R	Least Concern	Schedule IV
42	Glossy Ibis	*Plegadis falcinellus*	R	Least Concern	Schedule IV
43	House Crow	*Corvus splendens*	R	Least Concern	Schedule IV
44	Plain Prinia	*Prinia inornata*	R	Least Concern	Schedule IV
45	Indian Pied Starling	*Gracupica contra*	R	Least Concern	Schedule IV
46	Baya Weaver	*Ploceus philippinus*	R	Least Concern	Schedule IV
47	Indian Spot-billed Duck	*Anas poecilorhyncha*	R	Least Concern	Schedule IV
48	Ashy Prinia	*Prinia socialis*	R	Least Concern	Schedule IV
49	Common Kingfisher	*Alcedo atthis*	R	Least Concern	Schedule IV
50	Eurasian Collared-Dove	*Streptopelia decaocto*	R	Least Concern	Schedule IV
51	Red Collared-Dove	*Streptopelia tranquebarica*	R	Least Concern	Schedule IV
52	Spotted Dove	*Spilopelia chinensis*	R	Least Concern	Schedule IV
53	Barred Buttonquail	*Turnix suscitator*	R	Least Concern	Schedule IV
54	Painted Stork	*Mycteria leucocephala*	R	Near Threatened	Schedule IV
55	Gray Heron	*Ardea cinerea*	R	Least Concern	Schedule IV
56	Shikra	*Accipiter badius*	R	Least Concern	Schedule IV
57	Indian Paradise-Flycatcher	*Terpsiphone paradisi*	R	Least Concern	Schedule IV
58	Rufous Treepie	*Dendrocitta vagabunda*	R	Least Concern	Schedule IV
59	Indian Gray Hornbill	*Ocyceros birostris*	R	Least Concern	Schedule IV
60	Ashy-crowned Sparrow-Lark	*Eremopterix griseus*	R	Least Concern	Schedule IV
61	Asian Woolly-necked Stork	*Ciconia episcopus*	R	Near Threatened	Schedule IV
62	Yellow-wattled Lapwing	*Vanellus malabaricus*	R	Least Concern	Schedule IV
63	Black Kite	*Milvus migrans*	R	Least Concern	Schedule I
64	Alexandrine Parakeet	*Psittacula eupatria*	R	Near Threatened	Schedule IV
65	River Tern	*Sterna aurantia*	R	Vulnerable	Schedule I
66	Eurasian Spoonbill	*Platalea leucorodia*	R	Least Concern	Schedule I
67	Indian Cormorant	*Phalacrocorax fuscicollis*	R	Least Concern	Schedule IV
68	Oriental Darter	*Anhinga melanogaster*	R	Near Threatened	Schedule IV

S.N.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
69	Black-winged Kite	*Elanus caeruleus*	R	Least Concern	Schedule I
70	Rufous-tailed Lark	*Ammomanes phoenicura*	R	Least Concern	Schedule IV
71	Little Grebe	*Tachybaptus ruficollis*	R	Least Concern	Schedule IV
72	Great Cormorant	*Phalacrocorax carbo*	R	Least Concern	Schedule IV
73	Eurasian Hoopoe	*Upupa epops*	R	Least Concern	Schedule IV
74	Indian Roller	*Coracias benghalensis*	R	Least Concern	Schedule IV
75	Red-rumped Swallow	*Cecropis daurica*	R	Least Concern	Schedule IV
76	Gray Wagtail	*Motacilla cinerea*	R	Least Concern	Schedule IV
77	Brahminy Kite	*Haliastur indus*	R	Least Concern	Schedule I

5.5.3.4.3 Mammals

Based on a comprehensive literature review[65], extensive local consultation, and meticulous field surveys, a total of 15 mammalian species were documented within the study area, and notably none of them are classified as threatened according to the IUCN Red List. However, Three (3) species - Golden Jackal (*Canis aureus*), Indian Porcupine (*Hystrix indica*) and Asian palm civet (*Paradoxurus hermaphroditus*) are listed in Schedule-I as per the Wildlife (Protection) Act, 1972 (***Table 5-38***).

Table 5-38 Mammals from the study area

S.N.	Common English Name	Binomial Scientific Name	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules	Reported or Observed
1	Bengal Fox	*Vulpes bengalensis*	Least Concern	Schedule II	Reported
2	Small Indian Mongoose	*Herpestes javanicus*	Least Concern	Schedule IV	Reported
3	Five-striped Palm Squirrel	*Funambulus pennantii*	Least Concern	Schedule IV	Observed
4	Golden Jackal	*Canis aureus*	Least Concern	Schedule II	Reported
5	Indian Grey Mongoose	*Herpestes edwardsii*	Least Concern	Schedule II	Observed
6	Indian Hare	*Lepus nigricollis*	Least Concern	Schedule IV	Observed
7	Indian Porcupine	*Hystrix indica*	Least Concern	Schedule I	Reported
8	Northern Plains Grey Langur	*Semnopithecus entellus*	Least Concern	Schedule IV	Observed
9	Jungle Cat	*Felis chaus*	Least Concern	Schedule II	Reported
10	Nilgai	*Boselaphus tragocamelus*	Least Concern	Schedule III	Observed
11	Rhesus Monkey	*Macaca mulatta*	Least Concern	Schedule II	Observed
12	Wild Boar	*Sus scrofa*	Least Concern	Schedule III	Observed
13	Asian palm civet	*Paradoxurus hermaphroditus*	Least Concern	Schedule I	Reported
14	Leschenault's rousette	*Rousettus leschenaultii*	Least Concern	Schedule IV	Reported
15	Indian flying fox	*Pteropus giganteus*	Least Concern	Schedule IV	Reported

[65] https://www.inaturalist.org/places/vadodara#taxon=40151 (accessed on 10 August 2023)

5.5.4 Protected and Key Biodiversity Areas

Within a 5 km radius of the project location, no protected areas, Ramsar sites, or designated Important Bird Areas were identified. The closest protected area, the Wadhvana Ramsar site, is situated approximately 30 km away from the project location in the South-east direction. The immediate 5 km radius surrounding the project site comprises a diverse landscape, encompassing agricultural lands, water bodies, seasonal water streams, Open Scrub, Grassland, and human settlements.

Nevertheless, it is essential to highlight that the Tibmi lake, situated 11 km away from the project site, holds considerable renown as a significant site for migratory birds during the winter season. It's status as an important large congregatory site for avian species cannot be underestimated. As such, this aspect bears immense ecological relevance and merits thorough consideration in light of the project's potential impacts on the region's avifauna and the broader ecosystem. The region also has another important areas is Wadhvana Wetlands, these both the site can be seen in map (***Figure 5-35***)

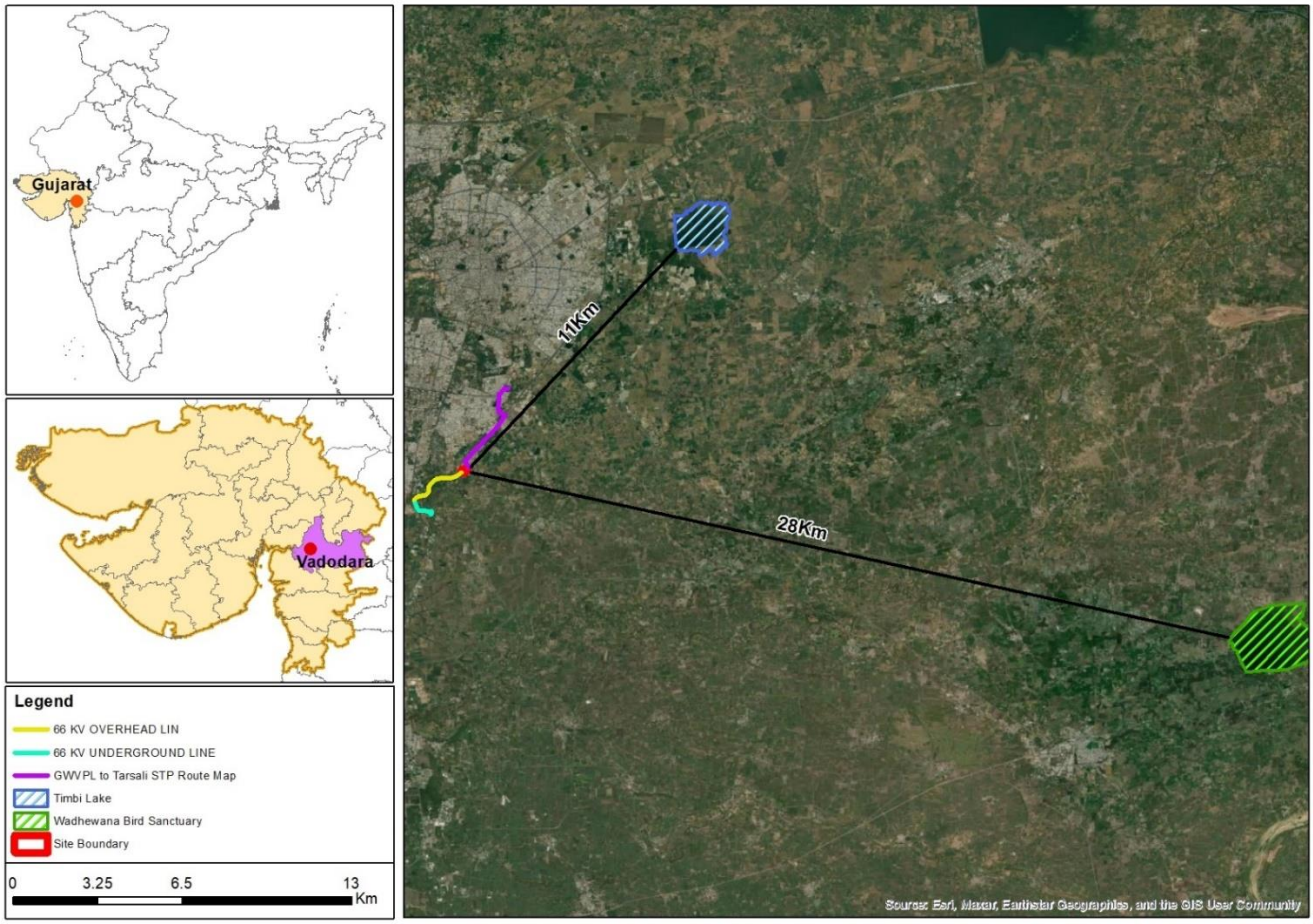
Wadhvana Wetland (Ramsar Site)[66, 67]

The Ramsar site spans 630 hectares and was established in 1910 by the former Baroda State. It is situated in a semi-arid agricultural landscape, surrounded by wheat and paddy fields as well as villages. The wetland's international significance lies in its role as a crucial wintering ground for over 80 migratory waterbird species, including threatened or near-threatened birds like the Endangered Pallas's fish-eagle *Haliaeetus leucoryphus*, Vulnerable Common Pochard *Aythya ferina*, and Near-Threatened Dalmatian pelican *Pelecanus crispus*, Grey-headed Fish-eagle *Icthyophaga ichthyaetus*, and Ferruginous Duck *Aythya nyroca*.

Furthermore, the Red-crested Pochard *Netta rufina*, typically rare in Western India, is regularly observed here during winter. Resident vulnerable species, such as the River Tern *Sterna aurantia* and Sarus Crane *Grus antigone*, and the Near-Threatened Black-necked Stork *Ephippiorhynchus asiaticus* also inhabit the wetland. Notably, a mid-winter waterbird census conducted in 2020 recorded almost 46,000 individual birds. This Ramsar site exemplifies a global model of how an irrigation reservoir transformed into a vital waterbird habitat and a center for ecotourism and nature education.

[66] https://rsis.ramsar.org/ris/2454 (Accessed on 04 Aug. 2023)
[67] https://wiienvis.nic.in/Database/ramsar_wetland_sites_8224.aspx. (Accessed on 04 Aug. 2023)

Figure 5-35 Ecological Sensitivity around the proposed site



5.5.5 Bird Migration Flyways

India majorly lies in the Central Asian Flyway [68](***Figure 5-36***). 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 database[69], at least 112 migratory birds including one Endangered **EN** (1) Black-bellied Tern *Sterna acuticauda,* One (1) Vulnerable **VL** Common Pochard *Aythya farina* and Five (5) Near Threatened **NT** (*Black-tailed Godwit* Pallid Harrier, Ferruginous Duck, Lesser Flamingo, Dalmatian Pelican, Eurasian Curlew). And 12 Schedule-I species (Eurasian Marsh-Harrier, Eurasian Sparrowhawk, Eurasian Wigeon, Gull-billed Tern, Pallid Harrier, Common Pochard, Ferruginous Duck, Booted Eagle, Black-bellied Tern, Common Crane, Demoiselle Crane and Eurasian Griffon) were reported from the region (***Table 5-32)***. Among the migratory 8 raptor species were reported from the region ***Table 5-33.***

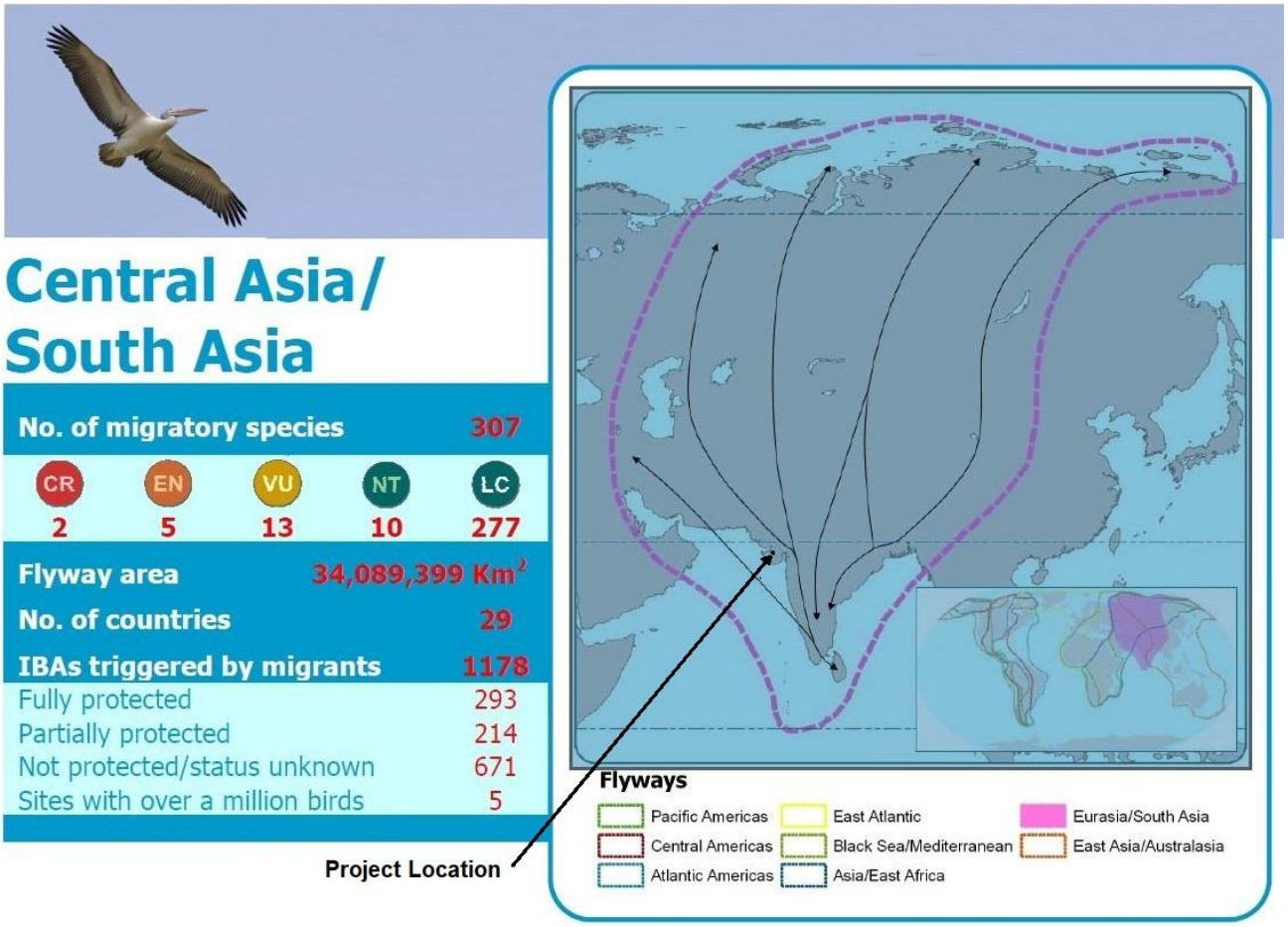
The available secondary data confirms the periodic presence of at least 28 Raptors (Bird of prey) species from the region including, Two Critically Endangered **CR** (Indian Vulture *Gyps indicus* and White-rumped Vulture *Gyps bengalensis*); Two (2) Endangered **EN** (Steppe Eagle *Aquila nipalensis* and Egyptian Vulture *Neophron percnopterus*); and Two (2) Vulnerable **VU** (Greater Spotted Eagle *Clanga clanga* & Indian Spotted Eagle *Clanga hastata* and one (1) Near Threatened Pallid Harrier *Circus macrourus.*

In the region, there are several key congregatory bird species[70, 71], including the Demoiselle Crane, Northern Pintail, Dalmatian Pelican, Black-tailed Godwit, Common Crane, Common Teal, Bar-headed Goose, Common Pochard Eurasian Coot *Fulica atra,* Gadwall *Mareca strepera,* Garganey *Spatula querquedula,* Small Pratincole *Glareola lacteal,* Little Stint *Calidris minuta,* Ruddy Shelduck *Tadorna ferruginea* and Eurasian Wigeon. In order to safeguard these bird populations and minimize the risks of collision and electrocution, certain mitigation measures have been proposed under the section addressing their impact on the biological environment.

[68] http://datazone.birdlife.org/userfiles/file/sowb/flyways/7_Central_Asia_Factsheet.pdf
[69] https://ebird.org/region/IN-GJ-VD?yr=all
[70] https://ebird.org/hotspot/L1979634?yr=all&m=&rank=mrec

[71] https://ebird.org/hotspot/L4008340?yr=all&m=&rank=mrec

Figure 5-36 Location of Project Site in the Central Asian Flyway



5.5.6 Critical Habitat Screening

Conceptualisation of Ecologically Appropriate Areas of Assessment (EAAA)

In accordance with paragraph 59 of IFC PS6, the determination of the ecologically appropriate area of analysis/assessment (EAAA) is crucial for identifying critical habitat presence. Therefore, a provisional EAAA with a 20-kilometer radius from the project's boundary was established. This decision was guided by considerations of species or ecosystem distribution, within the project's area of influence, as well as the ecological patterns, processes, features, and functions essential for their preservation. It's important to understand that this conceptualized EAAA is provisional and subject to change following a comprehensive survey for Critical Habitat Assessment (if required).

Species of Conservation Significance

The Integrated Biodiversity Assessment Tool (IBAT) was used to identify threatened species likely to occur within or nearby the Project Area. Apart from IBAT, extensive publicly available documents and research materials were reviewed to identify additional sensitivities and finalize the checklist of species of conservation significance. An initial desk-based screening of species likely to occur in and around the project location is presented in ***Appendix 20***. Based on this exercise, none of the species met the criteria to be screened-in for the Critical Habitat Assessment for the project's EAAA, suggesting that it is less likely to meet the thresholds outlined in IFC PS6 for critical habitat.

6 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 given below:

Table 6-1 List of Stakeholders

Category	Primary Stakeholders	Secondary Stakeholder
Community	• Rag Pickers • Opinion holders • Community leaders • Local Communities living near the plants	Nil
Institutional Stakeholders	• Local Gram Panchayats • Project Investors	• Village Institutions (education and health department) • Political Parties
Government Bodies	• Vadodara Municipal Corporation • Regulatory Authorities • District Administration	• State Administration
Other Groups	• Recyclers/recycling entities • Employees • Contractors and sub-contractors • Contractual workers	• Media • Local NGOs

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

Table 6-2 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					
Rag Pickers	This stakeholder group includes rag pickers working at VMC and land fill site. As informed, most of these rag pickers are from other state such as Rajasthan. These Rag Pickers are engaged in collection of waste and selling the waste to the respective scarp dealers. According to the site visit, only ~20 ragpickers are engaged in collecting recyclables from the landfills. However, given the volume of waste disposed at the landfill and the number of ragpickers, no economic displacement of these ragpickers is expected. (Refer to section 5.4.18 for more socio-economic profile of ragpickers)	Ragpickers with primary occupation as rag picking may have several concerns and expectations related to the Project: • The establishment of the project might lead to a decrease in the availability of fresh waste at landfill sites, affecting the livelihoods of ragpickers heavily dependent on this source. • A potential reduction in the quantity of recyclable waste due to the Project will impact the income of ragpickers, who rely on the collection and sale of recyclables. • Changes in waste management practices, such as direct waste delivery to the Project instead of landfilling, may alter the working conditions for ragpickers, potentially leading to job displacement. • Ragpickers may expect the project to provide alternative livelihood options or support in transitioning to other income-generating activities. • Expectations could include social and economic support, such as training programs, financial assistance, or cooperative initiatives that empower ragpickers economically	The influence of ragpickers with a primary occupation as ragpicking on the Project can manifest in several ways: • Ragpickers, being directly impacted by changes in waste management practices, may provide valuable insights and input during the project planning and implementation phases. • The project shall need to consider the social impact on ragpickers, recognizing their role in the informal waste management sector. Engaging with them can help identify potential challenges and formulate strategies for mitigating negative impacts. • Ragpickers may influence the economic dynamics of waste management in the project area. Their involvement or displacement can affect the local economy, and understanding these dynamic is essential for effective project management. • The relationship between the project and the ragpicker community can significantly influence the project's acceptance and success. Building positive relations involves addressing concerns, providing support, and considering the socio-economic aspects of the ragpicker community. • If the Project results in changes to waste management practices, it might impact the employment of ragpickers. Planning for a smooth transition and considering alternative livelihood options could mitigate potential conflicts.	The influence of the Project on ragpickers with primary occupation in ragpicking, are provided below: • The project will alter waste management practices, particularly in waste disposal, ragpickers may experience changes in employment. • If the Project results in changes to waste management practices, it might impact the employment of ragpickers. P • Changes in waste management practices can affect the economic conditions of ragpickers. The project may provide support programs to address any negative economic impacts • The project could offer training programs to help ragpickers transition to other roles within the waste management sector or get employment at the plant. • The project's approach to engaging with and mitigating the impacts on the ragpickers community will significantly influence community relations Ensuring transparency, providing clear information, and involving the community in decision-making processes can foster positive relations. • The project might provide access to resources such as education, healthcare, or housing as part of its corporate social responsibilities (CSR) initiatives. This can contribute to the overall well-being of the ragpicker community. • The project could provide a platform for ragpickers to voice their concerns and needs related to the Project's activities.	• Influence of Stakeholder: **Medium** • Influence of Project: **HIGH**
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 including local panchayats.	• 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	• This group is 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**

Relevant Stakeholders	Profile	Concerns and Expectations from the project	Influence of Stakeholder on Project	Influence of Project on Stakeholder	Influence Rating
		and the opportunities from the same			
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: **HIGH** • Influence of Project: **LOW**
Local Communities living near the plants	Refer to section 5.4.10 for socio economic baseline of local community.	The key concerns and expectations of this group from the project are: • Concerns about increased noise from the operation of the waste-to-energy plant. • Concerns about air pollution resulting from the transportation of waste. • Concerns about increased noise and unpleasant odors emanating from transportation of waste. • Concerns about increased traffic, congestion, and potential safety hazards associated with the transportation of waste to the WTE plant, particularly if transportation routes of big trucks pass through residential areas. • Expectation for the implementation of stringent health and safety measures to safeguard the well-being of the local community during the transportation of waste. • Expectation for well-planned and efficient traffic management strategies during waste transportation to minimize disruptions and ensure the safety of residents. • The proposed route of the 220 meters (out of the total 1.62 km) of underground is passing through a previously used burial ground of Mali community. The passing of underground	The local community living near the waste-to-energy plant can exert a considerable influence on the project's success and sustainability. The community's concerns, support, and engagement play a vital role in shaping the project's overall impact. Here are key aspects of the local community's influence on the Project: • The local community's acceptance and support are crucial for obtaining a social license to operate. Positive sentiment from the community can facilitate a smoother project approval process. • Active engagement and participation of the local community in project-related discussions and decision-making processes contribute to a collaborative approach. Involving residents in planning and mitigation strategies fosters a sense of ownership and cooperation. • The community's concerns about environmental impacts, and safety should be acknowledged and addressed. Successful projects often implement mitigation measures based on community feedback. • An informed community is more likely to support the project. Educational initiatives and transparent communication about the waste-to-energy process, benefits, and	The influence of the Waste-to-Energy (WtE) plant project on the local community living nearby can be substantial, affecting various aspects of their daily lives, environment, and overall well-being. Here are some key areas where the project can have an impact: • If the project incorporates advanced technologies and practices, it can contribute to reducing environmental pollution, minimizing reliance on landfills, and promoting a more sustainable waste management solution. • The implementation of proper safety measures and adherence to environmental regulations can positively contribute to community health and safety. • Active engagement with the local community, including regular communication, public consultations, and addressing concerns, can foster positive relations. • The project may lead to the development or improvement of local infrastructure, such as roads or utilities, benefiting the entire community.	• Influence of Stakeholder: **MEDIUM** • Influence of Project: **MEDIUM**

Relevant Stakeholders	Profile	Concerns and Expectations from the project	Influence of Stakeholder on Project	Influence of Project on Stakeholder	Influence Rating
		transmission line through the burial ground may result in opposition from Mali community. Thus it is expected from the project not to impact any form of this burial ground.	potential challenges help build understanding and trust. • The local community's concerns about potential health and safety risks should be taken seriously. Implementing robust health and safety measures and addressing community health concerns are vital for project acceptance. • The community's concerns about increased traffic and transportation-related issues should be addressed. Clear communication about waste transportation routes and efforts to minimize disruptions are essential for community satisfaction. • Establishing effective mechanisms for community feedback and grievance redressal enhances transparency and ensures that concerns are promptly addressed, fostering a positive relationship	• Implementing educational programs about waste management, environmental benefits, and the project's positive contributions can enhance community awareness and support. • If the project is well-managed, environmentally friendly, and brings tangible benefits to the community, it can enhance the overall perception and acceptance of the waste-to-energy plant.	
Vadodara Municipal Corporation (VMC)	The Vadodara Municipal Corporation (VMC) serves as the local governing body entrusted with the oversight of civic infrastructure and administration in the city of Vadodara, Gujarat, India. Positioned as a pivotal local government entity, VMC assumes responsibility for the management of diverse urban services, with a particular emphasis on waste management. In the context of the Waste-to-Energy Plant project within the city, VMC assumes a central role as the governing authority. This is underscored by the formal agreement issued by VMC, sanctioning the construction and operation of the Project. Notably, VMC is exclusively tasked with the collection of waste through an organized door-to-door collection process. Additionally, it oversees the efficient transportation of the collected waste to the Project (WTE plant). This delineation of responsibilities underscores VMC's pivotal role in the execution and success of the Project.	The Vadodara Municipal Corporation (VMC) likely has various concerns and expectations from the Project. These considerations can encompass environmental, economic, social, and operational aspects. Here are some common concerns and expectations that VMC may have: • Ensuring strict adherence to all relevant local and national regulations pertaining to waste management, emissions, and energy production • Verifying the reliability and effectiveness of the waste-to-energy technology employed to ensure optimal and consistent power generation. • Considering the social and economic impact of the project on the local community, including potential job creation, community development, and associated benefits • Expecting the Project to contribute significantly to the generation of renewable energy for the city. • Anticipating a notable reduction in the volume of municipal waste through effective waste-to-energy conversion processes • Expecting the waste-to-energy facility to operate efficiently, minimizing	The Vadodara Municipal Corporation (VMC) can have a significant influence on the Project at various stages of its lifecycle. Provided below key aspects of VMC's potential influence on the Project: • VMC holds the authority to grant approval and authorization for the establishment and operation of the Project within its jurisdiction. The project's initiation is contingent upon obtaining necessary permits and approvals from VMC. • VMC plays a pivotal role in the selection of the site for the waste-to-energy plant, ensuring compliance with local zoning regulations and municipal planning considerations. • As the entity responsible for waste management in the city, VMC directly influences the supply of municipal waste to the WTE plant. The efficiency of the waste collection and transportation process is essential for the Project's success. • VMC can influence community perceptions and support for the project by engaging in transparent communication, addressing concerns, and involving local residents in the decision-making process.	The influence of the Project on the Vadodara Municipal Corporation (VMC) can manifest in several ways, impacting various aspects of municipal governance, waste management, and community development. Provided below key potential areas of influence of the Project: • The project can contribute to the improvement of waste management practices in Vadodara by providing an alternative and sustainable method for waste disposal. • Project's environmentally friendly technologies, can positively influence VMC's efforts to mitigate the environmental impact of waste disposal, addressing concerns related to pollution and land use. • The project can enhance VMC's efforts to meet energy needs sustainably by contributing to the generation of renewable energy. • The Project will create job opportunities within the municipality, contributing to local employment and skill development. This can positively impact the socio-economic landscape of the community. • Project involves public-private partnerships, it can enhance VMC's	• 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
		downtime and ensuring a consistent power supply. • Expecting the waste-to-energy project to operate in accordance with the terms and conditions outlined in the agreement between VMC and the Project.	• VMC monitors the ongoing operations of the Project to ensure compliance with agreed-upon standards, regulations, and environmental practices. This oversight contributes to the project's sustained performance. • The renewal or modification of agreements between VMC and the project developers depends on the performance, compliance, and mutual satisfaction. VMC's influence is evident in negotiations for contract renewals	capacity to implement large-scale waste management projects. Collaboration with private entities may bring in expertise and resources that benefit the municipality. • The Project can contribute to reducing the reliance on traditional landfills, potentially extending the lifespan of existing landfill sites and minimizing environmental degradation. • A successful and environmentally responsible waste-to-energy project can enhance VMC's public image. Positive community perceptions may result in increased trust and support for municipal initiatives. • The project's compliance with environmental and waste management regulations can set a precedent for other municipal initiatives. VMC may be motivated to replicate successful models in future projects.	
Regulatory Authorities	This stakeholder group is comprised of the central, state and district level regulatory authorities including VMC & PWD. These 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	The key expectations and concerns of the group from the project include: • Project's compliance to the regulatory requirements; and • Timely disclosure of information and provisioning of updated information throughout the life of the project.	• The failure of the project to comply with the various rules and regulations applicable can affect the timely implementation of the project • This stakeholder group is also critical for 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 the Project in the area	• Influence of Stakeholder: HIGH • Influence of Project: LOW
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.	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
Recyclers/recycling entities	Following consultations with ragpickers at the landfill, it has been understood that all ragpickers engage in selling their collected recyclable waste to various Recyclers and recycling entities located in nearby villages. According to the feedback received from ragpickers, a single ragpicker can purchase waste from them ranging from INR 3000-4000. The area is host to approximately 8-10 recyclers/recycling entities.	Recyclers and recycling entities involved in the collection and processing of recyclable waste may have various concerns and expectations related to the Project. Here are some potential considerations: • Recyclers may be concerned about the Project affecting the supply of recyclable waste. If the waste is directed to the WTE plant, recyclers	Provided below potential factors that might influence the relationship: • Recyclers often have connections within local communities. Their influence may be reflected in community perceptions and support for or against the WTE plant based on how it aligns with recycling practices.	The influence of a waste-to-energy (WTE) project on recyclers or recycling entities can vary based on several factors. Here are some considerations: • The Project could introduce shifts in the local waste market, affecting the pricing and demand for recyclable materials. Recycling entities might need	• 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
	Moreover, these recycling entities extend their operations beyond procuring waste solely from ragpickers at the landfill. They also source recyclable waste from other individuals who collect or purchase such materials in the surrounding areas or within Vadodara city.	might experience a reduction in the quantity and quality of materials they purchase from ragpickers. • Recyclers may face increased competition for obtaining recyclable materials, leading to potential financial implications.	• Collaboration between the WTE plant and recyclers can lead to more effective waste management.	to adapt to these changes. • There could be opportunities for collaboration between the Project and recyclers. For instance, joint initiatives could be established to ensure efficient waste management and resource recovery.	
Staff & Contractors and Sub-Contractors	This stakeholder group is comprised of the technical & non-technical staff of Abellon 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 project activities to be carried out. • Fair business opportunities and contract closure • Business continuity • Payment of wages and other concerns related to Labor welfares • Ensuring the health and safety of staff, contractors, and sub-contractors is a top priority • Contractors must comply with all relevant environmental and safety regulations. • Promoting a strong safety culture among contractors ensures that safety is prioritized in all project activities • Providing necessary training to contractors on EHS procedures and standards • Effective communication between the project team and contractors ensures that everyone is aligned with project goals and expectations. • Encouraging collaboration between contractors and different project teams enhances overall project performance	• 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. • Their efficiency in executing tasks, managing resources, and coordinating with other entities directly impacts operational success. • Their adherence to safety and environmental regulations is crucial to mitigate risks and ensure responsible project execution. • Their ability to deliver on time and manage potential delays impacts the overall project schedule. • Clear communication channels between different entities are essential for project success.	The influence of the project on the group pertains to the role of the project in business opportunities and the process of contract closure. Provided below the key influences: • The project creates employment opportunities for a range of skilled and unskilled workers, contributing to local job creation. • Direct and indirect economic benefits for staff through salaries, benefits, and potential skill development. • Opportunities for skill enhancement and professional development through training programs provided by the project. • Adherence to rigorous health and safety standards to ensure the well-being of the project workforce.	• Influence of Stakeholder: **HIGH** • Influence of Project: **HIGH**
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	The primary concerns and expectations of the stakeholder group pertaining to the project is as follows:	• This stakeholder group is critical for the smooth functioning and timely	The influence of the project on the group pertains to the roles of the project in the continuance of economic opportunities, timely payment	• Influence of Stakeholder: **MEDIUM** • 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
	comprised of the semi-skilled workers involved in the construction work of the project.	• 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.	implementation of the project • This group may also play an important role in the formation of public opinion towards the project	of wages and ensuring the health and safety of the workers	
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 • Timely and adequate disclosure of information pertaining to the project.	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**
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 of project in achieving the goals of Swachh Bharat Mission and renewable energy generation 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: • Media may express concerns about the potential environmental impact of the Project, such as air emissions, ash disposal, and overall sustainability.	The influence of the media on the project can be significant, shaping public perception, influencing stakeholders, and impacting the project's overall success. Here are several potential influences: project • Media coverage shapes public perception of the	The influence of the project on the stakeholder is likely to be limited. However, provided below the include of the project on the media: • The project can provide accurate and timely information to the media. Transparent	• 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
		• Questions about the impact of the project on public health and safety may arise, especially if there are perceived risks associated with emissions or by transportation of waste or other by-products. • Lack of or insufficient community engagement and communication strategies may be a concern, leading to questions about transparency in the project's planning and execution. • Compliance to the regulatory requirements for the project • Project's role in the development of the area • Maintenance of positive relationship with the local community and other stakeholders • Timely disclosure of information in regard to the project activities • Media expects transparency from project developers and relevant authorities. Open communication about project details, progress, and any issues is crucial. • Expectations are set regarding how the project will benefit the local community, either through job creation, economic development, or community programs supported by the project. • Expectations include clear information on safety measures in place to protect both workers and the surrounding community from potential hazards. • Media may expect the project to demonstrate a commitment to environmental stewardship, including measures to minimize emissions, handle waste responsibly, and contribute to sustainable practices.	WTE project. Positive coverage can generate support, while negative stories may lead to scepticism or opposition. • Media can influence community engagement. Positive stories highlighting the benefits of the project may encourage local support, while negative coverage might fuel community concerns and opposition. • Media attention can attract regulatory scrutiny. Environmental agencies and authorities may respond to media reports, impacting the project's regulatory approvals and compliance . • Positive media coverage can enhance investor confidence in the project. On the other hand, negative publicity may raise concerns among investors and financiers. • Media coverage can influence political decisions. If a project gains public support through positive media, it may influence politicians to endorse or prioritize the project. Negative coverage could lead to political opposition. • The media can impact the brand image of project developers and stakeholders. Positive coverage enhances reputations, while negative stories can tarnish the image of the entities associated with the project. • Media coverage can influence public engagement and participation in public hearings, consultations, or advocacy efforts related to the WTE project.	communication helps journalists and reporters in creating well-informed narratives. • The project can facilitate media access to key information, experts, and project sites. Open communication fosters a more accurate representation of the project. • The project can organize media tours and briefings to offer journalists a firsthand look at the operations, technologies, and benefits of the waste-to-energy facility. • The project can actively engage in fact-checking and correction of any inaccuracies in media coverage. Timely corrections contribute to accurate reporting. • Sharing successful case studies and examples of waste-to-energy projects in other locations can provide context and showcase positive outcomes.	

6.1 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 (electricity, water supply and Road) which includes department of Industries, district administration and Vadodara municipal corporation. Further as informed some civil road works were undertaken under CSR for grave yard located closes to the project.

6.2 Engagement as part of the Impact assessment – this assignment

As part of EISA process, consultations were carried out with the project team, , rag pickers and, contractor staff working at site. These consultations were carried to assess the potential impacts of the project on the different 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 6-3***.

Table 6-3 Summary of Stakeholder Consultations

Location	Participants	Key Points of Discussion
Project Site	Project In charge, HR , and other technical support staff	Discussion was carried out with the project team regarding Project design, layout , project construction schedule, mobilisation of contractor and labour management, land procurement process, payment of compensation etc.
Project Site	Contracted labour	Discussion with contracted labour was carried out to understand the labour welfare practice followed at project level and grievance if any

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 on 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.

7.1 Project Activities

An overview of the typical activities during different phases of the Project has been summarised below.

Note: *For the project, 49% of the civil project activities during construction phase are already complete. Hence, impacts for the completed construction activities and Pre-construction and mobilization Phase has been scoped out. However, impacts due to construction of TL and water pipeline which are linked to the Project has been assessed and required mitigation measures has been suggested.*

Table 7-1 Project Activities

Sr. No.	Project Phase	Activities
1.	Pre-Construction Phase	• Site Survey • Land Identification and land procurement/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 batching plant, labour camp, site office, temporary storage areas, internal roads etc. • Transportation of Construction Machinery • Labour Engagement • Transportation and unloading of construction material • Handling and disposal of construction wastes including hazardous and non-hazardous wastes • Setting up of Project facilities such as boiler, fuel handling plant, ash handling plant, water treatment plant, etc. • Transportation of heavy construction equipment's and vehicles • Abstraction of water for civil work
3.	Operation and Maintenance Phase	• Storage and pre-processing of received waste • Operation and maintenance (O&M) of the waste to energy plant including boiler, ash handling plant, Demineralization Plant • O&M of transmission line and water pipeline • Water Transportation storage and management, Leachate management, sewage management, process wastewater management, handling & disposal of hazardous waste • Regular transportation and disposal of ash generated due to operation of the WTE plant • Compliance monitoring and reporting (Monthly & Quarterly) • Regular Emission Monitoring • Power Transmission through overhead and underground transmission line

7.2 Scoping

As part of ESIA study, 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 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 ongoing and remaining construction activities 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:

a. No interaction: Where the project is unlikely to interact with resources/receptor;
b. 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
c. Significant interaction: Where the resultant impact has a reasonable potential to cause a significant effect on the resource/receptor.

The impact interaction matrix highlighting the potential interaction between project activities and resources/receptors has been presented in ***Table 7-4.***

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 7-2***. 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 use of drilling fluids that can leave trace amounts of chemicals, improper waste disposal, discharge from site office may affect the existing soil quality. • During operation phase, soil quality will be impacted due to deposition of ash generated from combustion, improper handling and storage of received waste, fly ash, handling of sewage, improper leachate storage and disposal and other waste generated on site including hazardous waste. Also, leakage or chemical spill due to handling of hazardous material, chemicals, fuel etc. • In the operational phase, accidental spillage of stored chemicals and untreated effluents and leachate may impact the soil quality
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 mist cooling, make up water for blow down loss from boiler, regeneration for demineralised water plant and other miscellaneous activities including domestic consumption. As per CGWB Vadodara tehsil falls is an area marked as "semi-critical" in terms of groundwater development, • Approximately 2216 m3/day water will be obtained from the STP, of which 1387 m3/day treated water and sent to the plant and 7.5 m3/day will be fresh water requirement for domestic purposes. • Improper waste disposal including leachate and sewage management, improper management and disposal of hazardous material and waste, ash deposition, any leakage/spill from site may contaminate the soil and ground water of the area. • In the operational phase, accidental spillage of stored chemicals and untreated effluents, inadequate storm water management, contamination risk due to flooding and leachate may impact the water quality as well as soil quality of surrounding habitats (water bodies and open scrub / barren land
3	Impact on Air Quality	• During construction phase, air quality may be impacted largely due to the following activities:

Sr.No.	Potential Risk/ Impact	Risks Identified
		○ Fugitive dust emissions from, 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 waste/fly ash, vehicular emission due to deployment of vehicles for municipal waste transportation and other operations related activities including chemical handling, and fugitive emissions during ash handling and disposal. Therefore, it is anticipated that air 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 WtE plant during operation phase would be operation of boilers, blowers cooling system, turbines and generator, vehicular movements, unloading of waste and loading and management of fly ash etc.
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, confined spaces during maintenance, 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 odour, pathogens, flue gas emission from boiler, exposure to fly ash which may cause skin and respiratory disorders.
6	Habitat Modification and Loss due to Vegetation Clearance	• The project plant is coming up in an area which was previously a dumping yard for municipal solid waste and the adjacent areas is modified and agricultural lands. Due to the construction of the project, the land use of the 6 acres of land will be changed. Along with the plant, a 66 kV transmission line of 3.82 km length (1.62 km underground+ 2.2 km overhead) having 14 towers connecting the plant to GETCO Jambuva Substation will be laid across the natural habitat – water bodies (ponds and tributary of Vishwamitri river). For undergrounding approximately 2.00 acres will be dug and for overhead power line approximately 5.44 acres will be occupied. Thus there is a risk of habitat modification and loss due to vegetation clearance.
7	Impact on the Wildlife during Construction Activities	• Although the construction phase will be short, but it may cause disturbance to the wildlife of the surrounding area. The construction phase involves site preparation, building of processing units, installation of energy conversion equipment, and the establishment of waste storage areas. Such activities may lead to habitat disturbance and potential effects on local fauna. The excavation required for constructing these facilities directly impacts soil structure and composition, with potential consequences for soil-dwelling organisms. It poses a particular challenge to burrowing fauna, such as ground-dwelling mammals and

Sr.No.	Potential Risk/ Impact	Risks Identified
		reptiles, which rely on stable soils for shelter and protection. The alterations in soil properties and topography might indirectly influence surrounding flora and fauna by changing drainage patterns and nutrient availability. Furthermore, the human activity associated with the project, including transportation of waste and personnel, could introduce new stressors to the local fauna. Increased human activity and vehicle movement might force wildlife (Avifauna, Herpetofauna and Mammals) to remain more vigilant, potentially disrupting their natural behaviors, such as nesting, mating, and foraging. Noise generated from construction and operational activities can have a similar effect, disturbing the delicate balance of the ecosystem.
8	Collision and Electrocution Risk to the Avifaunal species	• In any power generation project, collision and electrocution are the universally recognized risks due to the transmission infrastructures. During the ecological survey, several species of birds were found perching on existing wires and poles in the study area. 66 kV transmission line from the project location to nearby Gujarat Energy Transmission Corporation Limited (GETCO) Substation is 3.8 kilometres out of which 2.2 km is overhead and 1.6 km is underground. The overhead line can possibly cause electrocution and collision risks to birds.
9	Human-Wildlife Conflicts	• The power project is located in close proximity to an active municipal corporation garbage dumping site and is surrounded by natural open scrub and modified agricultural habitats. These habitats sustain diverse herpetofauna, avifauna, and mammal populations, as documented in the ecological baseline survey. The presence and movement of these wildlife species within the project compound and along its boundary during the operation phase pose a potential risk of Human-Wildlife conflicts, especially snakes and monitor lizards.
10	Potential business disruption	• It was understood that project involves laying of transmission lines , the excavation work for underground transmission line and water pipeline most of the excavation work will be done in the govt. land along the existing ROW of Roads.
11	Increased employment and livelihood	• Based on the current understanding of the project the project is having potential of generating employment both during construction as well as operations stage. Nearly 120 staff including subcontracted staff will be working during operations stage.

7.2.2 Scoped Out-Potential Interactions

Based on interactions defined above, the impacts on the following resources have been scoped out.

Table 7-3 Scoped Out-Potential Interactions

S.no.	Aspect	Rationale for Scoping Out
1.	Pre-construction and Mobilization activities	49% of the construction activities for the project have already been completed. Therefore, impact pertaining to pre-operation and mobilization phase have been scoped out.
2.	Land Use	The previous land use for the project was barren and waste land. Waste land which was used by municipality for waste dumping has been allocated to the company, hence change is land use is scoped out Also, laying of underground water pipeline and portion of underground transmission line will not impact the land use of the route, therefore has been scoped out

S.no.	Aspect	Rationale for Scoping Out
3.	Impact on Soil- Construction Phase	Since, the time of site visit, the 49% of the construction was complete majority of civil works, therefore the impacts pertaining to activities such as site excavation, movement of heavy vehicles and equipment on unpaved roads, foundation work and backfilling have been scoped out
4.	Soil Erosion during construction phase	The project has already undertaken site clearing and excavation activities, therefore the same has been scoped out from the study.
5.	Impact on Topography & Drainage during construction phase	At the time of site visit, 49% of the construction was complete majority of civil works including land clearing activities. Therefore impacts due to Preparation of designated area of land for subsequent development activities involves levelling the ground surface, removal of vegetation, stockpiling and generation of construction waste has been scoped out.
6.	Transmission Line & Water Pipeline: Ambient Air Quality Impacts during Operation Phase	During operation phase, no significant impact on air quality is envisaged since transmission line is non-polluting and will not lead to increase in air emissions. Also, since the O&M work will be undertaken once or twice a year, the air emissions are envisaged to be negligible. Hence the project activity and receptor interaction has been scoped out.
7.	Topography and Drainage- Transmission Line and Water Pipeline	Since construction of transmission tower, laying if underground water pipeline and transmission line does not require major levelling work, the impact on topography and drainage due to the project is assessed to be very limited to negligible. Therefore, the project activity and receptor interaction has been scoped out.
8.	Involuntary resettlement / displacement	Project does not involve compulsory land acquisition of private land for the plant and the same will be developed on the govt. land which is leased to the project for 25 years. And reportedly the land use prior to the proposed project was barren or non-culturable land.
9.	Impact on ragpickers	The operation of the waste-to-energy plant will not result in the economic displacement of ragpickers. Vadodara generates approximately 2,000 tons of waste per day, which is significantly higher than the 1,000 tons/day required for the plant's operation. Based on this waste production and the total waste requirement for the project, it is evident that the project will not impact ragpicking activities at the dumpsite. Freshly generated waste will be dumped at the dumpsite even after the project's operation. Ragpickers will continue to collect recyclables from freshly dumped waste and sell them for recycling.

7.2.3 Potential Impacts

Table 7-4 Impact Interaction Matrix

Potential Impact Interaction Matrix	Resource													
	Topography and Drainage	Land Use	Soil and Sediment Environment	Water Availability	Marine Environment	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														
Labour Engagement			√	√	√	√	√	√	√		√	√	√	√
Handling and disposal of construction wastes including hazardous and non-hazardous wastes	√		√	√	√	√	√	√	√				√	√
Abstraction of water for civil work				√										√
Setting up project facilities and ancillary facilities such as batching plant, labour camp, site office, temporary storage areas, internal roads etc	√	√	√	√	√	√	√	√	√				√	√
Transport of raw materials, heavy construction equipment's, project components and vehicles			√			√	√	√			√		√	√
Excavation, foundation, and erection of transmission towers	√		√	√		√	√	√		√	√	√	√	√
Operation and Maintenance Phase														
Operation and maintenance (O&M) of the waste to energy plant including boiler, ash handling plant, compressed air plant, fuel handling plant, Demineralization Plant	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Waste Generation and Disposal			√	√	√	√	√	√	√				√	√
O&M of associated transmission line and towers and water pipeline	√	√	√				√	√					√	√

No interaction	
Potential Interaction	√

7.3 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.

7.3.1 Impact Estimation and Assessment

Criteria	Sub-Classification	Defining Limit
Spread: refers to area of direct influence from the impact of a project activity	Local spread	impact is confined within project footprint and/or within 500m of the project 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	Short Duration	when impact is likely to be restricted for duration of less than 4 months;
	Medium Duration	when impact is likely to be restricted for duration of more than 4 months to 3 years
	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 Construction, and Operation phases of the project are discussed in the subsequent sections.

7.3.2 Impact Significance Criteria

Spread	Duration	Intensity	Magnitude
Local	Short	Low	**Negligible**
Local	Short	Moderate	**Small**
	Medium	Low	
	Long	Low	

Spread	Duration	Intensity	Magnitude
	Long	Moderate	
	Permanent	Low	
Medium	Short	Low	
	Medium	Low	
Local	Medium	Moderate	Substantial
	Medium	High	
	Short	High	
	Long	High	
	Permanent	Moderate	
Medium	Short	Moderate	
	Medium	High	
	Long	Low	
	Long	Moderate	
	Permanent	Low	
	Permanent	Moderate	
High	Short	Low	
	Short	Moderate	
	Medium	Low	
	Medium	Moderate	
	Long	Low	
	Long	Moderate	
	Permanent	Low	
Local	Permanent	High	Major
Medium	Short	High	
	Long	High	
	Permanent	High	
High	Short	High	
	Medium	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 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%)

Table 7-6 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

7.4 Impacts on Physical Environment

The Project site is located in area with no major industrial/ anthropogenic activities except for waste dumping and management activities. This section outlines the potential impacts on the physical environment due to project activities planned during different phases of the Project lifecycle.

7.4.1 Impact during Construction Phase

Table 7-7 Activities and Sources of Impacts during Construction Phase

Activities	Sources of Pollution
Excavation of site layout- Scoped out as the site excavation is already complete	• Dust from excavation activities. • Dust and exhaust gases discharged by dump trucks, ground leveling materials.
Gather, store and preserve fuels and materials in service of works- Scoped out as the civil activity phase of the site visit is complete	• Trucks transporting construction materials such as cement, steel, sand, stone will cause dust and exhaust. • Leaks, dispersal of pollutants, dumps of raw materials, petrol.
Construction of associated Infrastructure such as water supply pipeline, transmission line	• Air pollution from the transportation of machinery and equipment used in construction. • Soil and water contamination due to solid wastes • Pollution of catchment area to receive wastewater, rain water overflows.
Installation of civil equipment, electrical equipment, etc	• Emissions, dust, transportation equipment, raw materials for installation and operation of machinery
Transportation of raw materials for the project	• Exhaust emissions, noise caused by the truck transporting materials into the works
Post-completion process, to increase durability and aesthetics, workers will paint a layer of waterproofing, moisture-proof works	• Exhaust gases from the painting process. The surface coating process produces vapors and volatile organic compounds (VOCS: Volatile Organic Compounds) such as formaldehyde, benzene, xylene and they can evaporate in the air
Welding the steel structures,	• The chemicals in the welding sticks are burned and emitted smoke containing toxic substances, potentially polluting the air environment and affecting the health of workers
Operation of machinery, tool & tackles and other construction activities	• Noise Impact

7.4.1.1 Ambient Air Quality

The fugitive emissions from the construction activities (laying of TL, water pipeline and construction activities on site) and emissions exhaust from transportation vehicles, generators include SO2, CO2, CO, NOx are likely to remain highly localized and confined to the identified waste to energy project area but would require adequate mitigation measures to prevent their spread outside the footprint of the WTE plant.

Based on ambient air quality monitoring conducted at four locations twice a week for 4 weeks within 10 km radius of the, parameters such as Sulphur Dioxide (SO_2), Oxides of Nitrogen (NO_x) and Carbon Monoxide (CO), Cadmium, Lead, Mercury (Hg), Nickel (Ni), Arsenic (Ar), Hydrogen Fluoride (HF), Hydrochloric Acid (HCL) were found to be within NAAQS CPCB permissible limits as well as WBG EHS guidelines, whereas exceedance was observed for PM 10 and PM 2.5 values, where the 24 hours sample values were found to be exceeding the WBG guideline as well as Interim target-3 values (refer ***Table 5-12*** and **Table 5-13**), therefore it can be considered that the project is located in a degraded airshed for PM10 and PM2.5. The WTE plant is spread across an area of 6 Acers of land and the air quality impacts would be confined to 500 m of the construction activity area and the access route. There are no settlements and industries located within 500 m of the plant, however, there are food outlets along the NH-64 and granite and marble shops located 200 m (aerial

distance) from site towards north and west directions. Since the project is within municipal dump site and landfill is located adjacent to the Plant. Further the construction activities will also involve increase in the number of vehicles entering the region for transportation of equipment & material and manpower. Villages along the access roads are anticipated to be impacted due to increased emissions.

The laying of underground water pipeline, transmission lines and setting up of treatment system at the Tarsali STP can have several air quality impacts, especially during the construction phase.

- Vehicle Emissions: The transportation of construction equipment, machinery, and materials to the transmission line and water pipeline route can result in vehicle emissions. This includes nitrogen oxides (NOx), volatile organic compounds (VOCs), and particulate matter released by construction vehicles, contributing to local air pollution and increase in traffic movement.
- Construction Machinery Emissions: The operation of construction machinery, such as excavators, backhoes, and compactors emit exhaust gases and other pollutants that affect air quality in the vicinity of the construction site.
- Asphalt and Concrete Production: The production of asphalt and concrete materials, which are used for road restoration after pipeline installation, can also generate emissions from the mixing and curing processes.
- Fugitive dust emissions from site clearance, excavation, levelling, foundation and erection work at the transmission line, stacking of soils, handling & transportation of construction material
- Exhaust emissions from construction machineries, other heavy equipment like cement mixer, JCB, and trucks
- Exhaustive emission due to excavation work at transmission line and water pipeline route

The transmission line length is 3.8 km and underground water pipeline is of length 4 km and the pre- treatment will be setup at the vacant land within the Tarsali STP premises, the air quality impacts would be confined to 500 m of the construction activity area, material storage area, route and settlements located within 500 m of the transmission line and water pipeline. The Project will not have any long-term impact on the ambient air quality of the study area. The construction activities will involve increase in the number of vehicles entering the region causing fugitive emissions from vehicular engines. State Highways will be utilized along with village roads for transportation of construction materials.

Adopted Control Measures

- Speed of vehicles on site is limited to 10-15km/h which helps in minimizing fugitive dust emissions due to vehicular movement.
- No heavy construction work was undertaken. Most of super structures are prefabricated. All earth work was not carried out simultaneously and was undertaken in phases for minimization of dust and particulate matter during excavation and other construction activities.

Specific to associated TL, water pipeline and treatment system

- Excavated soil at the construction site will be handled adequately and topsoil is heaped and water sprinkling is done to minimize dust generation
- Emissions from the D.G. set and other stationary machines will be controlled by ensuring that the engines are always properly tuned and maintained
- Minimizing of stockpiling by coordinating excavations, spreading, re-grading and compaction activities
- Preventive measures such as storage of construction material in sheds, covering of construction materials during transportation will be undertaken, for reducing dust emissions

Impact Magnitude

Impacts on ambient air quality during remaining construction activities for WtE Plant and construction activities for associated TL and water pipeline will be for limited period i.e. 10 months going forward therefore, the impact duration has been assessed to be short. Furthermore, since there will be dust emissions due to construction activities at the project site and along the access routes and for construction and laying of above ground and underground transmission line and underground water pipeline, the spread has been assessed to be local, i.e. limited to 500m from the project site as well as access roads. The intensity and frequency have been classified as moderate 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

- Vehicles entering site should be Pollution Under Control (PUC) certified
- Periodic inspection of construction equipment and DG sets should be conducted by the onsite contractor.
- DG sets (If any) used for power back up should be provided with adequate stack height as per CPCB norms
- A strict Project speed limit of 30 km/hr to be enforced for vehicles using un-metaled tracks and the RoW
- Regular maintenance of construction vehicles and machinery
- Use of Low-Emission Equipment's for minimize air pollution during the construction process.
- Scheduling construction activities during off-peak hours to reduce exposure to pollutants.
- Idling of vehicles and equipment must be prevented
- Cease or phase down work if excess fugitive dust is observed. Investigate the source of dust and ensure proper suppression measures
- Using windbreaks, netting screens or semi-permeable fences to reduce dust emissions from working areas close to sensitive, residential or agricultural locations or natural habitats
- Adequately sized construction yard will be identified at the site for storage of construction materials, equipment tools, earthmoving equipment, etc.
- Fuel tanks adequately designed to minimize fugitive emissions and welding gas cylinders will be stored in a secluded area within project site

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

7.4.1.2 Ambient Noise

During construction of the project, all activities, equipment on site generate noise. The level of noise propagation depends on the sound level and the distance from the location to the receiving environment. Noise affects the health of workers in the construction site and in the area surrounding the project site. Construction noise occurs discontinuously, depending on the type of operation of the machinery and equipment used. However, since 49% of the construction activities are complete including the majority of civil works within the Plant. Pending works during the construction phase includes laying of transmission line, water pipeline, electrical supply connection and electrical erection works.

The sources of noise for construction of associated TL and water pipeline during 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:

	Noise				Vibration
Machinery & Equipment	Noise at 2m distance (dBA)	Distance of 100m (dBA)	Distance of 200m (dBA)	Distance of 500m (dBA)	At the distance 10m from source of vibration
Dump truck	83 – 94	71.5	68.5	64.5	74
Crane	83 – 94	70.5	67.5	63.5	74
Piling machine	83 – 91	70	67	63	98
Generator	78 – 83	63.5	60.5	56.5	74
Bulldozers	93	76	73	69	81
Excavator	84 – 92	71	68	64	73
Compactor	85 – 90	70.5	67.5	63.5	90
Diesel compressor	87	70	67	63	72

Machinery & Equipment	Noise				Vibration
	Noise at 2m distance (dBA)	Distance of 100m (dBA)	Distance of 200m (dBA)	Distance of 500m (dBA)	At the distance 10m from source of vibration
Mortar pump	82 – 89	68.5	65.5	61.5	66
Concrete mixers	80 – 94	70	67	63	88
Concrete pump trucks	81 – 84	65.5	62.5	58.5	74
Water pumps	70	53	50	46	60
Cutting machines	78 – 86	65	62	58	68
Welder	71 – 82	59.5	56.5	52.5	61

Source: https://www.ruidos.org/Noise/WHO_Noise_guidelines_2.html

Noise levels and vibrations will only directly affect workers on construction site. However, all the equipment's do not operate at the same time, the noise level will not be more than 75dB(A). Impacts caused by the noise and vibration of the construction process of the project are anticipated to be local and the impact on the surrounding area is relatively low due to the short construction time of the machines and the wide spread of the space. The project will use winching machine for stringing of transmission line. The winching machine produces a noise level of more than 70 dB (A). This can cause disturbance to the settlement located within 500 m of the transmission route and workers working at the transmission line.

Based on the ambient noise quality monitoring conducted at four locations within study area (refer ***Table 5-15***),the Leq Day and Leq Night values of N1 was found within the limit prescribed by CPCB and WBG General EHS Guideline, but the values of N2,N3,N4 are found to be exceeding the limit of 55dB(A) and 45 dB(A) for Leq day and Leq night respectively. This can be attributed to the fact that since the monitoring locations was situated near the temple, mosque and school, activities such as morning assembly, morning and evening prayers and anthropogenic activities in the school may have led to increase in noise levels.

The construction work for the associated TL and water pipeline is envisaged to increase the existing noise level at the project study area. Since there are settlements located within 500 m of the associated TL and water pipeline, these settlements are anticipated to be impacted from increased noise levels due to their proximity to project site. Additionally, there will be increase in noise level due to transportation of construction material and manpower at under construction site. However, the impact is envisaged to be limited since construction phase will last for a short period of time i.e., 10 months.

Impact Magnitude

Impacts on ambient noise quality during construction activities will be for limited period going forward i.e. 10 months, therefore, the impact duration has been assessed to be short. Also, there are no permanent settlements located within 500 m of the WtE plant while the transmission line and the water pipeline are passing from the vicinity of the residential as well as commercial areas, there will be increase in noise level during movement of vehicles and construction materials and installation of Transmission tower and laying of the underground TL and pipelines for the project. Furthermore, since there will be noise emissions due to construction activities at the project site and along the access routes due to movement of construction vehicles and construction, the spread has been assessed to be local. The intensity and frequency has been classified as moderate and routine respectively as the construction work will be undertaken on daily basis which will contribute towards increasing the noise levels. Therefore, the impact magnitude based on the impact significance criteria has been classified as Small.

Adopted Control Measures

- The working hours for construction activities are defined i.e. from 8 am to 6pm.
- 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 WTE plant are instructed to obey speed limits and not to blow horns unless absolutely necessary.

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
- Noise generating equipment should be located away from settlement to reduce the disturbance;
- Noise limits for construction equipment to be installed at the project area during peak construction such as front loaders concrete mixers, cranes (moveable), will not exceed 75 dB (A), measured at one meter from the edge of the equipment in free field, as specified in the Environment (Protection) Rules, 1986;
- 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**	**Small**
With Mitigation Measures	Negative	Local	Short	Low	**Routine**	**Negligible**

7.4.1.3 Soil Compaction & Contamination

The volume of waste generated during the construction and installation of the project items includes: soil, rock, wood, building materials, cement, broken bricks, construction materials, iron excess. The volume of these sources of waste is difficult to quantify, depending on the raw material saving, skill level of the worker and the method of re-use of the waste produced for other purposes. Municipal wastes including food waste will be generated from site office and contractor facilities. The project may also generate hazardous waste in the form of used oil from diesel generators and construction machineries, empty containers of paints, contaminated cotton rags, hydraulic fluids etc. Any leaks or spills of oil and lubricants from heavy equipment during drilling activities at site and/or improper discharge of waste water at site may lead to long term negative impact on soil quality.

Daily general waste of workers in the construction site (organic matter, waste paper, etc.) is 0.74kg/person/day[72]. The number of employees/workers working on the site during construction phase are 86. The daily workload of workers on the project area is about 0.74kg/person/day x 86 person = 63.64 kg/day. The amount of waste generated is not large, however if not collected and managed daily, it increases the chances of degradation and increase the risk of contamination and surrounding.

During the construction of the project and associated TL and water pipeline, an amount of hazardous waste will be mainly generated from the maintenance of construction machinery and equipment. The waste generated needs to be collected and stored on the construction site, affecting the water, soil and air environment in the project area and the surrounding area.

As for soil compaction, excavation and collection of top soil during construction of associated TL and water pipeline may lead to soil compaction, thus increasing surface run-off and decreasing the percolation rate of the soil. However, the excavation work will be limited only to the associated TL and water pipeline area and no larger area will be excavated due to the project.

Impact Magnitude

[72] https://datatopics.worldbank.org/what-a-waste/trends_in_solid_waste_management.html

Since the ongoing construction phase will last for limited period of time i.e., 10 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, excavation work at construction site and any leaks and spills of oil from project activities may contaminate the soil in project site and immediate areas, therefore the spread has been classified as local. 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.

Adopted Control Measures

- Sewage generated onsite is being treated and disposed through septic tanks and soak pits
- Construction waste generated at the site is reused to the extent possible
- Spoil generated from excavation work is being reused to the extent possible for backfilling purpose within project boundary etc.
- Using existing roads to access the site to the extent possible
- Stripping of topsoil was not conducted earlier than required (vegetation cover will be maintained for as long as possible) in order to prevent the erosion (wind and water) of soil and the excavated soil for the underground transmission line and water pipeline will be used for backfilling of the excavated area as well.

Additional Mitigation Measures

- Dedicated waste storage areas should be developed at site
- Onsite workers should be provided with adequate trainings on waste management. Requirement to impart EHS trainings to the workers should be included in the contractor's agreement.
- Remaining construction waste which cannot be reused such as scraps, metals etc. should be disposed through authorized vendor.
- Hazardous waste generated at site should be stored on impervious floor with secondary containment and disposed to authorized vendor in accordance with Hazardous and other Wastes (Management & Transboundary Movement) Rules, 2016
- During servicing/repair of equipment or vehicles, a suitable drip tray shall be used to prevent oil/grease spills onto the soil, especially in case of emergency repairs
- Oil spill kits should be maintained onsite to handle minor leaks and spillage
- 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.
- Spoils which cannot be reused should be disposed through authorized vendor
- SPV to implement the developed waste management plan along with the ESMP onsite.
- The stock piles of the soil should be kept moist to avoid wind erosion of the soil;
- Soil to be ploughed in compacted area after completion of the construction work;
- Top soil that has been stripped should be stored for landscaping, if feasible at the transmission line area or connecting substations;
- As a best practice, site clearance, piling, excavation will not be carried out during the monsoon season to minimize erosion, compaction and run-off;
- Site to be restored at the end;
- Contractors deployed for construction of associated TL and water pipeline should ensure that no unauthorized dumping of used oil and other hazardous waste is undertaken along the transmission and waterpipe line route
- Construction and Demolition Waste should be stored separately and be periodically collected by an authorized vendor.
- All waste should be stored in a shed that is protected from the elements (wind, rain, storms, etc.) and away from natural drainage channels.
- Records should be maintained for quantity and type of hazardous waste generated.
- It is to be ensured that hazardous waste is not stored for more than 90 days. Hazardous waste should be disposed through SPCB authorized hazardous waste vendor only.
- Use of spill control kits to contain and clean minor spills and leaks.
- Unloading and loading protocols should be prepared for diesel, and used oil (if generated) respectively and workers trained to prevent/contain spills and leaks.
- In case of accidental/unintended spillage, the contaminated soil should be immediately collected and stored as hazardous waste.

- Limited movement of vehicles should be permitted for stringing of transmission line near to settlements.
- contractor should restore the project site and surrounding area (if used for any temporary structure) to its original condition. GWVPL should inspect the site and ensure, the project site is properly restored prior to issuing completion certificate to the contractors.

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

7.4.1.4 Water Resources

During the construction of the project, sources of water pollution include:

- Domestic waste water from workers at the site mainly contains debris, decomposing organic matter, nutrients (N, P) and microorganisms.
- Construction waste water.

Water is a critical requirement for the execution of civil works (transmission line, water pipeline), particularly for the preparation of raw materials such as concrete, etc. (i.e. tower foundation and installation, casting, construction of substation, laying of underground water and transmission line pipeline, bay extension, pumping station etc.). It is also required for dust suppression activities, domestic and drinking purposes.

Source water for domestic purpose and remaining construction activities at the WTE plant is currently ground water via a borewell installed within the WTE plant. With regards to drinking water, water campers are being sourced from local vendors.

As per CGWB, the project falls is an area marked as semi-critical as per GWRE 2017 categorization. Furthermore, as per CGWA notification dated 24 September 2020, in semi-critical assessment units, No Objection Certificate shall be granted for ground water abstraction to any new industry while paying ground water abstraction charges and along with compliance to terms and conditions as mentioned in the NOC. Therefore, the Project has obtained NOC from CGWA for abstraction of 7.5 m3/day of water from the borewell for the Project. Also, the project is located in an area where legacy waste has been dumped in the nearby vicinity. Based on the ground water quality monitoring results (as presented in ***section 5.3.6.4.1***), most of the parameters (as per IS 10500:2012) for the groundwater sample are within the desirable and permissible limit as per IS 10500:2012 and WHO guidelines. Also, there are no residential area within 500m aerial distance radius, therefore with the project extracting ground water during the construction phase will not affect the water levels in the area as the water will only be used during the remainder of construction phase (10 months) for drinking purposes .

As understood, the source of water for the construction of associated TL and water pipeline will be water tankers. However, it could not be confirmed at this stage, if the source of water in the tanker will be ground water from the project site or another source will be identified.

There is a potential for contamination of groundwater resources resulting from improper management of sewage. Furthermore, the accidental spillage of chemical and fuel may contaminate the ground water in the project area. However, the type of soil found in the project study area is loam and loamy sand which has low water mention capacity.

According to the drainage map (refer ***Figure 5-12***) there are multiple dendritic drainage channels located within 10 km of the Project area and within the water pipeline as well as transmission line, also a natural perennial water pond is located 140 m (aerial distance) from site towards south west direction. Vishwamitri river is flowing is flowing 180 m (aerial distance) from site towards south and east direction and Tarsali lake is located 2.5 km (aerial distance) from site towards north east direction. Improper handling of waste or leaks and spill of chemical and oil may contaminate the drainage located close to the project site, water pipeline as well as the transmission line route.

Adopted Control Measures

- Stored Rain water is also being used for construction and landscaping activities during the construction phase

Impact Magnitude

Since the associated TL and water pipeline for the project are not situated within the project site, abstraction of water will be along the route of the construction area (of TL and water pipeline) and for WTE plant, most of the civil activities are complete therefore the spread has been classified as local. Furthermore, water requirement for construction phase will last for limited period i.e., 10 months, the impact duration has been considered as short. Thus, the impact intensity has been classified as low to moderate. Therefore, based on impact significance criteria, the impact magnitude has been classified as small.

Additional Mitigation Measures

- Sensitize workers on water conservation and encourage optimal use of water. Requirement to conduct such trainings should be included in the contractor's agreement.
- Project should ensure it is compliant to the regulatory requirements for abstraction of water during project construction.
- Reuse and recycle water to the extent possible
- Regular inspection should be carried out for identifying water leaks and preventing water wastage
- Optimum use of water during sprinkling on roads for dust settlement, washing of vehicles, concrete mixing for etc.
- Groundwater quality monitoring should be conducted onsite quarterly during the construction phase

	Nature of Impact	Spread of Impact	Duration	Intensity	Significance of Impact
Without Mitigation Measures	Negative	Local	Short	Low to Moderate	**Small**
With Mitigation Measures	Negative	Local	Short	Low	**Negligible**

7.4.2 Impacts during Operation Phase

Table 7-8 Activities and Sources of Impacts during operation phase

Aspect	Source	Impact
Dust	• Dust arising from internal traffic • MSW transportation to the site	• Air environment • Water environment
Emission Odor	• Emissions from Boiler • Air emissions from MSW collection and transport include, dust and bio-aerosols, odors, and vehicle emissions	• Air environment • Water environment • Occupational Health & Safety
Bottom Ash & Fly Ash	• Boiler	• Water environment • Air environment • Soil environment • Occupational Health & Safety
Waste generated during the project operations (Hazardous waste, domestic waste, wastewater, leachate, and e-waste)	• Project Operations and operation of water Pre-treatment systems	• Air environment • Soil environment • Occupational Health & Safety • Water environment

7.4.2.1 Ambient Air Quality

During operation phase, primary sources of air emission from the project will include the following:

- Vehicular emission due to traffic movement within and outside the plant premises and from the waste collection centers to the project site
- Waste Pre-processing and handling
- Flue gas emission from boiler/furnace due to incineration of waste
- Fugitive fly ash emission from ash handling units and boilers and during ash transportation
- Exhaust emissions from diesel generators used for power back up

During the operation phase of the project, the dust emissions from the vehicles are anticipated during transportation of waste to the plant. Assuming the project operates at 100% capacity throughout the day, approximately 150-200 Vehicles are anticipated to bring fresh waste to the WTE plant.

Specialized transportation vehicles for the transportation of fresh waste from the garbage stations will be done using 5-10 tonne trucks with average waste transportation distance of about 10 km/vehicle. The fresh waste generated by the Vadodara city is currently being dumped at the existing dumping site (adjacent to the Project site) and post operation of the plant, the waste will be dumped at the bunker (within the Project site). The dust emissions from the waste transportation will not increase due to the project. Also, waste collection and dumping is in the scope of the municipality.

Emissions from the project activities are mainly emissions during the incineration process and fugitive emission from fly ash and bottom ash generated due to combustion of waste (~ 140TPD of ash will be generated from WTE plant).
The high-temperature flue gas generated by the combustion of waste in the incinerator is cooled by the heat recovery boiler to 190°C and then enters the flue gas purification system. Refer to ***Section 2.7.2*** on details of flue gas cleaning mechanism. The boiler will operate at 40 bar pressure and 410-degree temperature. Major emissions from the boiler stack is anticipated to be Poly Chlorinated-p-dioxins (PCDD) and related furans (PCDF), SOx, NOx, CO, HCL, HF, Mercury and its compounds, PM_{10}, $PM_{2.5}$, Cadmium +Thorium and their compounds, Scandium+ Arsenic + Lead+ cobalt+ Chromium+ Copper + Manganese+ Nickel+ Vanadium and their compounds. The flue gas emission from the boilers may disperse in the air up to a significant distance depending upon the meteorological condition of the Project area.

Flue gas cleaning system (FGCS) refers to a range of processes imposed on untreated combustion gas to limit harmful pollutants such as emissions of dust, acidic gases, heavy metals, and dioxins to levels well below legal emission limits. This flue gas cleaning system requires water, steam and chemicals for removal of pollutants substance from flue gas. Removal of pollutants in flue gas requires two processes physical and chemical. Selection of Technology/Combination of equipment's/ technologies proposed to be used to clean the flue gas to achieve the prescribed norms is as tabulated hereunder.

Table 7-9 Technology adopted for cleaning of Flue gas.

Flue Gas Component	Proposed Technology
Poly Chlorinated-p-dioxins (PCDD) and related furans (PCDF)	• Effective Combustion • Prevention of Re-formation • Adsorption of PCDD/F by injection of activated carbon or of other adsorbents
NOx	• Air supply, gas mixing and temperature control • Flue-gas recirculation
CO	• Effective Combustion
HCl & SOx	• Dry Sorbent Injection System
HF	HF is highly soluble in water. HF can be controlled by acid emission control techniques, i.e. use of hydrated lime and sodium bicarbonate
Mercury and its compounds	• Activated carbon injection for mercury adsorption
PM_{10}, $PM_{2.5}$	Bag Filter
Cadmium +Thorium and their compounds	Cadmium & Thallium Compounds: Adsorption of metal by injection of activated carbon or other reagents in combination with a dry sorbent injection system is used to reduce acid gas emissions
Scandium + Arsenic + Lead + cobalt + Chromium + Copper + Manganese +	Metals in incineration are converted mainly into non-volatile oxides and deposited with fly ash. Thus becomes a part of particulate matter and are managed by Bag Filters and ESP's

Flue Gas Component	Proposed Technology
Nickel + Vanadium and their compounds	

Formation of Dioxin and Furan generally takes place between temperature zone of 200°C to 400°C, subject to presence of chlorine, oxygen and available organic matter (benzene ring). GWVPL intends to suppress the formation of dioxin and furan by reducing the retention time in the above-mentioned temperature.

Odour arising from the handling, storage and treatment of waste and leachate include H_2S, ammonia, methyl mercaptan. During operation, accumulation of a large amount of waste in the bunker (capacity of 1400 Tonn) with incoming waste ~ 1000 tonnes per day when the plant is 100% operational will generate odour due to the decomposition of organic substances. Odour generated will impact the workers present within the project site, especially H_2S, when inhaling in high concentrations.

Air Quality Dispersion Modelling

To assess the impact of air emissions from various sources, an air dispersion modelling study was conducted as part of the ESIA. AERMOD View 9.8.3 model software was run with the Metrological data of 2022 (1st January 2022- 31st December 2022) for normal and worst-case condition and following Incremental Ground Level Concentration was obtained.

Modelling Details and Computation Framework

The predictions for air quality during operation phase were carried using CPCB/MoEF&CC/SEIAA approved "AERMOD (AMS/EPA Regulatory Model) View" which is developed by the AERMIC (American Meteorological Society (AMS)/United States Environmental Protection Agency (EPA) Regulatory Model Improvement Committee). The model is based on planetary boundary layer theory which incorporated the popular USEPA models into one interface. Aermod View fully incorporates the building wash algorithms, advanced depositional parameters, local terrain effects and advanced meteorological turbulence for the prediction of pollutants dispersion.

AERMOD View 9.8.3 model has been used to calculate the Ground Level Concentration (GLC) which can simultaneously simulate many sources with different shapes, at ground or elevated, buoyant or non-buoyant, emitting one or more pollutants and is capable to account for the non-homogeneous vertical structure of the boundary layer. Vertical mixing is limited in case of stable conditions. The dispersion for unstable conditions is non-Gaussian, so as to correctly describe the high concentrations of pollutants that can be observed close to stacks under convective conditions.

The AERMOD software generated concentration contours depicting the spatial distribution of pollutant concentrations on point source along the road segment. These contours provide visual representations of dispersion of pollutant patterns and highlight areas of elevated pollutant concentrations. This analysis helps us to identify potential air quality impacts of point sources as well line source on nearby receptors and sensitive receptors such as residential areas, schools, and hospitals.

AERMOD includes the several improvements of the standard Gaussian models as follows:

- Turbulence: AERMOD uses the vertical continuous profiles of horizontal and vertical turbulence that are measured/computed as compared to the ground level releases of the dispersion parameters corresponding to the stability classes.
- Dispersion under Convective Conditions: Under the convective conditions the plume is made of the three components – direct plume, indirect plume and a third plume (penetrating the mixing lid and dispersion more slowly in the stable layer above and re-enter in the mixing lid and reach the ground). AERMOD describes the non-Gaussian vertical dispersion under convective conditions that are characterized by the presence of updraft and downdraft motions with different probability of occurrence and different intensity.
- Dispersion under stable conditions: AERMOD took into account the boundary layer as compared to the assumption of infinite boundary layer for describing the horizontal and vertical dispersion.
- Plume Buoyancy: Under stable atmospheric conditions: AERMOD uses the values at stack height at half distance from the final height due to buoyancy, while under convective conditions it superimposes the random displacements due to the random fluctuations of the convective velocities.
- Nature of Source: Sources can be treated as rural or urban independently.

- Complex Terrain: AERMOD has a terrain processor (AERMAP) that prepares the data for their use within the model by advanced algorithms that discriminate the streamline division based on a critical height.

Methodology

There are two input data processors that are regulatory components of the AERMOD modeling system: AERMET, a meteorological data preprocessor that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, and AERMAP, a terrain data preprocessor that incorporates complex terrain using USGS Digital Elevation Data

Considerations/Control and model Input

There are following considerations/model inputs for this project based on the detailed project report provided, USEPA and various research Papers

1. Two stacks are considered for calculation of emission factor to get ground level concentration
2. Emission parameter values have been calculated based on 7% oxygen, as expected according to EU Norms 2000.
3. Two Conditions are considered for Plant operation one is Normal condition with APCD installed and another is worst condition with failure of APCD.
4. 24 hours value is utilized in Normal condition to run AERMOD.
5. Worst Case Scenario has also been considered for 1 Hours, taking into account failure of APCD.
6. 99% efficiency of Air Pollution Control Devices (ESP and Bag house filter) has been considered
7. 50 % efficiency of Air Pollution Control Device (Hydrated lime injection System) for removal of gases pollutant (N02 and SO2) is considered.
8. CO values are considered for both conditions. In normal conditions, values align with 24 hour EU Norms 2000, while in worst-case scenarios, a 50% increase from normal CO concentration is considered due to less efficient combustion.
9. For fugitive dust emission AP 42 has been considered to calculate the emission factor.
10. Fugitive dust emission calculated for PM10 and PM2.5 in Normal condition.
11. For worst condition only point source considered only in PM10, PM2.5 only.
12. Emission rate (g/s), base elevation, coordinates (UTM), release height (m), gas exit temperature (K), gas exit velocity (m/s), stack inside diameter (m) have been considered in input source file.
13. Wind speed at stack level is calculated by power law as given below
    Ustack =U10 (Stack height/10) p
    Where U10 is the wind speed at 10-meter level and p is the power law coefficient (0.07, 0.10, 0.15, 0.35 and 0.55 for stability classes A, B, C, D, E and F respectively) as per Irwin for rural areas (USEPA. 1987).
14. All the inputs related to positions of source and receptors are taken in UTM (Universal Transverse Mercator).
15. Rectangular grids receptors are considered for dispersion result with 500m x 500m grid.
16. Location is falling under datum 42Q
17. Orientation angle has been taken 0° as North and accordingly locations of sources have been defined in clockwise direction.
18. Operating data limits have been calculated along with efficiency of APCD for calculation of emission factors for Normal and Worst-case conditions.
19. The ground level concentration on settlements has been calculated on the basis of isopleth superimposed on the Google Earth.

Identification of Source

The under-construction plant is a waste to energy based power plant, two stacks has been considered as the point source for emission. MSW, RDF, segregated waste will be used in boiler. Flue Gas cleaning system will be installed after complete heat recovery from hot gas. This will control all defined emissions as per emission norms before it leaves to atmosphere through boiler Chimney (stack). Transportation has been considered as line source. The major pollutants are considered as PM_{10}, $PM_{2.5}$, NOx, SO_2 and CO only. Source of pollutants considered includes:

- Process Stack - PM10, PM2.5, SO2, NOx, CO
- Road Transportation - Fugitive dust

Table 7-10 Details of Boilers

S. No	Parameter	Unit	Operation of Boilers	
			Boiler-1	Boiler-2
1.	Capacity	TPH	2 boilers of capacity 40 TPH each	
2.	Stack Height	m	50 (Boiler-1)	50 (Boiler-1)
3.	Stack Diameter	m	2.093 (Boiler-1)	2.093 (Boiler-2)
4.	Velocity	m/s	10-15	10-15

Table 7-11 Traffic Flow

Sr. No.	Material Type	Vehicle Type	Vehicle Make	Vehicle Model	Loading Capacity in MT	Avg Moving Vehicle / Day
1	MSW	Dumper (BS IV), diesel based	Tata	SK 1613 / LPT 2518	12 / 25	65
2	MSW	Container (BS IV), diesel based	Ashok Leyland	2820	8	10
3	MSW	Compactor (BS IV), diesel based	Tata	LPT 1618	15	11

Table 7-12 Emissions in Normal and Worst-Case Scenario

Emissions in Normal and Worst-Case Scenario (from both the boiler combined)				
S. No	Pollutant	Emission rate in Normal Condition (g/s)	Emission Worst Case Condition (g/s)	Emission rate (mg/Nm3)
1.	PM10	0.4128	41.28	10
2.	PM2.5	0.4128	41.28	10
3.	NOx	8.256	16.512	200
4.	SO_2	2.064	4.128	50
5.	CO	2.064	3.096	50
Fugitive Dust Emission				
S. No	Pollutant	Emission rate in Normal Condition (g/s-m2)		
6.	PM10	3.82E-07		
7.	PM2.5	3.82E-08		

Identification of receptors

To identify the impact on receptors in 10 km radius a grid has been taken of 20 km x 20 km in North and East of the site considering centre of Site as the centre of the grid. A total of 41 points taken in both the sides and interval of 500m has been taken. All the intersection points are considered as the receptors and accordingly results have been obtained in form of isopleths showing the Ground Level Concentration (GLC).

Meteorological Data

1st January 2022- 31st December 2022 data has been considered for calculating the Maximum peak for whole period and worst-case scenario. Meteorological data is purchased for the period January-December 2022 and consist of wind direction, wind speed, temperature (in K), mixing height, stability class (urban and rural) and cloud cover.

Analysis of Results

AERMOD View 9.8.3 model software was run with the Meteorological data of 2022 (1st January 2022- 31st December 2022) for normal and worst-case condition. Ground Level Concentration (GLC) on sensitive receptors (village settlements) in 10 km radius around the Project site for all the pollutants due to point as well as line source was modelled.

Based on the 24 hours averaging period results, maximum concentration of the pollutants is limited to 500m radius. The maximum incremental GLC (24 hours averaging period, in normal conditions) for the PM10, PM2.5, NOx, SOx and CO (8 hours averaging period, in normal conditions) on the baseline conditions will be:

Normal Case (24 hours)

- PM10 – 1.839 ug/m3
- PM2.5 – 1.839 ug/m3
- NOx – 22.3479 ug/m3
- CO- 8.5226 ug/m3
- SO_2 – 5.49 ug/m3

Worst Case

- PM_{10} –1770.41 ug/m3
- $PM_{2.5}$ – 1770.41 ug/m3
- NOx – 715.14 ug/m3
- CO- 25.4120 ug/m3
- SO_2- 177.08 ug/m3

Detailed Results for 24 hour averaging period (for PM_{10}, $PM_{2.5}$, SO_2 & NOx) and 8 hour averaging period for CO with peak concentration at Normal and Worst Conditions and Isopleths been attached as ***Appendix 15***. Result for GLC for the villages falling within 10 km radius has been presented in ***Table 7-13*** below.

Referring to the modeling results, during the operation phase

- PM10: Maximum GLC is observed to be 1.84 µg/m3 which is at Project site. With the increase in distance from project site, GLC is getting reduced and by 460 m distance, the concentration is further reduced even less than 0.6 µg/m3.
- PM2.5: Maximum GLC is observed to be 1.84 µg/m3 which is at Project site. With the increase in distance from project site, GLC is getting reduced and by 460 m distance, the concentration is further reduced even less than 0.6 µg/m3.
- S02: Maximum GLC is observed to be 5.49 µg/m^3 which is at the Project site. With the increase in distance from project site, GLC is getting reduced and by 690 m distance, the concentration is further reduced even less than 2.0 µg/m3.
- NOx: Maximum GLC is observed to be 22.3 µg/m3 which is at Project site. With the increase in distance at 745 m from project site, the concentration is further reduced to less than 0.7 µg/m3.
- CO: Maximum GLC is observed to be 8.52 µg/m^3 at a distance of 385 m Project site. The concentration is further reduced to less than 3 µg/m3 at distance of 950 m from the project site.

Table 7-13 Results for Incremental Ground Level Concentrations

S.No	Villages within 10 km radius	X coordinates	Y Coordinates	Distance & Direction	Ground level concentration (µg/m^3)			Applicable Standards
					Normal Condition (24 hour)	Worst case Condition (24 hour)	Worst case Condition (1 hour)	
NO_x[73]								

[73] There are no Ambient Air quality standards for NOx as per National and International Standards. Furthermore, NO_2 is a part of NOx emissions, and since the NOx values are complying with the national as well as international ambient air quality standards, therefore it is understood that the values of

S.No	Villages within 10 km radius	X coordinates	Y Coordinates	Distance & Direction	Ground level concentration (µg/m³)			Applicable Standards
					Normal Condition (24 hour)	Worst case Condition (24 hour)	Worst case Condition (1 hour)	
1	Mujar Gamdi	314935	2458060	1.3 Km; S	5	10	70	
2	Kajapur	315295	2451194	8.2 Km; S	2	5	30	
3	Patarveni	319561	2453211	7.7 Km; SE	2	5	50	
4	Vadodara	314931	2466705	7.2 Km; N	2	4	50	
5	Shankarpura	321480	2464721	8.3 Km; NE	1	1.12	30	
6	Kelanpur	321810	2460719	6.9 Km; NE	2	6	50	**NAAQS Permissible Limits (24 Hr) :** 80 µg/m³
7	Chapad	309077	2460024	5.8 Km; W	4	7	30	
8	Vadadla	318605	2461547	4.1 Km; NE	4	7	50	
9	Alamgir	313683	2456003	3.6 Km; SW	2	7	70	**WBG Ambient Air Quality Standards (WHO Guidelines):** 1 year: 40 1 hour: 200
10	Manjalpur	313133	2463769	4.7 Km; NW	2	4	50	
11	Chansad	307302	2456935	8.0 Km; SW	2	4	30	
12	Bill	307804	2462288	7.7 Km; NW	1	1.12	30	
13	Makarpura	312607	2460758	2.7 Km; NW	4	7	70	
14	Akota	310791	2466780	8.5 Km; NW	1	1.12	30	
15	Varsada	311508	2452156	9.4 Km; SW	2	1.12	50	
PM_{10}								
1.	Mujar Gamdi	314935	2458060	1.3 Km; S	0.2	10	100	
2.	Kajapur	315295	2451194	8.2 Km; S	0.1	10	100	
3.	Patarveni	319561	2453211	7.7 Km; SE	0.1	10	100	
4.	Vadodara	314931	2466705	7.2 Km; N	0.1	10	100	**NAAQS Permissible Limits (24 Hr) :** 100 µg/m³
5.	Shankarpura	321480	2464721	8.3 Km; NE	0.1	8	80	
6.	Kelanpur	321810	2460719	6.9 Km; NE	0.1	10	100	
7.	Chapad	309077	2460024	5.8 Km; W	0.2	10	100	
8.	Vadadla	318605	2461547	4.1 Km; NE	0.2	10	100	**WBG Ambient Air Quality Standards (WHO Guidelines): 24 hour values** 150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)
9.	Alamgir	313683	2456003	3.6 Km; SW	0.2	10	100	
10.	Manjalpur	313133	2463769	4.7 Km; NW	0.1	10	100	
11.	Chansad	307302	2456935	8.0 Km; SW	0.1	10	80	
12.	Bill	307804	2462288	7.7 Km; NW	0.09	8	100	
13.	Makarpura	312607	2460758	2.7 Km; NW	0.2	10	100	
14.	Akota	310791	2466780	8.5 Km; NW	0.07	6	80	

NO_2 will also comply with the Air Quality Standards. . Therefore, if the Ground Level concentration (GLC) of NO_x at the villages due to emissions from WtE plant are well within the Ambient Air Quality Standards for NO_2 (as there are no Air Quality Standards for NO_x values), it can be considered that the NO_2 concentrations will also be within the Ambient Air Quality Standards.

S.No	Villages within 10 km radius	X coordinates	Y Coordinates	Distance & Direction	Ground level concentration (µg/m³)			Applicable Standards
					Normal Condition (24 hour)	Worst case Condition (24 hour)	Worst case Condition (1 hour)	
15.	Varsada	311508	2452156	9.4 Km; SW	0.1	8	100	
$PM_{2.5}$								
1.	Mujar Gamdi	314935	2458060	1.3 Km; S	0.2	10	100	
2.	Kajapur	315295	2451194	8.2 Km; S	0.1	10	100	
3.	Patarveni	319561	2453211	7.7 Km; SE	0.1	10	100	
4.	Vadodara	314931	2466705	7.2 Km; N	0.1	10	100	
5.	Shankarpura	321480	2464721	8.3 Km; NE	0.1	8	80	**NAAQS Permissible Limits (24 Hr) :** 60 µg/m³
6.	Kelanpur	321810	2460719	6.9 Km; NE	0.1	10	100	
7.	Chapad	309077	2460024	5.8 Km; W	0.2	10	100	
8.	Vadadla	318605	2461547	4.1 Km; NE	0.2	10	100	**WBG Ambient Air Quality Standards (WHO Guidelines): 24 hour values**
9.	Alamgir	313683	2456003	3.6 Km; SW	0.2	10	100	
10.	Manjalpur	313133	2463769	4.7 Km; NW	0.1	10	100	75 (Interim target-1)
11.	Chansad	307302	2456935	8.0 Km; SW	0.1	10	80	50 (Interim target-2)
12.	Bill	307804	2462288	7.7 Km; NW	0.09	8	100	37.5 (Interim target-3)
13.	Makarpura	312607	2460758	2.7 Km; NW	0.2	10	100	25 (guideline)
14.	Akota	310791	2466780	8.5 Km; NW	0.05	6	80	
15.	Varsada	311508	2452156	9.4 Km; SW	0.1	8	100	
SO_2								
1.	Mujar Gamdi	314935	2458060	1.3 Km; S	1	1	20	
2.	Kajapur	315295	2451194	8.2 Km; S	0.5	1	10	
3.	Patarveni	319561	2453211	7.7 Km; SE	0.6	1	10	
4.	Vadodara	314931	2466705	7.2 Km; N	0.5	1	10	**NAAQS Permissible Limits (24 Hr) :** 80 µg/m³
5.	Shankarpura	321480	2464721	8.3 Km; NE	0.4	0.8	7	
6.	Kelanpur	321810	2460719	6.9 Km; NE	0.8	1	10	
7.	Chapad	309077	2460024	5.8 Km; W	0.4	1	10	**WBG Ambient Air Quality Standards (WHO Guidelines): 24 hour values**
8.	Vadadla	318605	2461547	4.1 Km; NE	1	1	10	
9.	Alamgir	313683	2456003	3.6 Km; SW	0.8	1	10	
10.	Manjalpur	313133	2463769	4.7 Km; NW	0.6	1	10	125 (Interim target-1)
11.	Chansad	307302	2456935	8.0 Km; SW	0.4	1	7	50 (Interim target-2)
12.	Bill	307804	2462288	7.7 Km; NW	0.4	0.6	7	20 (guideline)
13.	Makarpura	312607	2460758	2.7 Km; NW	1	1	10	
14.	Akota	310791	2466780	8.5 Km; NW	0.109	0.5	7	
15.	Varsada	311508	2452156	9.4 Km; SW	0.4	0.8	9	

S.No	Villages within 10 km radius	X coordinates	Y Coordinates	Distance & Direction	Ground level concentration (µg/m³)			Applicable Standards
					Normal Condition (24 hour)	Worst case Condition (24 hour)	Worst case Condition (1 hour)	
Carbon Monoxide (CO)- 8 hour								
1.	Mujar Gamdi	314935	2458060	1.3 Km; S	2	5	10	**NAAQS Permissible Limits (8 Hr)**: 2 mg/m³ (2000 µg/m³)
2.	Kajapur	315295	2451194	8.2 Km; S	1	1	9	
3.	Patarveni	319561	2453211	7.7 Km; SE	1	1	10	
4.	Vadodara	314931	2466705	7.2 Km; N	0.5	1	10	
5.	Shankarpura	321480	2464721	8.3 Km; NE	0.7	1	6	
6.	Kelanpur	321810	2460719	6.9 Km; NE	1	3	9	
7.	Chapad	309077	2460024	5.8 Km; W	1	3	9	
8.	Vadadla	318605	2461547	4.1 Km; NE	1	3	10	
9.	Alamgir	313683	2456003	3.6 Km; SW	1	3	10	
10.	Manjalpur	313133	2463769	4.7 Km; NW	0.6	1	10	
11.	Chansad	307302	2456935	8.0 Km; SW	0.9	1	7	
12.	Bill	307804	2462288	7.7 Km; NW	0.5	1	8	
13.	Makarpura	312607	2460758	2.7 Km; NW	1	3	10	
14.	Akota	310791	2466780	8.5 Km; NW	0.2	1	7	
15.	Varsada	311508	2452156	9.4 Km; SW	0.7	1	9	

The ground level concentration (GLC) of various pollutants due to the emission from the waste to energy plant for all the sensitive receptors (village settlements) within 10 km radius are well within the National Ambient Air Quality Standards as well as WBG EHS Ambient Air Quality Standards (WHO Guidelines) for normal scenario's for 24 hours values. The impact during normal scenario will be limited to 10 km radius from the project site, whereas it will exceed the 10 km radius in the worst case scenario. As confirmed by the GWVPL, the plant will always have operational APCD, in case of any failure of APCD's the plant will be shut down and will not be operated without APCD's. Faulty or non-operational APCD's can be immediately detected as a Continuous Emission Monitoring System (CEMS) will be installed at both the stacks to monitor the pollutants.

With proper functioning of Air Pollution Control Devices, Incremental ground level concentration will have minimal impact. Also, the emissions from the plant (**Table 7-11**) are well within the WBG EHS Air emission standards for MSW incinerators as well as the Standards for Incineration as per SWM Rules 2016 (refer ***Table 4-8***)

The table below (**refer *Table 7-14*)** presents the Resultant Pollution Load in normal working conditions (i.e. all the Air Pollution Control Devices (APCD) devices are fully functional) of the WTE plant. The resultant pollution load for the project area was calculated wrt Existing Baseline Ambient Air Quality and Incremental Ground Level Concentration due to waste to energy plant at the ambient air quality monitoring locations.

As per analysis of results from the ambient air quality undertaken for the Project site, all the parameters such as Dioxin, Furan, PM 10, PM 2.5, Sulphur Dioxide (SO_2), Oxides of Nitrogen (NO_x) and Carbon Monoxide (CO), Cadmium, Lead, Mercury (Hg), Nickel (Ni), Arsenic (Ar), Hydrogen Fluoride (HF), Hydrochloric Acid (HCL) were found to be within NAAQS CPCB permissible limits. However, for few of the samples PM10 and PM2.5 was observed to be exceeding the WBG Interim Target 3 and WBG EHS Guideline (refer ***Section 5.3.8***).

The modeling results (**refer**

Table 7-14), indicate that there will be no significant change in the existing ambient air quality parameters due to the project operations. As per modeling results, ground level concentration (GLC) of PM 10, PM2.5, NO_X, SO_2, and CO at the nearest receptors from the project where monitoring was conducted was recorded to be 59.529 – 75.749 µg/m^3 , 29.528-36.119 µg/m^3, 46.947-51.727 µg/m^3, 14.17-15.73µg/m^3 and 0.509-0.609 mg /m^3 respectively. The PM10 and PM2.5 values are well within the NAAQS standard however are exceeding the WBG AAQ interim target-3. For parameters NO_X, SO_2, and CO, the values are well within the NAAQS as well as WBG AAQ standards.

The airshed is already degraded, the % increase in the pollutant load in ambient air quality lies in the range of 2.49 - 3.19 % and 5.36 to 6.64 % respectively for 24 hours values with APCD devices for PM 10 & PM 2.5. Projects located within poor quality airsheds should ensure that any increase in pollution levels is as small as feasible and amounts to a fraction of the applicable short-term and annual average air quality guidelines or standards as established in the project-specific environmental assessment. The emissions are “a fraction” of the air quality guideline for a degraded airshed for PM 10 & PM 2.5. The modelled contribution due to emissions from the project are well within the reference point of “a fraction” of the air quality guideline for a degraded airshed.

For parameters such as CO, SO_2 and NO_x, where the air shed is considered as non-degraded, the % increase in the pollutant load in ambient air quality lies in the range of 1.42-1.7, 53.63 – 63.27, 76.07 – 90.95 % respectively for 8 hours/ 24 hours values with APCD devices (refer **Table 7-14**). The baseline values for CO, SO_2 and NO_x are quite low and well within the limits and the emission by the plant are also well below the standards.

Table 7-14 Resultant Concentration for Pollutants at the Monitoring Locations (Receptors within 3km radius)

S. No,	Location	Baseline maximum concentration (µg/m³)	Incremental GLC (as obtained from Dispersion Modelling) (µg/m³)		Location of max. incremental GLC	Total Concentration (µg/m³) (Incremental GLC + Baseline Maximum Concentration Values)		% Incremental GLC wrt standard		% Increase of the Pollutants (Incremental GLC/Baseline *100)		Applicable Standards (WBG EHS Guidelines & NAAQS Standards)
			24 Hour- 1st Highest (With APCD)	1 Hour (without APCD)		24 Hour- 1st Highest (With APCD)	1 Hour (without APCD)	24 Hour (1st Highest) With APCD	1 Hour without APCD	24 Hour- 1st Highest(With APCD)	1 Hour (without APCD)	
PM_{10}												
AAQ1	Project Site	64.17	1.83912	1770.41	Project Site	66.00912	1834.58	1.83912	1770.41	2.87	2758.93	**NAAQS Permissible Limits (24 Hr) :** 100 µg/m³ **WBG Ambient Air Quality Standards (WHO Guidelines): 24 hour values** • 150 (Interim target-1) • 100 (Interim target-2) • 75 (Interim target-3) • 50 (WBG EHS guideline)
AAQ2	Dasha Maa Mandir, Mani Nagar Residential Area	71.35				73.18912	1841.76			2.58	2481.30	
AAQ3	Primary School, Vora Gamdi Residential Area	73.91				75.74912	1844.32			2.49	2395.36	
AAQ4	Parvati Nagar Residential Area	57.69				59.52912	1828.10			3.19	3068.83	
$PM_{2.5}$												
AAQ1	Project Site	34.28	1.83912	1770.41	Project Site	36.11912	1804.69	3.07	2950.68	5.36	5164.55	**NAAQS Permissible Limits (24 Hr) :** 60 µg/m³ **WBG Ambient Air Quality Standards (WHO Guidelines): 24 hour values** • 75 (Interim target-1)
AAQ2	Dasha Maa Mandir, Mani Nagar Residential Area	33.61				35.44912	1804.02			5.47	5267.50	
AAQ3	Primary School, Vora Gamdi Residential Area	34.23				36.06912	1804.64			5.37	5172.09	

S. No,	Location	Baseline maximum concentration (µg/m³)	Incremental GLC (as obtained from Dispersion Modelling) (µg/m³)		Location of max. incremental GLC	Total Concentration (µg/m³) (Incremental GLC + Baseline Maximum Concentration Values)		% Incremental GLC wrt standard		% Increase of the Pollutants (Incremental GLC/Baseline *100)		Applicable Standards (WBG EHS Guidelines & NAAQS Standards)
			24 Hour- 1st Highest (With APCD)	1 Hour (without APCD)		24 Hour- 1st Highest (With APCD)	1 Hour (without APCD)	24 Hour (1st Highest) With APCD	1 Hour without APCD	24 Hour- 1st Highest(With APCD)	1 Hour (without APCD)	
AAQ4	Parvati Nagar Residential Area	27.69				29.52912	1798.10			6.64	6393.67	• 50 (Interim target-2) • 37.5 (Interim target-3) • 25 (WBG EHS guideline)
						NO_x						
AAQ1	Project Site	26.81				49.15794	741.95			83.36	2667.44	**NAAQS Permissible Limits (24 Hr) :** 80 µg/m³ **WBG Ambient Air Quality Standards (WHO Guidelines):** • 1 year: 40 • 1 hour: 200
AAQ2	Dasha Maa Mandir, Mani Nagar Residential Area	24.60	22.34794	715.14	Project site	46.94794	739.74	27.93	893.93	90.85	2907.07	
AAQ3	Primary School, Vora Gamdi Residential Area	29.15				51.49794	744.29			76.67	2453.31	
AAQ4	Parvati Nagar Residential Area	29.38				51.72794	744.52			76.07	2434.10	
						SOx						
AAQ1	Project Site	9.24				14.73	186.32			59.44	1916.47	**NAAQS Permissible Limits (24 Hr) :** 80 µg/m³ **WBG Ambient Air Quality Standards (WHO Guidelines): 24 hour values** • 125 (Interim target-1)
AAQ2	Dasha Maa Mandir, Mani Nagar Residential Area	9.01	5.49	177.08	Project Site	14.50	186.09	6.865	221.3517625	60.95	1965.39	
AAQ3	Primary School, Vora Gamdi Residential Area	8.68				14.17	185.76			63.27	2040.11	

S. No,	Location	Baseline maximum concentration (µg/m³)	Incremental GLC (as obtained from Dispersion Modelling) (µg/m³)		Location of max. incremental GLC	Total Concentration (µg/m³) (Incremental GLC + Baseline Maximum Concentration Values)		% Incremental GLC wrt standard		% Increase of the Pollutants (Incremental GLC/Baseline *100)		Applicable Standards (WBG EHS Guidelines & NAAQS Standards)
			24 Hour- 1st Highest (With APCD)	1 Hour (without APCD)		24 Hour- 1st Highest (With APCD)	1 Hour (without APCD)	24 Hour (1st Highest) With APCD	1 Hour without APCD	24 Hour- 1st Highest(With APCD)	1 Hour (without APCD)	
AAQ4	Parvati Nagar Residential Area	10.24				15.73	187.32			53.63	1729.31	• 50 (Interim target-2) • 20 (guideline)
					CO (8 hour)							
AAQ1	Project Site	0.86 (mg/m³)				0.509	0.525			1.705	5.082	NAAQS Permissible Limits (8 Hr): 2 mg/m³ (2000 µg/m³)
AAQ2	Dasha Maa Mandir, Mani Nagar Residential Area	0.66 (mg/m³)	8.52261 (µg/m3) 0.008523 (mg/m³)	25.41200 (µg/m3) 0.025412 (mg/m3)	At distance of 385 m from project site	0.509	0.525	0.426	1.271	1.705	5.082	
AAQ3	Primary School, Vora Gamdi Residential Area	0.73 (mg/m³)				0.609	0.625			1.420	4.235	
AAQ4	Parvati Nagar Residential Area	0.59 (mg/m³)				0.609	0.625			1.420	4.235	

Proposed Control Measures

- Adequate air pollution control measures such as flue gas cleaning system, adequate stack height shall be provided before commissioning of the Plant. Additional facilities required, if any, to achieve the standards laid down by the statutory authority shall also be made along with.
- The waste will be transported in closed and covered waste collection trucks
- Provision of closed waste handling and storage areas
- Internal Roads are made of Concrete instead of asphalt and least distance will be travelled by the material within the facility.
- Separate waste segregation/MRF Facility with AI driven technology will be developed with no human intervention
- Use negative pressure in processing buildings to manage odor
- Waste will be incinerated at high temperatures and no chemical treated with any chlorinated disinfectants will be undertaken prior to incineration
- Mist cooling is planned to keep down dusts, especially during and prior to loading or other handling procedures
- Waste segregation and/or presorting to avoid incineration of wastes that contain metals and metalloids that may volatilize during combustion and be difficult to control through air emission technology (e.g., mercury and arsenic)
- Plant shall be operated (combustion chambers) with such temperature, retention time and turbulence, as to achieve total Organic carbon (TOC) content in the bottom ash less than 3%, or their loss on ignition is less than 5% of the dry weight.
- Ensure temperature within combustion/gasification chambers (always above 850 °C) avoids the formation of dioxins and furans
- Waste introduction into the incinerator only after the optimum temperature is reached in the final combustion chamber
- The waste charging system is interlocked with the temperature monitoring and control system to prevent waste additions if the operating temperature falls below the required limits
- Provision of flue gas treatment system to control acid gases, particulate matter, and other air pollutants
- Minimize formation of dioxins and furans by maintaining the boiler temperature above 850°C
- Periodic monitoring of concentrations of PCDDs, PCDFs, other combustion products, and heavy metals in flue gas
- Reduction in the generation and emission of PCDDs and PCDFs, by ensuring rapid cooling of flue gas as well as good turbulence of the combustion gas, high temperature, adequate oxygen content, and adequate residence time.
- Design stack heights according to Good International Industry Practice (GIIP) to avoid excessive ground level concentrations and minimize impacts, including acid deposition
- Implementation of Air Pollution Control Devices to manage emissions from the facility
- Implementation of continuous emission monitoring systems (CEMS) to monitor the plant's emissions in real-time. Regular reporting of emissions data to relevant environmental authorities promotes transparency and compliance with air quality regulations.
- Provision of greenbelt and landscape area within the Project premises.
- All the vehicles and other equipment will be periodically checked to ensure compliance to the emission standards.
- Provision of Ash handling system with silos, hoppers, and submerging of bottom ash
- Bag Filters with PTFE bag material will be used for fly ash collection and bottom ash will be collected
- GWVPL will implemented a combination of both ESP and high efficiency of bag filters in series. ESP will acts act as a pre-dedusting mechanism (Efficiency of ESP design is around 90-95%) before addition of Activated Carbon and Lime dosing for removal of Dioxin & Furan Compound, heavy metal oxide, HF removal and acid gas control. Bag house acts as final filtration system with high efficiency PTFE fabric filters (99%-99.7%).
- Development of belt area within the plant premises that may support in suppression of fugitive emissions
- Periodic maintenance of the bag filter & ESP will be carried out to avoid dust emissions during removal of fly ash.
- A continuous emission monitoring system to be installed at site as per conditions stipulated in the CTO to display emissions for NOx, PM (PM10 & PM2.5), CO or as included in CTO
- Steam Turbine shall comply with the relevant International Electro-technical Commission (IEC) standards or equivalent

Additional Mitigation Measures

- According to the Point Source Air Emissions Prevention and Control Technologies provided in WBG 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%.

- Periodic monitoring (quarterly) of concentrations of PCDDs, PCDFs, other combustion products, and heavy metals in flue gas, i.e. stack monitoring as well as ambient air quality monitoring to be undertaken on quarterly basis
- Use extraction system to remove dust from working areas, buildings, and storage vessels, and treat as needed to control particulate emissions
- Manual segregation and removal of chlorinated plastic and other elements unsuitable for thermal treatment.
- Water Sprinkling to be done at the access road to manage dust emissions from the vehicles transporting waste to the plant.
- Implement good housekeeping practices to reduce fugitive emissions and control dust and particulate matter within the facility.
- As stated in the General EHS Guidelines, emissions from a single project should not contribute more than 25% of the applicable ambient air quality standards to allow additional, future sustainable development in the same airshed[74].
- Fly Ash will be transported in covered trucks and tippers to the fly ash recipients. Fly ash generated from bag filter should be sent to cement plants. GWVPL to discuss with VMC for disposal of ash in line with MoEFCC draft notification no. G.S.R. 285(E) dated 22/04/2021, with previous notification on 2016.

	Nature of Impact	Spread of Impact	Duration	Intensity	Significance of Impact
Without Mitigation Measures	Negative	Medium	Permanent	Moderate	Substantial
With Mitigation Measures	Negative	Medium	Permanent	Low	Small

7.4.2.2 Ambient Noise

During the operation phase, noise might be generated due to industrial activities involved in handling, transporting, processing of solid waste or RDF and generation of electricity and same will be felt upon work personnel and commercial setup present within 500m radius. Impacts are evaluated qualitatively taking into consideration the noise generating sources together with environmental conditions and the receptors in the project influence area.

Major sources of noise generation in the proposed Waste to Energy (WTE) plant are handling, transporting, processing of solid waste or RDF and generation of electricity units during operational phase and are classified into two categories:

- Stationary sources due to operation of heavy duty machinery at the project site like Fuel handling and feeding systems, Boiler and steam generation system, Steam turbine generator, Flue gas cleaning systems, Compressors, Pumps, Cooling Towers, Ancillary equipment including hydraulics, waste pre-processing equipment (such as grabber, moving belt feeder, splitter, shredder, star screen) compressed air supply etc.
- Mobile sources corresponding to mainly vehicular traffic for staff mobilization, solid waste transportation etc.

According to the noise monitoring results presented in Table 5-14, Leq Day and Leq Night values of N1 which is located in an industrial area was found to be within limits as prescribed by CPCB as well as WBG guidelines, whereas for sample N2, N3 & N4 were found to be exceeding the limit of 55dB(A) and 45 dB(A) respectively which is approximately at a distance of 2-3km. Operation of the project may contribute to increasing the noise levels in the project study area. Since the Noise levels are exceeding the background levels of 3 dB at the nearest receptor location off-site, therefore stringent mitigation measures needs to be adopted.

The project will deploy approximately 120 on roll workers during operation phase who will be exposed to the noise emissions along with the workers. Furthermore, there are no permanent residential settlements present within 500m aerial radius of the project, only commercial food outlets are present within the 500m radius. No permanent residential receptors within 500 m are anticipated to be impacted due to the Project activities.

Noise Modeling

Sources of Noise

[74] For example, the US EPA Prevention of Significant Deterioration Increments Limits applicable to non-degraded airsheds provide the following: SO2 (91 µg/m3 for 2nd highest 24-hour, 20 µg/m3 for annual average), NO2 (20 µg/m3 for annual average), and PM10 (30 µg/m3 for 2nd highest 24-hour, and 17 µg/m3 for annual average).

An inventory of noise equipment at the project site, encompassing various machinery and systems associated with the waste-to-energy process, is provided in Table below along with their corresponding noise level data.

Table 7-15 Inventory of Noise Equipment at Project Site

S. No	Equipment	Number of Equipment	Noise level dB(A)	
1.	**Pre processing**		70.8	60.8
	Orange peel Grabber	1		
	Radial grabber	-		
	Moving bed feeder	2		
	Splitter	2		
	Shredder	2		
	Star screen	4		
	Magnetic separators	4		
	Belt conveyors for intermittent transfer	Lot		
	Residue collection conveyors	Lot		
	Control station for pre processing	1		
2.	**Boiler fuel feeding**		70.1	59.2
	Boiler fuel bunker	1		
	Orange peel grabber	2		
	Fuel pushing mechanism	4		
	Hydraulic pusher	-		
	Auxiliary burner	-		
	Startup burner	-		
	Vibro feeder	4		
3.	**Boiler Aux fuel feeding**		70.1	59.2
	Aux fuel silo	2		
	Orange peel grabber	-		
	Drag chain conveyor	2		
	Screw conveyors	8		
	Fuel feeding chutes	8		
4.	**Steam Boiler**		72.2	61.5
	Combustion grate	2		

S. No	Equipment	Number of Equipment	Noise level dB(A)	
	Furnace and refractory wall	Lot		
	Boiler feed pump	3		
	Safety valves	13		
	Steam drum	2		
	Steam coil Air preheater	2		
	Sec air preheater	2		
	Primary air preheater	4		
	Evaporator	2 Lot		
	Superheater	2 Lot		
	Attemperator	2 Lot		
	Economizer	2 Lot		
	Boiler cleaning system	2 Lot		
	Blow down tank	2		
5.	**Fans - boiler**		72.2	61.5
	Primary fan	2		
	Secondary fans	2		
	Flue gas rec fan	2		
	Induced draft fan	2		
6.	**Flue gas cleaning system**		70.2	63.6
	Electrostatic precipitator	2		
	Acid control reactor tower	2		
	Dry sorbent injection	2		
	Filter bag house	2		
	Continuous emission monitoring system	2		
	Stack	2		
7.	**Ash Handling System**		72.2	61.5
	Submerged belt conveying system	2		
	Bank zone ash conveying system	2		
	ESP ash conveying system	2		
	Bag filter ash conveying system	2		
	Ash extractor	-		

S. No	Equipment	Number of Equipment	Noise level dB(A)	
	Shifting ash conveyor	-		
	Shifting ash add on conveyor	-		
8.	**Stream Turbine**		86.0	82.0
	Generator	1		
	Distributed control system	1		
	SIGMA control system	-		
9.	**Primary Water Treatment Plant**		70.2	63.6
	Multi grade filter	5		
	Activated carbon filter	2		
	Softener	2		
	Soft water storage tank	2		
	Soft water transfer pump	3		
	Ultra filtration	2		
	UF storage tank	2		
	UF water transfer pump	2		
	Reverse osmosis plant	2		
	RO transfer pump	3		
10.	**Boiler Water Treatment Plant**		73.5	68
	Dual media filter	1		
	Ultra filtration	1		
	RO plant	1		
	De mineralize system	1		
	DM storage tank	4		
11.	**Condenser water cooling system**		73.5	68
	Mist Cooling system	-		
	Induced draft cooling tower	1		
	Cooling water circulation pump	3		
12.	**Air compressor - boiler house (ACBH)**	**3**	71	60
13.	**Power evacuation - substation**		71.8	59.7
	HT panel (Breaker)	5		
	Power Transformer	1		
	Lighting arrestor	6		
	Isolator	2		
	Current transformer	6		
	Potential transformer	6		

S. No	Equipment	Number of Equipment	Noise level dB(A)
	Main ABT meter	1	
	Check ABT meter	1	
	Auxiliary transformer	1	

Methodology

The noise modeling methodology entails utilizing software such as Dhwani Pro to simulate noise propagation from sources to receptors. This involves collecting input data such as terrain features, emission characteristics, and receptor locations to accurately predict noise levels. The software uses mathematical algorithms and models to simulate the propagation of noise from sources to receptors in the study area. For modeling purposes, a base map with a radius of 1.5 kilometers was used. The map is divided into a grid of 500 x 500.The data used for running of model is as follow:

Table 7-16 Details of Point Sources

Source ID	X-Coordinate	Y-Coordinate	SPL (dB(A))
Air Compressor	314977	2459440	70.65
Boiler fan	314957	2459440	71.95
Flue Gas Cleaning System	314978	2459466	71.79
Turbine	314945	2459389	89.3
Boiler Water Treatment Plant	314927	2459422	71.79
Boiler	314977	2459440	71.95
Boiler Aux fuel feeding	314967	2459410	69.79
Condenser	314894	2459396	75.76
Ash Handling System	314977	2459440	71.95
Boiler fuel feeding	314967	2459382	69.79
Water Treatment Plant	314897	2459413	71.79
Substation	314945	2459435	71.13
Pre-processing area (PPA)	314977	2459391	70.8
Boiler Water Treatment Plant (CR)	314941	2459392	75.76

Table 7-17 Details of Vehicular Movement

Sr. No.	Material Type	Vehicle Type	Vehicle Make	Vehicle Model	Loading Capacity in MT	Avg Moving Vehicle / Day
1	MSW	Dumper	Tata	SK 1613 / LPT 2518	12 / 25	65
2	MSW	Container	Ashok Leyland	2820	8	10
3	MSW	Compactor	Tata	LPT 1618	15	11

Table 7-18 Boundary Details

Source ID	X1-Coordinate	Y1-Coordinate	X2-Coordinate	Y2-Coordinate	Height
B_002	314890	2459429	314908	2459428	3
B_003	314908	2459428	314904	2459456	3
B_004	314904	2459456	314915	2459468	3
B_005	314915	2459468	314987	2459477	3
B_006	314987	2459477	315028	2459492	3
B_007	315028	2459492	315064	2459510	3
B_008	315064	2459510	315101	2459511	3
B_009	315101	2459511	315128	2459498	3
B_010	315128	2459498	315132	2459487	3
B_011	315132	2459487	315116	2459457	3
B_012	315116	2459457	315079	2459429	3
B_013	315079	2459429	315051	2459398	3
B_014	315051	2459398	315036	2459378	3
B_015	315036	2459378	315029	2459367	3
B_016	315029	2459367	315015	2459364	3
B_017	315015	2459364	314964	2459364	3
B_018	314964	2459364	314915	2459364	3
B_019	314915	2459364	314887	2459367	3
B_020	314887	2459367	314887	2459372	3
B_021	314887	2459372	314885	2459390	3
B_023	314888	2459389	314890	2459370	5
B_024	314890	2459370	314923	2459366	5
B_025	314923	2459366	314957	2459367	5
B_026	314957	2459367	314983	2459366	3
B_027	314983	2459366	315019	2459366	5
B_028	315019	2459366	315028	2459370	5
B_029	315028	2459370	315043	2459389	5
B_030	315043	2459389	315054	2459406	5
B_031	315054	2459406	315075	2459428	5
B_032	315075	2459428	315097	2459445	5
B_033	315097	2459445	315114	2459458	5
B_034	315114	2459458	315130	2459488	5
B_035	315130	2459488	315127	2459495	5
B_036	315127	2459495	315101	2459508	5
B_037	315101	2459508	315062	2459508	5

Source ID	X1-Coordinate	Y1-Coordinate	X2-Coordinate	Y2-Coordinate	Height
B_038	315062	2459508	314988	2459476	5
B_039	314988	2459476	314917	2459467	5
B_040	314917	2459467	314907	2459457	5
B_041	314907	2459457	314911	2459429	5
B_042	314911	2459429	314892	2459427	5

Modelling Results

During the operation phase of the project, the turbine is identified as the major source of noise. To model the noise propagation and assess the potential impact on receptors, a sound wave propagation model was run considering a worst-case scenario.

In this scenario:

- All equipment, including the turbine, are assumed to be running simultaneously.
- The analysis is conducted with and without a boundary wall (barrier) in place.

The purpose of running the model under these conditions is to evaluate the cumulative noise levels at the receptors (points where noise is measured or monitored). By considering both scenarios (with and without the barrier), the effectiveness of the barrier in mitigating noise is assessed. The analysis likely involves simulating the propagation of sound waves from the turbine and other equipment to the receptors, considering factors such as distance, terrain, atmospheric conditions, and the presence of barriers. The results would provide insights into the expected noise levels at the receptors under different conditions, allowing for informed decision-making and potential mitigation measures if noise levels exceed acceptable limits.

Table 7-19 Cumulative noise level without boundary wall

Receptor ID	X-Coordinate	Y-Coordinate	Predicted Level (dB(A))*	Baseline (dB(A))	Resultant (dB(A))	Incremental Noise
Air Force Pre Primary School, Himmat Nagar	314261	2460158	23.8	60.4	60.4	0
Dasha Maa Mandir, Mani Nagar	316202	2460129	21.0	57.5	57.5	0
Mosque, Vora Gamdi	316676	2458348	16.8	68.3	68.3	0
Near Pre-processing area	314987	2459371	50.3	68.75	68.8	0.05
Near Water Treatment Plant	314902	2459426	50.7	68.75	68.8	0.05
Near Exit	315111	2459492	39.5	68.75	68.8	0.05

**Noise level for traffic flow less than 1000 vehicles / 18 hours is not computable in Dhwani Pro Software*

Table 7-20 Cumulative noise level with boundary wall

Receptor ID	X-Coordinate	Y-Coordinate	Predicted Level (dB(A))*	Baseline (dB(A))	Resultant (dB(A))	Incremental Noise
Air Force Pre-Primary	314261	2460158	16.3	60.4	60.4	0

Receptor ID	X-Coordinate	Y-Coordinate	Predicted Level (dB(A))*	Baseline (dB(A))	Resultant (dB(A))	Incremental Noise
School, Himmat Nagar						
Dasha Maa Mandir, Mani Nagar	316202	2460129	14.8	57.5	57.5	0
Mosque, Vora Gamdi	316676	2458348	12.3	68.3	68.3	0
Near Pre-processing area	314987	2459371	50.3	68.75	68.8	0.05
Near Water Treatment Plant	314902	2459426	50.7	68.75	68.8	0.05
Near Exit	315111	2459492	39.4	68.75	68.8	0.05

**noise level for traffic flow less than 1000 vehicles / 18 hours is not computable in Dhwani Pro Software*

Table 7-21 Cumulative noise level Near Project Site

Receptor ID	X-Coordinate	Y-Coordinate	Predicted Level (dB(A))	Baseline (dB(A))	Resultant (dB(A))	Incremental Noise
Near Pre-processing area	314987	2459371	50.3	68.75	68.8	0.05
Near Water Treatment Plant	314902	2459426	50.7	68.75	68.8	0.05
Near Exit	315111	2459492	39.4	68.75	68.8	0.05

Figure 7-1 Predicted Noise Level at Receptors Without Boundary Wall (Barrier)

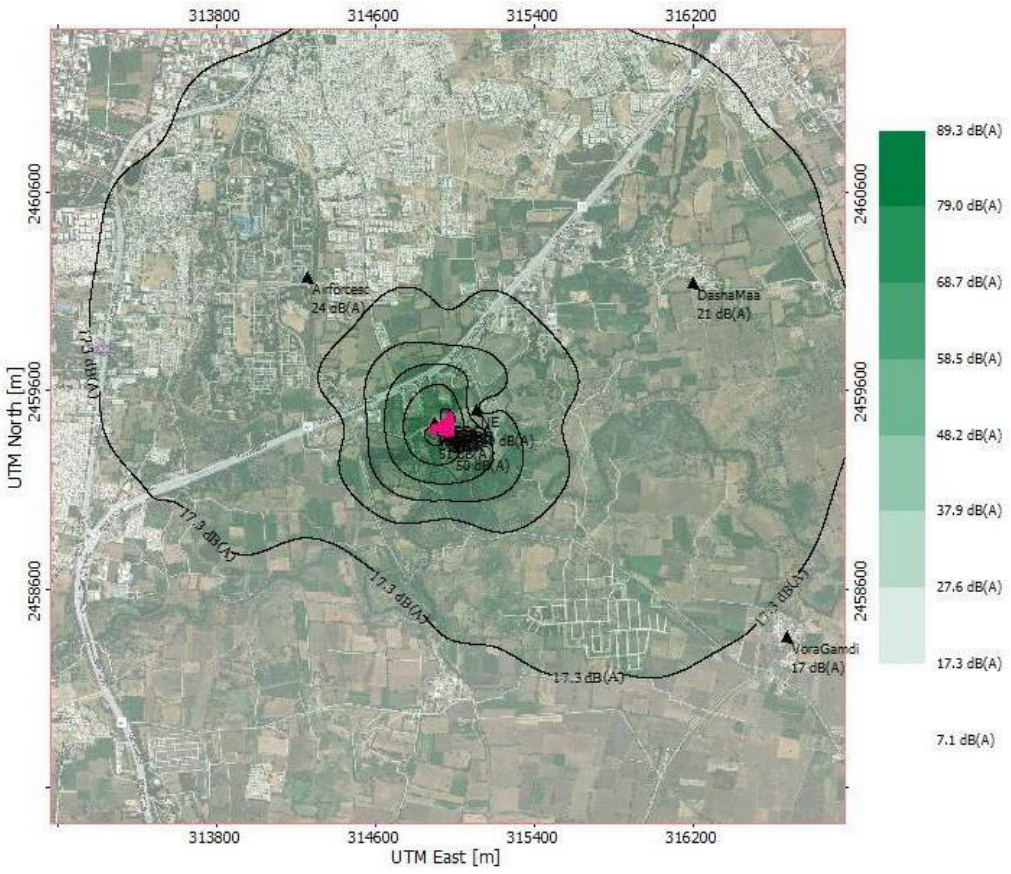
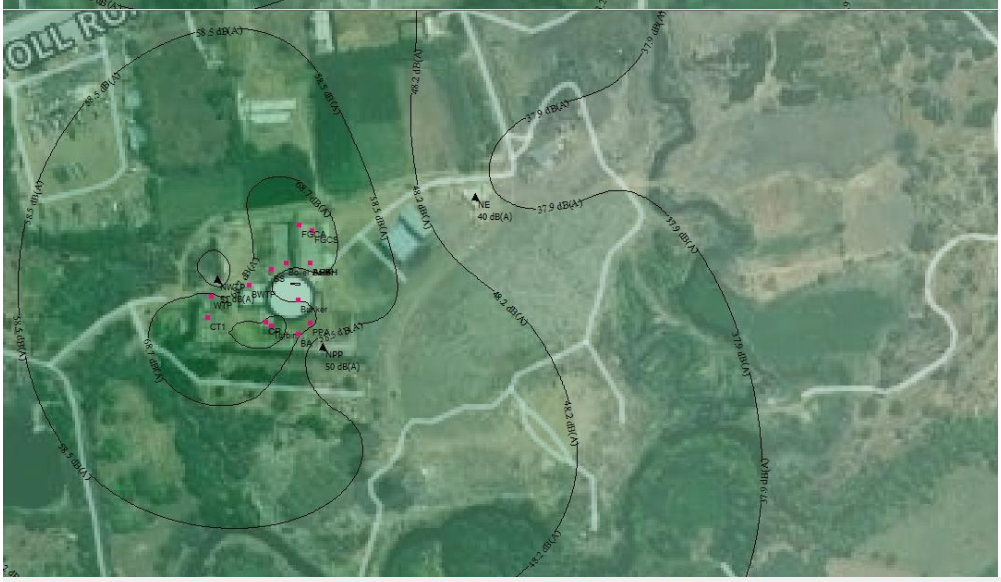
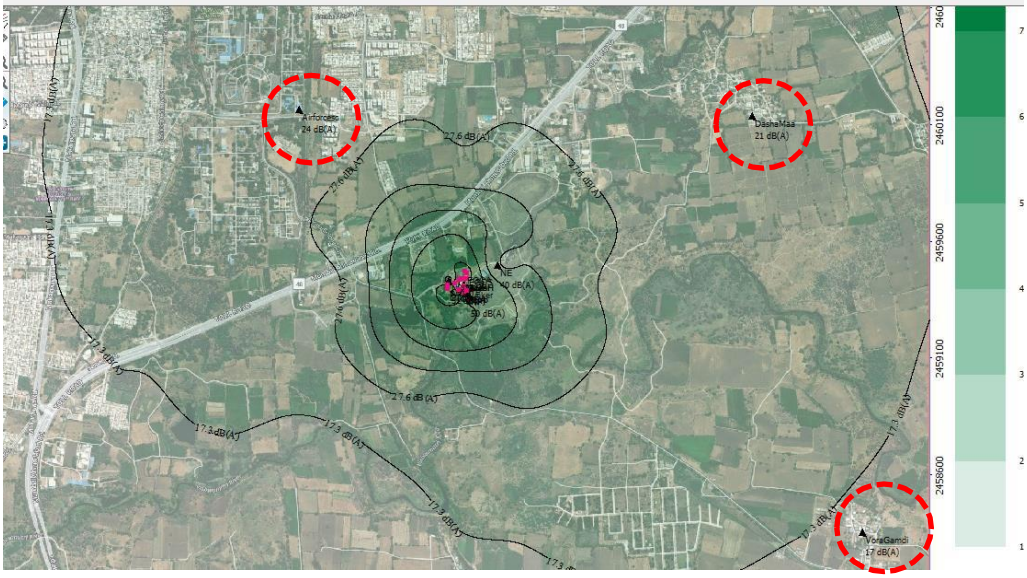


Figure 7-2 Contour Level Within the Vicinity of the Project Site and Surrounding

Contour near the exit, water treatment plant and preprocessing





Contour near the three receptors without boundary walls

Figure 7-3 Predicted Noise Level at Receptors with Boundary Wall (barrier)

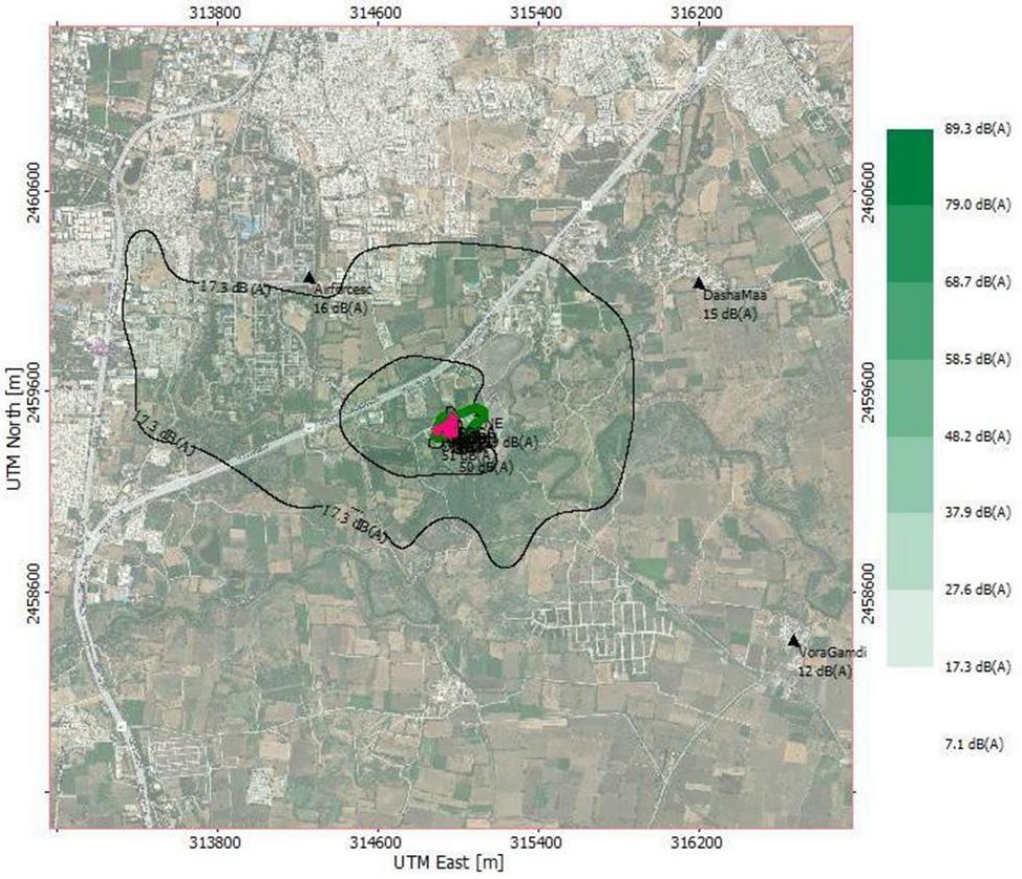
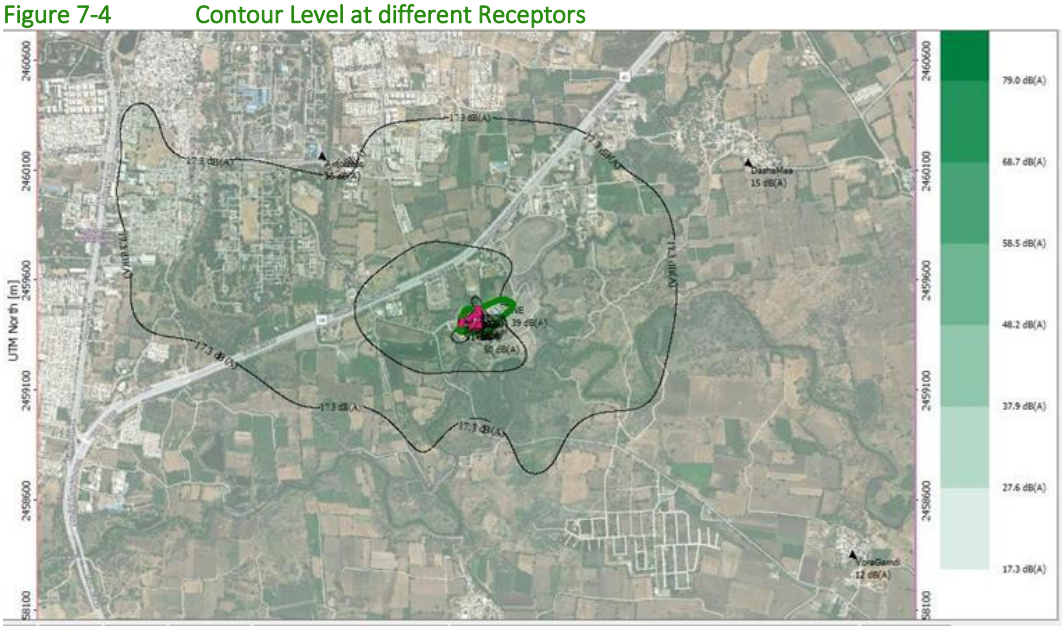
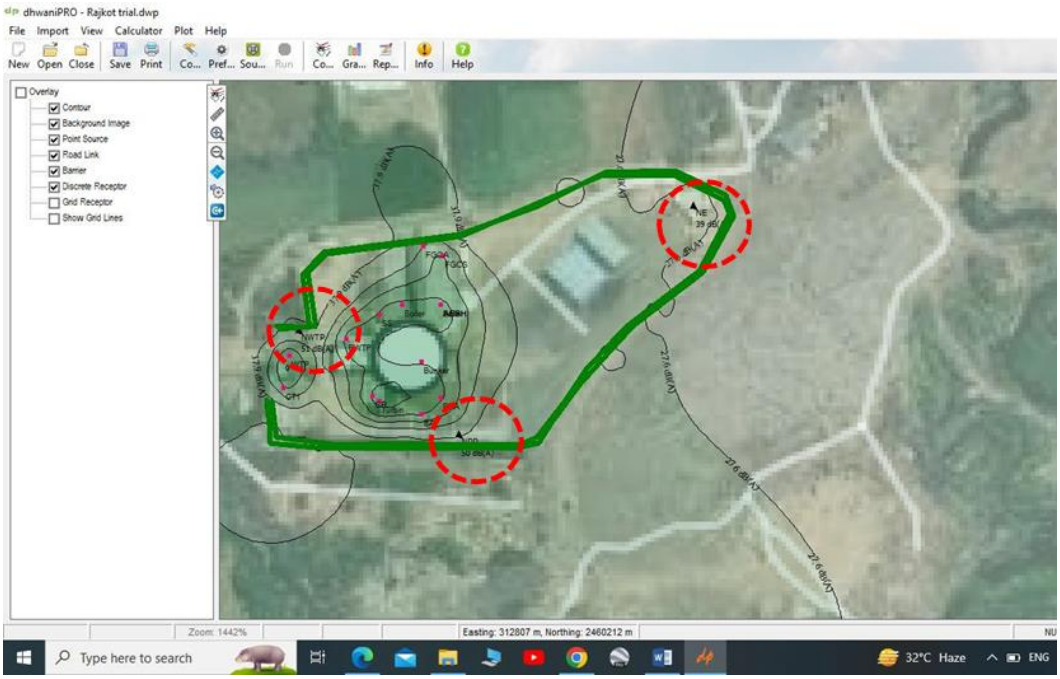


Figure 7-4 Contour Level at different Receptors



Predicted noise Contour near the three receptors



Predicted noise contour level near the exit, WTP and pre-processing due to proposed project

It is to be noted that the baseline noise level of the receptor is already significantly high. As per the noise modeling results, incremental noise due to project operations is negligible. Therefore project is expected to have negligible impacts on the overall cumulative noise.

Proposed Control Measures

- The project will 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.
- The area of the greenbelt will not be less than 33% of the total area of the site. Greenbelt with tall growing trees has been developed along the boundary of the site
- Provision of sound-insulated control rooms with noise levels below 75 dBA[75]

Impact Magnitude

The project is located in an Industrial area with no residential settlements present within 500m radius of the project, However workers present within the plant 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 baseline noise level at N3 also exceed the applicable standard for residential area areas during day and night-time. Therefore the spread has been classified as local spread with permanent duration. The noise generation will be a routine activity as the machineries and equipment will be operational during the working hours (18-24 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
- Installing silencers for fans and suitable mufflers on engine exhausts and compressor components
- Pump operators (near STP, storage tanks, hoppers etc.) are generally exposed to higher noise. Housing / casing will be provided for all noise generating machines

[75] Recommendation of 60 dBA as GIIP, with an understanding that up to 65 dBA can be accepted for reciprocating engine power plants if 60 dBA is economically difficult to achieve.

- Periodic maintenance of the equipment to be used in the developmental works will be carried out. Worn out parts will be replaced and rotating parts will be lubricated to minimise noise emissions
- Adequate PPE's (earmuffs, earplugs) to be provided to employees working in high noise generation area's and machineries
- The occupational noise exposure to the workers in the form of eight hour timely weighted average will be maintained well within the prescribed Occupational Safety and Health Administration (OSHA) standard limits
- 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 mentioned in the CTO (to be obtained) for the project operations at site to ensure noise parameters are within prescribed MoEFCC guideline as well as WBG 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
- 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

	Nature of Impact	Spread of Impact	Duration	Intensity	Frequency	Significance of Impact
Without Mitigation Measures	Negative	Local	Permanent	Moderate	**Routine**	**Substantial**
With Mitigation Measures	Negative	Local	Permanent	Low-Moderate	**Routine**	**Small**

7.4.2.3 Soil Contamination due to Improper waste management

During operation phase of the project, the following types of wastes will be generated:

- Ash (Hazardous and Nonhazardous wastes)
- Leachate
- E-waste, battery waste etc. from site office and the plant
- Biodegradable waste from the kitchen and canteen
- Hazardous wastes including used oil from DG sets, transformers, gear box; contaminated rags; chemical waste, 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.

Potential impacts on soil environment are envisaged due to hazardous and non-hazardous wastes generated due to operations of Waste to Energy (WtE) plant. Sludge, used & waste oil slurry, batteries, fly ash, bottom ash etc. are the hazardous waste anticipated due to project operations.

Chemical composition of fly ash contains heavy metals such as arsenic (As), lead (Pb), zinc (Zn), nickel (Ni), copper (Cu), manganese (Mn), cadmium (Cd), Chromium (Cr) and selenium (Se). Poor management of bottom ash and fly ash and other wastes including hazardous waste from the operations may lead to soil contamination.

According to the soil monitoring conducted at project site, the soil type within 5 km radius of the plant can be characterized as 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 Measure

- Bottom ash and Fly ash will be collected separately from other flue gas treatment residues to avoid contamination of the bottom ash
- Fly ash collected from bag house will contamination and will be categorized as hazardous in nature. ESP will be added as pre-deduster which will significantly reduce the quantity of hazardous fly ash from bag house

- The hazardous wastes generated if any will be stored in temporary storage for a period of 90 days. Hazardous waste such as waste oil from transformers and other machineries will be stored in designated enclosed hazardous waste storage area on paved surface.
- Hazardous waste will be sent to nearby TSDF and management shall be done as per Hazardous and Other Waste (Management and Transboundary Movement) Rules, 2016 and amendment thereof
- Silos will be developed for Fly ash handling and the bottom ash will be submerged and sent to sludge drying bed
- Bottom Ash quenching will be done using the waste water generated from the secondary treatment process
- Environmental monitoring for soil will be conducted on half yearly basis.
- Glass and metal will be collected and stored within the plant and further will be disposed of through local scrap vendors.

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-medium. 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-high 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 and low water retention, 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 to substantial.

Additional Mitigation Measures

- Separate remaining ferrous metals from bottom ash as far as practicably and economically viable, for their recovery
- GWVPL to develop non-leachable concrete floor with dedicated leachate collection pit for bottom ash area and to dispose the generated bottom ash on daily basis. GWVPL to ensure that the covered trucks are used by VMC to dispose the bottom ash in the nearest sanitary landfill. GWVPL to track bottom ash generation and disposal
- Treat bottom ash on or off-site (e.g., by screening and crushing) to the extent that is required to meet the specifications set for its use or at the receiving treatment or disposal site (e.g., to achieve a leaching level for metals and salts that is in compliance with the local environmental conditions at the place of use);
- Hazardous waste inventory to be managed and recorded and to include a summary table with the information such as: Name and description (e.g. composition of a mixture) of the Hazmat, Classification (e.g. code, class or division), Internationally accepted regulatory reporting threshold quantity or national equivalent, Quantity of Hazmat used/generated per month, Characteristic(s) that make(s) the Hazmat hazardous (e.g. flammability, toxicity)
- GWVPL to conduct characterization analysis of ash as per IS 3812 covering all the parameters stipulated by BIS to identify any hazardous content before its disposal through VMC trucks. If fly ash is identified as hazardous, it is to be sent to hazardous waste landfill site through authorized vendors and records to be maintained.
- Hazardous ash to be stored and handled as per the hazardous and other waste (management and transboundary movement) rules, 2016 as amended.
- Non-hazardous ash may be disposed of in an MSW landfill or considered for recycling in construction materials or provided to cement and fly ash brick manufacturers
- GWVPL is recommended to obtain chain of custody documents from VMC for final disposal destination to ensure that the hazardous waste is being disposed at the authorized hazardous waste landfill as per the applicable Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, as amended.
- GWVPL to also establish through relevant agencies whether disposal site (where hazardous ash is disposed) is being operated to acceptable standards before disposal. If this is not established, GWVPL shall consider alternative disposal options, including the possibility of developing its own recovery or disposal facility at the project site or else reduce generation of hazardous ash.
- If GWVPL is uncertain that the disposal conducted by VMC is as per the applicable rules, GWVPL will themselves take the responsibility of disposal and will ensure disposal is conducted to the hazardous waste authorized site as per the applicable norms.
- Promote use of fly ash generated from bank zone and ESP for making non-leachable concrete pavers
- Good housekeeping and best practices of waste handling shall be adopted to eliminate/minimise the risks of soil contamination
- Only covered and closed trucks will be allowed to enter the site for unloading of municipal solid waste

- E-waste generated onsite should be channelized through collection center or dealer of authorized producer or dismantler or recycler or through the designated take back service provider of the producer to authorized dismantler or recycler. It should be ensured to keep the records of e-waste generated and sending out to authorized agencies
- Battery waste to be disposed via buy back policy with the battery supplier/manufacturer. It should be ensured to keep the records of waste generated and sending out to authorized agencies.
- Generated biodegradable waste from the canteen, kitchen, office etc. will be utilized within the plant
- Description or SOP's of response activities in the event of a spill, release, or other chemical emergency or including Internal and external notification procedures, Specific responsibilities of individuals or groups, Decision process for assessing severity of the release, and determining appropriate actions, evacuation routes, Post-event activities such as clean-up and disposal, incident investigation, employee re-entry, and restoration of spill/equipment/area to be developed.
- Since hazardous waste and material will be generated and present within the project premises, GWVPL to develop hazardous material management plan which includes potential risks along with the objectives of protection of the workforce and the prevention and control of releases and accidents.
- GWVPL should conduct environmental audit annually and submit environmental statement pertaining to previous year to GPCB by 30th September every year in compliance conditions as stipulated in the consent

	Nature of Impact	Spread of Impact	Duration	Intensity	Significance of Impact
Without Mitigation Measures	Negative	Local-Medium	Permanent	Moderate	Substantial
With Mitigation Measures	Negative	Local	Permanent	Low	Small

7.4.2.4 Water Resources - Availability & Quality

During operation phase, sources of water pollution include

- Sewage generated from domestic activities of workers at the site
- Wastewater Discharge: Wastewater generated during the project operation, primarily from flue gas cleaning processes and other cooling systems.
- The wastewater streams in a WTE plant include cooling tower blowdown; ash handling wastewater; wet FGD system discharges; material storage runoff; metal cleaning wastewater; and low-volume wastewater, such as air heater and precipitator wash water, boiler blowdown, boiler chemical cleaning waste, floor and yard drains and sumps, laboratory wastes, and backflush from ion exchange boiler water purification units
- Utility operations such as cooling towers and demineralization systems will result in potential release of high temperature water containing high dissolved solids, residues of biocides, residues of other cooling system anti-fouling agents, etc.
- Leachate Generation: Leachate generated on site will be from the waste pre-processing bay, Pre-Processing area and Fuel Bunker and bottom ash handling. Leachate from waste caused by exposure to precipitation and from residual liquids in the waste itself contain organic matter, nutrients, metals, salts, pathogens, and hazardous chemicals. If allowed to migrate, leachate will further contaminate soil, surface water, and groundwater potentially causing additional impacts such as eutrophication and acidification of surface water and contamination of water supplies.
- Air Emissions and Acid Rain: Some pollutants released during the combustion of waste in the WtE process, such as sulfur dioxide (SO2) and nitrogen oxides (NOx), can contribute to the formation of acid rain when then interact with water vapor in the atmosphere. Acid rain can harm aquatic ecosystems and lower the pH of water bodies.
- Contamination from Accidents or Spills: Accidents, equipment failures, or improper waste handling at WtE plants can lead to spills or releases of pollutants into water sources, causing acute water quality issues and potential harm to aquatic life.
- Heavy Metals and Toxic Compounds: Waste materials processed in WtE plants may contain heavy metals, dioxins, and other toxic compounds. If these pollutants are not effectively managed and treated, they can find their way into water bodies and accumulate in the food chain, posing health risks to aquatic organisms and potentially to humans through the consumption of contaminated fish.

According to the drainage map there are dendritic drainage channels passing through out the project area along with a natural perennial water pond is located 140 m (aerial distance) from site towards south west direction. Vishwamitri river is flowing is flowing 180 m (aerial distance) from site towards south and east direction and Tarsali lake is located 2.5 km (aerial distance) from site towards northeast direction, Also, there are some dendritic channels crossing over from the underground water pipeline route.

According to the water utilization plan, approximately 1387 water is required for project operations, the water requirement will be sourced from the STP[76]. According to the water balance diagram *(**refer Figure 2-11**)* the daily water requirement for industrial purpose within the WTE plant is 1387 m3/day, for which Primary treatment is required for 2216 m3/day of water at the STP. The project has received permission for receiving 2 MLD water from the VMC STP. The project will treat 2216m3/day of treated STP water and all reject water (829m3/day) in the form of backwash/regeneration/reject from MGF, ACF, Softener & RO etc. will sent back to STP Inlet for further treatment at the STP plant itself. Thus, reduction in quantity of treated water i.e. 1387m3/day will be transported to WTE plant, i.e., 4 km via underground water pipeline. Phase II analysis indicates that GW at site should not be used for any portable purpose such as drinking or any other domestic purposes.

The Pre-treated water will be further treated (secondary treatment) on-site prior to be used in the boiler (Refer ***section 2.8.2.1***).

As per Central Groundwater Authority (CGWA), Ministry of Jal Shakti, Notification dated 24 September 2020[77], industries will have to obtain authorization from CGWA before abstraction and use of groundwater. The project has obtained permission to extract water from the existing borewell within the project premises. As per the categorization, Vadodara falls in an area categorized as semi-critical in terms of availability of ground water. As per the NOC, the project can abstract 7.5 m3/day water from one existing borewell within the project premises.

Contamination in the blow down and wastewater generated within the WtE plant arises from demineralizers; lubricating and auxiliary fuel oils; trace contaminants in the fuel (introduced through the ash-handling wastewater and wet FGD system discharges); and chlorine, biocides, and other chemicals used to manage the quality of water in cooling systems. Cooling tower blowdown tends to be very high in total dissolved solids but is generally classified as non-contact cooling water and, as such, is typically subject to limits for pH, residual chlorine, and toxic chemicals that may be present in cooling tower additives (including corrosion inhibiting chemicals containing chromium and zinc whose use should be eliminated).

Control Measures Planned

- Leachate collection will be done in a designated leachate collection tank using a series of underground pipes connecting the leachate collection area to the tank
- Impervious surface area will be developed for leachate collection and a Screen will be provided at the leachate collection area so as to screen waste particles going to the leachate collection tank
- Groundwater monitoring wells within the project perimeter have been installed at four locations and depths sufficient to evaluate whether leachate is migrating into the uppermost groundwater unit.
- Silos will be developed for Fly ash handling and the bottom ash will be submerged and sent to sludge drying bed
- Treated Water obtained from the STP will be further treated at the Pre-Treatment plant at the STP premises and Secondary treatment at the project site.
- GWVPL has obtained No Objection Certificate from VMC dated to procure secondary treated water from STP for meeting water requirement for industrial purpose. GWVPL has also obtained permission to lay underground pipeline connecting the STP to the Project's pump house.
- In addition to the above, GWVPL has also obtained permission from VMC to return excess STP water (if any) and treated reject water for further treatment back to the STP during project lifecycle
- The rejected water generated from secondary treatment and mist blow down will also be used in bottom ash quenching and plantation after verification of the Total Dissolved Solid (TDS) to ensure suitability of rejected water for plantation purpose
- Reject water form Secondary treatment will be blended water from STP and used for landscaping. Also, Zero discharge concepts will be adopted.

[76] For obtaining water 1387m3/day of treated water, 2216m3/day needs to be treated at STP and the reject water of 829 m3/day will be returned to the STP itself. Currently, the project has received permission for receiving 2 MLD water from the VMC STP, the excess 216 m3/day water the project will apply for revision of the permission to receive 2.3 MLD treated water from the STP

[77] 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

- Domestic wastewater generated from the project will be stored in soak pit and septic tanks. As reported, the septic tanks and soak pits are cleaned half yearly or on need basis.
- Storm water drains have been developed to harvest the rainwater and recharge the ground water. Rainwater harvesting will be undertaken. Rainwater harvesting tanks 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.
- Use of treated water for cooling using misting systems

Additional Mitigation Measures

- Alternative source of water to be identified for domestic use and ground water to not be used for domestic purpose except flushing.
- The waste storage areas of the plant should have a leachate barrier system that forms a secure barrier between the groundwater, soil, and substrata and the composting or stored organics.
- Secondary containment for leachate to be included with volumes greater than 220 liters. The available volume of secondary containment should be at least 110 percent of the largest storage container, or 25 percent of the total storage capacity (whichever is greater), in this specific location, considering the area is susceptible to rains and cyclones.
- Segregated collection for storm water from operations/waste and ash handling areas and from non operations areas to be undertaken to avoid contamination of storm water and further risk of contamination of ground water due to ground water recharge.
- Reduce the potential for leachate generation from bottom ash prior to final disposal
- SOPs for the management of secondary containment structures, specifically the removal of any accumulated fluid, such as rainfall, to ensure that the intent of the system is not accidentally or willfully defeated
- Measure and record the quantity and quality of leachate generated. Changes in leachate quantity or quality not attributable to weather or other factors to be accounted for.
- A dedicated leachate management plan should be developed for proper collection, storage and disposal of leachate from the Project to avoid contamination of subsurface soil and groundwater. The plan should include leachate collection system designed for the project and installation of additional leachate collection pits, drainage (if required) along with process flow for leachate generation, collection, storage and final disposal.
- Effluents from the DM plant generally acidic from the cation units and alkaline from the anion units, should be neutralized. The neutralized effluent shall have less than 5 ppm suspended solids and a pH value of about 7.5 to 8.0 in line with CPCB standards. The DM plant should have pH meter and turbidity meter to ensure the neutralized effluent, suspended solids and pH are within limit prior to be used for plantation activities and can also be used for bottom ash quenching
- Waste storage areas should be located away from drainage lines
- Spill kits to be maintained at site for cleaning minor spills/leaks
- Workers should be trained on proactive use of designated bins/areas for waste disposal.
- Provide magnetic flow meters with totalizers at the outlet of facility
- Operate and maintain online real time monitoring system along with web camera facilities and shall ensure that it is connected to GPCB / CPCB websites as per CPCB directions
- 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
- Explore installation of water efficient plumbing fixtures that use less water without any reduction in quality and service
- 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
- Water audit to be undertaken on annual basis to understand water usage and to identify measures for water reduction
- Water utilization to be documented
- Display online data outside the main 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.
- A wastewater and water quality monitoring program with adequate resources and management plan should be developed and implemented to meet the objective(s) of the monitoring program. The wastewater and water quality monitoring plan should include monitoring parameters, monitoring type and frequency locations, data quality,

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 long-term, as the ground water is proposed to be abstracted throughout the operation phase for domestic activities and the transportation of treated water from STP are being considered as a routine activity. Also, considering the characteristics of wastewater generated, the WTE plant will be a zero discharge and wastewater will be reused within the site. 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 fresh water intake is only limited to the domestic water requirement, thereby reducing the stress on the ground water availability. The geographical extent of impact is assessed to be limited to medium spread. Therefore, intensity of the impact is assessed as moderate and the overall impact significance on ground water resource and quality is assessed as substantial.

	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	Long	Moderate-Low	Routine	Small-Substantial

7.4.2.5 Climate Change Impacts

According to Climate Change Department, Government of Gujarat[78], the state has longest coastline in India (~1,663 km) and it is susceptible to Climate Change impacts. Extending from Kutch in the north to Valsad in the south, the State of Gujarat lies exposed to the likely sea level rise and changes in sea surface temperatures, which may probably increase storm surge occurrence and cyclonic activity in the Arabian Sea. The changes in rainfall patterns may potentially lead to reduced surface flow in Luni, Mahi, Sabarmati, and Narmada rivers which could affect both domestic and agriculture water availability. This in turn, along with temperature variations, could affect crop productivity adversely. The Government of Gujarat has thus established a standalone Climate Change Department to take actions required for mitigation and adaptation to Climate Change.

According to the Gujarat State Action Plan on Climate Change (GSAPCC), 2021[79], the critical climate change risks to which the state is vulnerable include temperature, precipitation extremes and sea level rise. Since Gujarat has India's longest coastline with 9.9 million people living in 40 coastal talukas (as per Census, 2011), the state is vulnerable to the impacts of sea-level rise, cyclonic events, salinity ingress and shifts in fish breeding patterns, which may result in future migration and climate refugees (UN's World Migration Report, 2020). It is anticipated that climate change may impact temperature patterns and cause an increase in the frequency of extreme temperature events. According to World Bank, 19 of the 26 districts in Gujarat may become climate change hotspots by 2050, with temperatures expected to rise by 2-2.5°C.

The projected climate trends in the state of Gujarat have been presented in the subsequent sections based on projections from Coupled Model Intercomparison Project (CMIP6), which was featured in Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6) and available in World Bank Climate Change Knowledge Portal[80].

Note: It should be noted that this is a high-level review of publicly available information, and no detailed site-specific analysis or modelling has been undertaken. Hence, further investigation may be required to quantify the risks in more detail for consideration of specific mitigation and adaptation options.

Precipitation

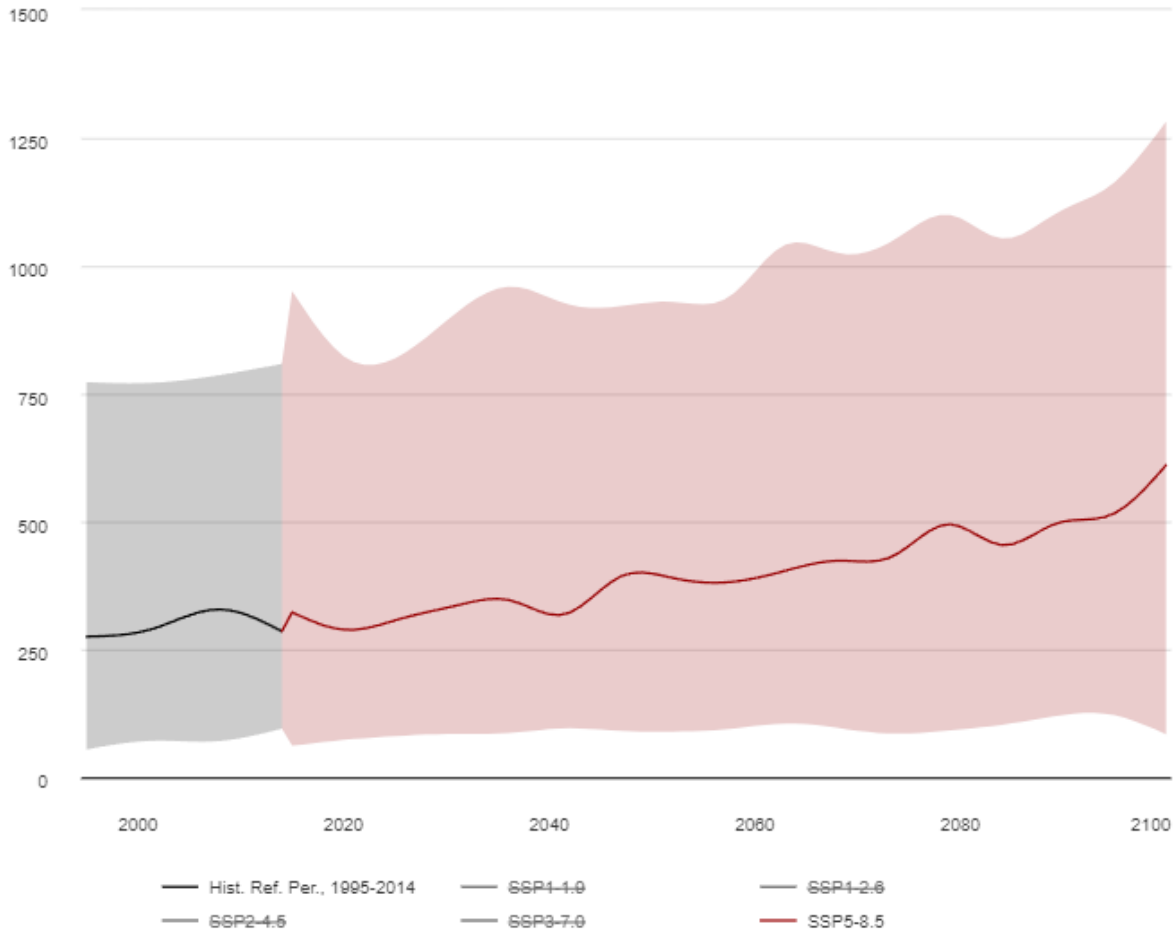
The projection period for precipitation has been considered as 2020-2039. The projected precipitation anomaly for Gujarat has been presented in ***Figure 7-5*** (reference period as 1995-2014) for selected scenarios i.e., CMIP6 SSP5-8.5. Average

[78] https://ccd.gujarat.gov.in/
[79] https://ccd.gujarat.gov.in/Images/Gujarat-State-Action-Plan-on-Climate-Change.pdf
[80] https://climateknowledgeportal.worldbank.org/

precipitation anomaly is the indicator for precipitation increase, where any change greater than 0 signals precipitation increase from historical trend.

As per the figure below, there will be gradual increase in precipitation in Gujarat, where the median (50th percentile) precipitation for selected scenario SSP5-8.5 in the year 2039 is projected to be between 318.25 mm as compared to the historic reference base period 1995-2014, where it was 285.15 mm in 2014.

Figure 7-5 Mean Projected Precipitation in Gujarat for 2020-2039 (reference period: 1995-2014)

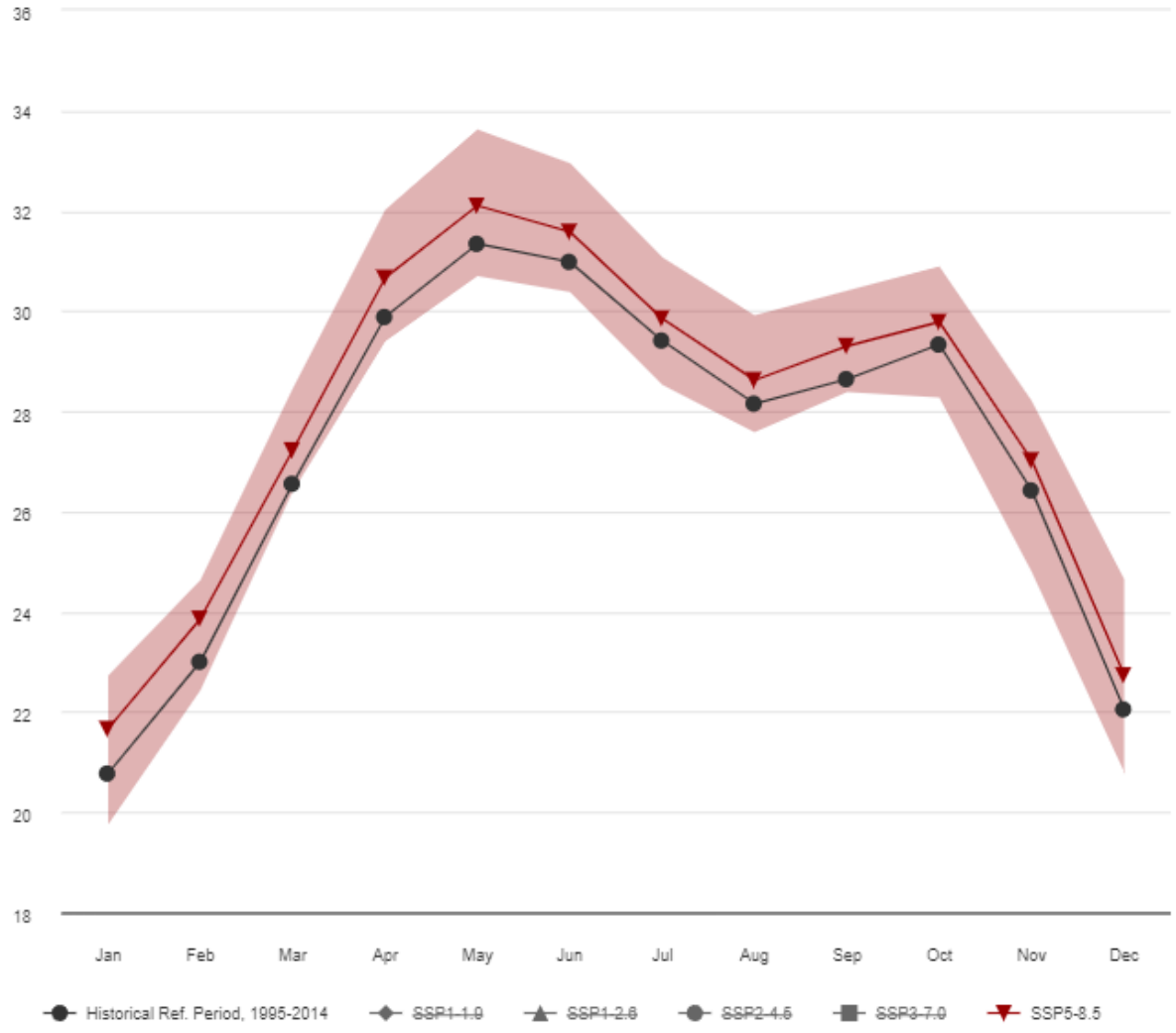


Source: World Bank Climate Change Knowledge Portal

Temperature

As per World Bank Climate Change Knowledge Portal, the temperature in Gujarat state has an increasing trend over the historical record. The projected monthly mean temperature for 2020-2039 has been presented in ***Figure 7-6.*** The projected temperature for the period 2020-2039 for selected scenario SSP5-8.5 was highest in the month of May i.e., 32.10°C as compared to historical data (1995-2014) where the temperature was recorded to be 31.34 °C in the same month. The projection indicates 0.76 °C increase in temperature for scenario SSP5-8.5 in 2020-2039 as compared to historical record.

Figure 7-6 Projected Mean Temperature in Gujarat for 2020-2039 (reference period: 1995-2014)



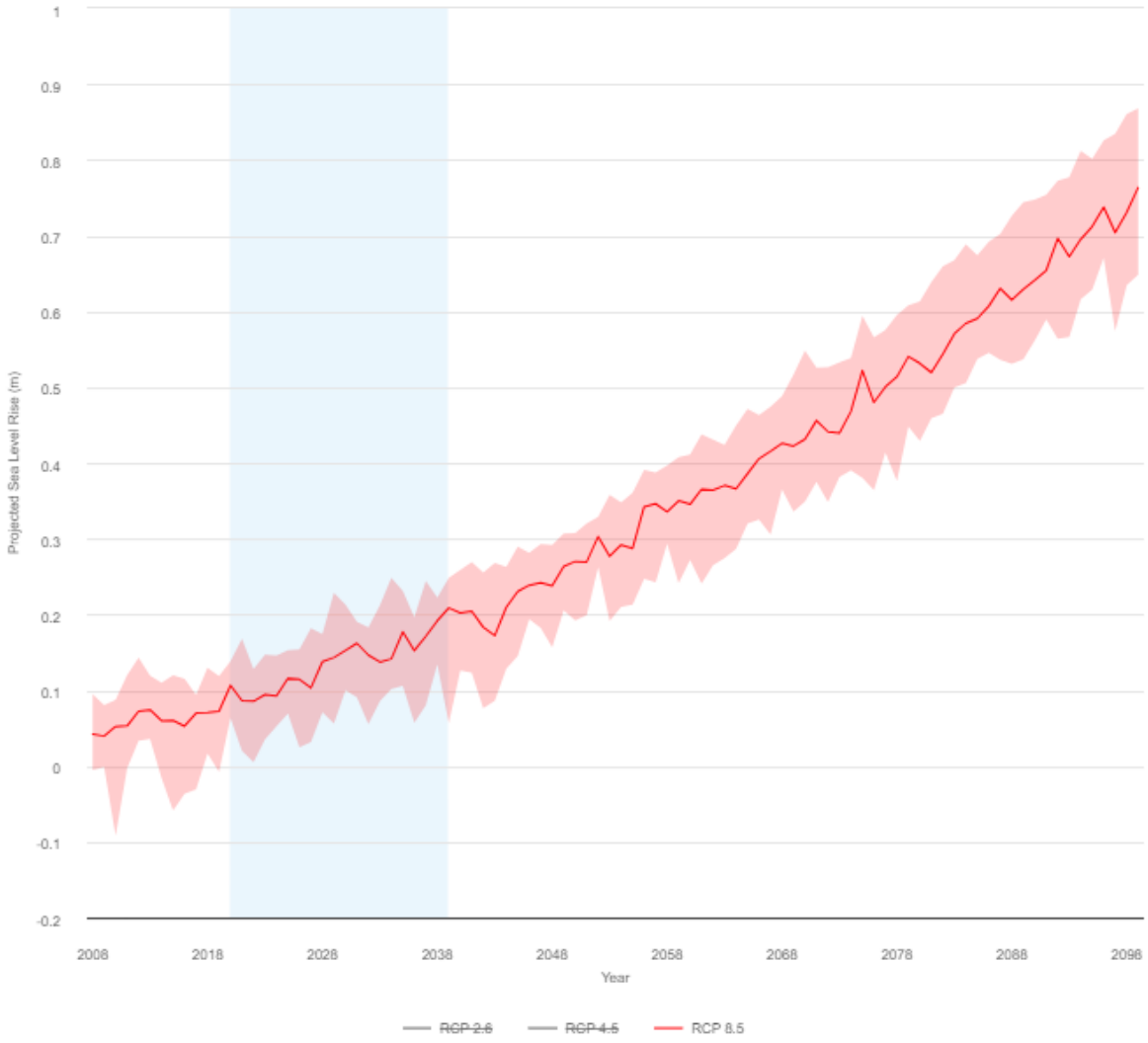
Source: World Bank Climate Change Knowledge Portal

Sea Level Rise

According to World Bank Climate Change Knowledge Portal, rising sea levels create not only stress on the physical coastline, but also on coastal ecosystems. Saltwater intrusions can contaminate freshwater aquifers, many of which sustain municipal and agricultural water supplies and natural ecosystems. As global temperatures continue to warm, sea level will keep rising for a long time because there is a substantial lag to reaching an equilibrium. As per GSAPCC, sea level rise poses a threat to the coastal infrastructure as it can lead to inundations, flood and storm damages in form of cyclones, erosion, saltwater intrusion into groundwater and wetland loss.

The projected sea level rise for period 2020-2039 with selected scenario SSP5-8.5 has been presented in ***Figure 7-7.*** According to the data presented below, an increasing trend in projected sea level rise can be observed in the selected period (2020-2039) and beyond as compared to the historical record. As observed the sea level rise in 2008 was 0.04 m and the same has been projected to be 0.15 m in 2030 and 0.21 m in 2039 for SSP5-8.5 scenario. Therefore, it is projected that there will be 0.11 m increase in 2030 and 0.17 m increase in 2039 in sea level as compared to the historical year of 2008.

Figure 7-7 Projected Sea Level Rise for Coastal Gujarat (2020-2039)



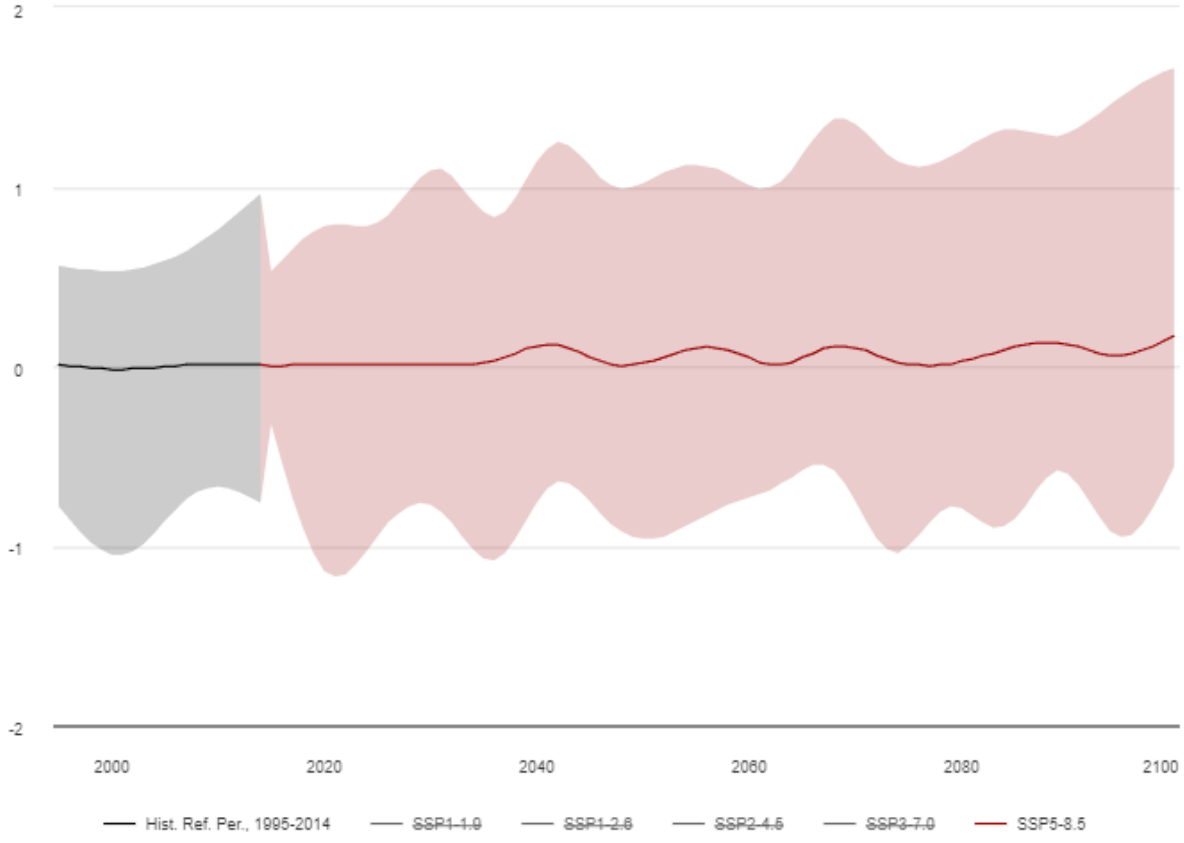
Source: World Bank Climate Change Knowledge Portal

Drought

World Bank Climate Change Knowledge Portal has been used to estimate annual Standardized Precipitation Evapotranspiration Index (SPEI). Negative value of SPEI indicates decrease in drought and increased water availability, positive value indicates increased drought and decreased water availability and no changes in SPEI Index means no change in water availability.

The projected annual SPEI drought index for Gujarat state has been presented in ***Figure 7-8.*** The annual SPEI Drought Index average value indicated small positive value in the period 2020-2039 for scenario CMIP6 SSP5-8.5 as compared to historical base period 1995-2014. Therefore, it is anticipated that the state will not be significantly impacted due to drought in the selected future period (2020-2039).

Figure 7-8 Projected Annual SPEI Drought Index, Gujarat, India (Reference Period: 1995-2014)

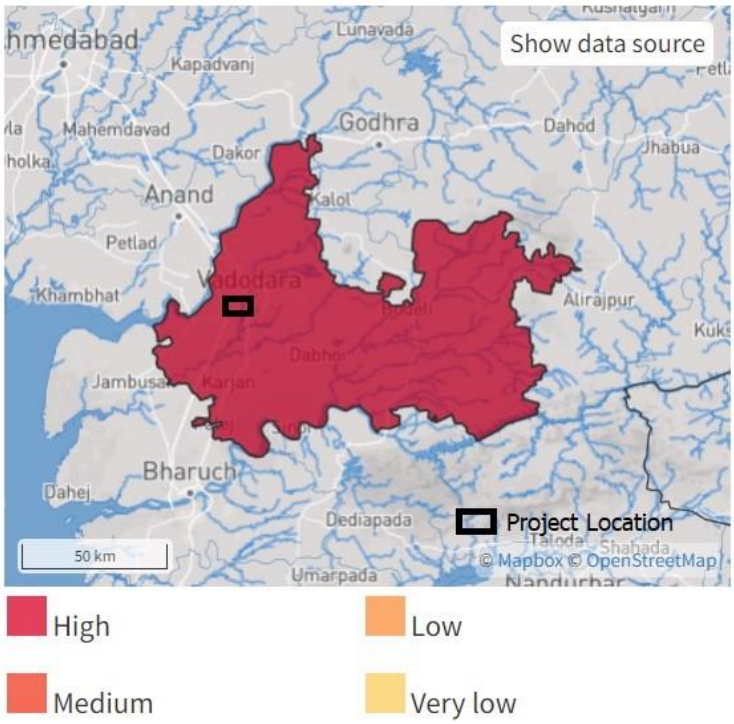


Source: World Bank Climate Change Knowledge Portal

Cyclone

The Cyclone Hazard Map (provided by Think Hazard) as presented below shows that Project site is classified as high risk according to the information that is currently available.

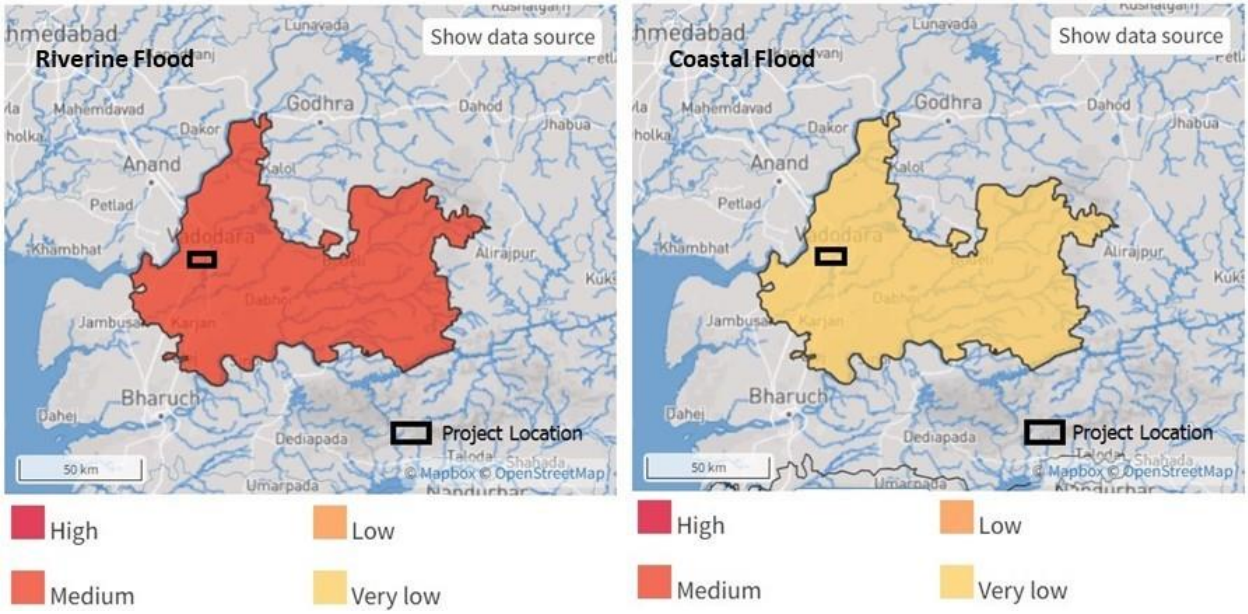
Figure 7-9 Cyclone Hazard Map



Flood

As per information available in ThinkHazard, riverine flood hazard is considered to be Medium and coastal flood hazard is classified as very low in the project location, presented in ***Figure 7-10***.

Figure 7-10 Flood Risk Map



Projects Vulnerability to Climate Change

The GWVPL project located in Vadodara is anticipated to be vulnerable to precipitation and increased temperature based on the projected climate trends described above. The projected increase in precipitation in the project area in future may lead to increase in leachate deposition at the site due to storage of 1000 TPD municipal solid waste at the bunker area.

Increase in precipitation may potentially expose the project to flood and localised waterlogging due to presence of Vishwamitri river flowing 180m (aerial distance) from site towards north east direction. As per BMTPC also, the project site is located in an area vulnerable to floods. Vadodara city has faced intense flood situations in the past due to heavy rainfall.

Control Measures

- The project has been designed in a way such that the stormwater flow from the upstream side of the plant is restricted and stormwater collected within the plant will flow through the rainwater harvesting design and utilized in cooling tower.
- The floor level and foundation level of the project equipment will include expected rainfall and topographical details of the area to avoid impact due to heavy rainfall within the Plant.

Mitigation Measures

- Undertake detailed flood risk assessments, for the plant location and incorporate the recommendation in the Emergency response plan.
- Ensure there is a dedicated, forward-looking budget for mitigating weather-related risks
- Continue to monitor the evolving scientific understanding of climate change hazards and reassess climate change induced risks to specific project elements at regular intervals (e.g., every five years) in the future
- Ensure adequate drainage is developed in and around the plant to avoid water logging and adequate leachate pit is constructed to manage excessive leachate generation during operation phase

7.5 Impacts on Biological Environment

The possible impacts on the biological environment in construction and operation phase have been assessed below,

7.5.1 Impacts during the Construction Phase

7.5.1.1 Habitat Modification and Loss due to Vegetation Clearance

The project plant is coming up in an area which was previously a dumping yard for municipal solid waste and the adjacent areas is modified and agricultural lands. Due to the construction of the project, the land use of the 6 acres of land will be changed.

Along with the plant, a 66 kV transmission line of 3.82 km length (1.62 km underground+ 2.2 km overhead) having 14 towers connecting the plant to GETCO Jambuva Substation will be laid across the natural habitat – water bodies (ponds and tributary of Vishwamitri river). For undergrounding approximately 2.00 acres will be dug and for overhead power line approximately 5.44 acres will be occupied.

As per the baseline, the site is predominated by *Prosopis juliflora*, *Acacia farnesian, Acacia nilotica*, *Aerva javanica*, *Azadirachta indica*, *Calotropis procera*, *Capparis decidua*, *Prosopis cineraria*, *Ziziphus spp* and aquatic submergents. No floral species of conservation importance was identified in the study area.

According to baseline data the presence of at least 28 Raptors (Bird of prey) species from the region including, Two Critically Endangered CR (Indian Vulture *Gyps indicus* and White-rumped Vulture *Gyps bengalensis*); Two (2) Endangered EN (Steppe Eagle *Aquila nipalensis* and Egyptian Vulture *Neophron* percnopterus); and Two (2) Vulnerable VU (Greater Spotted Eagle *Clanga clanga* & Indian Spotted Eagle *Clanga hastata*, and one (1) Near Threatened (Pallid Harrier *Circus macrourus*). And at least 112 migratory birds including one Endangered EN (1) Black-bellied Tern *Sterna acuticauda,* One (1) Vulnerable VL Common Pochard *Aythya farina* and Five (5) Near Threatened (*Black-tailed Godwit* Pallid Harrier, Ferruginous Duck, Lesser Flamingo, Dalmatian Pelican, Eurasian Curlew). And 12 Schedule-I species (Eurasian Marsh-Harrier, Eurasian Sparrowhawk, Eurasian Wigeon, Gull-billed Tern, Pallid Harrier, Common Pochard, Ferruginous Duck, Booted Eagle, Black-bellied Tern, Common Crane, Demoiselle Crane and Eurasian Griffon) were reported from this region. Regarding the mammals, a total of 15 mammalian species were documented within the study area, and notably none of them are classified as threatened according to the IUCN Red List. But among these Three (3) species (Golden Jackal *Canis aureus*, Indian Porcupine *Hystrix indica* and Asian palm civet *Paradoxurus hermaphroditus*) are listed in Schedule-I as per the Wildlife (Protection) Act, 1972.

Neither of these Critically Endangered and Endangered species have been detected within the core area, nor is their population substantially reliant on the project footprint. Nevertheless, regarding the Critically Endangered CR Vultures, encompassing the Indian Vulture (Gyps indicus) and White-rumped Vulture (Gyps bengalensis), despite their non-occurrence

in the recent past within the project's central area (within a 5km radius), the presence of these species cannot be overlooked due to their tendency for venturing into new foraging habitats.

Control Measures planned for the Project

According to discussion with the project officials, the clearance of vegetation will be limited to the project area and transmission towers.

Impact Significance

As the project is established for a long time, thus the **Duration** has been *permanent*. As the impact is restricted within the footprints of the Project boundary or within 500 m of the boundary wall, the **Spread** has been classified as *Local*. The **Intensity** has been classified as *moderate* as the numbers and ecological significance of species under the risk. Thus, the impact magnitude has been classified as ***Substantial*** based on the **Impact Significance Criteria (7.3.2**Table 7-6**)**

Proposed Mitigation Measures

The mitigations proposed to minimize the impact(s) on Habitat and Species have been given as,

- Vegetation clearance activities should be restricted within the project site and transmission towers
- The area for the storage yard, labour camps and other supplementary facilities should be selected away from any water body, canal, etc.
- There should be a ban on the use of woody plants as kitchen fuel, collected from the nearby areas
- Plantation of native plants in and around the project boundary, on the available land should be practiced and promoted.

	Nature of Impact	Spread of Impact	Duration	Intensity	Receptor Vulnerability	Significance of Impact
Without Mitigation Measures	Negative	Local	Permanent	Moderate	Medium (Species)	**Substantial**
With Mitigation Measures	Negative	Local	Permanent	Low	Medium (Species)	**Small**

7.5.1.2 Impact on the Wildlife during Construction Activities

Although the construction phase will be short, but it may cause disturbance to the wildlife of the surrounding area. The construction phase involves site preparation, building of processing units, installation of energy conversion equipment, and the establishment of waste storage areas. Such activities may lead to habitat disturbance and potential effects on local fauna. The excavation required for constructing these facilities directly impacts soil structure and composition, with potential consequences for soil-dwelling organisms. It poses a particular challenge to burrowing fauna, such as ground-dwelling mammals and reptiles, which rely on stable soils for shelter and protection. The alterations in soil properties and topography might indirectly influence surrounding flora and fauna by changing drainage patterns and nutrient availability. Furthermore, the human activity associated with the project, including transportation of waste and personnel, could introduce new stressors to the local fauna. Increased human activity and vehicle movement might force wildlife (Avifauna, Herpetofauna and Mammals) to remain more vigilant, potentially disrupting their natural behaviors, such as nesting, mating, and foraging. Noise generated from construction and operational activities can have a similar effect, disturbing the delicate balance of the ecosystem.

According to baseline results, premises and the surrounding of the project supports the various reptile species falling under the Schedule I category as per the Wildlife (Protection) Act, 1972 [i.e. Bengal Monitor Lizard (*Varanus bengalensis*), Checkered Keelback (*Xenochrophis piscator*), Indian Cobra (*Naja naja*), Indian Flapshell Turtle (*Lissemys punctata*), Indian Roofed Turtle (*Pangshura smithii*), Indian Tent Turtle (*Pangshura tentoria*), Oriental Ratsnake (*Ptyas mucosa*), Russell's Viper (*Daboia russelii*), Mugger crocodile (*Crocodylus palustris*) and Pond Slider (*Trachemys scripta*) (***Table 5-36***) and three (3) mammas

species - Golden Jackal (*Canis aureus*), Indian Porcupine (*Hystrix indica*) and Asian palm civet (*Paradoxurus hermaphroditus*) are listed in Schedule-I as per the Wildlife (Protection) Act, 1972 (***Table 5-38***).

The region is also supporting least 28 Raptors (Bird of prey) species from the region including, Two Critically Endangered **CR** (Indian Vulture *Gyps indicus* and White-rumped Vulture *Gyps bengalensis*); Two (2) Endangered **EN** (Steppe Eagle *Aquila nipalensis* and Egyptian Vulture *Neophron* percnopterus); and Two (2) Vulnerable **VU** (Greater Spotted Eagle *Clanga clanga* & Indian Spotted Eagle *Clanga hastata*, and one (1) Near Threatened (Pallid Harrier *Circus macrourus*). And at least 112 migratory birds including one Endangered **EN** (1) Black-bellied Tern *Sterna acuticauda,* One (1) Vulnerable **VL** Common Pochard *Aythya farina* and Five (5) Near Threatened (*Black-tailed Godwit* Pallid Harrier, Ferruginous Duck, Lesser Flamingo, Dalmatian Pelican, Eurasian Curlew). And 12 Schedule-I species (Eurasian Marsh-Harrier, Eurasian Sparrowhawk, Eurasian Wigeon, Gull-billed Tern, Pallid Harrier, Common Pochard, Ferruginous Duck, Booted Eagle, Black-bellied Tern, Common Crane, Demoiselle Crane and Eurasian Griffon) were reported from this region.

Control Measures planned for the Project

According to 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 presence of wildlife. The labor camps, concrete mixing plant and equipment storage sites (if located outside the project boundary) need to be selected away from the water resources to avoid any deposition/contamination.

Impact Magnitude

During the construction phase, the above-mentioned activities will be performed for a limited period i.e., 8-10 months, thus the **Duration** has been *short*. As the construction activities will be performed in the project boundary, as well as along the routes of transmission lines and underground water pipeline, the **Spread** has been classified as medium. The **Intensity** has been classified as *moderate* based on the diversity and numbers of species inhabiting the area impacted by the construction activities. Thus, the impact magnitude has been classified as **Substantial** based on the impact significance criteria **Impact Significance Criteria** (7.3.2).

Proposed Mitigation Measures

To reduce the possible impact on wildlife and avifauna during construction phase, following good business practices have been suggested to implement,

The mitigations proposed to minimize the impact(s) on Habitat and Species have been given as,

- The construction activities should be restricted to the project area, routes of transmission line and underground water pipeline
- Night-time (6:00 pm to 6:00 am) construction and transportation activities should be avoided
- The areas of high animal activity (such as natural habitats), 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 bodies and drains
- Sites with existing burrows or roosts should be avoided where possible, and temporary fencing should be installed over excavated areas (for underground water pipeline)
- 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 worker 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
- Construction workers should receive adequate training and be aware of the importance of safeguarding wildlife. Any stray wildlife in the area should not be harmed or killed during construction operations.
- Measures should be implemented to minimize construction-related noise to reduce its potential impact on the surrounding environment and wildlife.

	Nature of Impact	Spread of Impact	Duration	Intensity	Receptor Vulnerability	Significance of Impact
Without Mitigation Measures	Negative	Medium	Short	Moderate	Medium (Species)	Substantial
With Mitigation Measures	Negative	Medium	Short	Low	Medium (Species)	Small

7.5.2 Impacts during the Operation Phase

7.5.2.1 Collision and Electrocution Risk due to the Power Transmission

In any power generation project, collision and electrocution are the universally recognized risks due to the transmission infrastructures. During the ecological survey, notable number of species of birds were found perching on existing trees, water channels, bushes, wires and poles in the study area. 3.8km 66 kV transmission line (2.2km overhead and 1.6 km Underground) as well as transmission towers (14 in numbers) can possibly cause electrocution and collision risks to birds.

As per the baseline data, it revealed the presence of a minimum of 315 avifaunal species within a radius of 10-15 km around the project site , including vultures, raptors, and migratory bird species in the designated area, which includes two (2)Critically Endangered CR (White-rumped Vulture *Gyps bengalensis* and Indian Vulture *Gyps indicus*), Three (3) Endangered EN (Black-bellied Tern Sterna acuticauda, Egyptian Vulture Neophron percnopterus and Steppe Eagle Aquila nipalensis), Five (5) Vulnerable VL (Greater Spotted Eagle Clanga clanga, Indian Spotted Eagle Clanga hastata, River Tern Sterna aurantia, Common Pochard Aythya farina and Sarus Crane Antigone antigone) and Thirteen (13) Near Threatened NT (Alexandrine Parakeet Psittacula eupatria, Asian Woolly-necked Stork *Ciconia episcopus*, Black-headed Ibis Threskiornis melanocephalus, Black-necked Stork Ephippiorhynchus asiaticus, Black-tailed Godwit Limosa limosa, Eurasian Curlew Numenius arquata, Ferruginous Duck Aythya nyroca, Great Thick-knee Esacus recurvirostris, Lesser Flamingo Phoeniconaias minor, Oriental Darter Anhinga melanogaster, Painted Stork Mycteria leucocephala, Dalmatian Pelican Pelecanus crispus, and Pallid Harrier Circus macrourus). 33 Schedule-I species (Amur Falcon, Barn Owl, Black Kite, Black-bellied Tern, Bonelli's Eagle, Booted Eagle, Brahminy Kite, Brown Fish-Owl, Common Buzzard, Common Crane, Common Pochard, Cotton Pygmy-Goose, Demoiselle Crane, Egyptian Vulture, Eurasian Griffon, Eurasian Marsh-Harrier, Eurasian Moorhen, Eurasian Sparrowhawk, Eurasian Spoonbill, Eurasian Wigeon, Ferruginous Duck, Greater Spotted Eagle , Gull-billed Tern, Indian Peafowl, Indian Spotted Eagle, Indian Vulture, Osprey, Pallid Harrier, River Tern, Sarus Crane, Short-eared Owl, Short-toed Snake-Eagle, Steppe Eagle and White-rumped Vulture).

The raptor which more prone to collisions with powerlines, there are at least 28 Raptors (Bird of prey) species from the region including, Two Critically Endangred CR (Indian Vulture Gyps indicus and White-rumped Vulture Gyps bengalensis); Two (2) Endangered EN (Steppe Eagle *Aquila nipalensis* and Egyptian Vulture *Neophron percnopterus*); and Two (2) Vulnerable VU (Greater Spotted Eagle *Clanga clanga* & Indian Spotted Eagle *Clanga hastata*, and one (1) Near Threatened (Pallid Harrier *Circus macrourus*). And at least 112 migratory birds including one Endagered EN (1) Black-bellied Tern Sterna acuticauda, One (1) Vulnarable VL Common Pochard Aythya farina and Five (5) Near Thretened (Black-tailed Godwit Pallid Harrier, Ferruginous Duck, Lesser Flamingo, Dalmatian Pelican, Eurasian Curlew). And 12 Schedule-I species (Eurasian Marsh-Harrier, Eurasian Sparrowhawk, Eurasian Wigeon, Gull-billed Tern, Pallid Harrier, Common Pochard, Ferruginous Duck, Booted Eagle, Black-bellied Tern, Common Crane, Demoiselle Crane and Eurasian Griffon) were reported.

Neither of these Critically Endangered and Endangered species have been detected within the core area, nor is their population substantially reliant on the project footprint. Nevertheless, regarding the Critically Endangered CR Vultures, encompassing the Indian Vulture (Gyps indicus) and White-rumped Vulture (Gyps bengalensis), despite their non-occurrence in the recent past within the project's central area (within a 5km radius), the presence of these species cannot be overlooked due to their tendency for venturing into new foraging habitats.

Control Measures planned for the Project

Waste received from the municipal corporation will not be stored in the open.

Impact Magnitude

During the operation phase, power evacuation will remain till the life of the project, thus the **Duration** has been *permanent*. The length of overhead 66 kV transmission line (TL) is 2.2 km overhead passing close to waterbody and Tributary of *Vishwamitri* locations (22.229295°, 73.203323° to 22.227979°, 73.200355°) and (22.226300° 73.193939° to 22.220236° 73.187745°) medium size waterbodies are present on the seasonal stream which are very close to the TL route (***Figure 5-33***); therefore, the **Spread** has been classified as *medium*. The **Intensity** has been classified as *moderate* as the numbers and ecological significance of species under the risk of collision and electrocution. Thus, the impact magnitude has been classified as **Substantial** based on the **Impact Significance Criteria** (**7.3.2**).

Proposed Mitigation Measures

The mitigations proposed to minimize the impact(s) on bird species have been given as,

- Avian Flight Diverters[81]: Install avian flight diverters on the power transmission line to increase the visibility of the overhead wires to birds, reducing the risk of collisions especially near to the water bodies, river stream (22.229295°, 73.203323° to 22.227979°, 73.200355°) and (22.226300° 73.193939° to 22.220236° 73.187745°)
- Bird-Friendly Pole Designs: Utilize bird-friendly pole designs that minimize the risk of electrocution, such as bird guards or insulators designed to prevent accidental contact.
- Disposal of corpses / garbage near the power lines should be restricted and carcasses observed along the transmission line should be immediately removed to avoid attracting raptors.

	Nature of Impact	Spread of Impact	Duration	Intensity	Receptor Vulnerability	Significance of Impact
Without Mitigation Measures	Negative	Medium	Permanent	Moderate	Medium (Species)	**Substantial**
With Mitigation Measures	Negative	Medium	Permanent	Low to Moderate	Medium (Species)	**Small to Substantial**

[81] Galis, M. and Sevcik, M. (2019) Monitoring of effectiveness of bird flight diverters in preventing bird mortality from powerline collisions in Slovakia. Raptor Journal 13: 45–59.

7.5.2.2 Human-Wildlife Conflicts

The Project is located in close proximity to an active municipal corporation garbage dumping site and is surrounded by natural open scrub and modified agricultural habitats. These habitats sustain diverse herpetofauna, avifauna, and mammal populations, as documented in the ecological baseline survey. The presence and movement of these wildlife species within the project compound and along its boundary during the operation phase pose a potential risk of Human-Wildlife conflicts.

As per the baseline, one Schedule I reptiles, Bengal Monitor Lizard (Varanus bengalensis) (Wild Life (Protection) Act, 1972) and three mammals, Bengal Fox (Vulpes bengalensis), Indian Grey Mongoose (Herpestes edwardsii), Rhesus Monkey (Macaca mulatta), etc. are capable to climb and thus can enter within the project compound. Beside these species, Common Krait (Bungarus caeruleus), Indian cobra (Naja naja), Oriental Ratsnake (Ptyas mucosa) and Saw-scaled Vipers (Echis carinatus) were also reported from the study area which enter the project premises.

Control Measures planned for the Project

Pre-casted wall is present around the plant to eliminate any possibility of wildlife entrance within the plant.

Impact Magnitude

As the project will be established for a long time, thus the **Duration** has been *permanent*. As the impact is restricted within the footprints of the Project boundary or within 500 m of the boundary wall, the **Spread** has been classified as *local*. The **Intensity** has been classified as *moderate* as the numbers and ecological significance of species under the risk. Thus, the impact magnitude has been classified as **Small** based on the **Impact Significance Criteria** (7.3.2).

Proposed Mitigation Measures

- Frequent checking of the boundary wall to avoid any space for wildlife entrance into project compound.
- Employee Training: Conduct training programs for project personnel to raise awareness about the local wildlife and the importance of respecting their habitats. Employees should be educated on how to handle encounters with wildlife safely and responsibly.
- Emergency Response Protocol: Develop an emergency response protocol to handle any human-wildlife conflicts that may arise during the project's operation phase. This should include procedures for safely managing encounters and contacting relevant authorities if needed.
- Good housekeeping practices in the project compound play a crucial role in reducing the attraction of faunal species and mitigating potential human-wildlife conflicts. By implementing effective housekeeping measures, the project can create an environment that is less appealing to wildlife, thereby minimizing their presence within the compound.

By implementing these control measures, the Project can significantly mitigate the potential risk of human-wildlife conflicts, ensuring the safety of both the wildlife and project personnel while minimizing any disruptions to the project's operations.

	Nature of Impact	Spread of Impact	Duration	Intensity	Receptor Vulnerability	Significance of Impact
Without Mitigation Measures	Negative	Local	Permanent	Moderate	Low (Species)	**Substantial**
With Mitigation Measures	Negative	Local	Permanent	Low	Low (Species)	**Small**

7.6 Impacts on Socio- Economics

7.6.1 Impact during construction phase

7.6.1.1 Unhygienic and unsafe living conditions due to labor 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 are hired locally as well as other states. The details regarding the workforce of the Project site are estimated to 125 contractual workers. During, site visit confirms that nearly 56 % of the construction works is over. The appointed labour providing contractor has provided the workers' accommodation colony adjacent to the project boundary. As per the consultation with contractor representative and review of available information, the contractor has leased out privately owned land admeasuring 0.7 acre to construction the worker' accommodation. Further, per the site visit to the workers' accommodation, several concerns related to health, safety, and basic living conditions of the worker Some of the key issues identified are as follows:

- Brief description of workers' accommodation facility: The accommodation facility has approximately 50 rooms, these rooms are constructed of concrete walls and have tin shed as a roof. As reported, per room 2-3 individual male workers stays and one separate room is allotted to a family.
- Ventilation and Heat Protection: The lack of proper ventilation and thermal insulation in the rooms was observed to be insufficient. The provided rooms are closed structures without any windows or any open space (except the main door). Further, there is no electricity-based fan inside the rooms provided by the contractor. The lack of ventilation and thermal insulation in the rooms can lead to uncomfortable living conditions, especially during summers (where the temperature can reach to 45 degree Celsius in Vadodara). This may result in heat stress conditions for the workers, affecting their health and well-being.
- Cooking Facility: No separate cooking facility or canteen has been provided to the workers. Workers cook their food inside the room at *mud chulhas* and uses wood as fuel. The cooking of food inside the room with wood as fuel can cause acute respiratory infection, chronic airway disease, tuberculosis, asthma, lung cancer and other similar diseases and potential fire emergencies
- Toilet and Bathing Facilities: The accommodation has 12-toilet facilities. However, these toilet facilities are common for male and females and no sperate toilet facility has been provided for female (who come along as a family member of main worker). The provisions of common toilets without separate facilities for male and female workers can compromise privacy and hygiene. The lack of a dedicated bathing facilities for females has resulted in usage of common open area for bathing purposes. Females install a temporary close structure outside their rooms by using their saree for bathing purpose. The lack of dedicating bathing facility is a significant concern and raises issues related to privacy, safety, gender equity and may raise the risk of sexual harassment of females at workers' accommodation
- Availability of water: As reported by the contractor, treated drinking water is provided to workers for drinking and cooking facilities. For other domestic usage, the water is supplied through borewell installed at the accommodation facility.
- Water Drainage: There is no proper facility of drainage of used water (from toilet or from other domestic usage). The used water from the toilet is collected in an open pit through open sewage. The open pit was observed without any boundary. The untreated water in the open pit may raise the risk of spreading water borne diseases. Further, no boundary across the open pit may result in any incident related to children or other workers or family members
- Lighting facility: The contractor has provided the electricity inside the accommodation facility. The rooms are equipped with lighting, however, the electricity connection and wire used inside the room was uninsulated. The usage of uninsulated electrical wiring inside the rooms can pose safety risks and may lead to electrical hazards.

Control Measures Planned for the Project

- EHS conditions were 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.

Impact Magnitude

- As the constriction of the project is already completed 56% and duration of remaining work is short, and spread is local hence the intensity of the impact is evaluated as **Small.**

Proposed Mitigation Measures

GWVPL shall ensure the provided workers' accommodation shall follow the requirement of Guidance note by IFC and the EBRD on workers' accommodation. Provided below some of the key requirements of the Guidance note:

- **Ventilation and Natural Light:** Adequate ventilation and natural light should be provided in the rooms to maintain a healthy and comfortable living environment
- **Sanitary facilities:** The accommodation should have clean and well-maintained sanitary facilities, including separate toilets and bathing facilities for male and female workers
- **Clean water supply:** Access to a clean and safe water supply is essential for drinking, cooking, and personal hygiene
- **Hygiene and cleaning:** Regular cleaning and maintenance of the accommodation facility should be ensured to promote a hygienic living environment
- **Fire safety:** Adequate fire safety measures, including fire extinguishers and evacuation plans, should be in place to ensure worker safety
- **Electrical safety:** all electrical installations and appliances should be in compliance with safety standards to prevent electrical hazards
- **Privacy and Security:** Workers should have secure storage space for personal belongings and feels safe within the accommodation facility
- **Gender-sensitive Facilities:** Workers' accommodation should ensure and provide privacy to both male and female workers
- **Waste Management:** Proper waste management facilities should be in place to ensure proper disposal of waste and maintain a clean environment
- **Construct proper Drainage system:** Install a proper drainage system that collects and directs used water from toilets and other domestic usage to a designate treatment facility or a proper disposal method. The drainage system should be designed to prevent water stagnation and potential breeding grounds for disease-carrying vectors
- **Install Boundaries:** Erect boundaries around the open pit to prevent accidental falls and access by unauthorized individuals, particularly children. Securing the area will reduce the risk of accidents and ensure the safety of workers and their family members
- **Regular Maintenance:** Establish a regular maintenance schedule to ensure the drainage system and treatment facility are functioning effectively. Regular inspections and upkeep will prevent blockages and malfunctions that could lead to unhygienic conditions
- **Hygiene and sanitation Awareness:** Conduct hygiene and sanitation awareness programs for the workers and their families residing in the accommodation facility. Educate them about proper waste disposal, personal hygiene, and the importance of maintaining a clean-living environment

	Nature of Impact	Spread of Impact	Duration	Intensity	Significance of Impact
Without Mitigation Measures	Negative	Local	Short	Moderate	**Small**
With Mitigation Measures	Negative	Local	Short	Insignificant	**Negligible**

7.6.1.2 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 project components such as boilers, steam turbines, transmission towers and transmission lines etc.
- Risk while working at confined spaces at excavated areas
- Accidents during driving heavy duty vehicles for transportation of construction material at site including sorting stations
- 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, transmission line 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.
- The emission load from welding is will directly affect welders and workers on the site
- Dust arising during construction of the project can have a direct impact staff working at the construction site

Implemented Control Measures

- In line with the concession agreement, all the workers are provided with adequate PPE such as Safety helmet, Safety shoes, face mask and Safety vest. Additionally, workers working with scaffold are being provided with safety belts.
- HSE manual developed by the contractor is currently being implemented on the Project site. The HSE manual included training requirements such as first aid training, job specific training, daily work instructions and toolbox talk.
- 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 are imparted to the workers
- Cranes and other lifting equipment are operated by trained and authorized persons
- First aid box's with adequate medicines are provided at the site

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

- GWVPL to develop dedicated environmental, health and safety (EHS) plan, Occupational Health & Safety Plan and emergency response plan (ERP) applicable to all project phases, i.e. construction as well as operation. Measures provided in the respective plans with respect to health and safety to be implemented at site.
- The Project to develop a training calendar and associated training materials to impart trainings at regular intervals to the contractors and workers. The trainings as per the training calendar should be provided to all the workers at the WTE plant, workers involved in construction of transmission line and underground water pipeline.
- GWVPL to develop and maintain hazard identification and risk assessment (HIRA) for the project and its associated TL and water pipeline and communicate the same to the workers. The HIRA register should be update whenever a new hazard is identified at the site.
- In line with the concession agreement, monthly/quarterly safety meetings should be conducted on site to discuss the unsafe work practices or conditions and suggest corrective actions. The minutes of the meeting (MoM) along with implementation of corrective actions to be shared with the EHS Manager at the corporate level.
- The Project to develop a training calendar and associated training materials as part of the OHS to impart trainings at regular intervals to the contractors and workers. The trainings as per the training calendar should be provided to

all the workers at the WTE plant, workers involved in construction of transmission line and underground water pipeline.

- Project should conduct full body check-up of workers as part of premedical check-up and annual medical check-up. These should include blood test, ECG, Pulmonary Function test, urine test etc.
- GWVPL to develop a formal procedure to record near miss, incident, and minor accidents onsite.
- 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.
- Workers who are engaged in welding works will be provided with welder's protective eye shields;
- 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;
- Appoint a trained person to take charge of the first aid boxes. The location of first aid arrangements to be displayed on site;
- 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.
- GWVPL to 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.

	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**

7.6.1.3 Impact due to installation of transmission line

As an integral component of the Project, 3.233 km transmission line is proposed. The transmission infrastructure will consist of two types: (i) overhead transmission line spanning 2.185 km, and (ii) underground transmission line also extending over a length of 1.048 km. Furthermore, a spatial assessment of the route has identified specific land categories falling within the Right of Way (RoW) of the transmission line:

Land Use	Area (acres)
Overhead Transmission Line	
Open Scrub Land	0.32
Agricultural Land	6.45
Road Land	0.07
Waterbody	0.73
Nalla Land	2.20
Sub total	**9.77**
Underground Transmission Line	
Road Land	0.25
Substation land	0.01

Land Use	Area (acres)
Sub-total	0.26
Grand Total	10.03

Note: The proposed Right of Way (RoW) for the overhead transmission line spans 18 meters, while for the underground transmission line, it is designated at 1 meter. It is pertinent to note that the information pertaining to the RoW for the underground transmission line has been provided by the Project, as no government-issued standards currently exist to determine the RoW for underground transmission lines.

Impact due to installation of transmission line

Overhead transmission Line

The installation of the overhead transmission line has affected 13 private landowners. The designated contractor responsible for the installation of the transmission line has appropriately disbursed compensation to these 13 affected landowners, following the prescribed guidelines articulated in the Government of Gujarat Circular No. JET-11-2015-GOI-199-K, dated 14.08.2017, and 31.12.2021.

According to information provided by the project, compensation has indeed been distributed to the impacted landowners. In order to ensure compliance with the provisions detailed in the Gujarat Circular No. JET-11-2015-GOI-199-K, dated 14.08.2017, and 31.12.2021, as well as adherence to prevailing market rates, both the service provider and the Project have formally sought information from Gujarat Electricity Transmission Company Limited (GETCO). However, it is noted that GETCO has not disclosed the specific amount of compensation disbursed to the landowners.

Underground Transmission Lines

As evident from the provided land use table, the impact of the underground transmission line is confined to a mere 0.017 acres of agricultural land and is impacting one (1) private landowner. In alignment with the process followed for the overhead transmission line, the designated contractor has duly compensated the impacted landowners and has submitted a comprehensive report to GETCO. However, it is noteworthy that GETCO has not disclosed the specific details regarding the compensation disbursed to the affected landowners.

Control measure Planned for the Project

Overhead Transmission Line

The project, in collaboration with its designated contractor responsible for the installation of the transmission line, is mandated to carry out construction activities in strict adherence to the stipulations outlined in Gujarat Circular No. JET-11-2015-GOI-199-K, dated 14.08.2017, and subsequent updates on 31.12.2021. Compensation to the affected landowners must be disbursed in accordance with the guidelines specified in the aforementioned circular, subject to mutual negotiations with the landowners.

Furthermore, the contractor is obligated to submit a comprehensive compensation payment report to GETCO. Construction of the transmission line is contingent upon GETCO's satisfaction with the compensation disbursement process, ensuring alignment with regulatory standards and the fulfillment of contractual obligations before proceeding with the construction activities.

Underground Transmission Line

In a manner parallel to the approach taken for the overhead transmission line, the contractor has diligently compensated the impacted landowners (three) through a process of mutual negotiation, subsequently submitting the compensation report to GETCO.

In an effort to mitigate the impact on the 20 roadside vendors and kiosks located in the primary market, the project has implemented strategic measures. Construction activities are scheduled during night-time, minimizing disruptions to vendors and kiosks. Furthermore, the construction process is phased, with the contractor addressing 10 meters at a time, allowing for the restoration of the land to a state conducive for the resumption of business activities by these entities.

In the event that full restoration proves challenging, the contractor is committed to covering the impacted area with metal planks. This proactive step aims to ensure continued access for roadside vendors and kiosk owners, preventing any prolonged disruption resulting from the construction activity.

Impact Magnitude

1. Land Use and Access
   - **Magnitude:** Small to Negligible
   - **Description:** Construction activities may temporarily disrupt land use patterns, especially where the transmission line passes through residential or agricultural areas. However, the duration and spread of the impact is short and local in nature.
2. Economic Impact on Roadside vendors, kiosks owners, and Private Landowners
   - **Magnitude:** Small to Negligible
   - **Description:** The compensation to impacted landowners shall be paid in accordance with the government regulation and mutually negotiated with the owners. The compensation report shall be submitted to GETCO for their approval. Further, the project has already put in place the mitigation measures to mitigate the access stoppage or business disruption impact for roadside vendors and kiosks owners. Additionally, the spread and duration of the impact is Local and short to medium.

Proposed Mitigation Measures

In addition to the planned mitigation measures, following mitigation measures shall be implemented by the Project:

- Establish a grievance mechanism that allows affected stakeholders to raise concerns, provide feedback, and seek resolution for any project-related issues,
- Ensure accessibility, transparency, and fairness in the grievance resolution process.
- Implement the established Stakeholder Engagement Plan outlining how the project will engage with and involve stakeholders throughout the project lifecycle.
- Ensure that engagement is inclusive, transparent, and facilitates meaningful participation.
- Continue with the practice of conducting construction activities during nighttime to minimize disruption to businesses and daily activities.
- Maintain a phased approach to construction, allowing for the gradual restoration of affected areas.
- Implement a comprehensive restoration plan, ensuring that areas impacted by construction activities are returned to a usable state.
- Establish mechanisms for ongoing monitoring of the impact on stakeholders during and after construction.
- Furthermore, in the event of any physical damage to any form of privately owned or used physical structure resulting from the construction activity (especially the underground transmission line) of the transmission line, the project shall fully compensate for the loss or damage to impacted structures' owner at replacement cost[82] or construct the structure as it was earlier to the construction activities.
- Prepare regular reports outlining the progress of restoration efforts and addressing any challenges encountered.

	Nature of Impact	Spread of Impact	Duration	Intensity	Significance of Impact
Without Mitigation Measures	Negative	Local	Short	Moderate	**Small**
With Mitigation Measures	Negative	Local	Short	Insignificant	**Negligible**

[82] The replacement cost as per IFC Performance Standard 5 (PS5) refers to the value required to allow Affected Communities and persons to replace lost assets with assets of similar value. It includes the market value of assets plus transaction costs and does not take depreciation into account.

7.6.1.4 Impact due to laying down of water pipeline

As an integral component of the Project, a 3.973 km water pipeline is proposed. The water pipeline will be connecting Tarsali Sewage Treatment Plant to the WTE plant. Furthermore, a spatial assessment of the route has identified specific land categories falling within the Right of Way (RoW) of the water pipeline:

Land Use	Area (acres)
STP Plant Land	0.05
Road Land	1.42
Total	**1.47**

Note: The proposed Right of Way (RoW) for the water pipeline is designated at 1 meter. It is pertinent to note that the information pertaining to the RoW for the water pipeline has been provided by the Project, as no government-issued standards currently exist to determine the RoW for laying down of water pipeline.

Impact due to installation of water pipeline

The installation of water pipeline is not impacting any private landowners and is majority laying down through the existing RoW of state highways and municipal roads. However, ~1.27 km of water pipeline will be passing through the main market and habitation area of Tarshali, Vadodara, and it is anticipated to affect 30 roadside vendors and kiosks. This impact is primarily related to the disruption of business activities for these vendors and kiosks, given that they operate within the Right of Way (RoW) of the state highway, which coincides with the identified route for laying down the water pipeline.

Control Measures planned for the Project

In an effort to mitigate the impact on the 30 roadside vendors and kiosks located in the primary market, the project has implemented strategic measures. Construction activities are scheduled during nighttime, minimizing disruptions to vendors and kiosks. Furthermore, the construction process is phased, with the contractor addressing 10 meters at a time, allowing for the restoration of the land to a state conducive for the resumption of business activities by these entities.

In the event that full restoration proves challenging, the contractor is committed to covering the impacted area with metal planks. This proactive step aims to ensure continued access for roadside vendors and kiosk owners, preventing any prolonged disruption resulting from the construction activity.

Impact Magnitude

- **Magnitude:** Small to Negligible
- **Description:** The construction may disrupt the business activities of roadside vendors and kiosk owners, leading to a temporary loss of income. However, the project has already put in place the mitigation measures to mitigate the access stoppage or business disruption impact for roadside vendors and kiosks owners. Additionally, the spread and duration of the impact is local and short

Proposed Mitigation Measures

In addition to the planned mitigation measures, following mitigation measures shall be implemented by the Project:

- Establish a grievance mechanism that allows affected stakeholders to raise concerns, provide feedback, and seek resolution for any project-related issues,
- Ensure accessibility, transparency, and fairness in the grievance resolution process.
- Implement the existing Stakeholder Engagement Plan outlining how the project will engage with and involve stakeholders throughout the project lifecycle.
- Ensure that engagement is inclusive, transparent, and facilitates meaningful participation.
- Continue with the practice of conducting construction activities during nighttime to minimize disruption to businesses and daily activities.
- Maintain a phased approach to construction, allowing for the gradual restoration of affected areas.
- Implement a comprehensive restoration plan, ensuring that areas impacted by construction activities are returned to a usable state.

- Establish mechanisms for ongoing monitoring of the impact on stakeholders during and after construction.
- Furthermore, in the event of any physical damage to any form of privately owned or used physical structure resulting from the laying down activities of water pipeline, the project shall fully compensate for the loss or damage to impacted structures' owner at replacement cost or construct the structure as it was earlier to the laying down activities.
- Prepare regular reports outlining the progress of restoration efforts and addressing any challenges encountered.

	Nature of Impact	Spread of Impact	Duration	Intensity	Significance of Impact
Without Mitigation Measures	Negative	Local	Short	Moderate	**Small**
With Mitigation Measures	Negative	Local	Short	insignificant	**Negligible**

7.6.1.5 Increased local employment and livelihood

As per the available data it was understood that total manpower requirement for the project is nearly 85 persons, which will include both skilled and nonskilled workers. The work force will mostly engage the 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

As the project is likely to employ workers across different regions and states therefore the project is having high spread and most of the project construction activities are over (56%) so the duration of the impact is short hence based on the impact assessment matrix the magnitude of the impact is evaluated as **small.**

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	Receptors' Vulnerability	Magnitude of Impact
Without Mitigation Measures	**Positive**	High	Short	**Short**	**Intermittent**	**Low**	**Small**
With Mitigation Measures	Positive	High	Short	**Short**	**Intermittent**	**Low**	**Small**

7.6.2 Impact during operation phase

7.6.2.1 Impact on Ragpickers

Based on the information provided by the project, the waste generated by Vadodara City is significantly higher than the waste requirement for the operation of the WTE plant. With a waste generation of more than ~2,000 TPD and a requirement of 1,000 TPD for the operation of WTE plant, there is still a substantial amount of waste that needs to dump at Vadodara landfill site. The waste will continue to be dumped at the Vadodara landfill site where approximately 20 ragpickers are collecting recyclable waste from freshly dumped waste. Given that there is a sufficient waste available at the landfill site, it is envisaged that the ragpickers will continue their activities without being economically displaced due to the development and operation of the WTE plant.

7.6.2.2 Operation of underground water pipeline

The project will install 3.973 km of underground water pipeline and operate the same during the operation phase. As stated above in section 7.6.1.3, the underground transmission line is majorly crossing through the existing RoW of municipal roads.

Impact due to operation of water pipeline

As reported by the Project, during the operational phase of the underground water pipeline, no physical structures will be erected within the Right of Way (RoW) allocated for the underground transmission line, which is approximately 1 meter. The predominant section of this transmission line traverses existing RoW areas designated for road use, administered by the relevant government authority. The project has successfully obtained a No Objection Certificate (NOC) from the said authority, ensuring compliance with regulations, and confirming that no structures will be constructed on this land.

Control Measures planned for the Project

The project will not impose any access stoppage during the operation of the water pipeline.

Impact Magnitude

The impact **negligible** of the operation of the underground transmission line is expected to be minimal. The project has outlined measures to ensure that there is no disruption of access for the local community.

Proposed Mitigation Measures

In addition to the planned mitigation measures, following mitigation measures shall be implemented by the project:

- Establish a grievance mechanism that allows affected stakeholders to raise concerns, provide feedback, and seek resolution for any project-related issues,
- Ensure accessibility, transparency, and fairness in the grievance resolution process.
- Develop a Stakeholder Engagement Plan outlining how the project will engage with and involve stakeholders throughout the project lifecycle.
- Ensure that engagement is inclusive, transparent, and facilitates meaningful participation.
- The project commits to ensuring that there will be no stoppage of access for the local community during the operation of the water pipeline. This ensures that the normal flow of activities in the community remains unaffected.

- The project shall proactively inform stakeholders in advance of any scheduled maintenance activities. This advance notice ensures that stakeholders are prepared for any temporary disruptions and can plan accordingly.
- In the case of emergency maintenance, the project shall promptly provide information to stakeholders before initiating any maintenance activities. This proactive communication is crucial, particularly for stakeholders such as roadside vendors and kiosk owners, allowing them to evacuate the Right of Way (RoW) if necessary.
- Furthermore, in the event of any physical damage to any form of privately owned or used physical structure resulting from the operation and maintenance activity of water pipeline, the project shall fully compensate for the loss or damage to impacted structures' owner at replacement cost or construct the structure as it was earlier to the operation phase.
- Following the completion of maintenance work, the project shall restore the RoW to its pre-maintenance condition.

	Nature of Impact	Spread of Impact	Duration	Intensity	Significance of Impact
Without Mitigation Measures	Negative	Local	Short	Insignificant	**Negligible**
With Mitigation Measures	Negative	Local	Short	Insignificant	**Negligible**

7.6.2.3 Operation and Maintenance of transmission line

As reported by the Project, during the operational phase of the underground transmission line, no physical structures will be erected within the Right of Way (RoW) allocated for the underground transmission line, which is approximately 1 meter. The predominant section of this transmission line traverses existing RoW areas designated for road use, administered by the relevant government authority. The project has successfully obtained a No Objection Certificate (NOC) from the said authority, ensuring compliance with regulations, and confirming that no structures will be constructed on this land.

Importantly, the project assures that the operation of the underground transmission line will not impede the access of local communities, thereby mitigating disruptions and preserving community mobility. However, during the maintenance phase, there may be scenarios of digging of RoW and result into temporary access stoppage of roadside vendors and kiosks owners.

Control Measures Planned for the Project

The project will not impose any access stoppage during the operation of the transmission line.

Impact magnitude

The impact negligible of the operation of the underground transmission line is expected to be minimal. The project has outlined measures to ensure that there is no disruption of access for the local community. The overall impact is anticipated to be limited, given the adherence to specified guidelines and commitments to facilitate normal community activities in the affected areas.

Proposed Mitigation Measures

In addition to the planned mitigation measures, following mitigation measures shall be implemented by the project:

- Establish a grievance mechanism that allows affected stakeholders to raise concerns, provide feedback, and seek resolution for any project-related issues.
- Ensure accessibility, transparency, and fairness in the grievance resolution process.
- Implement the established Stakeholder Engagement Plan outlining how the project will engage with and involve stakeholders throughout the project lifecycle.
- Ensure that engagement is inclusive, transparent, and facilitates meaningful participation.

- The project commits to ensuring that there will be no stoppage of access for the local community during the operation of the transmission line. This ensures that the normal flow of activities in the community remains unaffected.
- The project shall proactively inform stakeholders in advance of any scheduled maintenance activities related to the underground transmission line. This advance notice ensures that stakeholders are prepared for any temporary disruptions and can plan accordingly.
- In the case of emergency maintenance, the project shall promptly provide information to stakeholders before initiating any maintenance activities. This proactive communication is crucial, particularly for stakeholders such as roadside vendors and kiosk owners, allowing them to evacuate the Right of Way (RoW) if necessary.
- Furthermore, in the event of any physical damage to structures of roadside vendors and kiosk owners or any other form of privately owned or used physical structure resulting from the operation of underground transmission line, the project shall fully compensation for the loss or damage to these structures' owners or user at replacement cost or construct the structure as it was earlier to the construction.
- Following the completion of maintenance work, the project shall restore the RoW to its pre-maintenance condition.

	Nature of Impact	Spread of Impact	Duration	Intensity	Significance of Impact
Without Mitigation Measures	Negative	Local	Short	Insignificant	**Negligible**
With Mitigation Measures	Negative	Local	Short	Insignificant	**Negligible**

7.6.2.4 Supply Chain Management

The supply chain of the Project is a complex network that involves the efficient management of resources, waste streams, technology, and partnerships. It encompasses various stages from waste collection to the generation of electricity. Here is an overview of the key components of the supply chain:

- The supply chain initiates with the collection of municipal solid waste (MSW) from households' door-to-door collection. The door-to-door collection of the waste will be undertaken by Vadodara Municipal Corporation (VMC) through its authorised contractor and vendors. The household waste is collected through small trucks (tippers), the waste is then transported to transfer stations for preliminary sorting and transportation in bulk quantity.
- The sorted waste, including fresh waste, is transported from transfer stations to the Waste-to-Energy plant. The Efficient logistics and transportation are vital to maintaining the continuity of waste supply to the plant.

<u>Control Measures Planned for the Project's Supply Chain</u>

The operational phase of the project has not commenced, and consequently, definitive control measures for its supply chain are yet to be implemented by the project.

<u>Impact Magnitude</u>

The magnitude of the supply chain of the project is considered as **Significant.** In the comprehensive assessment of the waste-to-energy project's supply chain, several critical observations and concerns have been identified:

1. Door-to-door Waste Collection and Transportation
   - **Process Overview:** The key component involves the collection and transportation of household waste to the transfer station.
   - **Contractor Responsibility:** The waste collection process is executed by contractors engaged by the Vadodara Municipal Corporation (VMC).
   - **Risk of Child Labour:** During site visits, it was noted that the appointment of drivers and helpers by the contractors lacks direct supervision by VMC, potentially posing a risk of child labour (especially for helpers) in this stage.
2. Waste Collector Employment Practices:
   - **Pre-Transportation Stage:** Waste collectors, responsible for house-to-house waste collection, may be employed directly by the municipality or contracted through private companies.

- **Lack of Monitoring:** In cases where waste collectors are employed by private companies, there is a notable absence of effective monitoring mechanisms to ensure the non-employment of child labour.

Proposed Mitigation Measures

1. Strengthened Contractor Oversight:
   - Action Steps:
     - Implement stringent monitoring mechanisms for contractors involved in waste collection and transportation. The project shall request VMC to undertake the monitoring, or the project shall undertake the monitoring in support of VMC.
     - Conduct regular audits to ensure compliance with ethical employment practices.
     - Establish a clear framework for the appointment of drivers and helpers, and waste collectors, emphasizing the prohibition of child labour.
2. Capacity Building and Training:
   - Action Steps:
     - Provide training sessions for contractors and subcontractors on the prohibition of child labour.
     - Raise awareness about the legal and ethical implications of employing children in the waste-to-energy supply chain.
     - Empower contractors with the knowledge and resources to implement and uphold child labour-free practices.
3. Child Labour Due Diligence:
   - Action Steps:
     - Conduct periodic due diligence assessments on all stages of the supply chain to identify and address child labour risks.
     - Engage with local child protection organizations to enhance the effectiveness of monitoring efforts.
     - Regularly update and refine the due diligence process to align with evolving standards and regulations.

	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	Low	Routine	Negligible

7.6.2.5 Occupational Health & Safety

The significant occupational health and safety impacts typically associated with workers at waste management facilities occur during the operational phase and include:

- Accidents and injuries
- Chemical exposure
- Exposure to pathogens and vectors
- Heat
- Noise & Vibrations
- Confined spaces
- Electrical hazards
- Fire and explosion hazards
- Dust
- Wounds from equipment or sharp objects
- Extreme/adverse weather
- Manual handling
- Machinery & vehicles - accidents may occur in the use of machines and vehicles, including worker transportation, waste transportation. 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.

Solid waste workers are particularly prone to accidents involving trucks and other moving equipment, so traffic management systems and traffic controllers are recommended.

Processing of MSW can also generate bioaerosols, suspensions of particles in the air consisting partially or wholly of microorganisms, such as bacteria, viruses, molds, and fungi. These microorganisms can remain suspended in the air for long periods of time, retaining viability or infectivity. Workers may also be exposed to endotoxins, which are produced within a microorganism and released upon destruction of the cell and which can be carried by airborne dust particles.

Workers can be exposed to pathogens contained in manure and animal excreta found in MSW from the disposal of sludge, carcasses, diapers, and yard trimmings containing domestic animal waste.

Apart from the project operations, GWVPL will also develop and operate wastewater treatment facility at the exiting STP itself where the operators may be exposed to physical, chemical, and biological hazards. Examples of these hazards include the potential for trips and falls into tanks, confined space entries for maintenance operations, and inhalation of VOCs, bioaerosols, and methane, contact with pathogens and vectors, and use of potentially hazardous chemicals, including chlorine, sodium and calcium hypochlorite, and ammonia.

Vibrations are expected to be generated by various activities associated with the project during operational phase. The impact of vibrations beyond the site would be negligible during normal operation phase. However, the impacts on workers engaged in the plant area would be considerable due to occupational exposure.

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 WtE plant. Therefore, intensity of the impact is assessed as moderate-high, and the overall impact significance is assessed as small-substantial.

Planned Control Measures

- Adequate ventilation of enclosed processing areas (e.g., dust in waste size reduction areas, VOCs driven off by high temperatures during composting)
- The pre-proccing area including boiler main bunker will always remain in negative air pressure, forced draft fan will suck primary air from these areas. Thus any formation of methane due stacking of prepared RDF in main boiler bunker will be sucked in to the boiler.
- All other areas of pre-processing and transfer will have adequate volume of overall processing area. The average height of preprocessing is about 8 mtr from finish floor level which will ensure adequate presence of oxygen in pre-processing area.
- It is further to note that boiler bunker has huge void area which eliminate any deficiency of oxygen.
- Largely use of automatic (non-manual) waste handling methods in pre-processing and processing area
- Provision of suitable personal protection equipment (PPE- footwear, masks, protective clothing and goggles in appropriate areas), emergency eyewash and shower stations, ventilation systems, and sanitary facilities
- Provision of annual health checkup and provision of prompt medical attention for cuts and bruises
- The plant will be equipped with fire detectors, alarm systems, and fire-fighting equipment.
- Adequate no of lavatory facilities (toilets and washing areas) will be provided for the number of people expected to work in the plant and allowances will be made for segregated facilities. Toilet facilities will also be provided with adequate supplies of running water, soap, and hand drying devices.
- Passageways for pedestrians and vehicles have been segregated within the plant premises to provide for easy, safe, and appropriate access
- Hand, knee and foot railings will be installed on stairs, fixed ladders, platforms, permanent and interim floor openings etc.
- Negative air pressure for management of Odor
- Greenbelt development along the layout boundary along with adequate green buffers between facilities and utilities/common areas

Additional Mitigation Measures

- Provide adequate personnel facilities, including washing areas and areas to change clothes before and after work;

- Job safety analysis to undertaken to identify specific potential occupational hazards and industrial hygiene surveys, as appropriate, to monitor and verify chemical exposure levels, and compare with applicable occupational exposure standards.
- Since hazardous waste and material will be generated and present within the project premises, GWVPL to develop hazardous material management plan which includes potential risks along with the objectives of protection of the workforce and the prevention and control of releases and accidents.
- Provide adequate and suitable personal protective clothing and equipment.
- Provide worker immunization (e.g. for Hepatitis B and tetanus).
- Provision of dust masks or respirators for workers engaged in pre-processing area.
- Maintain good housekeeping in waste processing and storage areas.
- Regular inspection and maintenance of pressure vessels and piping
- Reducing the time required for work in elevated temperature environments and ensuring access to drinking water.
- Shielding surfaces where workers come in close contact with hot equipment, including generating equipment, pipes etc.
- Consider installation of hazard warning lights inside electrical equipment enclosures to warn of inadvertent energization.
- Deactivation and proper grounding of live power equipment and distribution lines according to applicable legislation and guidelines whenever possible before work is performed on or proximal to them.
- Hazardous areas (electrical rooms, compressor rooms, etc.), installations, materials, safety measures, and emergency exits, etc. should be marked appropriately. Signage should be in accordance with international standards and be well known to, and easily understood by workers, visitors and the general public as appropriate.
- The ERP developed should include fire escape route for the WTE plant and the same should be displayed with adequate illumination at designated locations and should be updated with details of the authority responsible to respond in case of emergency beyond 500 m (in case, appointed Disaster Control Director declare “NO RESPONSIBILITY OF THE PLANT” to the emergency beyond 500m)
- Fire Exit sign boards to be displayed in local language along with English for clear understanding of the workers.
- The Fire exit doors should be made up of fire resisting material in compliance to the Gujarat Factories Rules, 1963.
- GWVPL should provide at least two exits at the pre-processing unit which can be used by workers for evacuation in case of fire emergency.
- First aid box at the Plant to be maintained in accordance with the Rule 70 of The Gujarat Factories Rules, 1963. Regular inspection of the first aid box to be conducted and all the expired shall be replaced regularly.
- Workplace monitoring programme to be developed and implemented which should include temperature, ventilation, lux levels, humidity levels, noise etc. for the workplace.
- The occupational noise exposure to the workers in the form of eight hour timely weighted average will be maintained well within the prescribed Occupational Safety and Health Administration (OSHA) standard limits.
- Vibration generating sources and their platforms should be maintained properly to minimize vibrations and related impacts.
- Implementation of inspection programs to maintain the mechanical integrity and operability of pressure vessels, tanks, piping systems, relief and vent valve systems, containment infrastructure, emergency shutdown systems, controls and pumps, and associated process equipment
- OHS orientation training to be provided for all new employees to ensure they are apprised of the basic site rules of work at / on the site and of personal protection and preventing injury to fellow employees.
- Training should consist of basic hazard awareness, sites specific hazards, safe work practices, and emergency procedures for fire, evacuation, and natural disaster, as appropriate. Any site-specific hazard or color coding in use should be thoroughly reviewed as part of orientation training
- Training of operators on release prevention, including drills specific to hazardous materials as part of emergency preparedness response training. Also Provision of specialized electrical safety training to those workers working with or around exposed components of electric circuits. This training should include, but not be limited to, training in basic electrical theory, proper safe work procedures, hazard awareness and identification, proper use of PPE, proper lockout/tagout procedures, first aid including CPR, and proper rescue procedures. Provisions should be made for periodic retraining as necessary
- Documentation of availability of specific personal protective equipment and provision of training needed to respond to an emergency

	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**

7.6.2.6 Increased local employment & livelihood

As per the available data it was understood that total manpower requirement for the project is nearly 238 persons, which will include both skilled and nonskilled workers. The work force will mostly engage the 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

As the project is likely to employ workers across different regions and states therefore the project is having high spread and the project duration will be at least for 25 years therefore the duration of impact will be long hence based on the impact assessment matrix the magnitude of the impact is evaluated as **substantial**

Proposed Enhancement Measures for the Project

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 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	Receptors' Vulnerability	Magnitude of Impact
Without Mitigation Measures	**Positive**	High	Short	**Permanent**	**Routine**	**Low**	**Major**
With Mitigation Measures	Positive	High	Short	Permanent	Routine	**Low**	**Substantial**

7.6.2.7 Community Health & Safety

Limited applicability for operation phase. As there are no community settlements within 500m radius of the project and the associated TL and water pipeline are also not impacting the residential areas. After the construction there will be no potential disturbance to the local community. And material movement (waste) will be done by VMC as it is done currently with a minor difference that instead of dumping to land fill site the same will be unloaded at the plant. Also, the civil work for WtE plant is 49% complete, also the transmission towers have also been erected. Further the project/ landfill site is outside the city limit and it does not have vending zone /hawkers in the close vicinity of the project.

The major community health and safety risks include community dissatisfaction, public accessibility and management of emergency situations, outbreak of viral or contagious disease 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, mobility of vehicles carrying construction materials etc. operational phase impacts 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;
- Transportation of waste to the project site
- Any spread of disease, virus by influx of migrant workers; and
- safety of workers and road commuters etc.

Community health and safety impacts which occur during the operational and decommissioning phases of WtE plant include General occupational and environmental health issues associated with waste scavenging, Physical, chemical, and biological hazards , Litter, Noise, Dust and odors.

Limited applicability for operation phase. The plant is located in an area where legacy waste has been dumped in the vicinity. There are no densely populated residential area in the 2 km radius with no residential settlements present within 500m radius of the project apart from commercial food outlets present within the 500m radius.

The major community health and safety risks include movement of vehicles and waste collection trucks and commuters via the main access road may be a potential risk for daily commuters. The specific receptors may include daily commuters and the residential settlements in the waste transportation routes from the waste collection centres to the WtE plant.

Emissions from wastewater treatment operations include hydrogen sulfide, methane, volatile organic compounds (e.g., chloroform generated from chlorination activities and other volatile organic compounds (VOCs)), gaseous or volatile chemicals used for disinfection processes (e.g., chlorine and ammonia), and bioaerosols. Odors from treatment facilities will impact the workers and the surrounding community.

Visitors and trespassers at waste management facilities may be subject to many of the hazards described for site workers.

Control Measures Planned

- Dense green cover fencing perimeter of adequate height around the site, with guarded site access gate and buildings
- Fully enclosed the waste management site with fencing so that no livestock or wildlife is able to come in contact with the waste, which contains significant potential to enable the spread of livestock and zoonotic disease, as well as spillover disease to wildlife
- Security cameras at key access points linked to recording equipment and remote access CCTV, where required
- Use of a site visitor register
- Management of incoming vehicle in coordination with the garbage stations

Construction Phase for associated TL, water pipeline and treatment plant

- High noise generating activities such as blasting, piling and drilling will not be scheduled during night time to minimize noise impacts
- Time bound construction activities will be carried out; so as to avoid concurrent effect of noise from the construction activities
- Personnel exposed to noise levels beyond threshold limits will be provided with protective gears such as earplugs, muffs, etc. especially construction personnel involved in pile driving operations. Rotation of personnel will also be adopted.
- Periodic maintenance of the equipment to be used in the developmental works will be carried out. Worn out parts will be replaced and rotating parts will be lubricated to minimize noise emissions
- Adequate PPE for noise mitigation need to be used for labors that are exposed to high noise

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. Therefore, intensity of the impact is assessed as low-moderate and the overall impact significance is assessed as small-substantial.

Additional Mitigation Measures

- Limiting the hours of operation for specific pieces of equipment or operations, especially mobile sources operating through community areas
- Reducing project traffic routing through community areas wherever possible
- Noise monitoring to be carried out for the purposes of establishing the existing ambient noise levels in the area, or for verifying operational phase noise levels
- Traffic management of vehicles engaged during both ongoing construction phase and upcoming operational phase. Traffic management plan to be followed
- 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
- 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 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
- Drivers need to be captioned or trained to avoid frequent use of horn unless otherwise it is required and educated for Silent zones and off hours between midnight and 6 am

	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

7.7 Impact during construction and operation phases

7.7.1 Contractor Management

As part of this assessment, contractor management refers to the process of overseeing and managing contractors who are hired by the project to provide human resource to perform specific tasks for operation of the WTE plant.

As reported, throughout the operational phase of the project, contractors will be enlisted to furnish contractual workers proficient in various skill levels, ranging from skilled to semi-skilled and unskilled. The primary areas of engagement for these contractors will predominantly include tasks such as waste handling and the provision of security personnel.

Further, refer to **Appendix 19** for compliance status of the appointed contractor against the applicable labour rules and regulations.

Control Measures in Place

The key considerations covered by the Project's adopted procedure for contractor management[83] are provided below:

- **Contractual Agreement:** As a process, GWRPL has established clear and detailed contracts that outline the terms and conditions of the employment relationship between the project and the contractor. The contact includes information about compliance with related laws on working hours, wages or compensation, duration of the contract, termination clauses, and working conditions and terms of employment related specific obligations or requirement. Contractors sign the established contract.
- **Monitoring and audition of contractors on their compliance with labour laws:** Contract workers, are entitled to certain rights and protection under applicable Indian labour laws. Therefore, to ensure that the contract workers' working condition comply with applicable labour laws and regulations, GWRPL has prepared a legal and statutory compliance period checklist. The checklist is filled by GWRPL against the compliance status of the appointed contractor. The key acts and their requirements covered by the checklist is outlined below:

Table 7-22 Internal HR auditing checklist with details of key acts covered and frequency of auditing

Sr. No.	Key Acts and associated rules	Acts' Requirements with frequency of auditing			
		Daily	Monthly	Half-yearly	Yearly
1	The Contract Labour (Regulation & Abolition) Act, 1970 and the Contract Labour (Regulation & Abolition) Rules, 1971	a. Muster Roll b. Attendance Card	a. Wage bill b. Employee of Contractor register c. Employment Card d. Service certificate e. Wage Register f. Wage Slips g. Damage/loss register h. Fine Register	-	c. Labour License d. Service Agreement

[83]

Sr. No.	Key Acts and associated rules	Acts' Requirements with frequency of auditing			
		Daily	Monthly	Half-yearly	Yearly
			i. Advance Register j. Overtime Register		
2	The Factories Act, 1948 & the Gujarat Factories Rules, 1963	-	a. Adult Register b. Leave with wage register c. Leave Book	-	-
3	Statutory compliance	-	a. PF – Challan b. ESI – Challan c. Provisional tax – challan	a. LWF - Challan	-
4	The Payment of Bonus Act, 1965 and the Payment of Bonus Rules, 1975	-	-	-	a. Computation of allocable surplus b. Set-on and set-off of allocable surplus c. Bonus paid to employees d. Annual return – Bonus paid to employees
5	The Payment of Gratuity Act, 1972 and the Payment of Gratuity Rules, 1973	-	a. Nomination form	-	-
6	The Employees' Provident Fund & Miscellaneous Provisions Act, 1952	-	a. Nomination Form	-	-
7	The Employees' State Insurance Act, 1948	-	a. Nomination Form	-	-

- **Non-discrimination and equal opportunity:** Contract workers should be treated fairly and without discrimination based on factors such as race, gender, age, religion, disability, or any other protected characteristics. To ensure, the non-discrimination and equal opportunity, Abellon has established an Equal Opportunity and Non-discrimination policy.
- **Grievance Redressal Mechanism:** The provision of grievance redressal mechanism as per Abellon's Grievance Redressal Policy has been implemented at the Project level to resolve the grievance raised by the contractual workers.

Impact Magnitude

The impact magnitude of contractor management is classified as **substantial**, the reasoning for the same is provided below:

- Given the complexity of the Waste-to-Energy Project, any delays in operational phases can significantly impact overall energy producing efficiency. Effective contractor management is crucial for minimizing delays and ensuring timely completion.
- The Waste-to-Energy Project involves potentially hazardous activities. The impact on health and safety is of utmost importance, making effective contractor management critical to minimize accidents and ensure a safe working environment.
- The Waste-to-Energy sector is subject to stringent environmental and labour regulatory standards. Failure to comply can result in legal and reputational consequences. Proper contractor management is vital to ensure all activities align with established standards.

Proposed Mitigation Measures

Proposed mitigation measures for contractor management:

- Provide comprehensive training to contractors on the established contractual agreements, emphasizing compliance with labour laws, working conditions, and terms of employment. Regular awareness sessions should be conducted to ensure contractors understand and adhere to project expectations.
- Strengthen the monitoring process by conducting regular audits on contractor compliance. Increase the frequency of internal HR audits outlined in the checklist. This includes daily checks on items like muster rolls and attendance cards, monthly checks on wage-related documents, and yearly audits on critical acts such as the Contract Labour (Regulation & Abolition) Act.
- Organize capacity-building workshops for contractors, focusing on educating them about key lab or laws, safety regulations, and ethical labour practices. This proactive approach can contribute to improved contractor understanding and compliance.
- Reinforce non-discrimination and equal opportunity principles through targeted training sessions. Contractors should be educated on the Equal Opportunity and Non-discrimination policy, emphasizing the importance of treating all workers fairly regardless of race, gender, age, religion, disability, or any other protected characteristics.
- Strengthen the existing grievance redressal mechanism by promoting transparency and accessibility. Ensure that contractual workers are aware of the grievance redressal process and can easily report concerns. Regularly review and update the mechanism based on feedback and evolving needs.
- Foster a collaborative partnership with contractors through regular communication channels. Conduct joint workshops and forums to address challenges, share best practices, and build a sense of shared responsibility for the success of the project.
- Conduct periodic reviews of policies, ensuring they remain aligned with evolving labour laws and industry best practices. Regularly update contractors on policy changes and provide the necessary support for implementation.
- The contractor shall obtain the Registration under the Employees' Provident Funds and Miscellaneous Provisions Act, 1952.

	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	Low	Routine	**Small**

7.8 Cumulative Impacts

There are no new projects proposed in immediate proximity of the proposed WTE plant. Nor any other developmental projects are proposed in immediate future. Therefore, no cumulative impacts are anticipated from the operations of the proposed WTE plant.

There will be a slight modification in movement of waste carrying trucks which will now be directed to the WTE plant instead of the landfill, no increase in vehicle movement is anticipated. Only limited number of vehicles transporting - ash generated from the operations will be added which will have insignificant cumulative impact on the traffic movement.

8 Environmental & 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.

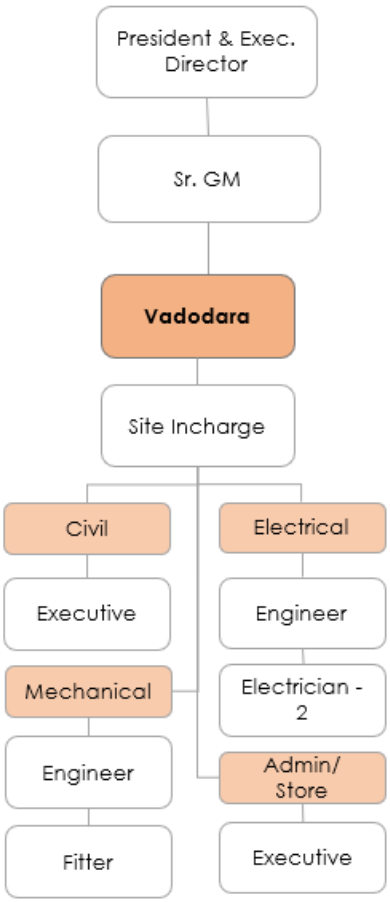
8.1 Organizational Structure

The Project at the corporate level is headed by the ACEL's President and Executive Director who is supported by Senior General Manager. Currently EHS officer position at the corporate level is vacant and ACEL is under process to hire a dedicated EHS officer at the corporate level to monitor EHS aspects at all the ACEL's WTE sites including the under construction 14.90 MW project at Vadodara

At site level, the under-construction project is monitored by GWVPL's team comprising of site in charge who is supported by Civil and Electrical Engineers, Mechanical Engineer, admin/store executives and electricians.

The project is being developed by the Civil contractor (Dave Construction & Engineering Company) who has deployed a dedicated site in-charge for day-to-day construction monitoring at site who is supported by Senior Site Engineer, site supervisor, QA/QC Engineer, and accountant/store in-charge. The Civil contractor has also deployed a cluster specific construction safety engineer who is responsible for managing safety aspects of Dave Construction & Engineering Company project including the GWVPL's 14.90 MW project. As reported, the construction Safety Engineer visit the project site on random basis to monitor the health and safety aspects associated with the project.

Figure 8-1 Organizational Structure- Construction Phase



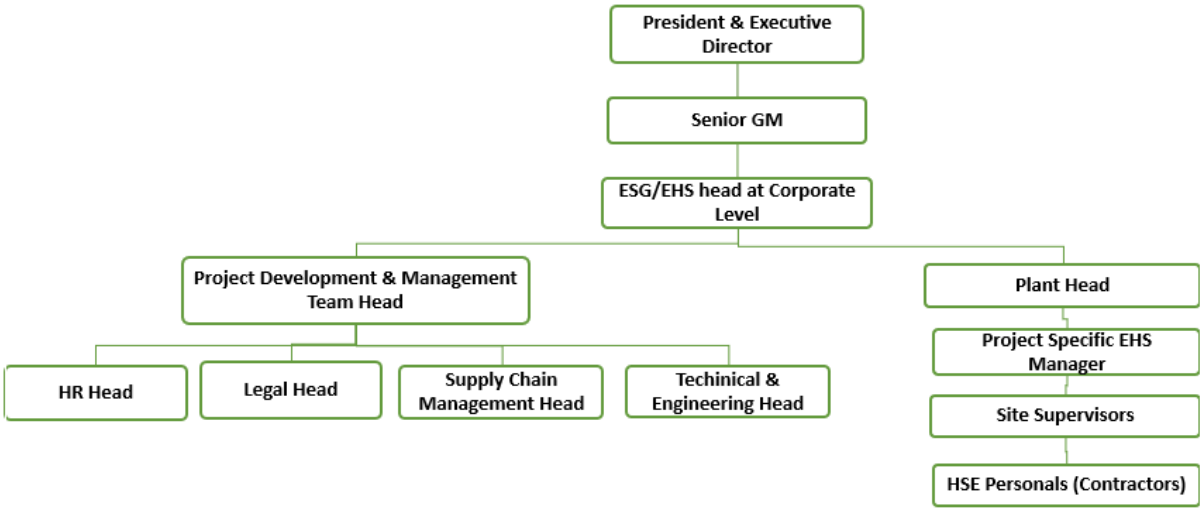
To ensure the efficacy of environmental and social management plan, certain institutional mechanism with well-defined roles and responsibilities is essential for effective implementation of identified mitigation measures both during

construction and operation phases. GWVPL will have ultimate responsibility for implementing the provisions of the ESMP. 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. GWVPL 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.

GWVPL during the operation phase of the project will have a dedicated HSE team (refer Figure 8-2) comprising of 3 members, i.e., Project head, EHS Manager & Site Supervisor. The HSE Team which will be responsible for overall management of the project site, which will be headed by Project Manager and will be supported by EHS Manager. A dedicated EHS Manager will be appointed for overall HSE management of the site and will be supported by the Site Supervisor. EHS personal of the contractors will be reporting to the site supervisor.

Project Head will act as bridging gap between the corporate (ACEL) and the project SPV (GWVPL). Project Manager will be responsible for overlooking the on-going management of environmental and social impacts, monitoring of contractor's performance as well as development of mechanisms for Project SPV for dealing with environmental and social problems at site level. Project Head along with EHS Manager 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 8-2 Organizational Structure- Operation Phase



8.1.1 Roles and Responsibilities

The HSE team will be headed by Project Head. An outline for responsibilities of the proposed HSE team is given below

Role	Responsibility
Project Specific 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.

Role	Responsibility
	• 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
Plant Head	• Implementation of on-site procedures related to the E&S • Tracking of E&S compliance related aspects for regulatory and lenders' requirements • 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 Plants • Communication and reporting to corporate level. • Development of KPI's, resolution of issues and managing the manpower and the project.
Project Specific EHS Manager	• 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
Project Management Team	• To assisting the Project Manager 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.; • Initiate local labour recruitment and management. • To conducting meetings with the local communities

8.2 Existing Policies & Management Plans

8.2.1 Environmental Health and Safety Policy

Abellon Clean Energy Limited at the corporate level has a dedicated Environment Health and Safety Policy duly signed by Managing Director and CEO. The policy highlights ACEL's commitment to carry out business operations with due regards to environment, safety and wellbeing of its people and the community. The policy mandate ACEL to comply with all legal requirements and regulations pertaining to health, safety, and environment. It also mandates ACEL to continually improve its management systems, processes and practices that enable a safe work environment, protect the health of workers, respect biodiversity, optimize use of natural resources, minimize pollution, and ensure integrity of the assets.

The Policy is applicable to all the ACEL's WTE plants including the GWVPL project. The overall responsibility of implementing the policy at the project site remains with the Operation Head or Project Head, as the case may be.

8.2.2 Social Policies

8.2.2.1 Human Resource Management

HR Policy : Abellon at the group level has established group level policies which refers to a set of guidelines and rules established by the Abellon to govern all of its waste-to-energy projects' practices and procedures related to managing its on-roll and contractual employees or human resources. These policies serve as a framework for HR decision-making and help ensure consistency, fairness, and compliance with legal and ethical standards. Here are some common areas covered by Abelson's human resource policies:

- Contractor worker attendance policy: The policy aims at devising the guidelines with respect to attendance of contract workers, in compliance to the legal requirements and applicable laws, and commitment to the company's values of discipline and work-life balance. The policy defines three (3) shifts – each working for 8 hours, including break and charge handover time. Timing of shifts are as below:

    i. 1st shift – from 08:00 am to 04:00 pm (with a break of half an hour in rotation)
    ii. 2nd shift – from 04:00 pm to 12:00 am (with a break of half an hour in rotation)
    iii. 3rd shift – from 12: 00 am to 08:00 am (with a break of half an hour in rotation)
    iv. General shift – 09:30 am to 06:00 pm (generally for manager level contractual employees)

- Contract workers leave policy: The policy aims at devising the guidelines with respect to leave rules for contract workers, in accordance with various acts enacted as per the law and so applicable to the project's contractor, and commitment to the project's value of work-life balance and workers' well-being. The entitlement to leave will be subject to the leave rules made and amended by contract management forum from time to time.

- Contract worker statutory benefits policy: The policy identifies the following benefits for all the contract workers:

    i. Provident Fund (PF) – as per provisions of the Employees' Provident Fund & Miscellaneous Provisions Act, 1952
    ii. Employees' State Insurance (ESI) – as per provisions of the Employees' State Insurance Act, 1948
    iii. Bonus – As per provisions of the Payment of Bonus Act, 1965
    iv. Gratuity – As per provisions of the payment of Gratuity Act, 1972
    v. Employee's Compensation (EC) – As per provisions of the Employees' Compensation Act, 1923

- Contractor Appointment Policy: The policy aims at devising the guidelines with respect to new contractor appointment, in compliance to the legal requirements and applicable laws. The following key aspects covered by the policy:

    i. Contractor shall submit necessary legal documents with seven (7) days of appointment and the personnel department will check the documents
    ii. Contractor shall obtain applicable legal licenses and registrations
    iii. Contractor must provide sufficient workers and maintain the workforce for assigned work as per terms and conditions of service agreement.
    iv. Contractor must adhere to the company's 'Prohibition of child labour at workplace' policy.
    v. Contractor must issue gates pass, identity card and attendance card to all the workers deployed, and distribute wages to the workers
    vi. Contractor must pay the workers as per the Minimum Wages Act, 1948, and must comply with the Factories Act, 1948; Building and other Construction workers' Act, 1996; Payment of Wages Act, 1936; and maintain compliance with other applicable Acts
    vii. Contractor must submit the proof of remittance of Employee State Insurance (ESI) and Employee Provident Fund (EPF) every month on time
    viii. Contractor shall ensure that the workers follow all safety rules at the workplace

- Employee Retrenchment Policy: The policy aims at devising the guidelines with respect to retrenchment, in accordance with the provisions of Industrial Disputes Act, 1947 or clauses of agreement (appointment letter) between the company and employee, and commitment to the company's value of security, harmony, and fairness. The policy detailed out the following guidelines and process:

    i. No Employee will be retrenched under normal circumstances
    ii. In inevitable circumstances, if the company retrenches the employees whose continuous service is not less than a year, then the company will serve one month's notice in writing, indicating the reasons for retrenchment and the period of notice. Also mentioned would be whether the period of notice has expired, or the employees has been paid in lieu of such notice, or salary has been paid for the period of notice
    iii. The company will follow the rule of 'last person to be employed to be retrenchment first' in that category
    iv. The company will give preference to the retrenched employees for re-employment at the time of future recruitment and selection
    v. The company will abide by the provision of legal laws, and obtain necessary permission as applicable

- Equal Opportunity and Non-discrimination policy: The policy aims at devising the guidelines with respect to providing equal opportunity and adopting non-discriminatory practices, in accordance with the relevant provisions under the Equal Remuneration Act, 1976, and commitment to the company's value of equity, diversity, and fairness. The scope of the policy covers with on-roll employee and contract workers

- Grievance Handling Policy: The key objective of the policy is to lay down the guidelines with respect to grievance handling, in accordance with the relevant provisions of the Industrial Disputes Act, 1947 that will form an integral part of overall policies, and commitment to the company's values of fairness, openness, and zero tolerance towards any misdeed. The scope of the policy covers with on-roll employee and contract workers.

- Overtime and Compensation Policy: The scope of the policy covers on-roll employees and contract workers. The policy details out the following policy and processes:

    i. No employees/contract workers will be compelled or allowed to work at plant for more than 48 hours a week
    ii. All employees/contract workers will be allowed half an hour rest in a day, after continuously working for 5 hours
    iii. Overtime might be needed to handle emergencies, heavy workloads, or other issues. But frequent and excessive overtime work will not be allowed
    iv. Total hours of work along with overtime of employee/contract worker will not exceed 60 hours of work a week in any case. Total number of hours of overtime will not exceed 50 hours a quarter
    v. The company will advise employees/contract workers to work overtime only when they have to finish urgent work, and up to the stipulated hours
    vi. When employees/contract workers work at plant for more than 8 hours a day or more than 48 hours a week, she/he, with respect to overtime done, will be entitled for allowance at the rate of twice her/his ordinary rate of salary/wage

- Prevention of Sexual Harassment at Workplace Policy: The policy aims of the policy to lay down guidelines with respect to prevention of sexual harassment, in accordance with the recently laid down statue of the Sexual Harassment of Women at Workplace (Prevention, Prohibition, and Redressal) Act, 2013 and the Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Rules, 2013, and commitment to the Abellon's value of fairness, equality, and zero tolerance any misdemeanour. The scope of the policy covers both category of on-roll employees and contract workers.

- Prohibition of Child Labour at Workplace Policy: The primary objective of the policy is to prohibit employment of child labour at workplace, in accordance with the relevant provisions under the Child Labour (Prohibition and Regulation) Act, 1986, and commitment to the Abellon's values of sensitivity and compassion, thereby, ensuring no human exploitation, especially children. The scope of the policy covers both category of on-roll employees and contract workers

8.2.2.2 Contractor Management

As part of this assessment, contractor management refers to the process of overseeing and managing contractors who are hired by the project to provide human resource to perform specific tasks for operation of the WTE plant. The key considerations covered by the Project's adopted procedure for contractor management are provided below:

As part of this assessment, contractor management refers to the process of overseeing and managing contractors who are hired by the project to provide human resource to perform specific tasks for operation of the WTE plant. The key considerations covered by the Project's adopted procedure for contractor management are provided below:

- Contractual Agreement: As a process, GWVPL has established clear and detailed contracts that outline the terms and conditions of the employment relationship between the project and the contractor. The contact includes information about compliance with related laws on working hours, wages or compensation, duration of the contract, termination clauses, and working conditions and terms of employment related specific obligations or requirement. Contractors sign the established contract.

- **Monitoring and audition of contractors on their compliance with labour laws:** Contract workers, are entitled to certain rights and protection under applicable Indian labour laws. Therefore, to ensure that the contract workers' working condition comply with applicable labour laws and regulations, GWVPL has prepared a legal and statutory compliance period checklist. The checklist is filled by GWVPL against the compliance status of the appointed contractor. The key acts and their requirements covered by the checklist is outlined below:

Table 8-1 Internal HR auditing checklist with details of key acts covered and frequency of auditing

Sr. No.	Key Acts and associated rules	Acts' Requirements with frequency of auditing			
		Daily	Monthly	Half-yearly	Yearly
1.	The Contract Labour (Regulation & Abolition) Act, 1970 and the Contract Labour (Regulation & Abolition) Rules, 1971	• Muster Roll • Attendance Card	• Wage bill • Employee of Contractor register • Employment Card • Service certificate • Wage Register • Wage Slips • Damage/loss register • Fine Register • Advance Register • Overtime Register	-	• Labour License • Service Agreement
2.	The Factories Act, 1948 & the Gujarat Factories Rules, 1963	-	• Adult Register • Leave with wage register • Leave Book	-	-
3.	Statutory compliance	-	• PF – Challan • ESI – Challan • Provisional tax – challan	LWF - Challan	-
4.	The Payment of Bonus Act, 1965 and the Payment of Bonus Rules, 1975	-	-	-	• Computation of allocable surplus • Set-on and set-off of allocable surplus • Bonus paid to employees • Annual return – Bonus paid to employees
5.	The Payment of Gratuity Act, 1972 and the Payment of Gratuity Rules, 1973	-	Nomination form	-	-
6.	The Employees' Provident Fund & Miscellaneous Provisions Act, 1952	-	Nomination Form	-	-

Sr. No.	Key Acts and associated rules	Acts' Requirements with frequency of auditing			
		Daily	Monthly	Half-yearly	Yearly
7.	The Employees' State Insurance Act, 1948	-	Nomination Form	-	-

As part of ESIA, the following management plans have been developed.

- Emergency Preparedness and Response Plan: The Project SPV shall maintain an Emergency Preparedness and Response Plan (EPRP) for its plant's operations in collaboration with all relevant stakeholders such as the contractors, associated TL and water pipeline operators, residential areas, labour colonies, district authorities etc. It shall address identification of areas where accidents and emergency situations may occur, communities and individuals that may be impacted, response procedures, provision of equipment and resources, designation of responsibilities, communications and periodic training to ensure effective response. Emergency Preparedness and Response Plan has been attached as ***Appendix 4***.
- Traffic Management Plan: A traffic management plan assists in the prevention of personal injury, damage to plant / vehicles and property, risk to community health & safety, etc. associated with the construction and operations of a plant. Construction phase involves transportation of raw material and manpower to the site and operations involve transportation of waste, export of waste residue & fly ash and movement of manpower to the plant. Such activities will thus have a significant impact on the nearby community and surrounding villages, especially near schools and hospitals. In order to ensure compliance and good practice measures, a traffic management plan proposes certain planned activities along with control actions followed by the GWVPL, its contractors, and subcontractors involved. A Traffic Management Plan is provided as ***Appendix 7***
- Community Health & Safety: The project SPV has identified community health and safety risks and hazards associated with project life cycle and included mitigation for effectively managing the risks and minimize any incidents and accidents. Community Health & Safety Plan has been presented ***Appendix 16***
- Occupational Health & Safety: Workers working in Waste to Energy Plant will be exposed to hazards. These occupational H&S risks need to be identified and controlled. Site specific plan for occupational health and safety has been included as ***Appendix 14***
- Environmental and Social Monitoring Plan and Key Performance Indicators (KPI): Environmental and social monitoring is to assess environmental and working conditions and trends within the project site to monitor and ensure conformity with laws and regulations and to mitigate risks on the natural environment and protect the health of human beings. The monitoring will cover construction and operation phases. Site specific plan for environment and social monitoring has been included as ***Appendix 13***
- Contractor Management Plan: Using contractors involves engaging with an external organization which are outside the company's risk control activities and can place the workers, staff and company at risk. Contractor Management Plan ***(Appendix 5)*** covers contractor/ supplier selection criteria, specific and generic contract requirements on EHS&S compliance management, management measures around construction health and safety, labour accommodation, pollution prevention, resource efficiency, traffic safety, emergency response, and capacity requirements, as well as criteria for their performance evaluation.
- Pollution Prevention and Management: The construction and operation activities of projects, have a potential to generate a range of pollution sources that require proper planning from the outset to avoid resulting in impacts to human, ecological or other environmental receptors. These pollutants includes emissions to air, water and soil, amongst others. This Plan (Refer Appendix 6) applies to all activities undertaken by each project site and their Contractor/ Sub-contractors during construction/upgradation/expansion, operation & maintenance.
- Resource Efficiency and Conservation Management Plan: Proper resource efficiency and management planning of will enable GWVPL to promote sustainable growth while improving organizational efficiency and cost effectiveness of its business operations. Addressing resource efficiency should be a key goal for the business and something to be actively managed in order to be sustainable. ***Appendix 8*** enlists the steps for improving efficiency.
- Biodiversity Management Plan: In this plan, suggested selective measures have been agreed upon and are set to be implemented to mitigate the impact of identified risks and manage the existing biodiversity in the project area. (Appendix 9)
- Security Risk and management plan (Appendix 10): As plant operations are limited in terms minimal workforce and there are no adverse impact on the general community, as well as their plant does not have armed security

risk related to private security is not foreseen however in order to negate any possible risk , security management plan is prepared. Details are given in **Appendix 10**

- **Stakeholder Engagement Plan & Grievance Handling and Redressal (Appendix 11):** The stakeholder engagement is critical aspect for every project for maintaining strong relationships with every community. In order to carry out engagement activities detailed stakeholder engagement plan is given in Appendix 11. The Grievances and its management is essential for maintaining heathy relations with the concerned stakeholder which includes but not limited to community, workers/ staff and investors and other external stakeholders. Details of GRM is given in
- **Labor Management and Working Conditions including labor camps (Appendix 17**): As per the site conditions most of the civil work is already completed and the requirement of labour and labor camps management plan is limited as most of the labor force is already demobilized from the respective sites. However based on the need same can be implemented at site to manage the potential risk/ impacts. Details are given in ***Appendix 17***.

8.3 E&S Review and Communications

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, GWVPL 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 GWVPL (project team) as well as Corporate team (ACEL) and the entire process of inspections and audits/ monitoring will be documented.

GWVPL 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.

8.3.1 Key Performance Indicators

GWVPL will also consider mapping its activities against international standards and benchmarks and identify key performance indicators based on risks and opportunities associated with project portfolio operations.

Table 8-2 Key Performance Indicators

Overarching Themes	Performance Indicators
E&S Management	• Number of trainings conducted on EHS & Social Policy and ESMS • Regulatory issues identified proactively and resolved • Number of notices of regulatory violations • Number of internal EHS compliance audits conducted during a year • Numbers of E&S findings and corrective actions from the audits
Labour Management & Working Conditions	• Adoption of a practices governing safe working conditions (including as access to water, sanitation) and PPE usage • Number and nature of internal grievances received, and time taken to redress the same • Improved % of women and differently abled as on roll employees and contractual workers • Voluntary and involuntary turnover rates of all employees

Overarching Themes	Performance Indicators
Pollution Prevention & Resource Efficiency	• Identification of organization wide opportunities or goals & targets to reduce consumption of resources such as electricity, water, fuel (diesel) etc. • Total water consumption in a year • Zero discharge of waste water • Percentage reduction of greenhouse gas emissions • Percentage Reduction in air emissions; • Reduction in quantity of waste from the combustion process • Waste management targets (Fly ash and leachate management) • Reportable environmental incidents • Number of trainings conducted on sustainability aspects such as resource efficiency/resource conservation (e.g. water), GHG emission management amongst others
Health &Safety	• Number of EHS training/mock drills conducted during a year • Number of recordable injuries / illnesses that resulted in lost time • Number of near misses reported and recorded • Number of recordable incidents involving public/ community
Stakeholder Engagement	• Number of community outreach activities implemented by company • Number of grievance registered and redressed.

Based on the above identified KPIs, Project Manager in coordination with department heads will review the significant aspects/ risks/ opportunities and consider for setting as organisational targets/ objectives. Also, whenever an aspects/ risks/ opportunity is leading to a business concern, it can be taken up as an objective along with the other set objectives. The final targets/ objectives will be approved by the ESG Head at corporate level.

The E&S objectives and targets will thus be established based on:

- Environment & Social Policy commitments of the organization;
- Legal and other requirements;
- Technological options - whether it is technically possible to reduce the scale of the risk;
- Financial requirements - whether a financial budget is available for implementing the necessary change;
- Operational requirements - what will be the operational control to reduce the impact/ risk;
- Business requirements - whether the objective will be important from a business point of view.

GWVPL will maintain a record of targets to introduce more resource efficient technology. New techniques develop over time so these should be referred to regularly. The E&S objectives and targets shall be communicated to all the relevant personnel for effective implementation of action plans and achievement of targets. The objectives and targets shall be reviewed every year by, in light of new regulations, new projects and commitments and changes in operations and updated.

8.3.2 Inspection, Review 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, GWVPL will ensure that the conditions stipulated in various permits are complied. The inspections and audits will be done by trained personnel of GWVPL 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.

EHS Team at project level will ensure that permits for the Project 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

Table 8-3 Review & Reporting Schedule

S. No	Type of Report	Development Responsibility	Supervisory Responsibility	Frequency
1	Report on Compliance to Work Plan including tool box talks, incident accident records, environment checklist, etc	Contractor EHS Personal	Project level EHS Manager	Weekly or Fortnightly
2	Progress reports on ESMP	Project level EHS Manager	Project Manager	Monthly
3	Training registers for staff and workers	Contractor's EHS Personal	Project level HR/ Project Specific EHS Manager	Monthly
4	Compliance to Environmental, Social/Labour related requirements	Project level HR and EHS Manager	Legal Head & Project Manager	Quarterly
5	Internal Audit Report	Project specific EHS Manager	Corporate Level ESG Head	Quarterly
6	Environment and Social Monitoring	Project specific EHS Manager	Project Manager & Corporate Level ESG Head	Quarterly and Half Yearly based on the requirements as specific

8.4 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).

8.5 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
- GWVPL 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

Table 8-4 Training Requirement

S. No	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 behavioral 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 GWVPL 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

8.6 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.

The ESMP for the project has been presented in ***Table 8-5 and Table 8.6***.

8.7 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 8-5 Construction Phase: Environment and Social Management Plan

Sr. No.	Environmental/Social Resources	Impact/Issues	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	Supervisor responsibility	Reporting Requirements
Physical Environment									
1.	Air Quality	Particulate, fugitive and vehicular emission	• Vehicles entering site should be Pollution Under Control (PUC) certified. • Periodic inspection of construction equipment and DG sets should be conducted by the onsite contractor. • DG sets (If any) used for power back up should be provided with adequate stack height as per CPCB norms. • A strict Project speed limit of 30 km/hr. to be enforced for vehicles using un-metaled tracks and the RoW. • Regular maintenance of construction vehicles and machinery • Use of Low-Emission Equipment's for minimize air pollution during the construction process. • Scheduling construction activities during off-peak hours to reduce exposure to pollutants. • Idling of vehicles and equipment must be prevented. • Cease or phase down work if excess fugitive dust is observed. Investigate the source of dust and ensure proper suppression measures. • Using windbreaks, netting screens or semi-permeable fences to reduce dust emissions from working areas close to sensitive, residential or agricultural locations or natural habitats. • Adequately sized construction yard will be identified at the site for storage of construction materials, equipment tools, earthmoving equipment, etc. • Fuel tanks adequately designed to minimize fugitive emissions and welding gas cylinders will be stored in a secluded area within project site.	• Contractor's EHS representative	EHS Inspection	Monthly	Project EHS representative of GWVPL	EHS Manager at GWVPL	Report from Contractor EHS team to GWVPL EHS team
2.	Noise Quality	Impact on receptors	• 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. • Noise generating equipment should be located away from settlement to reduce the disturbance; • Noise limits for construction equipment to be installed at the project area during peak construction such as front loaders concrete mixers, cranes (moveable), will not exceed 75 dB (A), measured at one meter from the edge of the equipment in free field, as specified in the Environment (Protection) Rules, 1986; • Machinery and construction equipment that may be in intermittent use should be shut down or throttled down during non-work periods	• Contractor's EHS representative	Visual Observation and EHS Inspection	Monthly	Project EHS representative of GWVPL	EHS Manager at GWVPL	Report from Contractor EHS team to GWVPL EHS team
3.	Soil Environment	Compaction and Contamination	• Dedicated waste storage areas should be developed at site. • Onsite workers should be provided with adequate trainings on waste management. Requirement to impart EHS trainings to the workers should be included in the contractor's agreement. • Remaining construction waste which cannot be reused such as scraps, metals etc. should be disposed through authorized vendor. • Hazardous waste generated at site should be stored on impervious floor with secondary containment and disposed to authorized vendor in	• Contractor's EHS representative	Visual Observation and EHS Inspection	Monthly	Project EHS representative of GWVPL	EHS Manager at GWVPL	Report from Contractor EHS team to GWVPL EHS team

Sr. No.	Environmental/Social Resources	Impact/Issues	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	Supervisor responsibility	Reporting Requirements
			accordance with Hazardous and other Wastes (Management & Transboundary Movement) Rules, 2016 • Municipal waste generated onsite should be segregated and proper collection and handover to local municipal body/ local authority should be ensured for further disposal. • During servicing/repair of equipment or vehicles, a suitable drip tray shall be used to prevent oil/grease spills onto the soil, especially in case of emergency repairs. • Oil spill kits should be maintained onsite to handle minor leaks and spillage. • 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. • Spoils which cannot be reused should be disposed through authorized vendor. • SPV to implement the developed waste management plan along with the ESMP onsite. • The stock piles of the soil should be kept moist to avoid wind erosion of the soil; • Soil to be ploughed in compacted area after completion of the construction work; • Top soil that has been stripped should be stored for landscaping, if feasible at the transmission line area or connecting substations; • As a best practice, site clearance, piling, excavation will not be carried out during the monsoon season to minimize erosion, compaction and run-off; • Site to be restored at the end; • Contractors deployed for construction of associated TL and water pipeline should ensure that no unauthorized dumping of used oil and other hazardous waste is undertaken along the transmission and waterpipe line route. • Construction and Demolition Waste should be stored separately and be periodically collected by an authorized vendor. • All waste should be stored in a shed that is protected from the elements (wind, rain, storms, etc.) and away from natural drainage channels. • Records should be maintained for quantity and type of hazardous waste generated. • It is to be ensured that hazardous waste is not stored for more than 90 days. Hazardous waste should be disposed through SPCB authorized hazardous waste vendor only • Use of spill control kits to contain and clean minor spills and leaks. • Unloading and loading protocols should be prepared for diesel and used oil (if generated) respectively and workers trained to prevent/contain spills and leaks. • In case of accidental/unintended spillage, the contaminated soil should be immediately collected and stored as hazardous waste. • Limited movement of vehicles should be permitted for stringing of transmission line near to settlement • Contractor should restore the project site and surrounding area (if used for any temporary structure) to its original condition. GWVPL should inspect the site and ensure, the project site is properly restored prior to issuing completion certificate to the contractors.					

Sr. No.	Environmental/Social Resources	Impact/Issues	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	Supervisor responsibility	Reporting Requirements
4.	Water Resources	Availability & Contamination	• Sensitize workers on water conservation and encourage optimal use of water. Requirement to conduct such trainings should be included in the contractor's agreement. • Project should ensure it is compliant to the regulatory requirements for abstraction of water during project construction. • Reuse and recycle water to the extent possible • Regular inspection should be carried out for identifying water leaks and preventing water wastage. • Optimum use of water during sprinkling on roads for dust settlement, washing of vehicles, concrete mixing for etc. • Groundwater quality monitoring should be conducted onsite quarterly during the construction phase	• Contractor's EHS representative	Visual Observation and EHS Inspection	Monthly	Project EHS representative of GWVPL	EHS Manager at GWVPL	Report from Contractor EHS team to GWVPL EHS team
Socioeconomics									
5.	Occupational Health & Safety	Electrocution, accident, fire hazard, respiratory and hearing problems while working at site	• GWVPL to develop dedicated environmental, health and safety (EHS) plan, Occupational Health & Safety Plan and emergency response plan (ERP) applicable to all project phases, i.e. construction as well as operation. Measures provided in the respective plans with respect to health and safety to be implemented at site. Refer ***Appendix 14*** • The Project to develop a training calendar and associated training materials to impart trainings at regular intervals to the contractors and workers. The trainings as per the training calendar should be provided to all the workers at the WTE plant, workers involved in construction of transmission line and underground water pipeline. • GWVPL to develop and maintain hazard identification and risk assessment (HIRA) for the project and its associated TL and water pipeline and communicate the same to the workers. The HIRA register should be update whenever a new hazard is identified at the site. • In line with the concession agreement, monthly/quarterly safety meetings should be conducted on site to discuss the unsafe work practices or conditions and suggest corrective actions. The minutes of the meeting (MoM) along with implementation of corrective actions to be shared with the EHS Manager at the corporate level. • The Project to develop a training calendar and associated training materials as part of the OHS to impart trainings at regular intervals to the contractors and workers. The trainings as per the training calendar should be provided to all the workers at the WTE plant, workers involved in construction of transmission line and underground water pipeline. • Project should conduct full body check-up of workers as part of premedical check-up and annual medical check-up. These should include blood test, ECG, Pulmonary Function test, urine test etc. • GWVPL to develop a formal procedure to record near miss, incident, and minor accidents onsite. • 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. • Workers who are engaged in welding works will be provided with welder's protective eye shields; • 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.	• Contractor's EHS representative	Visual Observation and EHS Inspection	Quarterly	Project EHS representative of GWVPL	EHS Manager at GWVPL	Report from Contractor EHS team to GWVPL EHS team

Sr. No.	Environmental/Social Resources	Impact/Issues	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	Supervisor responsibility	Reporting Requirements
			• Training of the workers on climbing techniques, and rescue of fall-arrested workers; • Appoint a trained person to take charge of the first aid boxes. The location of first aid arrangements to be displayed on site; • 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 • GWVPL to 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.						
6.	Labor Influx	Unhygienic and unsafe living conditions	• As the construction of the project was already started the camps should be retrofitted to meet the basic requirements of the EBRD/IFC guidelines on workers accommodation 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	Project in charge / HR/ EHS/ Contractor's EHS	Site inspection & visual observation and house keeping records	Weekly	Contractor site manager	Project in charge / EHS team	Housekeeping check list , photograph , inspection report
7.	Impact due to installation of transmission line	Temporary economic and livelihood impact	In addition to the planned mitigation measures, following mitigation measures shall be implemented by the Project: • Establish a grievance mechanism that allows affected stakeholders to raise concerns, provide feedback, and seek resolution for any project-related issues, • Ensure accessibility, transparency, and fairness in the grievance resolution process. • Implement the existing Stakeholder Engagement Plan outlining how the project will engage with and involve stakeholders throughout the project lifecycle. • Ensure that engagement is inclusive, transparent, and facilitates meaningful participation. • Continue with the practice of conducting construction activities during nighttime to minimize disruption to businesses and daily activities. • Maintain a phased approach to construction, allowing for the gradual restoration of affected areas. • Implement a comprehensive restoration plan, ensuring that areas impacted by construction activities are returned to a usable state. • Establish mechanisms for ongoing monitoring of the impact on stakeholders during and after construction.	Project Incharge / HR/ EHS/ Contractor's EHS	Site inspection & visual observation and verification of records	Daily	Contractor site manager	Project Incharge / EHS team	photograph , inspection report feedback and community complaints

Sr. No.	Environmental/Social Resources	Impact/Issues	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	Supervisor responsibility	Reporting Requirements
			• Furthermore, in the event of any physical damage to any form of privately owned or used physical structure resulting from the construction activity (especially the underground transmission line) of the transmission line, the project shall fully compensate for the loss or damage to impacted structures' owner at replacement cost[84] or construct the structure as it was earlier to the construction activities • Prepare regular reports outlining the progress of restoration efforts and addressing any challenges encountered.						
8.	Impact due to laying down of water pipeline	Temporary economic and livelihood impact	In addition to the planned mitigation measures, following mitigation measures shall be implemented by the Project: • Establish a grievance mechanism that allows affected stakeholders to raise concerns, provide feedback, and seek resolution for any project-related issues, • Ensure accessibility, transparency, and fairness in the grievance resolution process. • Implement the existing Stakeholder Engagement Plan outlining how the project will engage with and involve stakeholders throughout the project lifecycle. • Ensure that engagement is inclusive, transparent, and facilitates meaningful participation. • Continue with the practice of conducting construction activities during nighttime to minimize disruption to businesses and daily activities. • Maintain a phased approach to construction, allowing for the gradual restoration of affected areas. • Implement a comprehensive restoration plan, ensuring that areas impacted by construction activities are returned to a usable state. • Establish mechanisms for ongoing monitoring of the impact on stakeholders during and after construction. • Furthermore, in the event of any physical damage to any form of privately owned or used physical structure resulting from the laying down activities of water pipeline, the project shall fully compensate for the loss or damage to impacted structures' owner at replacement cost or construct the structure as it was earlier to the laying down activities. • Prepare regular reports outlining the progress of restoration efforts and addressing any challenges encountered.	Project Incharge / HR/ EHS/ Contractor(s)' EHS	Site inspection & visual observation and verification of records	Daily	Contractor site manager	Project Incharge / EHS team	photograph , inspection report feedback and community complaints
9.	Local Employment and Livelihood	Increased local employment and livelihood	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	• Project in charge /HR/ Contractor	Stakeholder engagement, verification of records	Monthly	HR/ Contractor	Project In charge	Job cards, PF records, wage register etc.

[84] The replacement cost as per IFC Performance Standard 5 (PS5) refers to the value required to allow Affected Communities and persons to replace lost assets with assets of similar value. It includes the market value of assets plus transaction costs and does not take depreciation into account.

Sr. No.	Environmental/Social Resources	Impact/Issues	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	Supervisor responsibility	Reporting Requirements
			• 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,						
10.	Contractor	Contractor Management	Proposed mitigation measures for contractor management: • Provide comprehensive training to contractors on the established contractual agreements, emphasizing compliance with labour laws, working conditions, and terms of employment. Regular awareness sessions should be conducted to ensure contractors understand and adhere to project expectations. • Strengthen the monitoring process by conducting regular audits on contractor compliance. Increase the frequency of internal HR audits outlined in the checklist. This includes daily checks on items like muster rolls and attendance cards, monthly checks on wage-related documents, and yearly audits on critical acts such as the Contract Labour (Regulation & Abolition) Act. • Organize capacity-building workshops for contractors, focusing on educating them about key labour laws, safety regulations, and ethical labour practices. This proactive approach can contribute to improved contractor understanding and compliance. • Reinforce non-discrimination and equal opportunity principles through targeted training sessions. Contractors should be educated on the Equal Opportunity and Non-discrimination policy, emphasizing the importance of treating all workers fairly regardless of race, gender, age, religion, disability, or any other protected characteristics. • Strengthen the existing grievance redressal mechanism by promoting transparency and accessibility. Ensure that contractual workers are aware of the grievance redressal process and can easily report concerns. Regularly review and update the mechanism based on feedback and evolving needs. • Foster a collaborative partnership with contractors through regular communication channels. Conduct joint workshops and forums to address challenges, share best practices, and build a sense of shared responsibility for the success of the project. • Conduct periodic reviews of policies, ensuring they remain aligned with evolving labour laws and industry best practices. Regularly update contractors on policy changes and provide the necessary support for implementation. • The contractor shall obtain the Registration under the Employees' Provident Funds and Miscellaneous Provisions Act, 1952.	• Project Incharge / HR/ EHS/ Contractor head/ Contractor(s)' EHS	Site inspection & visual observation and verification of records	During Maintenance	Contractor site manager	Project Incharge / EHS team	Internal Monitoring report
Biological Environment									
11.	Vegetation Clearance	Habitat Modification and Loss	• Vegetation clearance activities should be restricted within the project site and transmission towers	• Contractor's EHS representative	Visual Observation and EHS Inspection	Quarterly	Project EHS representative	EHS Manager	Quarterly Report from Contractor EHS team to project EHS Manager

Sr. No.	Environmental/Social Resources	Impact/Issues	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	Supervisor responsibility	Reporting Requirements
			• The area for the storage yard, labour camps and other supplementary facilities should be selected away from any water body, canal, etc. • There should be a ban on the use of woody plants as kitchen fuel, collected from the nearby areas • Plantation of native plants in and around the project boundary, on the available land should be practiced and promoted.						
12.	Increase Anthropogenic movement	Increased Human activities, Noise and Sedimentation	• The movement of workers between camps and construction sites must be restricted, and they should refrain from visiting natural areas that are not part of the planned construction activities. • Construction workers should receive adequate training and be aware of the importance of safeguarding wildlife. Any stray wildlife in the area should not be harmed or killed during construction operations • Measures should be implemented to minimize construction-related noise to reduce its potential impact on the surrounding environment and wildlife.	• Contractor's EHS representative	Visual Observation and EHS Inspection	Quarterly	Project EHS representative	EHS Manager	Quarterly Report from Contractor EHS team to project EHS Manager

Table 8-6 Operation Phase: Environment and Social Management Plan

Sr. No.	Environmental/Social Resources	Impact/Issues	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	Supervisor responsibility	Reporting Requirements
			Physical Environment						
1.	Air Quality	Flue gas emission, dust emission and vehicular emission, particulate matter etc.	• Manual segregation and removal of chlorinated plastic and other elements unsuitable for thermal treatment. • Use extraction system to remove dust from working areas, buildings, and storage vessels, and treat as needed to control particulate emissions • Implement good housekeeping practices to reduce fugitive emissions and control dust and particulate matter within the facility. • According to the Point Source Air Emissions Prevention and Control Technologies provided in WBG 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%. • Use extraction system to remove dust from working areas, buildings, and storage vessels, and treat as needed to control particulate emissions • Implement good housekeeping practices to reduce fugitive emissions and control dust and particulate matter within the facility. • As stated in the General EHS Guidelines, emissions from a single project should not contribute more than 25% of the applicable ambient air quality standards to allow additional, future sustainable development in the same airshed . • Fly Ash will be transported in covered trucks and tippers to the fly ash recipients • Periodic monitoring (quarterly) of concentrations of PCDDs, PCDFs, other combustion products, and heavy metals in flue gas, i.e. stack monitoring as well as ambient air quality monitoring to be undertaken on quarterly basis	GWVPL EHS Manager	EHS Inspection	Quarterly	GWVPL Project Head	EHS Head at ACEL	Report from EHS team to Project head and further to corporate team
2.	Noise Quality	Impact on receptors	• Enclosures, noise and vibration mufflers, acoustic barriers and anti-vibration mats to be provided at places with high noise generation process or machineries	GWVPL EHS Manager	EHS Inspection	Quarterly	GWVPL Project Head	EHS Head at ACEL	Report from EHS team to Project head and further to corporate team

Sr. No.	Environmental/Social Resources	Impact/Issues	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	Supervisor responsibility	Reporting Requirements
			• Installing silencers for fans and suitable mufflers on engine exhausts and compressor components • Pump operators (near STP, storage tanks, hoppers etc.) are generally exposed to higher noise. Housing / casing will be provided for all noise generating machines • Periodic maintenance of the equipment to be used in the developmental works will be carried out. Worn out parts will be replaced and rotating parts will be lubricated to minimize noise emissions • Adequate PPE's (earmuffs, earplugs) to be provided to employees working in high noise generation area's and machineries • The occupational noise exposure to the workers in the form of eight hour timely weighted average will be maintained well within the prescribed Occupational Safety and Health Administration (OSHA) standard limits • 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 mentioned in the CTO (to be obtained) for the project operations at site to ensure noise parameters are within prescribed MoEFCC guideline as well as WBG 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 • 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						
3.	Soil Environment	Contamination	• Separate remaining ferrous and non-ferrous metals from bottom ash as far as practicably and economically viable, for their recovery • GWVPL to develop non-leachable concrete floor with dedicated leachate collection pit for bottom ash area and to dispose the generated bottom ash on daily basis. GWVPL to ensure that the covered trucks are used by VMC to dispose the bottom ash in the nearest sanitary landfill. GWVPL to track bottom ash generation and disposal • Treat bottom ash on or off-site (e.g., by screening and crushing) to the extent that is required to meet the specifications set for its use or at the receiving treatment or disposal site (e.g., to achieve a leaching level for metals and salts that is in compliance with the local environmental conditions at the place of use); • Hazardous waste inventory to be managed and recorded and to include a summary table with the information such as: Name and description (e.g. composition of a mixture) of the Hazmat, Classification (e.g. code, class or division), Internationally accepted regulatory reporting threshold quantity or national equivalent, Quantity of Hazmat used/generated per month, Characteristic(s) that make(s) the Hazmat hazardous (e.g. flammability, toxicity) • GWVPL to conduct characterization analysis of ash as per IS 3812 covering all the parameters stipulated by BIS to identify any hazardous content before its disposal through VMC trucks. If fly ash is identified as hazardous, it is to be sent to hazardous waste landfill site through authorized vendors and records to be maintained.	GWVPL EHS Manager	EHS Inspection	Quarterly	GWVPL Project Head	EHS Head at ACEL	Report from EHS team to Project head and further to corporate team

Sr. No.	Environmental/Social Resources	Impact/Issues	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	Supervisor responsibility	Reporting Requirements
			• Hazardous ash to be stored and handled as per the hazardous and other waste (management and transboundary movement) rules, 2016 as amended. • Non-hazardous ash may be disposed of in an MSW landfill or considered for recycling in construction materials or provided to cement and fly ash brick manufacturers • GWVPL is recommended to obtain chain of custody documents from VMC for final disposal destination to ensure that the hazardous waste is being disposed at the authorized hazardous waste landfill as per the applicable Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, as amended. • GWVPL to also establish through relevant agencies whether disposal site (where hazardous ash is disposed) is being operated to acceptable standards before disposal. If this is not established, GWVPL shall consider alternative disposal options, including the possibility of developing its own recovery or disposal facility at the project site or else reduce generation of hazardous ash by proper screening of industrial hazardous waste proposed to be handled and used as feedstock. • If GWVPL is uncertain that the disposal conducted by VMC is as per the applicable rules, GWVPL will themselves take the responsibility of disposal and will ensure disposal is conducted to the hazardous waste authorized site as per the applicable norms. • Promote use of fly ash generated from bank zone and ESP for making non-leachable concrete pavers • Good housekeeping and best practices of waste handling shall be adopted to eliminate/minimize the risks of soil contamination • Only covered and closed trucks will be allowed to enter the site for unloading of municipal solid waste • E-waste generated onsite should be channelized through collection center or dealer of authorized producer or dismantler or recycler or through the designated take back service provider of the producer to authorized dismantler or recycler. It should be ensured to keep the records of e-waste generated and sending out to authorized agencies • Battery waste to be disposed via buy back policy with the battery supplier/manufacturer. It should be ensured to keep the records of waste generated and sending out to authorized agencies. • Generated biodegradable waste from the canteen, kitchen, office etc. will be utilized within the plant and will be • Description or SOP's of response activities in the event of a spill, release, or other chemical emergency or including Internal and external notification procedures, Specific responsibilities of individuals or groups, Decision process for assessing severity of the release, and determining appropriate actions, evacuation routes, Post-event activities such as clean-up and disposal, incident investigation, employee re-entry, and restoration of spill/equipment/area to be developed. • Since hazardous waste and material will be generated and present within the project premises, GWVPL to develop hazardous material management plan which includes potential risks along with the objectives of protection of the workforce and the prevention and control of releases and accidents					

Sr. No.	Environmental/Social Resources	Impact/Issues	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	Supervisor responsibility	Reporting Requirements
4.	Water Resources	Availability & Contamination	• Alternative source of water to be identified for domestic use and ground water to not be used for domestic purpose except flushing. • The waste storage areas of the plant should have a leachate barrier system that forms a secure barrier between the groundwater, soil, and substrata and the composting or stored organics. • Segregated collection for storm water from operations/waste and ash handling areas and from non-operations areas to be undertaken to avoid contamination of storm water and further risk of contamination of ground water due to ground water recharge. • Reduce the potential for leachate generation from bottom ash prior to final disposal. • Secondary containment for leachate to be included with volumes greater than 220 liters. The available volume of secondary containment should be at least 110 percent of the largest storage container, or 25 percent of the total storage capacity (whichever is greater), in this specific location, considering the area is susceptible to rains and cyclones. • SOPs for the management of secondary containment structures, specifically the removal of any accumulated fluid, such as rainfall, to ensure that the intent of the system is not accidentally or willfully defeated • Measure and record the quantity and quality of leachate generated. Changes in leachate quantity or quality not attributable to weather or other factors to be accounted for. • A dedicated leachate management plan should be developed for proper collection, storage and disposal of leachate from the Project to avoid contamination of subsurface soil and groundwater. The plan should include leachate collection system designed for the project and installation of additional leachate collection pits, drainage (if required) along with process flow for leachate generation, collection, storage and final disposal. • Effluents from the DM plant generally acidic from the cation units and alkaline from the anion units, should be neutralized. The neutralized effluent shall have less than 5 ppm suspended solids and a pH value of about 7.5 to 8.0 in line with CPCB standards. The DM plant should have pH meter and turbidity meter to ensure the neutralized effluent, suspended solids and pH are within limit prior to be used for plantation activities • Waste storage areas should be located away from drainage lines • Spill kits to be maintained at site for cleaning minor spills/leaks • Workers should be trained on proactive use of designated bins/areas for waste disposal. • Provide magnetic flow meters with totalizers at the outlet of facility • Operate and maintain online real time monitoring system along with web camera facilities and shall ensure that it is connected to GPCB / CPCB websites as per CPCB directions • 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 • Explore installation of water efficient plumbing fixtures that use less water without any reduction in quality and service • 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.	GWVPL EHS Manager	EHS Inspection	Quarterly	GWVPL Project Head	EHS Head at ACEL	Report from EHS team to Project head and further to corporate team

Sr. No.	Environmental/Social Resources	Impact/Issues	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	Supervisor responsibility	Reporting Requirements
			Data thus collected should be sent at regular intervals to MoEFCC, CGWA and CGWB • Water audit to be undertaken on annual basis to understand water usage and to identify measures for water reduction • Water utilization to be documented • Display online data outside the main 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. • A wastewater and water quality monitoring program with adequate resources and management plan should be developed and implemented to meet the objective(s) of the monitoring program. The wastewater and water quality monitoring plan should include monitoring parameters, monitoring type and frequency locations, data quality,						
Socioeconomics									
5.	Occupational Health & Safety	Electrocution, accident, fire hazard, respiratory and hearing problems etc. while working at site	• Provide adequate personnel facilities, including washing areas and areas to change clothes before and after work; • Job safety analysis to undertaken to identify specific potential occupational hazards and industrial hygiene surveys, as appropriate, to monitor and verify chemical exposure levels, and compare with applicable occupational exposure standards. • Since hazardous waste and material will be generated and present within the project premises, GWVPL to develop hazardous material management plan which includes potential risks along with the objectives of protection of the workforce and the prevention and control of releases and accidents. • Provide adequate and suitable personal protective clothing and equipment. • Provide worker immunization (e.g. for Hepatitis B and tetanus). • Provision of dust masks or respirators for workers engaged in pre-processing area • Maintain good housekeeping in waste processing and storage areas • Regular inspection and maintenance of pressure vessels and piping • Reducing the time required for work in elevated temperature environments and ensuring access to drinking water • Shielding surfaces where workers come in close contact with hot equipment, including generating equipment, pipes etc. • Consider installation of hazard warning lights inside electrical equipment enclosures to warn of inadvertent energization. • Deactivation and proper grounding of live power equipment and distribution lines according to applicable legislation and guidelines whenever possible before work is performed on or proximal to them • Hazardous areas (electrical rooms, compressor rooms, etc.), installations, materials, safety measures, and emergency exits, etc. should be marked appropriately. Signage should be in accordance with international standards and be well known to, and easily understood by workers, visitors and the general public as appropriate. • The occupational noise exposure to the workers in the form of eight hour timely weighted average will be maintained well within the prescribed Occupational Safety and Health Administration (OSHA) standard limits • Vibration generating sources and their platforms should be maintained properly to minimize vibrations and related impacts.	GWVPL EHS Manager	Visual Observation and EHS Inspection	Quarterly	GWVPL Project Head	EHS Head at ACEL	Report from EHS team to Project head and further to corporate team

Sr. No.	Environmental/Social Resources	Impact/Issues	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	Supervisor responsibility	Reporting Requirements
			• Implementation of inspection programs to maintain the mechanical integrity and operability of pressure vessels, tanks, piping systems, relief and vent valve systems, containment infrastructure, emergency shutdown systems, controls and pumps, and associated process equipment • OHS orientation training to be provided for all new employees to ensure they are apprised of the basic site rules of work at / on the site and of personal protection and preventing injury to fellow employees. • Training should consist of basic hazard awareness, sites specific hazards, safe work practices, and emergency procedures for fire, evacuation, and natural disaster, as appropriate. Any site-specific hazard or color coding in use should be thoroughly reviewed as part of orientation training • Training of operators on release prevention, including drills specific to hazardous materials as part of emergency preparedness response training. Also Provision of specialized electrical safety training to those workers working with or around exposed components of electric circuits. This training should include, but not be limited to, training in basic electrical theory, proper safe work procedures, hazard awareness and identification, proper use of PPE, proper lockout/tagout procedures, first aid including CPR, and proper rescue procedures. Provisions should be made for periodic retraining as necessary • Documentation of availability of specific personal protective equipment and provision of training needed to respond to an emergency						
6.	Community Health & Safety	Construction & Operation Phase	• Limiting the hours of operation for specific pieces of equipment or operations, especially mobile sources operating through community areas • Reducing project traffic routing through community areas wherever possible • Noise monitoring to be carried out for the purposes of establishing the existing ambient noise levels in the area, or for verifying operational phase noise levels • Traffic management of vehicles engaged during both ongoing construction phase and upcoming operational phase. Traffic management plan to be followed • 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 • 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 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	GWVPL EHS Manager	Visual Observation and EHS Inspection	Quarterly	GWVPL Project Head	EHS Head at ACEL	Report from EHS team to Project head and further to corporate team

Sr. No.	Environmental/Social Resources	Impact/Issues	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	Supervisor responsibility	Reporting Requirements
			• Drivers need to be captioned or trained to avoid frequent use of horn unless otherwise it is required and educated for Silent zones and off hours between midnight and 6 am						
7.	Economic Impact	Local Employment and Livelihood	• 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	Project Head/ HR/ CSR	Meetings, review of reports and audit	Monthly	HR/CSR	Project Head	training reports, funds utilization, photographs etc.
8.	Contractor	Contractor Management	Proposed mitigation measures for contractor management: • Provide comprehensive training to contractors on the established contractual agreements, emphasizing compliance with labour laws, working conditions, and terms of employment. Regular awareness sessions should be conducted to ensure contractors understand and adhere to project expectations. • Strengthen the monitoring process by conducting regular audits on contractor compliance. Increase the frequency of internal HR audits outlined in the checklist. This includes daily checks on items like muster rolls and attendance cards, monthly checks on wage-related documents, and yearly audits on critical acts such as the Contract Labour (Regulation & Abolition) Act. • Organize capacity-building workshops for contractors, focusing on educating them about key labour laws, safety regulations, and ethical labour practices. This proactive approach can contribute to improved contractor understanding and compliance. • Reinforce non-discrimination and equal opportunity principles through targeted training sessions. Contractors should be educated on the Equal Opportunity and Non-discrimination policy, emphasizing the importance of treating all workers fairly regardless of race, gender, age, religion, disability, or any other protected characteristics. • Strengthen the existing grievance redressal mechanism by promoting transparency and accessibility. Ensure that contractual workers are aware of the grievance redressal process and can easily report concerns. Regularly review and update the mechanism based on feedback and evolving needs. • Foster a collaborative partnership with contractors through regular communication channels. Conduct joint workshops and forums to address challenges, share best practices, and build a sense of shared responsibility for the success of the project. • Conduct periodic reviews of policies, ensuring they remain aligned with evolving labour laws and industry best practices. Regularly update	Project Incharge / HR/ EHS/ Contractor head/ Contractor(s)' EHS	Site inspection & visual observation and verification of records	During Maintenance	Contractor site manager	Project Incharge / EHS team	Internal Monitoring report

Sr. No.	Environmental/Social Resources	Impact/Issues	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	Supervisor responsibility	Reporting Requirements
			contractors on policy changes and provide the necessary support for implementation.						
9.	Supply Chain	Supply Chain Management	1. **Strengthened Contractor Oversight:** • **Action Steps:** • Implement stringent monitoring mechanisms for contractors involved in waste collection and transportation. The project shall request VMC to undertake the monitoring, or the project shall undertake the monitoring in support of VMC. • Conduct regular audits to ensure compliance with ethical employment practices. • Establish a clear framework for the appointment of drivers and helpers, and waste collectors, emphasizing the prohibition of child labour. 2. **Capacity Building and Training:** • **Action Steps:** • Provide training sessions for contractors and subcontractors on the prohibition of child labour. • Raise awareness about the legal and ethical implications of employing children in the waste-to-energy supply chain. • Empower contractors with the knowledge and resources to implement and uphold child labour-free practices. 3. **Child Labour Due Diligence:** • **Action Steps:** • Conduct periodic due diligence assessments on all stages of the supply chain to identify and address child labour risks. • Engage with local child protection organizations to enhance the effectiveness of monitoring efforts. • Regularly update and refine the due diligence process to align with evolving standards and regulations.	Project Incharge / HR/ EHS	Site inspection & visual observation and verification of records	During Maintenance	Contractor site manager	Project Incharge / EHS team	Internal Monitoring report
10.	Operation of underground water pipeline	Temporary access stoppage	In addition to the planned mitigation measures, following mitigation measures shall be implemented by the project: • Establish a grievance mechanism that allows affected stakeholders to raise concerns, provide feedback, and seek resolution for any project-related issues, • Ensure accessibility, transparency, and fairness in the grievance resolution process. • Develop a Stakeholder Engagement Plan outlining how the project will engage with and involve stakeholders throughout the project lifecycle. • Ensure that engagement is inclusive, transparent, and facilitates meaningful participation. • The project commits to ensuring that there will be no stoppage of access for the local community during the operation of the water pipeline. This ensures that the normal flow of activities in the community remains unaffected. • The project shall proactively inform stakeholders in advance of any scheduled maintenance activities. This advance notice ensures that stakeholders are prepared for any temporary disruptions and can plan accordingly. • In the case of emergency maintenance, the project shall promptly provide information to stakeholders before initiating any maintenance activities. This proactive communication is crucial, particularly for	Project Incharge / HR/ EHS/ Contractor(s)' EHS	Site inspection & visual observation and verification of records	During Maintenance	Contractor site manager	Project Incharge / EHS team	photograph , inspection report feedback and community complaints

Sr. No.	Environmental/Social Resources	Impact/Issues	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	Supervisor responsibility	Reporting Requirements
			stakeholders such as roadside vendors and kiosk owners, allowing them to evacuate the Right of Way (RoW) if necessary. • Furthermore, in the event of any physical damage to any form of privately owned or used physical structure resulting from the operation and maintenance activity of water pipeline, the project shall fully compensate for the loss or damage to impacted structures' owner at replacement cost or construct the structure as it was earlier to the operation phase • Following the completion of maintenance work, the project shall restore the RoW to its pre-maintenance condition.						
11.	Operation of transmission line	Limited access stoppage	• Establish a grievance mechanism that allows affected stakeholders to raise concerns, provide feedback, and seek resolution for any project-related issues. • Ensure accessibility, transparency, and fairness in the grievance resolution process. • Implement the established Stakeholder Engagement Plan outlining how the project will engage with and involve stakeholders throughout the project lifecycle. • Ensure that engagement is inclusive, transparent, and facilitates meaningful participation. • The project commits to ensuring that there will be no stoppage of access for the local community during the operation of the transmission line. This ensures that the normal flow of activities in the community remains unaffected. • The project shall proactively inform stakeholders in advance of any scheduled maintenance activities related to the underground transmission line. This advance notice ensures that stakeholders are prepared for any temporary disruptions and can plan accordingly. • In the case of emergency maintenance, the project shall promptly provide information to stakeholders before initiating any maintenance activities. This proactive communication is crucial, particularly for stakeholders such as roadside vendors and kiosk owners, allowing them to evacuate the Right of Way (RoW) if necessary. • Furthermore, in the event of any physical damage to structures of roadside vendors and kiosk owners or any other form of privately owned or used physical structure resulting from the operation of underground transmission line, the project shall fully compensation for the loss or damage to these structures' owners or user at replacement cost or construct the structure as it was earlier to the construction. • Following the completion of maintenance work, the project shall restore the RoW to its pre-maintenance condition.	Project Incharge / HR/ EHS/ Contractor(s)' EHS	Site inspection & visual observation and verification of records	During Maintenance	Contractor site manager	Project Incharge / EHS team	photograph , inspection report feedback and community complaints
Biological Environment									
12.	Power Transmission	Collision and Electrocution	• Avian Flight Diverters[85]: Install avian flight diverters on the power transmission line to increase the visibility of the overhead wires to birds, reducing the risk of collisions especially near to the water bodies, river stream (22.229295°, 73.203323° to 22.227979°, 73.200355°) and (22.226300° 73.193939° to 22.220236° 73.187745°) • Bird-Friendly Pole Designs: Utilize bird-friendly pole designs that minimize the risk of electrocution, such as bird guards or insulators designed to prevent accidental contact.	EHS Manager	Visual Observation and EHS Inspection	Quarterly	Project Head	EHS Head at ACEL	Quarterly Report from Site EHS team to Project head and further to corporate team

[85] Galis, M. and Sevcik, M. (2019) Monitoring of effectiveness of bird flight diverters in preventing bird mortality from powerline collisions in Slovakia. Raptor Journal 13: 45–59.

Sr. No.	Environmental/Social Resources	Impact/Issues	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	Supervisor responsibility	Reporting Requirements
			• Disposal of corpses / garbage near the power lines should be restricted and carcasses observed along the transmission line should be immediately removed to avoid attracting raptors.						
13.	Access of Wildlife to the Project Compound	Human-Wildlife Conflicts	• Frequent checking of the boundary wall to avoid any space for wildlife entrance into project compound. • Employee Training: Conduct training programs for project personnel to raise awareness about the local wildlife and the importance of respecting their habitats. Employees should be educated on how to handle encounters with wildlife safely and responsibly. • Emergency Response Protocol: Develop an emergency response protocol to handle any human-wildlife conflicts that may arise during the project's operation phase. This should include procedures for safely managing encounters and contacting relevant authorities if needed. • Good housekeeping practices in the project compound play a crucial role in reducing the attraction of faunal species and mitigating potential human-wildlife conflicts. By implementing effective housekeeping measures, the project can create an environment that is less appealing to wildlife, thereby minimizing their presence within the compound.	Site EHS Manager	Visual Observation and EHS Inspection	Quarterly	Project Head	EHS Head at ACEL	Quarterly Report from Site EHS team to Project head and further to corporate team
14.	Climate Change	Risk of flooding	• Undertake detailed flood risk assessments, for the plant location and incorporate the recommendation in the Emergency response plan • Ensure there is a dedicated, forward-looking budget for mitigating weather-related risks • Continue to monitor the evolving scientific understanding of climate change hazards and reassess climate change induced risks to specific project elements at regular intervals (e.g., every five years) in the future • Ensure adequate drainage is developed in and around the plant to avoid water logging and adequate leachate pit is constructed to manage excessive leachate generation during operation phase.	EHS Manager	Flood Risk Assessment		Project Head	EHS Head at ACEL	Report from Site EHS team to Project head and further to corporate team

9 Impact Summary and Conclusion

9.1 Introduction

This Environmental and Social Impact Assessment (ESIA) has been conducted to evaluate the impacts associated with the Waste to Energy (WTE) Plant. The impact assessment has been conducted in compliance with the requirement of applicable reference framework (refer to ***Section 4***).

9.2 Significance 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 9-1 Impact Assessment Summary

Impact Description	Period	Impact Classification	Phase of the Project	Significance of Impact	
				Without Mitigation	With Mitigation
Environment					
Ambient Air	Short Term	Negative	Construction Phase	Small	Negligible
	Long Term	Negative	Operation Phase	Substantial	Small- Substantial
Ambient Noise	Short Term	Negative	Construction Phase	Substantial	Small
	Long Term	Negative	Operation Phase	Substantial	Small
Soil Compaction and Contamination	Long-term	Negative	Construction Phase	Small	Negligible
Soil Contamination	Long Term	Negative	Operation Phase	Substantial	Small
Water Resources	Long Term	Negative	Construction Phase	Small	Negligible
Water- Availability & Quality	Long Term	Negative	Operation Phase	Substantial	Small- Substantial
Social					
Occupational Health & Safety	Short Term	Negative	Construction Phase	Substantial	Small- Substantial
	Long Term	Negative	Operation Phase	Substantial	Small- Substantial
Community Health & Safety	Short Term	Negative	Construction & Operation Phase	Substantial	Small- Substantial
Labour influx	Short term	Negative	Construction Phase	Negligible	Negligible
Local Employment and Livelihood	Short term	Positive	Operation Phase	Negligible	Negligible
Temporary Income Opportunity impact on local community due to installation of transmission line	Short term	Negative	Construction Phase	Small	Negligible
Impact Due to Laying Down of water pipeline	Short term	Negative	Construction Phase	Small	Negligible
Impact due to operation of underground transmission line	Short-term	Negative	Operation Phase	Negligible	Negligible
Impact due to operation of underground water pipeline	Short-term	Negative	Operation Phase	Negligible	Negligible
Impact due to operation of transmission line	Short-term	Negative	Operation Phase	Negligible	Negligible
Supply chain management	Long term	Negative	Operation Phase	Substantial	Negligible
Contractor Management	Long term	Negative	Construction and Operation phase	Substantial	Small
Ecology					

Impact Description	Period	Impact Classification	Phase of the Project	Significance of Impact	
				Without Mitigation	With Mitigation
Habitat Modification and Loss due to Vegetation Clearance	Permanent	Negative	Construction Phase	Substantial	Small
Impacts on the Habitat and Species due to Construction Activities	Short	Negative	Construction Phase	Substantial	Small
Collision and Electrocution Risk due to Power Transmission, etc.	Permanent	Negative	Operation Phase	Substantial	Small to Substantial
Human-Wildlife Conflicts	Permanent	Negative	Operation Phase	Substantial	Small

9.3 Project Categorization

IFC's Environmental and Social Review Procedure Manual has provided a provisional categorization tool for projects. The tool assigns an E&S category based on risk inherent to the particular sector, as well as on the likelihood of a development taking place and on what can be reasonably ascertained about the environmental and social characterization of the Project's likely geographical setting. The categories are defined as follows:

1. **Category A:** Projects with potential significant adverse environmental or social risks and/or impacts that is diverse, irreversible or unprecedented.
2. **Category B:** Projects with potential limited adverse environmental or social risks and/or impacts that is few in number, generally site-specific, largely irreversible and readily addressed through mitigation measures.
3. **Category C:** Projects with minimal or no adverse environmental or social risks and/or impacts.

This Project has been categorized as Category B as per the IFC guidelines. Rationale for categorization includes:

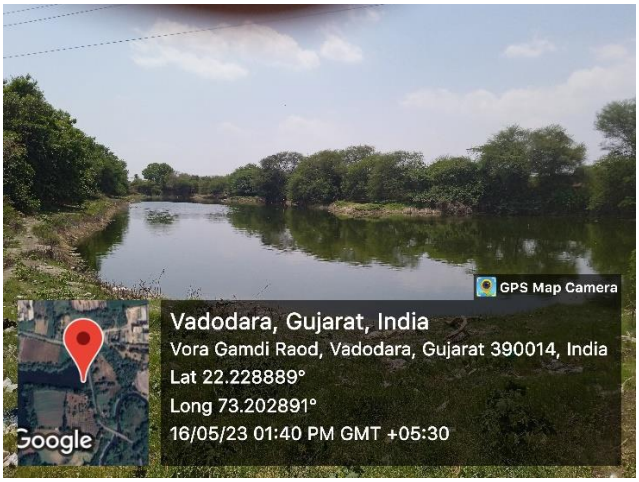
- The waste to energy is being developed within a plot which was previously used for waste dumping and the land for the facility has been allocated for development of the waste to energy plant.
- The construction activities involve air emission, noise emission, water consumption and soil contamination and may impact the Project surrounding area if adequate measures are not implemented. However, the impacts can be minimized and/or avoided by implementing adequate mitigation measures suggested in ESMP of this report.
- During operation phase, the Project will involve flue gas emission, ash deposition, leachate generation, noise, occupational health, and safety risks such as exposure to pathogens and community health and safety risks. However, the impacts can be minimized and/or avoided by implementing adequate mitigation measures suggested in ESMP of this report.
- The project is sourcing treated water from the STP and impact on water resources are not anticipated on ground water or surface water of the region.
- The identified impacts on the ecology and biodiversity are site specific, irreversible and could be addressed through suggested mitigation measures.
- The project will lay down 4 km of underground water pipeline from the project location to the Tarsali Sewage Treatment Plant (STP) Vadodara. During the site visit it was observed route is passing through the main market and habitation area of Tarshali, Vadodara. There are approximately 30 roadside vendors and kiosks (at the time of site visit) who are operating their business near the identified route of the underground water pipeline in Tarshali. Therefore, the installation process will require temporary closure or limited access of these 30 roadside vendors and kiosks owners for a maximum of three (3) days for each 25-meters stretch of the water pipeline. However, this impact can also be mitigated through implementation of provided mitigation. Thus, the impact also is not categorised as irreversible or unprecedented.

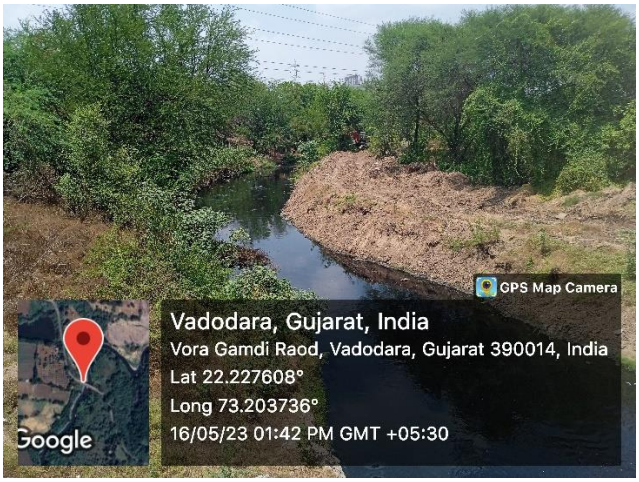
APPENDIX 1: DOCUMENTS REVIEWED

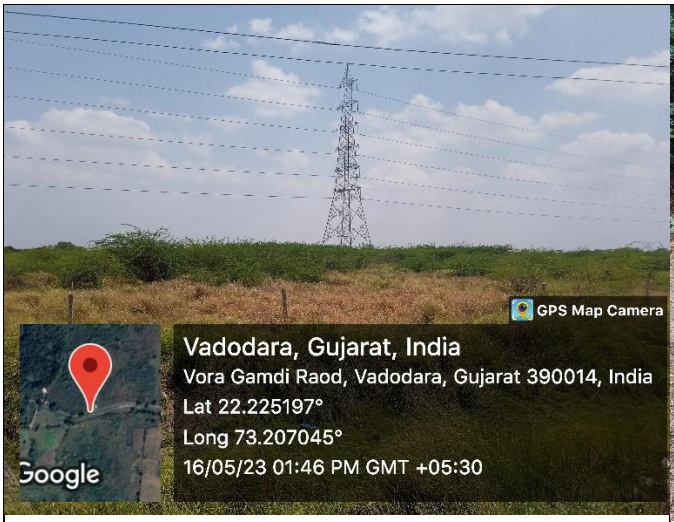
Abellon's Environment 8 Social Policies
Project Layouts and Components details
Details for water management
Project Booklet
Dust Control Systems
Ash Handling Systems
Leachate Management Systems
Process Flow
Master Plan
Details pertaining to waste sourcing
Permits obtained for the Project
Details for Green belt etc
List of contractors
List of manpower
PF details
Appointment Letter
HR Policy & GRM

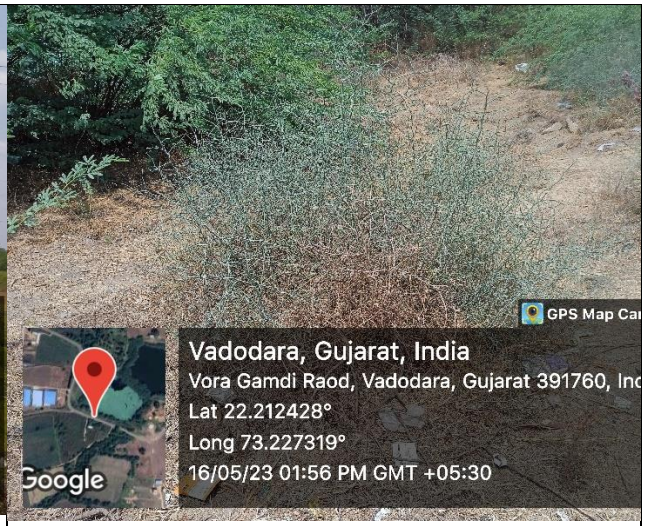
APPENDIX 2: PHOTOLOG

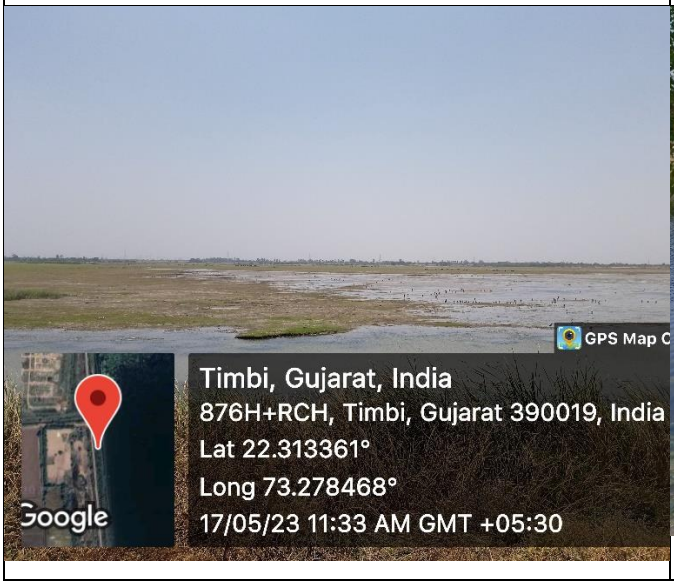
Diverse Habitat Representatives in the Project's Surroundings

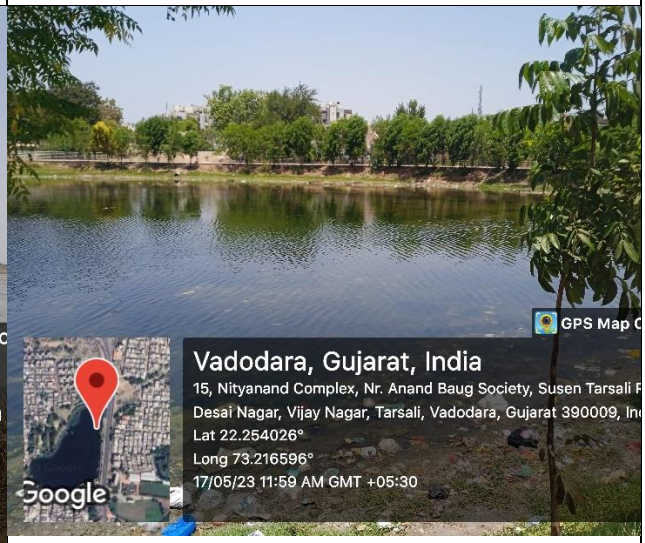


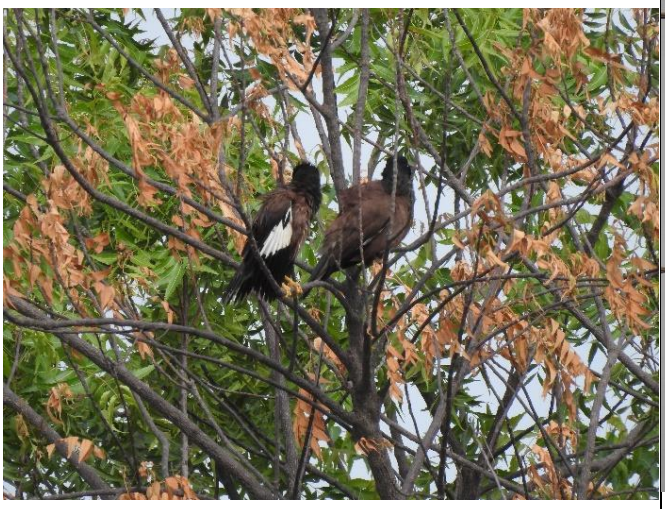












Common Myna

White-throated Kingfisher

Greater Cocal

Indian Pond Heron

Red-wattled Lapwing

Black-winged Kite

APPENDIX 3: DESIGN SPECIFICATION FOR FLUE GAS CLEANING SYSTEM

Electrostatic Precipitator

Design Parameters	Unit	Value
Inlet Flue Gases flow rate @ 180 °C	Am^3/hour	1,44,000
Inlet gas temperature	°C	150-180
Dust load at the inlet	g/Nm^3	7.0
Dust load at the outlet	g/Nm^3	1.0-1.5
No. of fields	Nos.	Single Field
Type		Horizontal, Dry Type
Collecting Area	m^2	1040
No. of Emitting Electrodes	Nos.	270
Electrode Type		HE-Rigid Pipe and Multi Spike
No. of Collecting Plates	Nos.	330
Flue Gas Velocity inside ESP	m/s	0.96
Treatment Time	Sec	5.21
Wrapping Mechanism		Tumbling Hammer driven by gear motor

Acid Control Reactor Tower

Design Parameters	Unit	Value
Tower Volume	m^3	122
Water Requirement	m^3/hour	2
Dimensions (Dia. X Height)	m	3.3 Ø x 14.3

Dry Sorbent Injection (DSI) System

Design Parameters	Value	
Source of Sorbent/Reagents/Lime and carbon:	1)Lime Unloading station 2)Activated carbon Unloading station	
Injection Point:	Activated carbon: In the Duct before reaction tower. Hydrated lime: In the reaction tower	
Material Handled	Hydrated Lime Powder	Activated Carbon
Dosing capacity	275 kg/hr.	7.5 kg/hr.

Filter Bag House

Description	Unit	Value
Flue gas flow @ 150 °C	$Am^3/hr.$	1,44,000
Type of Bag filter		Reverse Jet Pulse
Bag Cleaning		Online
Bags Fabric		PTFE felt with PTFE lamination
Fabric Withstanding Capacity	°C	250
Estimated Flue gas Temperature	°C	160
No. of bags	Nos.	1320
Filter Bag Type		Hose Bag Type
Bags Dimension	mm	Dia. 150 X Length 5000
Bag Fabric area - Gross	m^2	3111
Bag Fabric area - Net	m^2	2876
Gross Air to Cloth	$m^3/min/m^2$	0.77
Net Air to Cloth	$m^3/min/m^2$	0.83
Ash Discharge		Through RAV and Screw Conveyor

APPENDIX 4: EMERGENCY PREPAREDNESS AND RESPONSE PLAN

This plan is designed to facilitate understanding of the Emergency Preparedness & Response Plan for site employees, contractors, and other agencies engaged at the facility. The emergency response plan should be updated by GWVPL to include measures to handle emergency situations at the collection centers, once the locations of the collection centers are finalized.

The emergency scenarios presented in the EPRP along with the measures to be taken in case of emergency should be communicated to the nearby local community.

Scope

This procedure shall be applicable for all employees, contractors, and other agencies for the management of emergency incident involving Personnel, Projects, Environment, and Reputation under the influence of Company during construction as well as operation phase.

Definitions

Emergency: An emergency means a situation arising out of or as a result of any type of hazards like fire, explosion, uncontrolled gas release, or chemical spill which is likely to adversely affect the persons or population working on or near the site or residing in the adjacent or nearby areas around the work site.

Hazard: Source or situation with a potential for harms in terms of injury or ill health, damage to property, damage to the workplace environment, or a combination of these.

Incident: The event that gave rise to an accident or had the potential to lead to an accident.

NOTE: An incident where no ill health, injury, damage, or other loss referred to as a "near miss". The term "incident" includes "near-misses".

Risk: Combination of the likelihood and consequences of a specified hazardous event occurring.

Sub Agency/ Contractors/ Material Supplier: A company directly employed by GWVPL to undertake activities on behalf of the Company.

Levels of Emergencies

Level 0: An incident that can be resolved by site personnel or officer without outside agency involvement. May require an Incident/Accident report as documentation.

Level 1: Any incident, potential or actual, which will not seriously affect the overall functional capacity of the site. Can require an outside agency to respond, short-term evacuation and may involve injuries.

Level 2: Any incident, potential or actual, which affects an entire building or buildings, and which will disrupt the overall operation of the project site. Outside emergency services will probably be required.

Level 3: Any incident or occurrence that has taken place and has seriously impaired or halted the operations of the site. Level 3 situations will be where mass casualties and severe property damage may be sustained. A coordinated effort of all resources is required to effectively control the situation. Outside emergency services will be essential. Major policy considerations and decisions will usually be required from top management during times of crisis.

Potential Emergencies

- The collapse of the structure, building, cranes, boiler, turbine etc.
- Gas leakage
- Spillage of Hazardous fuels/ chemicals like diesel, concrete admixture etc.
- Fall from height with a severe consequence while erection.
- Personnel electrocuted/ electrical Hazards.
- Men being trapped under soil/in the Confined Space

- Fire or Explosion involving storage of material flammable materials of a gas cylinder, Oil/Diesel storage, Chemical, etc.
- The collision between moving vehicles/toppling Person falls in deep tanks.
- Food poisoning
- Floods
- Bomb Threat
- Earthquake
- Heavy Rains

Plant Emergency Facilities

The List of emergency facilities made available at the plant will be as follows:

- Tie up with the nearest hospital.
- Emergency rescue Vehicle/Ambulance.
- Emergency alarm system and audio announcement system
- Trained first Aid personnel from the working group & supervisor:
- Fire Extinguisher and Fire Buckets placed at different locations (both ABC & CO2 type).
- Other firefighting arrangements shall be as per the norms.
- Emergency Assembly Points at various places for easy access

Responsibilities of Emergency Response Team

1. Emergency Control Coordinator
   - Overall in-charge to control emergency, recovery & operation continuity.
   - Authorize resources.
   - Coordinate Emergency Control through on-site emergency teams.
   - Communicate with the interested parties including Head office, Local Authorities, mutual aids, etc.
   - Authorize for raise request for resources and its use at the site.
   - Coordinate with Medical Team, Rescue Team, Fire Fighting Team, etc. to facilitate control, rescue & treatment of victims.
   - Communicate with the Emergency Control Coordinator and apprise him of the emergency the situation at the site.
   - Responsible to assess and inform the end of an emergency at the site.
   - Responsible to call the end of the emergency.
2. Technical Support Team
   - Act in the capacity of the advisor to the Emergency Control Coordinator.
   - Coordinate with Administration & Legal support team to handle the labour unrest, local authority, treatment options, HR issues, PR issues, etc.
   - Investigate the causes of the Emergency & recommend corrective action.
   - Log the sequence of events so that the report of the emergency operation can be prepared to identify the deficiencies in the Emergency preparedness system and recommend improvement.
   - Evaluate the technical aspects of the control/ mitigation of the emergency operation continuity.
   - Review the technical documents and recommend feasibility.
   - Evaluate the need for emergency, understand the recovery measures, arrange for the resources, and supervise the recover till initiation of operation.
   - Arranging for cranes, equipment, and electrical assistance and coordinating with the emergency team.
   - Ensure the damage is controlled, removed from the site and the site is reinstated for the operation to start smoothly.
3. Administration & Legal Support Team
   - Coordinate with the Hospitals for the treatment of the injured.

- Coordinate with the Local Authorities including the Police etc.
- Communicate with the sub Agencies and ensure no Labor Unrest takes place.
- Ensure communication to the relatives in case of a fatality.
- Ensure coordination and communication with local communities
- Manage the Media with assistance from the Emergency Control Coordinator.
- Arrange for the food/ welfare facilities etc. if the rescue, recovery & operation continuity activity extends beyond the regular working hours.

4. Medical Team

- Coordinate with the Plant Emergency Controller.
- Communicate & coordinate with the first aider to provide first aid to the injured.
- Coordinate with the ambulance & rescue vehicle & other mutual Aid Ambulance to remove the victim to the nearest Hospital.
- Assist the First Aider to organize personnel for assistance.
- Record the victims' details and communicate with the Project Site Emergency controller

5. Emergency/Fire Fighting Team

- Coordinate with the Plant Emergency Controller.
- Communicate & coordinate with the first fighters to control the fire in the initial stages.
- Coordinate with the fire brigade in the event of a big fire and extend necessary assistance especially in case of chemical fire provide MSDS & quantity etc.
- Ensure the fire is controlled and does not pose any threat to the people or property.
- Responsible to declare the fire is controlled to the Project Site Emergency Controller.

6. Rescue Team

- Coordinate with the Plant Emergency Controller.
- Organize the search and rescue operation.
- Coordinate Head Count operation, obtain the Missing details & initiate a rescue operation.

Actions In Case of Emergency

In the event of an Emergency is declared:

- Do not panic.
- Stop all the jobs and report to the Safe Assembly Point.
- Stop all the Hot Jobs in the area including Welding, Gas Cutting, Grinding, etc. ensure no sparks are left.
- Stop all the machinery and park in a secure place, ensure it does not obstruct any movement of the fire engine etc.
- Communicate not to have any further entry to the site.
- Do not stop to collect personal belongings
- Turn Off generators, Compressors and other powered equipment, unless these provide power for emergency services.
- Attack fire with the equipment provided, if it is safe to do so and you know to operate the equipment.
- Obey the instruction manual and handbook of the H & S.
- Assist the Fire Fighting Team, Medical Team, Rescue Team, and technical team to control the emergency.

1. Safe Assembly Points

Three Assembly points have been identified for emergencies.

Assembly Point 1:

Assembly Point 2:

Assembly Point 3:

2. Evacuation procedures

General

- In declared emergency on-site, all personnel are to leave their area and proceed towards safe assembly points.
- Every person on-site shall know a minimum of two assembly points.
- DO NOT return to an evacuated building/areas unless told to do so by an authorized personnel.
- After any evacuation, report to your designated area assembly point. Stay there until an accurate headcount is taken.

Fire or explosion

- Know the location of the nearest fire extinguisher, exit in your area and how to use them training and information can be provided by the HSE Department.
- If a minor fire appears controllable, IMMEDIATELY contact the area safety steward or area engineer.
- Then upon selection of the appropriate fire extinguisher promptly direct the charge of the fire extinguisher towards the base of the flame source.
- If a suspected fire-related emergency exists, alert others by intermittent shouting as “fire”.
- Report to HSE engineer or site engineer.
- Proceed towards assembly points and alert others to do the same.
- In case of declared emergencies and alarm raised to leave the site, proceed towards safe clear area, which is at least 500 m away from the affected area or towards the side exit.

Collapse of structure, buildings, cranes

- In case of potential emergency of collapse is felt, proceed towards designated assembly points. Alert others to the same. CALL for Help.
- Wait for headcount.
- In case of declared emergencies and alarm raised to leave the site, proceed towards safe clear area, which is at least 500m away from the affected area or towards the side exit.
- Immediately after a collapse, the debris of the building is very unstable and prone to additional movement. Do not attempt to remove debris without any standing instruction which may lead to further damage of debris or trapped personnel.
- HSE engineer is the command person in this scenario.
- The preliminary effort in this scenario will be to concentrate on areas where people were last seen or known to be. Provide HSE department with this information.
- Administration department to provide with a list of the people in the damaged area. Additional information can be gathered from the people who survived the collapse.
- Barricade the area to restrict entry.
- Call firefighting crew, ambulance for rescue.
- Notify legal authorities in this regard.

Chemical/oil spillage

- Leave the spill area; alert others in the area and direct/assist them in leaving.
- Without endangering yourself: remove victims to fresh air, remove contaminated clothing and flush contaminated skin and eyes with water for 15 minutes
- Report to area safety officer or area engineer.
- Barricade the spill area to restrict further entry
- Shut off electrical equipment and power supply in the spill area.
- Do not attempt to go back into an area where a chemical spill has occurred.
- If the spill has occurred in confined space or closed room, isolate the area.
- Close the doors and barricade by means of tapes or posting warning signs.
- Establish exhaust ventilation if possible.

- Vent fumes only to the outside of the building.
- Open windows, if possible without exposing yourself to fumes
- Wait for spill control team for clean up

Trapped under soil/in the Confined Space

An emergency in a confined space or under soil could vary widely in degree or type, and include:

a) Employees are uninjured and evacuate themselves,
b) Employees are injured, but still capable of evacuating themselves,
c) Employees are assisted to evacuate by persons remaining outside the space,
d) Entry is required in order to evacuate employees,
e) Entry is required to provide medical treatment.

For situations a, b, c

- Inform the area officer or site engineer
- Rescue personnel

For Situation d & e

- Inform the area officer or site engineer
- Check for the presence of hazardous gases with the help of explosive meter or oximeter
- Provide appropriate PPE
- Rescue personnel.

Emergency Drills, Records & Reviews

The Emergency drill shall be carried out at least once in six months and the findings shall be recorded. Mock drills shall be carried out for all the levels covering identified emergencies. This procedure shall be reviewed in the event of major modification recommended by the Technical Team following an emergency/ emergency drill and or in the event of the major Re-shuffle of the team. The records of the drills and the recommendations/findings shall be maintained until the completion of the Project. Training on fire fighting and first aid shall also be provided and records shall be maintained.

The person who is responsible for recordkeeping shall keep the following records:

- Emergency Response Plan
- Evacuation Drills
- Equipment Inspection/Testing:
- Employee Training

Record Keeping/ Outcome

The table below provides the formats for the various lists and records that need to be maintained by the plant team to ensure the emergency response is provided in an efficient and timely manner. The lists need to be prepared as per the personnel and systems in place at plant and must be unique to each plant.

S.NO	Formats	NAME
1	Format I	List of key persons during emergency
2	Format II	List of key contacts: Internal Corporate
3	Format III	List of authorities: External
4	Format IV	Emergency line of communication
5	Format V	List of chemicals / material safety data sheets

S.NO	Formats	NAME
6	Format VI	Spill kit's locations
7.	Format VII	List of firefighting equipment's
8.	Format VIIII	List of first-aid boxes
9.	Format IX	List of assembly points
10.	Format X	List of first aid trained personnel's
11.	Format XI	Emergency drill form
12.	Format XII	Training records

Format I: Emergency Contact List

This list is to be made available at plant, to be displayed at various locations and must be updated regularly.

Personnel	Contact Details	External contact details
Project Manager		
Site Supervisor		
Safety Manager		
Control Room		
Fire Station (nearest location)		
Fire Station (location)		
Fire Station (location)		
Fire Station (location)		
Police Station (nearest location)		
Ambulance		
Hospital (nearest location)		
Hospital (nearest location)		
Disaster Helpline		
Blood Bank		
Traffic Police Control Room		
First-aid trained professionals		

Format V: List of Chemicals/Material Safety Data Sheets

S. No	Name of Chemical	Name of manufacturer	Manufacturer contact number	MSDS Sheet

Format VI: Spill Kits location

This list is to be made available at plant site must be updated regularly. The list to be communicated to the employees, contractors and other staff during the trainings.

S. No	Spill Kit Number	Location of Spill Kit	Person in-charge	Last inspection date

Format VII: List of firefighting equipment

S. No	Location	Type	Capacity	Last inspection date

Format VIII: List of First-Aid boxes

This list is to be maintained at plant site must be updated regularly. The list to be communicated to the employees, contractors and other staff during the trainings.

S. No	Location of First Aid box	Name of Person in-charge	Contact details of person in-charge	Inspection date

Format IX: List of assembly points

S. No	Assembly point number	Location of assembly point

Format XII: Mock Drill Format

This format is to maintain in the records to ensure that records for mock drills are maintained and that the mock drills are conducted regularly during the project operation.

Mock Drill No.
Date:
Event:
Emergency declared at (time):
In-charge of Mock Drill:
Name of Controller:

Name of Observer:				
Drill attended by :				
Sl. No. Time	Message from	Message	Action taken	Remarks
No. of mock casualties (if any) :				
No. of DCP / Fire Extinguisher used (Description):				
Observations:				
Controller:			Observer:	
Shortcomings:				
Members present:				
Corrective Action suggested:				
Designated Safety Officer			Authorized Signatory of Project	

Format XIII: Training Records

This list is to be maintained in the records to ensure that trainings are conducted regularly during the project operation.

Department:
Date & Time:
Person-in-charge:
Training name:
List of attendees:
Next date of training:
Prepared by:

Format XV: Records of past accidents/ occupational diseases/ dangerous occurrence/ emergency

Sr. No.	Accident Details									Detected Occupational Diseases						Incident /Dangerous Occurrence/ Emergency							
	Date	Time	Place	Type of	Nature	No. of	No. of	Day	Name	Chemical	Date	Type of	No. of	Type of	Remarks	Date	Time	Place	Chemical	Person Affected		Duration	Other

																		Inside		Out side			
																		Injured	Died	Injured	Died		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1.																								
2.																								
3.																								
4.																								

APPENDIX 5: CONTRACTOR MANAGEMENT PLAN

The management plan defines responsibilities of the project and provides requirements for selection and monitoring of subcontractors and suppliers by the project and its contractors. The purpose of these requirement is to minimize or eliminate risk to the environment and health & safety, and social (EHS&S) through the Project phases. This plan contains information regarding the procedure of selection of contractor and suppliers, contractual agreement, safeguards on EHS&S aspects, regular monitoring and reporting of EHS&S aspects. The management plan is intended to outline the relationship between the project and its contractors and sub-contractors, and to describe the process on how the overall contract will be managed.

Scope

In further details, the scope of the management plan is to:

- Summarize the contractors and sub-contractors' engagement and management processes, procedures and systems used
- Set out the procedure for selection of sub-contractors and suppliers by adopting commitment, capacity and track record methodology
- Set out the processes to ensure the implementation, by sub-contractors, of all requirements, their commitments, conditions and procedures – intended to assure the work to be done in compliance of the Applicable Reference Framework of this ESIA
- Define monitoring and reporting procedures including Key Performance Indicators (KPIs), to monitor the performance of sub-contractors and suppliers

Contractors and Supplier's selection, Contracting and Induction

GWVPL and its contractors shall adopt the contractor and suppliers process that will involve a multidisciplinary team, with one (1) or more qualified EHS&S professional. The participation and engagement of the EHS&S professional in the selection process is aimed to providing an early consideration of EHS&S matters and variables.

1. Prequalification

The contractors should be asked to provide details including (but not limited to):

- Past EHS performance
- Provision of E&S Policies and management systems
- Number and qualification of EHS personnel
- Occupational health and safety procedures and controls
- Human Rights Policies and code of conduct
- Grievance Redressal Mechanism, including means to address harassment.
- Human Rights safeguard policy or system
- Supply chain management as criteria for inclusion (specific consideration for child and forced labour).

The number of documents, and level of information and detail that are requested to sub-contractor(s) shall be commensurate to the scope of work and other specific features that the sub-contractor(s) is being pre-qualified against.

2. Request for Proposal from contractor(s) and supplier(s)

The section will provide the details of the general EHS&S requirements to come in the Request for Proposal (RfP) for all the sub-contractor(s) and suppliers.

General Requirement for all Sub-contractors

GWVPL and its contractors shall include following general EHS&S requirement in the RfP or other solicitations to prospective all categories of sub-contractors:

- Documentation showing compliance with in-country EHS&S legal requirements

- An affirmative statement or other commitment by prospective sub-contractor(s) that they will be responsible for EHS&S performance of their appointed contractors and suppliers

Raw material and other material supplier(s)

The specific requirement on EHS&S aspects for materials suppliers are provided below:

- Provide a copy of the supplier(s)' environmental, health & safety and social polices
- Provide details of any accreditation related to EHS&S such as (but not limited to) ISO 14001/OSHAS 18001 and/or alignment with ISO 26000, and other social responsibility standards/guidelines/formal initiatives
- Organisational chart that shows how EHS&S issues are managed
- Provide appropriate EHS&S metrics for the past three (3) calendar year, including spills, releases to the environment, number of labours related or environmental fines or regulatory administrative processes
- Provide appropriate health and safety metrics for the past two (2) calendar years, including:
    - Total recordable fatalities
    - Total recordable injury frequency rate
    - Total recordable disease frequency rate
- Provide details on how the supplier(s) typically manages solid waste, both hazardous and non-hazardous, generated by its activities
- Provided details on how the supplier(s) typically manages wastewater generated by its activities

Contractor(s) for Providing Human Resources

The specific requirement on EHS&S aspects for sub-contractor(s) providing human resources are provided below:

- Provide details of any accreditations such as (but not limited to) ISO 26000, and other social responsibility standards/guidelines/formal initiatives
- Provide details of the sub-contractor(s) HR policies and grievance mechanism, and describe how there will be communicated to all workers on-site
- Provide details on how the sub-contract(s) will comply with national labour and employment laws
- Provided information on past social and labour performance. The information required from sub-contractor(s) include (but not limited) to past violation of labour regulations, reports of sexual harassment or discrimination, training provided on applicable laws and regulations and labour inspection reports
- Provide details how the sub-contractor(s) will manage equal opportunities and non-discrimination, sexual harassment issues, migrant labour and retrenchment among its workforces
- Provide details of the sub-contractor(s)' policy for adequate protection of human rights of workforce

3. Proposal evaluation and contractor(s) and supplier(s) selection

GWVPL and its contractor shall establish an evaluation criterion alongside the RfP and that these are included with the RfP so that contractor(s) and supplier(s) can see early on the relative weightings of the EHS&S aspects of their proposal.

Evaluation methodology, criteria, KPIs and weightings will be established in discussion with the Project team and EHS&S team. Primarily, the evaluation will be done based on the contractor(s)' and suppliers' existing policies, their capacity to implement EHS&S requirements, and the provided information on past EHS&S performance shall be among the key criteria to evaluate.

While the evaluation methodology will vary according to the different category of contractor(s), scope of work, and any specific features, it will be agreed on by the project team and EHS team. However, at minimum following will be considered as grounds for disqualification:

- Failure to provided information on past E&S performance, including health and safety records
- Reports of past performance deemed unacceptable for the current phase of the Project
- Notices of material labour issues between workers and management
- Fines and sanction imposed by EHS and labour regulators and authorities
- Material community grievances and high-profile adverse press report on EHS&S matters

Further, among the team evaluating proposal at least one (1) qualified and experienced EHS&S professional who have been involved in the development of RfP and the establishment of the criteria that be used to evaluate contractor(s) and supplier(s)' EHS&S qualifications.

4. Contracting

Based on the pre-qualification (commitment, capacity and track record analysis) and selection procedure, the identification of EHS&S plans to be developed by the contractor(s) will be identified. The same plans will be incorporated in the EHS&S conditions of the contract. The EHS&S condition will have all EHS&S management plans and associated documentation that must be prepared or refined and implemented by the sub-contractor(s) and require that these documents by submitted for review and approval of GWVPL within an agreed timeline.

Specific provisions of EHS&S requirement will be included in the contract only after they are deemed to be acceptable by the evaluation panel, including the EHS&S representative(s) and approved by GWVPL management.

General terms and condition for all contractors

While onboarding contractors, after the screening and evaluation, The contractors will have to be introduced to policies and requirements that they may have not been practicing or aware of before their engagement with GWVPL. Some of the indicative clauses to be included as part of the Contractor Agreements are suggested below. GWVPL shall ensure that their contracts and the sub contracts include key EHS&S requirement (but not limited to):

- Explicit commitment to compliance with applicable EHS&S rules and regulations, IFC PS Requirements and WBG EHS Guidelines, conditions of approval and acquisition of all required permits, license, consent and approval prior to undertaking the activities being permitted or otherwise approved
- Submission of relevant documents to regulatory authorities as agreed with/required and maintenance of relevant records of the same (such as the contract labour license, inter-state migrant worker's registration etc.);
- Preparation of all relevant plans and other documentation, as identified through the ESMP or other commitments of GWVPL;
- Adherence to E&S management Plan for the site;
- Notice of any incident/accident on site or off-site to GWVPL within 24 hours; and
- Acknowledgement and agreement to ongoing monitoring and periodic audits during the project lifecycle.
- Creation and maintenance of records on EHS&S performance
- Penalties or incentives for EHS&S performance
- Clear contract statement that the contractor(s) is responsible for the EHS&S performance of their appointed contractor(s)
- Statement that invoices of sub-contractor(s) will be approved based on the EHS&S performance of contractor(s), and GWVPL and its contractors have authority to temporary or permanently withhold the payment
- Contract statement that on the contractor(s) failure to meet the EHS&S requirements in such a way as to prevent significant impacts to workers, local communities or individual or environmental resources, and on the contractor(s) failure to correct such deficiencies upon receiving proper notice, GWVPL has the right to appoint and pay another party to repair damage or otherwise remedy the impacts and reduce payment to the contractor(s) in the amount paid to the appointed such third-party.

Specific EHS&S terms and condition for material supplier(s)

- Number and qualification of EHS&S personnel required to be on staff – including those responsible for HR; workers' health and safety; environmental management; community health; safety and security and emergency response
- Monitoring of environmental parameters (such as noise, air emissions and air quality, water flows and quality, waste generation and management) that supplier(s) requires to carry out

Specific EHS&S terms and condition for sub-contractor(s) providing human resources

- Development and adoption of social and labour policies or commitment to adhere to the GWVPL EHS&S systems, as necessary
- Number and qualification of EHS&S personnel required to be on staff – including those responsible for HR; worker grievances; and worker accommodation (if provided)

- Induction and training programs for workforce, including training on applicable HR policy provisions, grievance mechanism, and occupational health and safety
- Implementation of a grievance redressal mechanism for workers either through a grievance redressal mechanism implemented and managed by GWVPL's contractors or through extending the grievance redressal mechanism of the GWVPL

Health and Safety clauses in Contract Agreements

In case of big contracts requiring mobilization of more than 50 workers, separate HSE plan should be prepared by the contractor. At minimum following clauses should be included in the contract agreement

- All the workers must be provided with adequate personal protective equipment (PPEs) such as safety helmet, safety shoes, safety glasses, safety harness and gloves etc. as required for different construction and operation activities;
- Adequate and appropriate safety precautions (as per applicable standards and good industry practices) shall be taken by the contractor while conducting their activities onsite;
- The PPE requirement and adequacy for their work shall be decided by GWVPL and the contractor shall implement and maintain 100% PPE compliance;
- Tool box talks should be conducted daily before starting the routine activities. A suitable format for recording the tool box talk should be filled and maintained at a site by the site safety in-charge or site manager;
- Areas being used for activities such as welding, bar cutting, bending, excavated areas and material stacking areas should be barricaded with a barricading tape and hard barricade;
- At areas in a construction or operation site, where work such as welding, cutting is carried out with aid of electrical power, proper care should be taken so that electrical wire with open joints are not spread on ground in haywire condition posing risk of electrocution and trip hazard to workers;
- Adequate safety signages indicating use of PPEs, different hazards etc. should be conspicuously displayed in local language at adequate locations within a construction and operation site;
- Walking pathways for the workers and the drive ways for the vehicles should be kept separate and properly marked;
- Vehicle parking areas should be maintained outside the areas of construction and operation activities and should be conspicuously marked;
- Adequate lighting arrangements should be made within the site if construction or operation activities are undertaken after sun set or in absence of day light;
- Heavy equipment such as hydra cranes and bulldozers or other earthmover equipment must be equipped with alert siren for reverse gear;
- Cranes, other lifting equipment, slings should be inspected thoroughly as per standard inspection procedures. Copy of such inspection records should be kept readily available for review with the respective equipment;
- GWVPL sites are strictly 'No Smoking' zones. Smoking, naked fires, possession of matchboxes, lighters (other than industrial lighters) shall be strictly prohibited inside the premises. Appropriate fire extinguishers and buckets filled with dry sand should be maintained at appropriate locations;
- First aid kits should be maintained at site at appropriate locations and workers should be made aware of whom to contact in case of injuries requiring first aid. First aid kit should be kept in charge of a responsible person who shall be readily available during the working hours. Supervisors at site should have obtained formal first aid training;
- A site specific emergency contact numbers which should include, nearest police station, hospital, fire station and the site in-charge should be conspicuously displayed;
- An ambulance van or an arrangement with a nearby hospital should be made for transportation of serious cases of accidents or sickness of any worker/s;
- Standard operating/working procedures with respect to safety should be implement for undertaking works such as working in confined spaces, working at heights, lifting of heavy parts with cranes and other lifting equipment;
- In addition to the aforementioned activities, adequate safety measures, as required, during different phases of project development shall be implemented; and
- The contractor shall comply with all HSE instructions and guidelines of GWVPL that may be updated from time to time.

Labour Clauses in Contractor Agreements

In case of labour contractors, the key labour clauses to be included in the contractor agreements are indicated below:

- Compliance to the GWVPL's terms (as per the Contract Agreement- payment terms, special terms and conditions, code of ethics and general terms and conditions etc.);
- The contractor must be registered and have a valid license under the Contract Labour Regulation and Abolition Act, 1970 and the Inter-State Migrant Workmen Act, 1979 (where applicable);
- All workers shall be provided with appointment letters, clearly stating the following:
    - Name of worker;
    - Father's Name;
    - Mother's Name;
    - Spouse Name;
    - Present Address;
    - Permanent Address;
    - Contact Number;
    - Designation;
    - Type of work;
    - Date of joining;
    - Class of worker;
    - Wages or pay scale;
    - Other payables and benefits;
    - Terms and conditions of employment and the job description; and
    - Service rules applicable
- The contractor shall maintain a copy (duly signed) of the letter of appointment in the worker's personnel file;
- Each worker shall be provided with an identity card, clearly stating Name, class of worker, age and validity;
- The identity card and letter of appointment shall be issued once the worker clears the physical fitness to work test at the site;
- The workers shall be organized into shifts of 8 hours each. Any worker working more than 8 hours shall be paid overtime for the extra hours worked, in keeping with the labour regulations;
- No worker shall be forcibly required to work for more than 8 hours a day or 48 hours in a week without payment of overtime. Overtime should not exceed the regulatory requirement as mandated by law;
- Every worker shall be given one day off in a week;
- Each worker shall be eligible for the following leaves:
    - Casual Leave;
    - Sick Leave;
    - Festivals;
    - Maternity Leave; and
    - Annual Leave.
- All Workers shall be paid at least minimum wages;
- GWVPL shall put in place the following clauses in its contractor agreements in keeping with the labour regulations:
    - Prohibition of Child Labour and forced labour;
    - Abolition of Discrimination
    - Working Hours and Overtime policy;
    - Leave policy;
    - Conviction and misconduct policy;
    - Punishment and termination policy ;
    - Wages and remuneration policy;
    - Bonus policy ;
    - Maternity benefits
- The contractor shall provide wages and benefits in keeping with the labour regulations, including service benefits, Provident Fund, ESIC (or workmen compensation), festival bonuses etc.,
- The contractor must maintain but not limited to the following registers, in keeping with the labour regulations:
    - Labour/Worker's Register;
    - Leave Register;
    - Wage register;
    - Overtime Register;
    - Register for night duty female workers;
    - Register for advance amounts ;
    - Proof of age and competence of all workers;

  - Register of cleanliness;
  - Register of the accidents and report of half yearly accidents.
- In case of sudden natural disasters or an emergency outside of human control, which results in laying off of workers, the contractor shall be liable to pay the legal arrears or full pay to the workers in keeping with the labour rules. These costs shall be invoiced and claimed from the project;
- The contractor shall initiate a group insurance policy for all of its workers; and
- No worker shall be disbarred from seeking membership in a trade union or association

Contractor Induction

Once the contractor agreement is signed, and prior to initiation of work, an initiation training will be provided to each contractor and all the contractual workers involved. This training will typically be a day long training and will be undertaken by the EHS team and HR team (possibly supported by Legal team). The intent of this training will be in keeping with the specific scope of work and aimed at familiarizing the contractor and workers with the terms of EHS and labour law compliance aspects and duties and rights of contractors and contractual workers. Job specific H & S trainings may be provided if required. In case required, the EHS team and HR/ legal team may also consider a longer capacity building workshop/ training of the contractors, depending upon present capacity.

In addition to this class room training, a day of hands on training shall also be provided to contractual workers, if required. Once all these trainings are complete, an assessment shall be undertaken of the contractors and contractual workers. Only those contractors and contractual workers, who successfully pass these assessments will be issued a Contractor/ Worker Safety Card and ID number to print as proof of successful induction completion. If the contractor or contractual worker fails to pass the training, an option of a refresher training shall be provided. A documentary proof of these inductor trainings will need to be maintained outlining the duly signed list of participants, training covered and the minutes thereunder

Monitoring of sub-contractors and suppliers

GWVPL shall monitor E&S performance of contractors and suppliers, throughout construction, from mobilization through demobilization and operations. The monitoring shall involve both visits to work locations and reviews of records kept by the sub-contractors. The frequency of site visit shield be commensurate with the magnitude of the E&S risks of the activities being carried out and permanence of potential impacts that could result from ongoing activities.

Project E&S personnel should review one or more recent inspection reports and the contractor's previous month's E&S progress report prior to visiting the site to monitor the contractor's E&S performance. Further, Project's E&S personnel shall review contractor reports and follow up as needed to ensure timely resolution of issues of non-compliance with E&S requirements. This may include further communications with contractors E&S personnel, issuance of notices of deficiency or warnings to the contractor. Further, at any stage of construction or operation or other work, if the sub-contractor has not taken appropriate action to achieve compliance with E&S requirements after repeated notices of violation and warnings of noncompliance, and significant E&S impacts are occurring or imminent, the Project should order the sub-contractor to stop work until E&S performance is brought under control and up to acceptable standards

Contractor Monitoring and Reporting

GWVPL should require contractor to monitor and keep records on E&S performance in accordance with the applicable E&S management system and plans. This may include monitoring of E&S matters, scheduled and unscheduled inspections to work locations, observations made during routine activities, desk reviews, drills, and any other monitoring protocols implemented by the contractors to ensure E& compliance. The project E&S personnel must be familiar with the contractor's monitoring and record keeping system so this aspect of the contractor's performance can itself be monitored.

Responsibilities for monitoring need to be clear between the project and contractor, and results (if project and contractor are both collecting data) must be comparable. Project should require contractor to report on E&S performance on at least a monthly basis through the construction phase and once in three (3) months during operation phase. Reported E&S information should include the following:

i. *Safety:* hours worked, recordable incidents and corresponding Root Cause Analysis (lost time incidents, medical treatment cases), first aid cases, high potential near misses, and remedial and preventive activities required (for example, revised job safety analysis, new or different equipment, skills training, and so forth).

ii. *Environmental incidents and near misses:* environmental incidents and high potential near misses and how they have been addressed what is outstanding, and lessons learned.
iii. *Major work:* those undertaken and completed, progress against project schedule, and key work fronts (work areas)
iv. *E&S staffing:* new hires and departures, and listing of current staff and titles
v. *E&S requirement:* noncompliance incidents with permits and national laws (legal noncompliance), project commitments, or other E&S requirements
vi. *E&S inspections and audits:* by sub-contractor, engineer, or others, including authorities – to include date, inspector or auditor name, sites visited and records reviewed, major findings, and action take
vii. *Workers:* number of workers, indication of origin (expatriate, local, nonlocal nationals), gender, and skill level (unskilled, skilled, supervisory, professional, management)
viii. *Training on E&S issues:* including dates, number of trainees, number of trainees, and topics
ix. *Footprint management:* detail of any work outside boundaries or major off-site impacts cause by ongoing construction – to include date, location, impacts, and action taken
x. *Details of any security risks:* details of risks the contractor may be exposed to while performing its work – the threats may come from third parties external to the project or from inappropriate conduct from security forces employed either by the project or public security forces
xi. *External stakeholder grievances:* grievance and date submitted, action(s) taken and date(s), resolution (if any) and date, and follow-up yet to be taken – grievances listed should include those received since the preceding report and those that were unresolved at the time of that report
xii. *Deficiency and performance management:* actions taken in response to previous notices of deficiency or observations regarding E&S performance and/or plans for action to be taken – these should continue to be reported until the Project determines the issues is resolved satisfactorily.

This monitoring shall be carried out by the following teams.

GWVPL Team	Aspects to be covered	Monitoring Mechanism	Timeline for Monitoring
EHS team	• PPE usage by Workers • Maintenance of Documentation	Accident Register Review	Weekly and Monthly
		Visual observation	At least weekly
		Discussion with Workers	Monthly
		Discussion with Contractor	Monthly
		Review of grievances (if any)	Monthly
HR & Legal Team	• Maintenance of Registers as required by labour laws. • Valid registrations under labour laws • Payment of wages • Overtime work done and payment for the same • Labour working conditions- especially labour camp monitoring • Child labour and forced labour issues • Other compliances against labour law	Registration and certifications review	Based on validity of documents submitted
		Registers required by law	Monthly
		Records/ Registers of wage payments and overtime	Monthly
		Review of identification documentation of workers	At the time of contractor signing and renewal
		Visual reconnaissance of labour camp	Weekly
		Discussion with Workers	Monthly
		Discussion with Contractor	Monthly
		Review of grievances (if any)	Monthly
Finance Team	• Compliance to general terms and conditions of contract • Compliance to timeline • Compliance to invoicing terms and conditions	Visual reconnaissance Documentation review	In keeping with milestones identified in agreement

Approving Invoices for Payment

EHS Manager or representative will be part of the process for signing of all payment to contractor(s) and supplier(s) EHS Manager will work closely with the Project manager or finance department to determine if there are any outstanding EHS&S items and whether including the full or partial payment under specific line item of the bill of quantities will be withheld, either temporary or permanently.

E&S Review of Contractor(s) Invoices

- Temporary withholding shall be done in case of repeated minor violation of EHS&S requirement that are not leading to significant impacts on workers, external parties or resources; minor violations that are not corrected after repeated warnings of first-time major violation that can be corrected easily and that have not led to permanent EHS&S impacts. The withheld amounts shall be paid upon sub-contractor(s) correction of the defiance to the GWVPL's satisfaction
- Permanent withholding will be done for minor violations that are not corrected after repeated warnings and that could result in significant impacts. Some portion of such withholding may be released upon satisfactory resolution of the issues, but some significant portion will be permanently withheld as a penalty to discourage repeated incidents
- Payment that are withheld either temporarily or permanently will be all or part of the payment specified for a line time in the bill or quantities, which in turn will be the payment due for a separate portion of the total workers. GWVPL and its contractor EHS&S personnel will work with the project managed and others as need to arrive at the amount to be withheld This amount will not base directly on the cost of compliance but rather will be somewhat higher than this amount, and based on a specific percentage of the line item in question
- sub-contractor(s) will be notified of the specific amount that must be taken in order to receive further payments for the works in question or to receive payment that has been temporarily withheld.

In case if the contractor(s) does not take timely action to reach compliance with EHS&S requirement, GWVPL EHS Manager and the project manager or finance department will continue to appropriate action to encourage compliance, which could include orders to stop work, withholding of further payments or escalation of the issue to higher management of GWVPL. If significant impacts are occurring or imminent. GWVPL may notify the contractor(s) that another external party will be brough in to deal with the issue and the payment of the contractor(s) will reduced by the amount paid to the appointed external party.

APPENDIX 6: POLLUTION PREVENTION AND MANAGEMENT PLAN

Project construction and operation activities have the potential to generate a range of pollution sources that require proper planning from the outset to avoid resulting in impacts to human, ecological or other environmental receptors. These includes accidental emissions to air, water and soil, amongst others. GWVPL seeks to proactively manage such potential pollution sources and to this effectively will undertake the following management plan into consideration. The management plan is applicable to all GWVPL staff, contractors and sub-contractors. The Plan covers air emission, odour, leachate, fly ash, water, noise, waste management and outlines actions and measures necessary for the effective prevention.

Scope

- Outlines actions and measures necessary for the effective prevention of pollution;
- Covers both accidental and intended emissions to air, noise, water and soil;
- Specific control measures to be implemented by GWVPL and its contractors (and subcontractors), to achieve this.

Responsibility & Requirement

GWVPL will be obtaining all necessary consents, licenses and permissions for their activities as required by current legislation governing the protection of the environment. The Project also needs to be aligned with the requirements of IFC PS and WBG guidelines.

This plan should be viewed as an evolving document(s), tailored to suit specific activities or work areas, and be continually reviewed at meetings for the duration of the works.

Pollution Prevention & Mitigation

There are a number of potential sources of pollution from a waste to energy plant which may adversely impact upon the nearby sensitive receptors.

1. Air Emission Management

Air emissions from a WTE plants depends on the specific waste composition and the presence and effectiveness of air pollution control systems. Polluting emissions includes carbon dioxide (CO2), CO, NOX, sulphur dioxide (SO2), particulate matter, ammonia, amines, acids (HCL, HF), VOCs, dioxins/furans, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), metals (Hg), and sulphides, etc., depending on the waste content and combustion conditions.

The following measures will be undertaken to prevent, minimize, and control air emissions:

Activity	Mitigation Measures
Construction phase The likely emissions from construction activities will include the following • Fugitive emissions from site clearing, digging, filling, material handling, transportation, use of construction machinery, etc.; • Fugitive dust emission from unpaved roads; • Dust emissions from batching plant; • Vehicular emission from increased traffic volume from vehicles used for transport of construction material; equipment and accessories; • Emissions from operation of emergency diesel generator;	Adopted Control Measures • Speed of vehicles on site is limited to 10-15km/h which helps in minimizing fugitive dust emissions due to vehicular movement. • No heavy construction work was undertaken. Most of super structures are pre-fabricated. All earth work was not carried out simultaneously, and was undertaken in phases for minimization of dust and particulate matter during excavation and other construction activities. **Specific to associated TL, water pipeline and treatment system** • Excavated soil at the construction site will be handled adequately and top soil is heaped and water sprinkling is done to minimize dust generation • Emissions from the D.G. set and other stationary machines will be controlled by ensuring that the engines are always properly tuned and maintained

Activity	Mitigation Measures
	• Minimizing of stockpiling by coordinating excavations, spreading, re-grading and compaction activities • Preventive measures such as storage of construction material in sheds, covering of construction materials during transportation will be undertaken, for reducing dust emissions Additional Mitigation Measures • Vehicles entering site should be Pollution Under Control (PUC) certified • Periodic inspection of construction equipment and DG sets should be conducted by the onsite contractor. • DG sets (If any) used for power back up should be provided with adequate stack height as per CPCB norms • A strict Project speed limit of 30 km/hr to be enforced for vehicles using un-metaled tracks and the RoW • Regular maintenance of construction vehicles and machinery • Use of Low-Emission Equipment's for minimize air pollution during the construction process. • Scheduling construction activities during off-peak hours to reduce exposure to pollutants. • Idling of vehicles and equipment must be prevented • Cease or phase down work if excess fugitive dust is observed. Investigate the source of dust and ensure proper suppression measures • Using windbreaks, netting screens or semi-permeable fences to reduce dust emissions from working areas close to sensitive, residential or agricultural locations or natural habitats • Adequately sized construction yard will be identified at the site for storage of construction materials, equipment tools, earthmoving equipment, etc. • Fuel tanks adequately designed to minimize fugitive emissions and welding gas cylinders will be stored in a secluded area within project site
Operation phase Flue gas emissions, particulate matter emissions Leakages & shutdowns	Proposed Control Measures • Adequate air pollution control measures such as flue gas cleaning system, adequate stack height shall be provided before commissioning of the Plant. Additional facilities required, if any, to achieve the standards laid down by the statutory authority shall also be made along with. • The waste will be transported in closed and covered waste collection trucks • Provision of closed waste handling and storage areas • Internal Roads are made of Concrete instead of asphalt and least distance will be travelled by the material within the facility.

Activity	Mitigation Measures
	• Separate waste segregation/MRF Facility with AI driven technology will be developed with no human intervention • Use negative pressure in processing buildings to manage odor • Waste will be incinerated at high temperatures and no chemical treated with any chlorinated disinfectants will be undertaken prior to incineration • Mist cooling is planned to keep down dusts, especially during and prior to loading or other handling procedures • Waste segregation and/or presorting to avoid incineration of wastes that contain metals and metalloids that may volatilize during combustion and be difficult to control through air emission technology (e.g., mercury and arsenic) • Plant shall be operated (combustion chambers) with such temperature, retention time and turbulence, as to achieve total Organic carbon (TOC) content in the bottom ash less than 3%, or their loss on ignition is less than 5% of the dry weight. • Ensure temperature within combustion/gasification chambers (always above 850 °C) avoids the formation of dioxins and furans • Waste introduction into the incinerator only after the optimum temperature is reached in the final combustion chamber • The waste charging system is interlocked with the temperature monitoring and control system to prevent waste additions if the operating temperature falls below the required limits • Provision of flue gas treatment system to control acid gases, particulate matter, and other air pollutants • Minimize formation of dioxins and furans by maintaining the boiler temperature above 850°C • Periodic monitoring of concentrations of PCDDs, PCDFs, other combustion products, and heavy metals in flue gas • Reduction in the generation and emission of PCDDs and PCDFs, by ensuring rapid cooling of flue gas as well as good turbulence of the combustion gas, high temperature, adequate oxygen content, and adequate residence time. • Design stack heights according to Good International Industry Practice (GIIP) to avoid excessive ground level concentrations and minimize impacts, including acid deposition • Implementation of Air Pollution Control Devices to manage emissions from the facility • Implementation of continuous emission monitoring systems (CEMS) to monitor the plant's emissions in real-time. Regular reporting of emissions data to relevant environmental authorities promotes

Activity	Mitigation Measures
	transparency and compliance with air quality regulations. • Provision of greenbelt and landscape area within the Project premises. • All the vehicles and other equipment will be periodically checked to ensure compliance to the emission standards. • Provision of Ash handling system with silos, hoppers, and submerging of bottom ash • Bag Filters with PTFE bag material will be used for fly ash collection and bottom ash will be collected • GWVPL will implemented a combination of both ESP and high efficiency of bag filters in series. ESP will acts act as a pre-dedusting mechanism (Efficiency of ESP design is around 90-95%) before addition of Activated Carbon and Lime dosing for removal of Dioxin & Furan Compound, heavy metal oxide, HF removal and acid gas control. Bag house acts as final filtration system with high efficiency PTFE fabric filters (99%-99.7%). • Development of belt area within the plant premises that may support in suppression of fugitive emissions • Periodic maintenance of the bag filter & ESP will be carried out to avoid dust emissions during removal of fly ash. • A continuous emission monitoring system to be installed at site as per conditions stipulated in the CTO to display emissions for NOx, PM (PM10 & PM2.5), CO or as included in CTO • Steam Turbine shall comply with the relevant International Electro-technical Commission (IEC) standards or equivalent Additional Mitigation Measures • According to the Point Source Air Emissions Prevention and Control Technologies provided in WBG 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%. • Periodic monitoring (quarterly) of concentrations of PCDDs, PCDFs, other combustion products, and heavy metals in flue gas, i.e. stack monitoring as well as ambient air quality monitoring to be undertaken on quarterly basis • Use extraction system to remove dust from working areas, buildings, and storage vessels, and treat as needed to control particulate emissions • Manual segregation and removal of chlorinated plastic and other elements unsuitable for thermal treatment. • Water Sprinkling to be done at the access road to manage dust emissions from the vehicles transporting waste to the plant.

Activity	Mitigation Measures
	• Implement good housekeeping practices to reduce fugitive emissions and control dust and particulate matter within the facility. • As stated in the General EHS Guidelines, emissions from a single project should not contribute more than 25% of the applicable ambient air quality standards to allow additional, future sustainable development in the same airshed[86]. • Fly Ash will be transported in covered trucks and tippers to the fly ash recipients. Fly ash generated from bag filter should be sent to cement plants. GWVPL to discuss with VMC for disposal of ash in line with MoEFCC draft notification no. G.S.R. 285(E) dated 22/04/2021, with previous notification on 2016.

2. Odour Management

The most aggravating problem in a WTE plant is odour generated from the MSW waste and its components. Odours occur due to the presence of various gases such as ammonia, methane, etc. Limiting odour from the waste recycling facility can best be achieved through employing effective site management and good general practice. For this purpose, GWVPL will ensure the following:

- Odours from MSW delivery vehicles will be minimised by the use of enclosed vehicle containers. Also, the containers will be closed after unloading, so that the empty trucks are also not open to the atmosphere.
- The storage bunker will be designed to provide a slight negative pressure, minimising the risk of any odours being released.
- When the WTE plant is in operation, odour control will be achieved by drawing air from the storage bunker through into the combustion system, which will need air to ensure effective combustion of the MSW.
- Odour levels will be monitored regularly (quarterly) around the plant perimeter to assess the effectiveness of the odour control measures being applied.
- In case any complaint regarding odour generated at the plant is received, it will be managed in accordance with the Grievance Redressal Mechanism and will include an investigation into the source of the odour and whether any additional mitigation measures are required (such as use of the deodorising spray). If necessary, operational procedures will be amended as appropriate following the outcome of the investigation.
- Compact and cover waste promptly after discharge from the vehicle delivering the waste;
- Minimize open tipping face area;
- Dispose of odorous sludge in covered trenches;
- Restrict acceptance of loads known to be particularly odorous;
- Restrict tipping activities during periods of adverse weather (e.g., wind toward sensitive receptors);
- Aerate leachate storage areas.

GWVPL will also undertake sampling of odours and conduct odour monitoring in high odorous areas of the plant with the help of the third party laboratories. Odour monitoring and management shall be as per the Guidelines issued by Central Pollution Control Board (CPCB) from time to time, for waste management sites. They may undertake workplace monitoring of various gases within the plant premises and adopt adequate measures.

3. Leachate Management

Leachate from the waste storage bunkers contains dissolved constituents derived from the interstitial waters of the disposed waste as well as its degradation products. It also may contain some suspended solids, including pathogens. If

[86] For example, the US EPA Prevention of Significant Deterioration Increments Limits applicable to non-degraded airsheds provide the following: SO2 (91 µg/m3 for 2nd highest 24-hour, 20 µg/m3 for annual average), NO2 (20 µg/m3 for annual average), and PM10 (30 µg/m3 for 2nd highest 24-hour, and 17 µg/m3 for annual average).

not collected and treated, leachate can migrate and contaminate soil, groundwater, and surface water. GWVPL will ensure to install a leachate filtration and injection system, to collect leachate from bunker, fuel collection area and waste processing area into raw leachate collection pit, to be later disposed by pumping into the furnace; step of which are mentioned below

- All leachate collected from all different sources will be collected in separate storage areas.
- Leachate will be collected from pre-processing unit and main bunker. This leachate will be pumped to sludge drying beds
- From storage tank, leachate can also be pumped to into furnace by crusher type two pumps (one in operation, one in stand-by) via injection lances with retractable mechanism (pneumatically operated) on the furnace.
- The leachate injection system will be provided with automatic flushing system to avoid clogging of nuzzles.

4. Fly Ash Management

Combustion of wastes generates ash and other material remaining after incineration. GWVPL will ensure that fly ash will be temporarily collected and stored in the plant premises to be later disposed-off as per the Fly Ash notification, 2016 and the amendments thereafter; in all the plants. Also, ensure to quench the ash with treated wastewater to avoid fugitive dust emissions

In additions to above, GWVPL will ensure to undertake following measures to prevent, minimize, and control solid waste from incineration:

- Design the furnace to, as far as possible, physically retain the waste within the combustion chamber (e.g. narrow grate bar spacing for grates, rotary or static kilns for appreciably liquid wastes), and use a waste throughput rate that provides sufficient agitation and residence time of the waste in the furnace at sufficiently high temperatures, including any ash burn-out areas, in order to achieve a total organic carbon (TOC) value in the ash residues of below 3 weight percent and typically between 1 and 2 weight percent;
- Manage bottom ash separately from fly ash and other flue gas treatment residues to avoid contamination of the bottom ash for its potential recovery;
- Fly ash collected from bag houses will be contaminated and will be categorized as hazardous in nature. ESP will be added as pre-deduster which will significantly reduce the quantity of hazardous fly ash from bag house.
- Silos will be developed for Fly ash handling and the bottom ash will be submerged and sent to sludge drying bed
- Bottom Ash quenching will be done using the waste water generated from the secondary treatment process

Additional Mitigation Measures Recommended includes:

- Separate remaining ferrous and non-ferrous metals from bottom ash as far as practicably and economically viable, for their recovery;
- Treat bottom ash on or off-site (e.g., by screening and crushing) to the extent that is required to meet the specifications set for its use or at the receiving treatment or disposal site (e.g., to achieve a leaching level for metals and salts that is in compliance with the local environmental conditions at the place of use);
- Bottom ash and residuals should be managed based on their classification as hazardous or non-hazardous materials. Hazardous ash should be managed and disposed of as hazardous waste. Non-hazardous ash to be sent to fly ash utilizing units
- Fly ash shall be conveyed in closed conveying systems that end up in storage silos whose exhaust air can be dedusted via a central dedusting system
- The top of the bag filter housing shall be enclosed and shall be connected to the central dedusting system (while pulling/replacing bag-filter hoses)
- GWVPL to conduct characterization analysis of ash (occasionally) as per IS 3812 covering all the parameters stipulated by BIS to identify any hazardous content before its disposal through VMC trucks. If fly ash is identified as hazardous, it is to be sent to hazardous waste landfill site through authorized recyclers. Records of hazardous ash generation and disposal to be maintained.
- Hazardous ash to be stored and handled as per the hazardous and other waste (management and transboundary movement) rules, 2016 as amended.

- GWVPL is recommended to obtain chain of custody documents from Vadodara Municipal Corporation for final disposal destination to ensure that the hazardous waste is being disposed at the authorized hazardous waste landfill as per the applicable Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, as amended.
- GWVPL to also establish through relevant agencies whether disposal site (where hazardous ash is disposed) is being operated to acceptable standards before disposal. If this is not established, GWVPL shall consider alternative disposal options, including the possibility of developing its own recovery or disposal facility at the project site or else reduce generation of hazardous ash.
- If GWVPL is uncertain that the disposal conducted by VMC is as per the applicable rules, GWVPL will themselves take the responsibility of disposal and will ensure disposal is conducted to the hazardous waste authorized site as per the applicable norms.
- Non-hazardous ash may be disposed of in an MSW landfill or considered for recycling in construction materials or provided to cement and fly ash brick manufacturers
- Promote use of fly ash generated from bank zone and ESP for making non-leachable concrete pavers.

5. Noise Management

GWVPL will ensure to restrict noise level within the permissible limit, as per the statutory requirements. To confirm this, following measures will be undertaken:

- Noise emission generated from DG sets to be used for emergency power supply will be minimized through provision of acoustic enclosures and other noise generating activities will be restricted to day time only.
- Most of the noise generating activities and operation will be restricted to daytime only, if possible.
- Principal sources include exhaust fans and resulting in noise from the outlet of the stack; cooling system (for evaporation cooling and especially for air cooling); and turbine generators. Therefore, efficient and less noise generating machinery will be used for such purposes and regular maintenance and upkeep of the machinery will be done to ensure smooth operations.
- Noise emission from vehicular traffic for staff mobilization, waste & ash transportation – noise monitoring is conducted on half yearly basis, anti honking sign boards are placed in parking area and entry/ exit points.

6. Storm Water Management

Based on the master planning and contours, Plant area has been segregated in such a way to prevent crisscross movement of storm water drainage between operations area, ash handling area and landscape area. Site is sloped predominately towards south-west. Water collected in the catch pits installed within the Project site is collected through rain water pipe and is discharged into the percolation wells.

7. Waste Management

Solid waste and hazardous waste will be generated due to plant construction and operation activities. The solid waste generated by the project will consist of labour camp waste, garbage waste, metal scrap, and excess construction materials. The main types of waste that will be generated during construction, operation phase are mentioned below.

S. No.	Waste Type	Source	Method of Disposal
Non-hazardous waste			
1	Domestic solid waste	Labour activities	Waste will be segregated onsite and will be disposed of at site as approved by local authority.
2	Construction Debris (excavated earth)	Construction of plant, access road, etc.	Excavated materials to be used for backfilling and levelling and other debris shall be used for road construction.
3	Sludge from Wastewater Septic Tanks	Labour Camp	Mobile toilets with temporary septic tanks will be provided at the construction site as per IS 2470-1995 Part I and Part II specifications. The septic tanks will be emptied periodically through truck mounted tanker for offsite treatment and disposal by approved vendors. Collected and disposed of through contractors

S. No.	Waste Type	Source	Method of Disposal
4	Wastewater	Project	A water treatment system will be developed within the project area and the wastewater will be treated as required. Also, the waste water generated will be reused within the project site
5	All non- recyclables	Construction activities and Labour camps	Collected and disposed of by the contractor at designated landfill sites.
Hazardous waste			
6	Used oil/ waste oil, Waste Drum (Oil drums/ Chemical drum/ Misc. drum)	DG set, construction machinery	Collected and disposed of through approved recyclers in accordance to The Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.
7	Oil contaminated rags, Oil Sludge, Oil-Soaked Cotton, Used insulation Material (Glass wool /Mineral Wool), Used Grease	Maintenance activities	

General Procedures

- The same checklist shall be circulated to the respective contractors to inventories the solid waste generated in weekly basis. Record of all Solid Waste and Solid Waste Disposal on construction site shall be maintained.
  - Waste Storage and Handling, Management and Disposal
- A source-segregated waste storage system is recommended to be adopted inside the premises. The biodegradable waste shall not be mixed with any other type of wastes such as domestic hazardous wastes or construction and demolition waste.
- The concept of 3 Rs- Reduce, Recycle and Reuse shall be adopted to manage the non- hazardous solid waste generated within the premises.
- Quality housekeeping should be maintained by regular inspection and checking.
- Training on solid waste management procedures shall be part of the induction training for workers/ employees.

Construction and Demolition (C&D) Waste Management

- The construction waste largely comprises of earth, stones, concrete, bricks, lumber, roofing materials, plumbing materials, electrical wires etc. The components of construction waste include – major components - cement concrete, bricks, cement plaster, rubble, steel (from RCC, door/window frames, roofing support, railings of staircase etc.), stone (marble, granite, sand stone); and minor components - conduits (iron, plastic), pipes (GI, iron, plastic), electrical fixtures (copper/ aluminum wiring, Bakelite/ plastic switches, wire insulation), panels (wooden, laminated), others (glazed tiles, glass panes).
- The civil contractor responsible for the construction activities shall be responsible for sound handling and management of the C&D and municipal waste at the construction site including handling, storage, collection, re-use and clearing of the wasted construction material. The non-utilizable and utilizable C&D waste generated at site will be stored in a segregated manner at the construction site.
- Dumping of C&D waste in non-designated sites shall be strictly prohibited.
- All construction/demolition waste will be stored within the site itself. Metal mesh screen or GI screens will be provided so that the waste does not get scattered.
- C&D waste shall be stored separately and not allowed to get mixed with other waste (e.g., municipal / biomedical / e-waste / hazardous etc.).
- C&D waste shall be stored at the construction site in either skips or suitable containers and shall be directly transported to a suitable disposal facility by engaging services of an authorized collection agency
- Scrap metals shall be stored separately and shall be hauled to scrap metal dealers. The scrap metal skip should be covered when not in active use.

- Scrap metal from construction, renovation, or maintenance work shall be deposited separately. Oils shall be purged prior to disposal of metals into this container.
- The storage bins/ designated area shall be in accordance with the quantum and nature of the C&D waste.
- Clearly label the containers, preferably with waterproof signage, detailing which material can be disposed of in each one.
- Efforts shall be made to reduce the rate of waste generation by adopting efficient construction techniques and limiting waste generating activities. The measures for controlling construction waste may include limiting site clearance activities, planned stocking and gathering of construction materials and equipment, fencing around the construction yard, maintaining existing right of way to carry construction materials, adopting proper sanitation system for employees, banning of waste burning, and quality housekeeping.
- A designated place shall be identified and well-labelled for waste stocking with appropriate impermeable linings.
- For controlling runoff from construction yard and liquid waste, appropriate measures such as provision of a garland drain will be made.
- In case of road construction within the premises, empty containers of paint, prime coat, tack coat (considered as hazardous waste) shall be stored at a designated place / or a skip and sent to an authorized hazardous waste handler. All the records of the sale of items to authorized hazardous waste vendors will be preserved 7 years after completion and final payment of the contract.
- Company shall pay relevant charges for collection, transportation, processing and disposal of C&D waste generated by them, as notified by the concerned authorities. Payment shall be as per the provisions made under the Construction and Demolition Waste Management Rules, 2016 and is dependent on the quantum of C&D waste generated. [if Company generates more than 20 tons or more in one day or 300 tons in a month, then payment for waste processing and disposal shall also be made along with charges for storage and collection]

Biodegradable waste including Horticultural waste (Green Waste)

- All the biodegradable waste shall be stored separately at their source of generation and not be mixed with any other types of waste such as hazardous waste, C&D waste, dry recyclables. The biodegradable waste generated can be used in the boiler.

Dry Trash (Recyclables) Management

- All the dry recyclable items such as paper, plastic sheets, plastic cups, plastic cans, PET bottles, metal scrap, cardboard box etc. shall be collected and stored separately and not be mixed with any other types of waste such as hazardous waste, C&D waste. Such waste can be fed in the boiler and the material which cannot be fe din tehe bpooiler can be sold to scrap dealers .
- Glass waste including empty glass bottles, broken glass, window panes shall be stored separately in a container/ skip and sold off.
- The dry trash items waste shall be collected from all the points of generation, by the housekeeping staff and brought to Blue colored, high capacity waste containers, located at designated locations within the premises.

Sewage Disposal

- Appropriate number of toilets, separate for male and female employees and workers shall be provided in office area and shop floor and shall be maintained in hygienic conditions. The toilets shall be connected to sewerage system for its ultimate treatment in Sewage Treatment Plant for suitable capacity or connected to soak pit and septic tank systems.

Hazardous Waste Management

Legal Compliances:

- Company to identify all the hazardous waste generated during construction and operation phase as per the Hazardous and Other Wastes (Management and Trans-Boundary Movement) Rules, 2016 (HMR 2016).
- Company shall make an application in Form 1 to the State Pollution Control Board (SPCB) and obtain an authorization for managing hazardous and other wastes. SPCB, upon being satisfied, will grant an authorization in Form 2 which shall be valid for Five Years.
- Company shall be responsible for safe and environmentally sound management of hazardous and other wastes by sending or selling the waste to authorized actual user or by disposing it in an authorized disposal facility.

Storage of Wastes:

- As per Rule 8 of the HMR 2016, hazardous wastes cannot be stored on-site for a period exceeding 90 days. In case of storage of hazardous wastes on-site for a period in exceedance of that specified by the SPCB, management is required to intimate the same to the SPCB and obtain written permission to do so.
- A hazardous waste inventory form shall be maintained onsite by EHS Manager;
- Company shall ensure that potential hazardous solid and liquid wastes (such as used/ waste oils, etc.) are not disposed of in dumpsters designated for general domestic trash.
- Company shall ensure provision of secured storage (with adequate secondary containment) for all hazardous wastes generated on site.
- All containers containing liquid hazardous material (such as used oil, used transformer oil) should be kept in bunded storage or on bund trays.
- The designated hazardous waste storage area shall have proper enclosures with conspicuous signage, including safety requirements such as fire extinguishers, appropriate PPE and spill management kit (s).
- In order to have appropriate measures to prevent percolation of spills, leaks etc. to the soil and groundwater, the facility shall ensure that the storage area is provided with impervious flooring.
- Oil soaked rags, used filters, used Personal Protective Equipment (PPE) (such as gloves, masks, etc.), empty chemical containers and liners are considered as hazardous and need to be disposed of as hazardous waste to SPCB authorized waste vendors.
- The hazardous waste containers shall be provided with a label in the prescribed format under the HMR 2016. The labelling shall be done as per Form 8 of HMR 2016.
- Company shall maintain a record of hazardous and other wastes managed by them in Form 3 and prepare and submit to the SPCB, an annual return containing the details specified in Form 4 on or before the 30th day of June following the financial year to which that return relates.
- In case of spills / leaks, the facility shall ensure usage of spill management kit for cleaning instead of water. All areas where there is a likelihood of spillages to occur should be provided with a drain outlet that outfalls into a sump. The sump should be constructed of impervious material and its integrity tested periodically. The sump should be cleaned on a regular basis. Contents of the sump are to be treated as hazardous wastes and should be disposed of to SPCB authorized waste vendors only.

Authorized Access

- The facility shall ensure usage of adequate locks; control the issue of keys; and provision of fencing where appropriate.
- The hazardous waste storage area should be fenced properly and sign of "Danger" should be placed at the storage site.
- Signboards showing "Restricted Entry", "Hazardous Waste Storage Area" and the “Category of Wastes stored-", shall be displayed outside the earmarked area for storage of hazardous waste. "No Smoking" signs should also be placed conspicuously wherever any ignitable or reactive waste is stored.

Disposal of Waste

- The facility shall ensure disposal of the hazardous waste to a SPCB authorized vendor/ facility only.
- The facility shall ensure issuance of gate pass (challan) for all the hazardous wastes entering/leaving the site
- The facility shall ensure that the hazardous waste authorization of the vendor is checked and copies of the vendor operating permits and authorizations are maintained.
- Before transportation of hazardous wastes, the facility shall provide the transporter with relevant information in Form 10 (Waste Manifest) and Form 11 regarding the hazardous nature of the wastes and steps to be taken in case of emergency.
- Used/ Waste lead acid batteries (for e.g. lead-acid batteries associated with diesel generators) are to be handed over to a SPCB registered recycler as per the Batteries (Management & Handling) Amendment Rules, 2010 or to the supplier on a buy-back basis.

NOTE:

- Import and export of hazardous waste is not permitted for dumping and disposal.

Import and export of hazardous waste is permitted as raw materials for recycling and reuse, subject to the compliance of procedure prescribed involving the grant permission from MoEFCC for such import and export hazardous waste.

Monitoring

- The ACEL at corporate level will regularly inspect GWVPL's work to ensure compliance with the Pollution Prevention Plan;
- Plant level EHS Manager will perform regular checks of plant and equipment to identify any exhaust gas leakages/ odor leakages to confirm the condition of the plant;
- Regular checks for visual evidence of pollution, contamination, hygiene and safety will also be made in the plant premises and working areas;
- On site meetings/Inspections will be carried out as necessary to confirm the appropriate use of mitigation measures identified within the GWVPL's environmental plans relating to pollution control. These meetings/Inspections will highlight any further issues/measures which may be relevant either prior to commencement or during the works;
- Records will be kept of all inspections / findings for review for discussion during regular meetings; and
- Plant level EHS Manager will maintain a Pollution Prevention Measures Register (PPMR) in which all mitigation measures put into place will be listed, and will be audited monthly to assess the requirement for maintenance.

Records

Following records but not limited to the following shall be maintained by GWVPL at its plants:

- Reports on Pollution control equipment installed;
- Environmental monitoring reports (air, noise, water and soil) as prescribed by the SPCB in the consents;
- Ash generation and its disposal;
- Waste water generated and treated;
- Waste register for recording the generation and disposal of various categories of waste produced at sites;
- Hazardous waste manifests copies; and
- Environmental Statements reports.

The records will be kept for all initial, final and routine monitoring / inspections of construction areas, as well as ecological and environmental issues. These records will be stored in an agreed location within the plant and be available for internal and external monitoring as required; and

Record sheets will detail the date, location of inspection, frequency, findings, appropriate person/s notified and identified actions, as required

Training

- All employees, subcontractors, suppliers and visitors to the site will be notified via induction of the requirements on site for pollution prevention;
- Through tool box talks, site personnel and subcontractors will be educated on those aspects of environmental management as appropriate to the task assigned to them;
- Consultation meetings will include discussion on the works to be undertaken, review of other plans and agreement on required mitigation and pollution prevention measures. Measures agreed at such consultation meetings will be disseminated to the relevant employees, subcontractors, suppliers and other appropriate persons via tool box talks and formal communications (email / memo), particularly where required for record purposes (e.g. variations, auditing and monitoring records);
- GWVPL will ultimately be responsible for overseeing and enforcing pollution prevention procedures such that potential adverse impacts to human health or the environment from any activities involving handling of potential pollutants are avoided or mitigated. For the avoidance of doubt, pollution prevention procedures include, but are not necessarily limited to: all aspects of traffic, plant and materials management, air emission management, noise level management, surface water and drainage management.

APPENDIX 7: TRAFFIC MANAGEMENT PLAN

Scope

GWVPL to include the following information in the project specific traffic management plan:

- Traffic Management inside the Plant
- Traffic Management for the transportation of material and movement of staff
- Traffic Management for pedestrian
- Any effect on existing neighboring property traffic or access.

Traffic Management

The project in construction and operation phase will add to traffic on the access roads from morning to evening hours. Considering the present scenario, where the waste collection vehicles from Vadodara city and the waste collection centers are transporting the waste using the same roads to dump the waste at waste dumping site which is adjacent to the Project so no major increase in traffic due to the project is anticipated. However, it is to be noted that the fresh waste brought in to the project site from Vadodara city is managed and handled by Vadodara Municipal Corporation and GWVPL has no role in fresh waste transportation from the city to the collection centres and then further to the Project site. However, GWVPL will ensure that the community safety and vehicle maintenance and management measures are communicated to the waste transportation contractors bringing the fresh waste to the project site.

Following mitigation measures shall be incorporated by GWVPL at the project site:

- Proper management of vehicular movement within the site, especially during peak hours;
- Different time slots will be allotted to different waste collection centres. The same will be conveyed to all to prevent any inconvenience to others.
- GWVPL shall ensure adequate lighting is provided within the plant premises
- Stopping/Parking of vehicles in between the roads to be discouraged.
- Loading/ unloading area will be located within the plant premises. Entry/ exit of all the vehicles will be made via the separate truck entry area designated by GWVPL. Vehicular movements within the premises will be managed by trained traffic management operatives. All vehicles will enter and exit the site premise in forward facing direction. It will be ensured that vehicle driver is aware of the plant layout and safe working procedures within the plant premises.
- The movement of heavy, wide or slow-moving loads will be planned at times when traffic volume on the roads concerned is least.
- Appropriate supervision will be provided to control flow of traffic when machinery needs to cross roads.
- Wheel washing on site and road sweeping will be carried out to keep the local highway clear of mud and debris.
- Training and testing of heavy equipment operators and drivers, including vision tests, with records kept of all trainings.
- GWVPL shall dedicate a separate area for staff who will require daily access parking area within the Plant. Dedicated parking area for visitors shall be provided.

Transport of construction materials

- Impose and enforce speed limits (20 km/h on the internal access road and max speed limit of 80 km.hr on NH) on all haulage vehicles
- Vehicle route planning and alternative route map will be prepared and explained to the drivers
- Vehicles carrying fine and coarse materials like sand, gravel, cement etc. will be covered appropriately so as to avoid any deposition of loose materials on approach roads.
- Maintaining records of all accidents involving project vehicles and implementing a traffic complaint and corrective action procedure.
- Liaison with the police and other authorities prior to the movement of any abnormal loads or any over dimensioned consignment.
- The contractor should avoid over-loading of the trucks that transport material to construction sites.
- Peak hours inroads with moderate to high traffic should be avoided.

- The contractor shall minimize possible public nuisance due to dust, traffic congestion, air pollution, etc., due to such haulage;
- If local roads are used, routes are to be selected based on the truckload; loads should be divided to prevent damages to local roads and bridges.
- Speed limits as nationality stipulated for haulage must be maintained
- All vehicles used for haulage should be in good condition.
- If there are damages to local roads and other utilities due to hauling inroads caused by the contractor. The contractor shall attend to repair all damaged infrastructure/ roads if needed through relevant authorities
  A detailed plan for signage around the construction areas to facilitate traffic movement, parking facilities, provide directions to various components of the works, provide safety advice and warnings will be prepared. All signs shall be posted in both English and regional dialect.
- The parking of vehicles along footpaths, single lane roads shall be prohibited on community roads and public roads in the vicinity of the project site.
- The project traffic or any project activity will not obstruct the access to neighbouring properties.
- Ambulance and fire services will be consulted regarding road diversions. Road diversions will not increase the response time of these services to local communities.

Vehicle Maintenance & Management

This shall include the compliance of all vehicles with all safety related specifications (such as the fitting of the correct tyres, with adequate reserves of tread, safe for movement in snow areas, inflated to manufacturer recommended levels), as well as mechanically maintaining vehicles to manufacturer specifications so as to minimize fuel consumption as well ensure safety on road. The following requirements to be communicated to the contractor deploying vehicle.

GWVPL will ensure the following in respect of vehicle compliance, maintenance, noise and emission standards:

- Regular vehicle inspection to ensure compliance with statutory requirements (PUC, etc.)
- All vehicles shall be maintained so that their noise and emissions do not cause nuisance to workers or local people.
- New vehicles/equipment purchased ‘as new’ after contract award shall comply with emission standards in force on the purchase date.
- Older vehicles/equipment not purchased ‘as new’ after contract award shall be maintained so that noise and emissions levels are no greater than when the vehicle/ equipment was new.
- Avoidance of passage through and near settled areas during night-time hours.
- Oil and fuel leaks must be addressed within 24 hrs of observation or reporting on any vehicle or construction equipment.
- Vehicle maintenance and management parameters will form a critical component of key performance indictor for the contractor responsible to maintain their vehicles.
- All heavy vehicles like cranes, battery operated trolleys etc. will be provided with reversing siren.
- Provision for dedicated parking area will be made near the project office for parking the private vehicles of construction personnel.
- Concrete paved areas will be provided for parking of vehicles and overhaul provisions will be made for any accidental spill of oil or fuel during parking or whenever the vehicle is idling.
- Sufficient parking area will be provided within the Plant or sufficient parking space will be provided outside the premises. Parking outside the Plant will be managed by GWVPL and will be ensure that transportation vehicles do not cause inconvenience to the surrounding community.
- Different time slots will be allotted to different suppliers. The same will be conveyed to all to prevent any inconvenience to others

Driver Training

The project EHS requirements and Indian regulatory requirements specify the requirements for driver training. GWVPL will ensure that all drivers and driver trainers are suitably trained in accordance with driver training requirements. Drier training can be either be provided by municipal corporation since the drivers are engaged by municipal corporation, as the waste transportation is responsibility of municipal corporation. In case the trainings are not being provided by the municipal

corporation, GWVPL to either include driver training on-site, or can collaborate with municipal corporation to be provided offsite.

The following issues and documents are to be addressed during driver training in a language (regional dialect) mostly understood by drivers:

- Trip Management Plan;
- Daily pre-use vehicle inspection by the driver;
- Safety kit in vehicle;
- Health and Safety Standards and Practices and;
- National and local legal requirements to drive a vehicle.

Unauthorized passengers in project related vehicles will be strictly prohibited. All the personnel who drive vehicles as a part of contract will have to be in possession of a driving license and will adhere to the general Driver's Safety code and Passenger's Safety code.

Drivers of project vehicles will be required to undertake first aid training and all project vehicles will carry first aid kit which should be adequate to cater for the number of passengers present on the vehicle.

Periodic Road Safety Trainings will be provided to the driver, to ensure smooth transportation of materials during construction and operation phase

Driver Safe Practice Checklist

The following checklists/ records are to be maintained on a monthly basis by Site Safety/EHS Officer present at the site. Any discrepancies must be flagged and relevant action should be taken. It is to be noted that all the vehicles entering the facility during construction and operation phase are not owned or managed by Abellon.

S.No.	Safe Practice	Remarks
1	Only operate vehicles if you are competent and authorised to drive them	
2	Do not drive when your abilities are impaired by ill health, poor vision, prescribed/illegal drugs or alcohol	
3	Make sure you fully understand the operating procedures of the vehicles you control	
4	Know the site routes and follow them. Take care at pedestrian cross-overs	
5	Understand the system of signals used on site	
6	Visiting drivers: seek appropriate authority to enter the site and operate vehicles	
7	Know the safe operating limitations of your vehicles, particularly relating to safe maximum loads and gradients	
8	Carry out daily checks on your vehicles and report all defects immediately to supervisors	
9	Follow site procedures and comply with all site rules	
10	Do not drive at excessive speeds	
11	Wear appropriate PPE when out of the vehicle	
12	Ensure that windows and mirrors are kept clean and clear	
13	Keep the vehicle tidy and free from items which may hinder the operation of vehicle controls	
14	Do not allow passengers to ride on vehicles unless safe seating is provided	
15	Park vehicles on flat ground wherever possible, with the engine switched off, the handbrake and trailer brake applied and where necessary use wheel	
16	Do not reverse without reversing aid or banksman assistance	
17	Where visibility from the driving position is restricted, use visibility aids or a signaller. Stop if you lose site of the signaller or the visibility aids become defective	

S.No.	Safe Practice	Remarks
18	Do not remain on vehicles during loading operations, unless the drivers position is adequately protected	
19	Ensure loads are safe to transport	
20	Do not attempt to get on or off moving vehicles	
21	Do not make adjustments with the engine running and guards removed	
22	Do not smoke during refuelling operations	
23	Do not use a mobile phone whilst driving on site	
	Sign Below	
	Drivers Name	
	Drivers Signature	

APPENDIX 8: RESOURCE EFFICIENCY AND CONSERVATION MANAGEMENT PLAN

Scope

GWVPL business operations shall always be cognizant of its resource consumption, resource conservation and their efficient management. This plan has been developed with the following objectives-

- To promote sustainable use of resources (water, materials, energy);
- To improve power generation efficiency

Management Plan

Performance of the Plant can be measured by undertaking following:

- Monitoring the resource consumption;
- Conduct energy audits, water balance study, water audit etc.;
- Monitor greenhouse gases including its quantification as applicable.
- Resources consumption and resource efficiency analysis result shall be kept as record for continuous improvement of resource efficiency management.

Once the gaps are identified while monitoring, corrective action plan of the same shall be developed. This shall also include the department/ personnel responsible for closing the identified gaps along with a timeline of closure. Plant Head and ESG/EHS Head at corporate level will undertake regular follow ups to close the gaps within the specified timeframe

Training, Monitoring and Inspection

Maintenance and inspection program shall be implemented to ensure that equipment and processes operate at their desire energy efficiency and optimum resource utilization. At a minimum, this includes:

- Compliance with inspection and maintenance specified as per electrical safety regulation.
- Compressed air system: annual, perform a leak survey and address any findings;
- Regarding process heating and cooling system, implement a defined schedule for Inspection of air filters on air handling units, with replacement as needed and Cooling of heating / cooling coils, etc.;
- Water pipelines: monthly, inspect for water leaks and repair or replace any defective steam traps, valves, flanges, piping, or other equipment as necessary, once intimation to respective departmental Heads or responsible personnel at Plant

Responsibility

This plan is to be used by Plant Head in consultation with the department heads to identify:

- Opportunities for maximizing power generation;
- Measures to reduce emissions and waste derivatives; and
- Set targets for resource consumption (targets can be set in coordination with Head of department and EHS manager).

Records

- Each resource used shall be mapped and recorded for its consumption by concerned contractors / department (during operation phase) and all consumption records shall be submitted to Plant Head for further analysis on identification of new opportunities, its effectiveness and efficiency as per identified targets;
- All identified resource conservation opportunities shall be documented and a resource conservation plan shall be initiated for the opportunities giving significant reductions;
- Resources consumption analysis result shall be kept as record for continuous improvement in resource efficiency;
- Plant shall complete the Self-Assessment Checklist and provide records to Corporate ESG Manager; and
- Corporate ESG manager shall periodically track the progress of resource efficiency improvements at project level.

Table below presents the typical causes of high resource consumption/wastage and can be used for analysis and put forward conservation measures.

S. No.	Typical causes of high resource consumption/losses	Examples
1.	Technology	• Continuation of non-efficient technology • Lack of proper process and control equipment; • Lack of availability of trained manpower; and • Lack of information.
2.	Poor process / equipment design	• Mismatched capacity of equipment; • Wrong material selection; • Maintenance prone design; • Adoption of avoidable process steps; and • Lack of information / design capability.
3.	Poor layout	• Unplanned / ad hoc expansion; • Poor space utilization plan; and • Improper waste and material movement plan.
4.	Poor raw material quality	• Lack of quantity & quality specification; • Improper purchase management system
5.	Operational and maintenance negligence	• Sub optimal loading; • Unchecked water / air consumption; • Unnecessary running of equipment; • Lack of preventive maintenance, inadequate maintenance
6.	Poor housekeeping	• Leaking taps / valves / flanges; and • Worn out equipment/and its accessories.
7.	Inadequately trained personnel	• Increased dependence on casual / contract labour; • Lack of formalized training system and facilities; and • Lack of availability of personnel.

Self-Assessment Checklist

S. No.	Question	Yes/ No	Additional Information
General questions			
1.	Are the implications of local/national legislations for the business/ sector reviewed, and clearly communicated to the relevant departments/ personnel?		
2.	Have all the regulatory requirements applicable for purchase of material (includes technical components and battery) water/energy/ been identified and reviewed?		
3.	Is the technology used for power generation is efficient in terms of units generated per sq km?		
4.	Are the organizational goals and objectives for improving efficiency/resource conservation (water/energy)/ exploration of carbon credit by project operation, clearly defined by the senior management? For example, • Improvement in power generation efficiency by xx%, • Reduction in water requirement by xx%; • Identification of energy conservation opportunities;		
5.	Are the resource conservation programs initiated within the organization?		
6.	Has the staff training need on water and energy conservation been identified and provided?		
Water			
1.	Is the water consumption being monitored on continuous basis, are the water meters installed at site and are they calibrated?		
2.	Are you frequently monitoring the water systems for any leakages and losses?		

3. Is the water recycling system efficient and working properly?

4. Have you conducted the water balance study? Or any comprehensive water audits for the plant operations?

Energy

1. Have you identified the type of data that will be essential for the energy mapping exercise and to study the energy consumption patterns?
   For example is the following data/information available?
   - Details of energy consumption, energy demand breakdown (process/equipment wise).
   - Is the master list of energy using plant and equipment available?
   - Are the electricity bills and invoices for representative period (one/two years) available?
   - Is the past/historical representative data/information on all energy streams available?

2. Are any walk-through energy audit/similar exercise to identify energy losses conducted in past?

3. Is preliminary energy usage analysis being carried? For example

Energy Type	Total Annual Use	Units	Total annual cost
Fuel consumption -Vehicular fuel			
Electricity			

4. Is there an energy management team in place? And do they have relevant experience on energy management? Have they received any formal training in energy management?

5. Have the significant energy usage points been identified?

6. Is the identification of significant energy users and their consumption as a percentage of total energy consumption available? And is this documented?

7. Is the monitoring & tracking system established for energy?
   For example – deployment of meters at critical locations.

8. Implement a routine lighting maintenance schedule, including cleaning fixtures to reduce degradation of lighting quality

Carbon Saving

1. Do you have any team which is responsible for dealing with carbon performance? Do they have an understanding of
   - GHG emission calculations; and
   - Quantification methodology.

2. Has other areas for reducing GHG emissions identified?
   For example
   - Reduction in vehicular/indirect type of emissions.
   - Reduction in Scope 3 emissions?

APPENDIX 9: BIODIVERSITY MANAGEMENT PLAN

Abellon Clean Energy Limited will adhere the given framework for protecting biodiversity in the project area throughout the project lifecycle.

Scope

- This framework outlines a set of strategic actions and measures crucial for the preservation and effective management of biodiversity.
- It encompasses plans aligned with both national and international standards for the protection of biodiversity within the project site location.
- Details the specific control and safeguarding measures to be implemented by Abellon Clean Energy Limited, along with its contractors and subcontractors to achieve this.

Risks and Control Measures

During the construction phase, there is a risk of habitat modification and loss due to vegetation clearance required for plant area and transmission towers; there is also a chance of potential impacts on habitat and species because of other construction activities such as the installation of transmission lines, underground water pipelines, increased movement of people and goods, noise; and the potential for water resource sedimentation and pollution. While the operation of Waste to Energy project may have impact on fauna such as risks of collision & electrocution from operational transmission line; and risk of Human-Wildlife Conflicts.

Some of the broad level measures followed during construction phase includes:

Habitat Modification and Loss due to Vegetation Clearance

- Vegetation clearance activities will be confined to the project site and transmission tower areas.
- The selection of storage yards, workers camps, and supplementary facilities will prioritize locations away from water bodies and canals.
- There will be a strict prohibition on the use of woody plants from nearby areas as kitchen fuel.
- Active promotion and implementation of native plant plantation within the project boundary and surrounding areas will be carried out.

Impact on the Wildlife during Construction Activities

- The construction activities should be restricted to the project area, routes of transmission line and underground water pipeline
- Night-time (6:00 pm to 6:00 am) construction and transportation activities should be avoided
- The areas of high animal activity (such as natural habitats), 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 bodies and drains
- Sites with existing burrows or roosts should be avoided where possible, and temporary fencing should be installed over excavated areas (for underground water pipeline)
- 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 worker 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
- Construction workers should receive adequate training and be aware of the importance of safeguarding wildlife. Any stray wildlife in the area should not be harmed or killed during construction operations.
- Measures should be implemented to minimize construction-related noise to reduce its potential impact on the surrounding environment and wildlife.

Minimizing disturbance/impact on Wildlife and Avifauna during Construction Phase

- Construction activities will be limited exclusively to the project area, designated transmission line routes, and predetermined paths for the underground water pipeline.
- Construction and transportation activities will be suspended during the night-time period (6:00 pm to 6:00 am).
- In areas of high animal activity, such as natural habitats, construction and transportation activities will be avoided during dawn (6:00 am to 7:30 am) and dusk (5:00 pm to 6:30 pm).
- Hazardous materials will be stored at a safe distance from water bodies and drains to prevent any potential contamination.
- Sites with existing burrows or roosts will be actively avoided, and temporary fencing will be installed over excavated areas as required.
- Noise reduction measures will be systematically employed, and sound barriers will be erected where noise levels are identified as high.
- Construction sites and worker camps will be maintained with meticulous housekeeping and proper waste disposal practices.
- Worker movement between camps and non-designated natural areas will be restricted to minimize disruption to local wildlife.
- Comprehensive training will be provided to construction workers regarding wildlife protection and the avoidance of harming wildlife during construction operations.
- Implementing measures to minimize construction-related noise will be a priority to reduce its potential impact on the surrounding environment and wildlife.

Collision and Electrocution Risk due to Power Transmission

- Avian flight diverters will be strategically installed on transmission lines, particularly near water bodies (22.229295°, 73.203323° to 22.227979°, 73.200355°) and (22.226300° 73.193939° to 22.220236° 73.187745°).
- Bird-friendly pole designs will be incorporated, featuring guards or insulators to prevent electrocution.
- The disposal of refuse near power lines will be forbidden, and swift removal of carcasses will be carried out to prevent attracting raptors.

Human-Wildlife Conflicts

- The construction of pre-casted wall will encircle the project compound, effectively deterring climbing mammals.
- Frequent checking of the boundary wall to avoid any space for wildlife entrance into project compound.
- A comprehensive training program will be organized for project personnel, enhancing awareness about local wildlife and imparting skills for safe and responsible wildlife encounters.
- An emergency response protocol will be in place, outlining procedures for handling human-wildlife conflicts during the operational phase.
- Rigorous housekeeping practices will be maintained within the project compound to discourage wildlife presence and minimize potential conflicts. By rigorously implementing these control measures, the power project will substantially curtail the potential risk of human-wildlife conflicts. This approach ensures the safety of both the wildlife and project personnel, while simultaneously mitigating any disruptions to the project's operational efficiency.

Trainings

To reduce the possible risks because of Waste to Energy project during the operational phase following awareness and training will be conducted,

- Training sessions will focus on bird carcass monitoring along transmission line routes to monitor collision and electrocution incidents.
- Comprehensive awareness and training will be provided to project staff, contractors, and laborers regarding the wildlife protection and the avoidance of harming wildlife; strict enforcement of anti-poaching, trapping, and hunting policies.
- Programs will be conducted to raise awareness and provide guidance on practices to mitigate the risk of human-wildlife conflicts.

APPENDIX 10: SECURITY RISK AND MANAGEMENT PLAN

Introduction

The genesis of this security risk management plan lies in UN Voluntary Principles on Security and Human Rights.
The Voluntary Principles on Security and Human Rights is a collaborative effort by governments, major multinational extractive companies, and NGOs to provide guidance to companies on tangible steps that they can take to minimize the risk of human rights abuses in communities located near extraction sites. The principles documents provide guidance to companies in developing practices that maintain the safety and security of their operations while respecting the human rights of those who come into contact with security forces related to those operations. The principles give guidance on risk assessment, public safety and security, human rights abuses, and the interaction between companies and private and public security[87]. The implementation of the principles provides companies the tools and support to effectuate high standards of human rights conduct and to have a positive impact on local governance, peace and stability

Objectives

- To better anticipate situations in which human rights abuses are most likely to occur.
- Develop effective on-the-ground strategies to mitigate potential risks ; and
- Enhance participation of stakeholder and , policies and procedures with internationally recognized human rights principles regarding security of their operations.

Scope

The management plan provides a general guideline to the project to manager or fore see the potential Human Rights volitation risks associated with the private security arrangement during the life cycle of the proposed project

The polices entrusted in the management shall be applicable to all the company staff , contractor and especially private security agency.

Key Fundamental Aspects for Voluntary Principles

Assessing impacts

.The first key step is to identify the potential impacts of the business's security arrangements on people and communities. The accuracy of assessments depends on consideration of a broad range of factors, using regularly updated information and bringing in the perspectives of a wide range of stakeholders

Engaging stakeholders

The case for effective engagement with communities and governments on security includes being able to test the reliability of information used for risk assessments and being able to help ensure security is provided in an ethical and appropriate manner. But there are also pitfalls in communicating in a way that fails to take account of political, cultural and legal sensitivities and security concerns.

Supporting training and awareness

The ability of security providers to respond to incidents in a proportionate and ethical manner can be critical for a business's relations with local communities and its ability to sustain the safety and security of its operations. The Voluntary Principles identify support for training and education as a key means by which companies can work to achieve this goal. Developing awareness among our own relevant staff is also important.

Contracting security

[87] As per the current understanding of the proposed project, the project is related to generating electricity through municipal waste. The generation of energy from waste is not extractive in nature. It is closely related to sustainable waste management. As informed the risk associated with deployment of private security agency is not foreseen. The project will only deploy guards / watchman without any firearms. Their role will be mostly limited to look after the entry and exit to the plant, traffic management and as well as first person point of contact with stakeholders.

Through contracts, businesses can exercise influence over the conduct and performance of their private security provider. With a greater degree of influence comes a greater degree of responsibility, so it is essential for businesses to ensure their standards and expectations are communicated, understood, and enforced.

Providing security

Giving assistance to public security to support provision of security, whether through finance, donations or loans of equipment, or help-in-kind, can leave a business open to accusations of complicity in human rights abuses. It needs careful management. The case for businesses to follow a consistent approach to evaluating any request, assessing risks, putting in place safeguards and monitoring how assistance is used is compelling.

Responding to incidents

Allegations or actual cases of human rights violations associated with a business can, if inadequately managed or left unaddressed, impact operability, create exposure to legal risk, and damage the business and Group's reputation. Just as response plans for safety and environmental incidents are essential, procedures to respond to allegations of human rights violations should be standard practice where the business identifies a genuine risk.

Evaluating and reporting performance

In evaluating and reporting Voluntary Principles performance, businesses should aim to make a reasonable assessment of their performance, to take action where gaps exist and to continuously improve. The goal is not primarily to demonstrate compliance but to facilitate the appraisal and reporting of issues and concerns and to enable informed input to help solve problems on the ground.

Security Risk Management Action Plan

S. no	UN - VP	Activity	Methods	Frequency	Responsibility
1	**Risk Assessment** Comprehensiveness and timeliness of risk assessments conducted by the business to identify the potential impact of its security arrangements on people and communities	• Carry out Human Rights risk assessment due to the proposed security arrangement, assessment typically involve the identification of a range of security risks that might impact any business, such as theft, robbery, vandalism, fraud, workplace violence, terrorism, and social unrest • Based on the risk develop plan for security arrangements • Develop required skills sets of people managing and providing security services • Develop formats for reporting and investigation of incidence	Staff Meeting Stakeholder Consultations (Staff , civil society , Community labours , police and	Annual	Project in charge / security head/ HR / CSR
2	**Engaging stakeholders** Transparency of security arrangements Degree of transparency and public access to information regarding the security arrangements in place for the business.	• Develop external communication strategy on project security arrangement • Communicate to the concerned stakeholders	Community meetings: Publications: Toll Free Numbers Suggestion Box	Quarterly	Project in charge / security head/ HR / CSR
3	**Response procedures** Existence of procedures for recording and responding to credible human rights-related allegations, for referring such allegations to the appropriate authority, and for urging investigation.	• Project should develop response plan to effectively respond at the two issues and events with a human rights dimension. Depending on the circumstances, a human right related incident may prompt a response , crisis management. The flexibility of the system is able to provide for a robust response to all types of incidents, including for those with a potential human rights aspect • Establish Grievance handling Mechanism of expand the existing GRM to cover the potential Human Rights violation	Formation Grievance cell Information disclosure to the stakeholders	Monthly Review	Project in charge / security head/ HR / CSR

			• Appoint /designate executive to investigate the potential issues of human rights violations • Form committee and procedure to resolve issues related to human rights violation		
4	**Private security** training Extent to which private security personnel are trained to observe human rights-related policies and procedures relevant to their duties and to the business's operations	Based on our understanding most of the security agencies / security guards are not trained on human rights issues. The project should develop training modules for security guards . and it was also observed that there is high iteration rate among security agency therefore training of trainings will be instrumental in maintaining the standards across the lifecycle of the project. Following should be considered for developing training module: The curriculum may include four core sessions. 1. Introduction to human rights 2. Voluntary Principles on Security and Human Rights 3. Communications and conflict resolution skills 4. Principles governing the use of force	Develop training material Hire agency of training preferable from civil society background having experience in training and capacity building on human rights issues Develop core team of trainers within the project staff Develop training calendar Allocate funds for training and maintain the proper training records	Induction on Joining and refresher on every quarter	Project in charge / security head/ HR
5	**Private security contracting** Inclusion of Voluntary Principles-related provisions in contracts with private security companies.	As understood the security arrangement will be taken care off by the private security agency. Therefore project should try to cover following aspects in their contract agreements with private security agency: **Compliance with the Voluntary Principles** The contractor will provide security in a manner that complies with the Voluntary Principles and with the	Develop standard contract agreement	Before entering into contract agreement / renewal	Project in charge / security head/procurement

		Sarajevo Code of Conduct for Private Security Companies[88] **Employment and Vetting** The contractor will carry out pre-employment vetting for criminal records, human rights violations and records of misconduct. Unless otherwise agreed, it will recruit employees from local communities where it operates. **Deployment and Conduct** The contractor will provide defensive services only, refraining from any activity that is the responsibility of public security services. (police) It will maintain policies on standards of conduct, including on acting in a lawful manner and observing principles of proportionality and necessity in use of force. Under no circumstances will it permit employees to carry firearms. **Training The contractor** will maintain high levels of professional proficiency through continuous training of its employees, including on relevant human rights standards and guidelines and on appropriate use of force. **Monitoring and investigations** the contractor will provide any information requested to enable performance monitoring by the client, such as with respect to training records and incidents involving the use of force. It will promptly investigate any incident involving use of force and credible allegations of unlawful or abusive conduct that involve its employees			
6	**Evaluating and reporting performance**	**It** is imperative to evaluate performance of the management system and where necessary bridge the gaps. • The performance evaluation should consider the review of systems and procedure and where necessary recommendations for necessary update may be provided • Evaluation of effectiveness of engagement process , methods and frequency. • Number of recorded incidence and including the human rights violations if any and resolution of stakeholder grievances • Training of staff and security guards	Develop checklist of monitoring and evaluation Hire agency or train staff doing evaluation Develop format and tools for evaluation Reporting / documentation / Sharing of learnings, case studies and	Annual	in charge / security head/procurement

[88] The Sarajevo Code was launched in 2006 and sets out basic standards of professionalism and service delivery for employers and employees in the private security industry

APPENDIX 11: STAKEHOLDER ENGAGEMENT PLAN AND GRIEVANCE HANDLING & REDRESSAL

Stakeholder Engagement is defined as "the basis for building a strong constructive and responsive relationship that is essential for the successful management of a Project's environmental and social impacts. Stakeholder engagement is an ongoing process that may involve, in varying degrees, the following elements: stakeholder analysis and planning, disclosure and dissemination of information, consultation and participation, grievance mechanism and ongoing reporting to Affected Communities" Stakeholder Engagement is thus an umbrella term which encompasses a range of activities or interactions between a company and its internal and external stakeholders, through the life of the project.

Stakeholders for the Project are those people or groups that will have an interest in the operations or have an ongoing relationship with the project and can influence its operations. This document puts a plan that shall guide the stakeholder identification, analysis and engagement process for the project. This plan applies to the construction and operation phases of the Project.

This document presents SEP and GRM for the Project. The SEP is aimed at managing and facilitating future engagement activities with identified stakeholders through the various stages of the Project's lifecycles (construction and operation). Th primary purpose of this plan is to allow for the Project development to be undertaken in a manner that is consistent with the principle of information disclosure and stakeholder engagement of IFC.

Objective of the Stakeholder Engagement and Grievance Redressal

Stakeholder Engagement is fundamental to building trust with the local communities and other identified stakeholders The purpose of SEP is to enable the project to identify key stakeholders, ensure vulnerable groups are identified early on, understand sensitivities within each stakeholder groups and develop appropriate engagement mechanism to ensure all identified stakeholders are aware of the Project and its impacts, are consulted on a regular basis, and establish a two-way communication with the identified stakeholders.

The SEP is aide to guiding and facilitating the engagement of the Project with identified stakeholders in a systematic, inclusive, transparent, and culturally appropriate approach. The goal of the SEP is to facilitate decision making for the project and create an atmosphere of active participation of the stakeholders in timely manners, such that they can voice their concerns and influence Project decisions.

The purpose of the SEP and GRM is three (3) fold:

- To identify Project's specific external and internal stakeholder groups, who will be mapped, consulted, and engaged (as applicable) through the project's lifecycle
- To demonstrate commitments and mechanisms to help align the stakeholder engagement process to the applicable standards
- To provide a consistent framework to document stakeholder engagement and inform decision making and project execution through redressal mechanism.

Grievance Redressal is one of the most critical components of effective stakeholder engagement. As defined the grievance mechanism as a system or specified procedures for methodically addressing grievances or complaints and resolving disputes[89]. Further, for the purpose of this document grievance is defined as "a concern or compliant raised by an individual or a group affected by the project. Both concerns and complaints can result from either real or perceived impacts of project's operation and may be filed in the same manner and handled with the same procedure". The purpose of the GRM is to provide a forum to the identified external and internal stakeholders to voices their concerns, queries, complaints, and issues with the Project. The mechanism will provide the stakeholder with one (1) project personnel or one channel through which their complaints will be channeled as well as ensure timely responses to each complaint. The specific objectives of the GRM are as follows:

- To allow stakeholders the opportunity to raise comments/concerns
- To structure and manage the handling of comments, responses, and grievances, and allow monitoring of the effectiveness of the mechanism

[89] Grievances and complaints are used interchangeably in the document.

- To ensure that comments, responses, and grievances are handled in a fair and transparent manner, in line with the IFC's Policies

Scope of the SEP and GRM

This SEP and GRM applies to the entire Project, including any associated TL and water pipeline . This document is applicable to the entire life cycle of the Project. This document shall be a "living" document and will be updated regularly based on the emerging needs and patterns for engagement with various stakeholders.

Applicable Reference Framework

Applicable National Acts and Rules

The Industries Disputes (Amendment) Act, 2010:

- Every industrial establishment employing twenty or more workmen shall have one or more Grievance Redressal Committee for the resolution of disputes arising out of individual grievances.
- The Grievance Redressal Committee shall consist of equal number of members from the employer and the workmen.
- The chairperson of the Grievance Redressal Committee shall be selected from the employer and from among the workmen alternatively on rotation basis every year.
- The total number of members of the Grievance Redressal Committee shall not exceed more than six: Provided that there shall be, as far as practicable, one-woman member if the Grievance Redressal Committee has two members and in case the number of members is more than two, the number of women members may be increased proportionately.
- Notwithstanding anything contained in this section, the setting up of Grievance Redressal Committee shall not affect the right of the workman to raise industrial dispute on the same matter under the provisions of this Act.
- The Grievance Redressal Committee may complete its proceedings within forty-five days on receipt of a written application by or on behalf of the aggrieved party.
- The workman who is aggrieved of the decision of the Grievance Redressal Committee may prefer an appeal to the employer against the decision of Grievance Redressal Committee and the employer shall, within one month from the date of receipt of such appeal, dispose of the same and send a copy of his decision to the workman concerned.
- Nothing contained in this section shall apply to the workmen for whom there is an established Grievance Redressal Mechanism in the establishment concerned

Stakeholder Identification and Analysis

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 developed during the consultations with Project proponent. The analysis of the identified stakeholder is based on stakeholders' profiling and the significance of impact/influence of each stakeholder in relation to the Project.

Stakeholder Identification and Characterization

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. Keeping in mind the nature of the Project and its setting, the stakeholders have been identified and listed in the table given below:

Category	Primary Stakeholders	Secondary Stakeholder
Community	• Rag Pickers • Opinion holders • Community leaders	Nil
Institutional Stakeholders	• 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

Stakeholder Mapping

"Stakeholder mapping" is a process of examining the relative influence that different stakeholders have over the Project as well as the influence of the Project over them. The purpose of stakeholder mapping is to:

- Identify each stakeholder group
- Study their profile and the nature of the stakes
- Understand each group's specific issues, concerns as well as expectations from the Project
- Gauge their influence on the Project

Based on such an understanding, the stakeholders are categorized into High influence/priority, medium influence/priority, and low influence/priority.

The stakeholder engagement starts in the early stages of the Project, also need to be included in the impact assessment and risk identification process and continues across the life cycle of the Project. The stakeholder analysis also shapes the stakeholder engagement strategy for the Project and needs to be continuously update the stakeholder analysis and helps in integrating the impacts and risk identified in the Project designing and during the implementation stages to help the company better addresses the associated impacts with the Project.

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

Table: 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					
Rag Pickers	This stakeholder group includes rag pickers working at VMC and land fill site. As informed, most of these rag pickers are from other state such as Rajasthan. These Rag Pickers are engaged in collection of waste and selling the waste to the respective scarp dealers.	• The expectations and concern of this group from the project: – The Key expectations are to continue the waste collection at VMC land fill site , collection centers and household level – Get employment in the proposed plant – Proposed project should not negatively affect their livelihood and there should be no risk economic displacement	• Currently the influence of the stakeholder on the project is negligible however they constitute important linkage for waste collection and recycling process and their livelihood is primarily dependent on waste collection. • If there are any potential treats to their income these stakeholders can become hostile there might be fringe elements which can potentially negatively influence the project	• The project can prove to be potential source of livelihood /employer for the people engaged in the waste collection • Project can be instrumental in bringing community developmen t in their areas through CSR activities.	• Influence of Stakeholder: **Low** • Influence of Project: **HIGH**
Opinion Holder and	This stakeholder group is comprised of those individuals of the local community who hold	• The expectations and concerns of this group from	• This group is powerful enough to affect the functioning of the	These groups due to their social status, may already	• Influence of Stakeholder:

Relevant Stakeholders	Profile	Concerns and Expectations from the project	Influence of Stakeholder on Project	Influence of Project on Stakeholder	Influence Rating
Community Leaders	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 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	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	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	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	• 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

Relevant Stakeholders	Profile	Concerns and Expectations from the project	Influence of Stakeholder on Project	Influence of Project on Stakeholder	Influence Rating
		community in contractor and employment opportunities from the project – Regular updates on the project activities and the opportunities from the project			
Regulatory Authorities	This stakeholder group is comprised of the central, state and district level regulatory authorities including VMC & PWD. These 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	The key expectations and concerns of the group from the project include: • Project's compliance to the regulatory requirements; and • Timely disclosure of information and provisioning of updated information throughout the life of the project.	• The failure of the project to comply with the various rules and regulations applicable can affect the timely implementation of the project • This stakeholder group is also critical for 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 the Project in the area	• Influence of Stakeholder: **HIGH** • Influence of Project: **LOW**
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.	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	• 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	• 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**

Relevant Stakeholders	Profile	Concerns and Expectations from the project	Influence of Stakeholder on Project	Influence of Project on Stakeholder	Influence Rating
		throughout the life of the project	level authorities and the local community		
Staff & Contractors and Sub-Contractors	This stakeholder group is comprised of the technical & non-technical staff of Abellon 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 project activities to be carried out • Fair business opportunities and contract closure	• 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
		• 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	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
		overall development of the area • Involvement in the formulation and implementation of the community development activities; and • 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**

Relevant Stakeholders	Profile	Concerns and Expectations from the project	Influence of Stakeholder on Project	Influence of Project on Stakeholder	Influence Rating
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 of project in achieving the goals of Swachh Bharat Mission and renewable energy generation 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 community and other stakeholders • Timely disclosure of information in regard to the project activities	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: **Low** • Influence of Project: **LOW**

Propose Stakeholder Engagement Activities

This section provides the stakeholder engagement plan for the Project lifecycle going forward. This engagement plan builds on the activities undertaken thus far, the existing relationship with the stakeholders and their expectations and the requirements of the IFC . This section puts in place, the principle to be followed for stakeholder engagement through the Project lifecycle, the methods that may be used and the engagement plan This section provides an overall plan for the entire project lifecycle and a detailed plan for the land procurement and other phases of the Project. This is a living document and will be reviewed and updated on a regular basis.

Principle of Engagement

The stakeholder engagement process is informed by a set of core values that determines consultation, negotiation, and grievance management. The stakeholder engagement and grievance redress for the Project will be based on the following principles:

Commitment	Transparency and Fairness	Trust and Respect	Accessibility and Cultural Appropriateness	Open and Inclusive Mechanism
Description				
It is established when the process of engagement is started early on during the Project. It is demonstrated when the need to understand, identify and engage with every member of the affected community is recognized and acted upon from the planning stage of the Project.	The Process for Grievance resolution shall be transparent, in harmony with the local culture, and in the appropriate language. It should explicitly assure potential users that the mechanism would not impede their access to other judicial or administrative remedies	Meaningful information is provided to create open dialogue in the local language format that is easy to understand and adaptable to local context. The SE process should respect the local traditions, values and interests of the stakeholders.	Every member of the community or groups should have access to the grievance procedure. To allow all stakeholders to have access to the mechanism, the grievance redressal will be published in the local language of the community	The process of communication will be two-way, giving both the Project and the stakeholder (s) opportunity to exchange views, opinions, to listen and have their issues heard and addressed. It should be inclusive in representation of views, and hence provide additional support to vulnerable groups (women, elderly, physically disable, minorities) to participate in the communication process

Methods of Engagement

The methods of engagement incorporate individual profiles. Concerns, and expectations of the groups. Need to include the stakeholder engagement plan for the identified stakeholders for continued engagement during the operation stage. Further, different modes of engagement is necessary because the utilization of a common modes of engagement for all the stakeholders and for the whole project duration may result in the failure of the engagement process to achieving its intended goals. Therefore, the following methods have been identified for the purpose of this Project.

- One to One interviews and interactions
- Focus group discussions
- Meetings –Public meetings, and meetings with the community in the Project footprint
- Formal Communication (written)
- Awareness campaigns

In deciding the appropriate engagement method and frequency of such method used for the identified stakeholders, the following criteria has been considered:

- The acceptability of the engagement method
- The current level of engagement and desired level of engagement

- The aimed outcome of the engagement activity

Grievance Redressal Mechanism (GRM)

Grievance redressal is another critical component of effective stakeholder engagement. The purpose of GRM is to provide a framework to the internal and external stakeholders to voice their complaints, concerns, queries, and issues with the project. Such a mechanism provides the stakeholders with one channel of communication through which their complaints and queries can be raised, and timely response can be ensured. This allows for trust building amongst the stakeholders and prevents the accumulation of multitude of small issues into major community unrest. The GRM is aimed at being accessible and understandable to all stakeholders in the project and for the entire project life. The GRM will also be applicable for any contractor appointed during the construction and operations phases of the Project.

- This section contains the following:
- Objectives of GRM
- Grievance definition and categories, and GRM principles
- The process of receiving, documenting, addressing, and closing grievances

Objective of GRM

- To provide stakeholders with a clear process for providing comment and raising grievances
- To allow stakeholders the opportunity to raise comments/complaints through using the grievance redressal committee established
- To structure and manage the handling of comments, responses, and grievance are handled in a fair and transparent manner, in line with internal policies, and international best practices

Grievance Definition and Categories

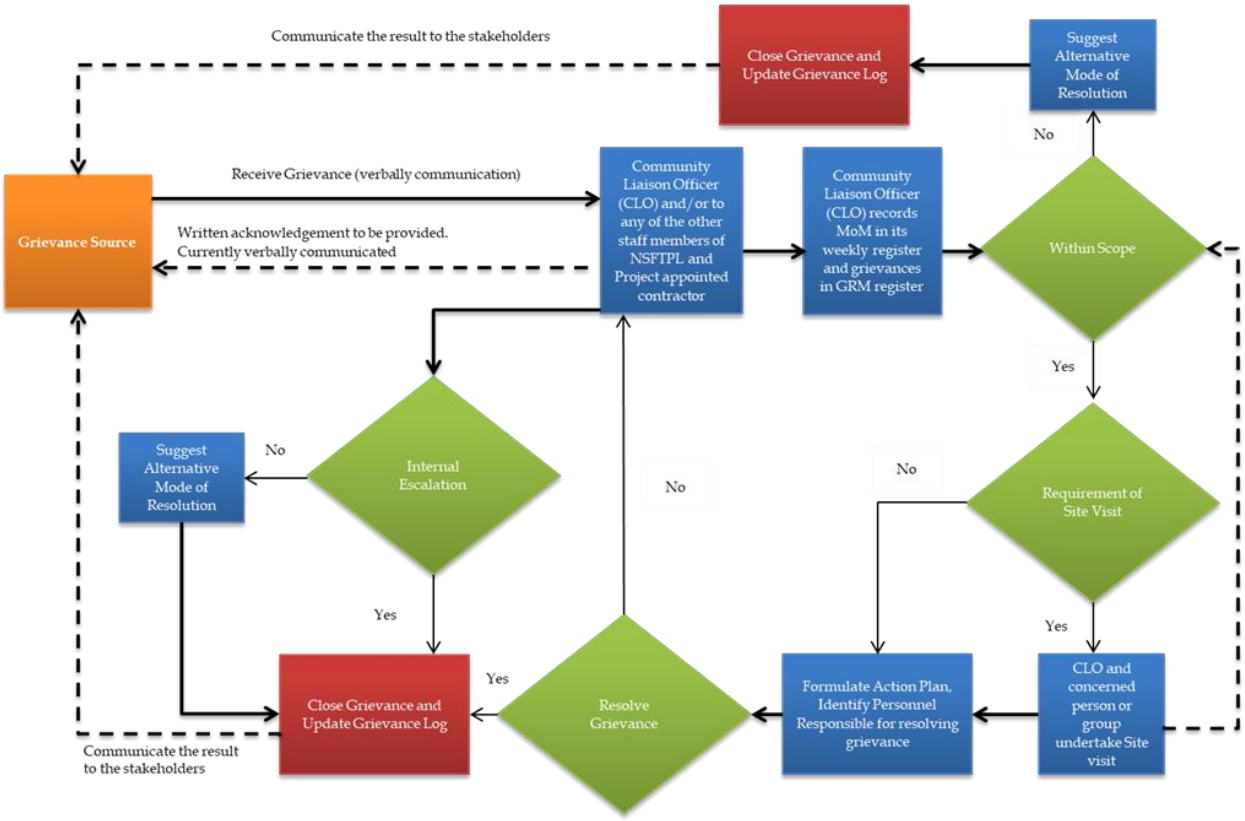
A grievance is a concern or complaint raised by an individual or a group within stakeholders affected by the company's operations. Both concerns and complaints can result from either real or perceived impacts of the company's operations and may be filed in the same manner and handled with the same procedure. Grievances may take the form of specific complaints for actual damages or injury, general concerns about Project activities, incidents and impacts or perceived impacts.

Anonymous complaint

The project shall also consider anonymous compliant as part of this GRM and the resolution of the compliant shall be in accordance with the provisions of this management plan

Internal and External Grievance Mechanism

The Process to be followed for the redressal of the external stakeholder grievances is summarized below:



In the above diagram. The bold lines represent the grievance escalated from stakeholder to concern staffs and then from concern staff to further escalated. The dotted lines are the representation of communicating back of resolution to the stakeholder.

Publication and Disclosure of the GRM

The GRM will be disclosed to the stakeholders through written and verbal communication. The medium to use for this purpose are public meetings, group discussions, and display of GRM provisions in Gram Panchayat , Land fill site , collection centers and plant centers , and other key locations. As part of the public meetings, the project will provide a refresher of the provisions of the GRM, and the way grievances can be communicated.

Receiving and Recording Grievances

A complaint can be submitted to Project through the following methods:

- During regular meeting held between stakeholder's and project team
- By submitting verbal complaint to appointed contractors and other to the project management team & HR
- For written communication of complaints, a sample grievance register is provided below:

S. No	Date	Village/ Location	Topic of grievance	Summary of grievance	Stakeholder Group	Acknowledgement date	First response date	Follow-up (if applicable)	Unique Grievance ID	Status
1.										

S. No	Date	Village/ Location	Topic of grievance	Summary of grievance	Stakeholder Group	Acknowledgement date	First response date	Follow-up (if applicable)	Unique Grievance ID	Status
2.										
3.										

Maintaining a Grievance Register

A grievance register will be created and maintain at the Project site by the Community Liaison Officer (CLO). Details of the stakeholder(s) communicating issues/compliant are noted along with the summary of the grievance. Depending upon the nature of the grievance, the option of legal redressal can be taken if requires.

The grievance register will regularly be updated at each stage of grievance redressal. Once the grievance is recorded in the register, a preliminary analysis will be undertaken by the concerned staff to ensure that the grievance is within the scope of the GRM. The grievance will be registered in the grievance register by CLO.

Acknowledgment of Grievance

Project will establish a timeline of communication such that – once the grievance is received and recorded, the stakeholder will be provided with an acknowledgment of the receipt within seven (7) working days, along with a summary of the grievance, as specific below:

GRIEVANCE REGISTRATION	
Grievance No.:	Date:
Name:	Father's/Spouse's Name:
Village:	Taluka:
Phone no.	
Category of grievance:	
Summary	
Name of person recording grievances:	
Designation of recording person:	
Proposed date of response to grievance:	
Signature of recording person	Signature of complainant
ACKNOWLEDGEMENT RECIEPT	

GRIEVANCE REGISTRATION	
Grievance No.:	Date:
This receipt is acknowledgement of grievance registration by_____ _____, resident of village _____ on date _____. His case number is _____ and the date for response is _____.	
Name of the person recording grievances:	
Designation of the recording person:	

GRIEVANCE REDRESSAL RESPONSE		
Date of redresses:		
Decision of CLO (give full details):		
Claimant accepts the outcome:	Accepted	Not accepted
Signature of claimant:		
Signature of CLO:		
Note: Please note, if at any time the grievant is unsatisfied with the resolution of the grievance, they may choose to ask for an escalation to the next level or may resort to legal redress.		

Providing Initial Response

The stakeholder that lodged the initial comment is then contacted within seven (7) working days to acknowledge that the Project site team will log the grievance and provide feedback in the written format. A copy of this notification is submitted to the stakeholder. The notification contains details of the next steps to be taken for investigation.

Investigation and Resolution

Depending upon the sensitivity of the grievance, and nature of the complaint, a site inspection may be required, but not in all cases. The purpose of the site inspection is to check the validity and severity of the grievance. For this purpose, the personnel may also undertake discussions with the external stakeholder concerned. The inspection is undertaken within **fifteen (15) working days** of receiving the grievance. After site inspection, the assigned individual then works with other relevant members of the Project team to investigate the problem, communicate an update to the concerned complainant, and identify measures to resolve the grievance as appropriate.

The update on the grievance is communicated to the aggrieved person, on a weekly basis or at frequency suitable for the nature of the case by the Project team.

Resolution, Escalation and Closure

The CLO, in consultation with the staff concerned, will identify a suitable resolution to the issue. This resolution is accordingly communicated to the aggrieved stakeholder within seven (7) working days of completing the investigation.

Update of Records

The records of the grievance register are updated every working week with the present status of the grievance. Once the grievance is resolved, and the same has been communicated to the complainant, the grievance is closed in the grievance register. The grievance register also provides an understanding of the manner in which the grievance was resolved. These instances shall then serve as references for any future grievances of a similar nature. However, the project will ensure that all grievances communicated will be maintained in a confidential manner.

Monitoring and Review

It is vitally important to monitor the effectiveness of the comment response and grievance mechanism. Appropriate measures/KPIs for this include monthly reporting on the number of grievances received, resolved and outstanding. In order to track the performance of grievance resolution process, analysis of the trends of the GRM will be undertaken. Project Team will involve the views of the stakeholders to improve the effectiveness of SEP and GRM.

Implementation Roles and Responsibilities

For the purpose of ensuring the proper and effective implementation of the SEP and GRM, this engagement and grievance redressal process is given importance as the other Project activities. Resources, both manpower, and financial, are made available for the same. The following sub-sections discuss both these resources requirements, in detail.

Responsibilities of implementation entities

The table given below outline the responsibility of each entity under grievance redressal committee.

Entity	Responsibility
Project Director /	• Approves and is accountable for implementation of the stakeholder engagement and GRM • Provide support for implementation of the grievance resolution process and enforcement of specific agreements, if required or escalated by the project stakeholder engagement and grievance redressal committee • Intervenes when the proposed resolution is not accepted by the stakeholder and identified additional actions to address the grievance • Approves the close-out of grievance when an agreement cannot be reached with the stakeholder
Project stakeholder engagement and grievance redressal committee	It has been set up specifically for stakeholder engagement and grievance resolution. The main responsibilities of the committee will be involved but are not limited to: • Manage all community liaison related tasks • Implement community engagement strategy and oversee all community liaison related matters • Manage the grievance mechanism at the project level and if required escalate the grievance to the top management team • Oversee implementation and monitoring project CSR activities or community development plans

Entity	Responsibility
	• Establish a monitoring and evaluation plan and other tools established such as the grievance register, and consultation register • Ensure that all individuals with responsibilities under the stakeholder engagement and grievance mechanism are made aware of the existence of the process and receive adequate training
Construction and operation heads	The role of construction and operations heads includes (but is not limited to): • Finalization of contractors on internally decided sustainability criteria, undertake due diligence of contractors' EHS&S process and regular monitoring of contractors' compliance towards applicable regulatory requirements • Integrating contractors in internal activities tap knowledge and further resources when, for example, selecting contractors or assessing existing contractors and striving for standards and certification • Addressing contractors' requirements at the internal dimensions' centers on transparency through one-way or two-way communication
Project HR and HSE Head	The role of Project HR and HSE head includes (but is not limited to): • Describe regulatory, company and/or other requirements for consultation and disclosure of information • Provide strategy and timetable for sharing information and consulting with each of internal groups (e.g., employees, contractual workers, another department) • Implement and regular monitoring of internal grievance redressal mechanisms for employees, contractual workers, etc. • Update or prepare policies, or SOPs related to labor welfare, terms and employment and Health & safety • Provide regular training one labor welfare, terms and employment and Health & safety • Regular auditing and monitoring of Human resources providing contractors on their compliance with applicable regulatory requirements
Community Liaison officer/CSR head	The CLO will be appointed or delegate of duty of existing employee to maintain stakeholder relations between project and the community and to implement social management process and GRM, and improvement in community development program or CSR activities as per the feedback received from community. The role of the CLO is as follows: • Establish and maintain an affective relationship between the local community and the Project • Build and foster an environment that supports community involvement, continuous community engagement • Provide community members with opportunities to express their concerns and raise issues

Entity	Responsibility
	• Provide regular and timely information and project updates to the local community and relevant stakeholders • Create stakeholder database, develop, and regularly update community profiles and expectations • Deliver weekly and monthly reports on activities • Identify and develop proposals for community development projects aligned with the established CSR policy and commitment • Serves as principal point of contact and liaison with complainants • Ensure communication with the complainant and follow specified procedures and timelines • Maintains a log of complaints received • Resolves complaints that do not need a substantives expert • Supports the substantive expert, if necessary • Serves as a liaison between the project and the third parties, as required • Monitors resolution of complaints • Prepares monitoring reports • Provides feedback on the effectiveness of the GRM to management

Training Requirements

Project/ HR /responsible employee will regularly undertake a review of the existing skill set and the need for skill enhancement in the resource identified related to SEP and GRM. This will also be done in keeping with the evolving project's changing stakeholder dynamics on the ground. The following compulsory training shall be done for the effective implementation of the SEP and GRM:

- Training contractor(s): for the construction and operation phase, the HR department or CLO will orient the contractors on the established SEP and GRM. The appointed contractors shall be inducted on the standards and guideline regarding the SEP and GRM, and the profile and importance of each stakeholder group associated with the Project.

- Financial Resources

The project shall ensure that the budget formulated for the purpose of the SEP and GRM is sufficient to meet the expenses of the same. In case of grievance requiring monetary compensation, the amount for the same shall be provided through dedicated budget set up for the Project.

Documentation, Monitoring and Reporting

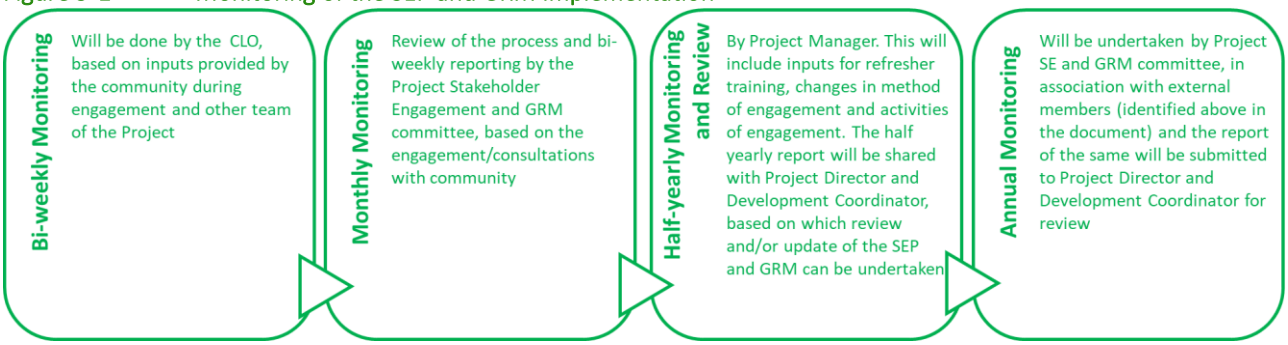
As the SEP is a 'live document', it will be regularly reviewed keeping in mind attributes such as the stakeholders, the evolving priority level, changing dynamics and the engagement process for each stakeholder and the reporting time for each. The documentation will be at two (2) levels – minutes of meetings including signatures/names of attendees and

photographs (attendance of every meeting). All such documentation will be linked to a database maintained for SEP that contains the engagement activities undertaken in chronological order. This SEP database is available for review of project management and the Project team.

Monitoring

The monitoring will be carried based on the below provided process:

Figure 9-1 Monitoring of the SEP and GRM Implementation



The annual monitoring and review will include:

- Auditing the implementation of the SEP in keeping with the principles and engagement plan developed
- Monitoring the effectiveness of the engagement process in managing impacts and expectations by:
    - Tracking feedback received from engagement activities
    - Recording and tracking updates given to the stakeholder
    - Assessing the efficacy of the engagement activities in terms of the purpose of engagement and the participation of the stakeholder groups
- Tracking of grievances received and their resolution status
    - Number of grievances received
    - Nature of grievances received
    - Proportion of grievances closed in satisfaction to the complainant
    - Proportion of grievances closed within seven (7) working days of receiving the grievances
    - Proportion of grievances escalated due to internal non-resolution
    - Proportion of grievances escalated by complainants due to non-satisfactory outcomes

Reporting

Based on the documentation and monitoring process, the following reporting is maintained for the SEP and GRM.

- Weekly reports:

  - The CLO maintains a register of its weekly meeting that is conducted on a regular basis. The register contains two (2) parts – attendance of the participants and minutes of meeting. In addition, the GRM register is maintained and updated by the CLO in the local language format
  - These weekly reports are shared by CLO with the Project SE and GRM committee, and translated into English language for of understanding of other management

- Monthly report: the CLO will prepare monthly reports on stakeholder engagement activities for the Project SE and GRM committee. It will include:
  - Activities conducted during each month
  - Public outreach activities (type of engagement and stakeholder attendance)
  - Entries to the grievance register
  - Number of grievances raised to the Project SE and GRM committee
  - Progress on partnership and other social projects
  - New stakeholder groups identified (where relevant)
  - Plan for the next month.

Reporting back to stakeholders

Project SE and GRM committee will share the reports with stakeholders as part of the information disclosure process on matters relating to:

- Main findings from the annual monitoring review of the Project
- Progress on implementation of social investment initiatives or CSR activities
- Trends in Grievance redressal and analysis of grievance categories

APPENDIX 12: LABOR MANAGEMENT AND WORKING CONDITIONS INCLUDING LABOUR CAMPS

Objective

The contractor and labour management plan have been developed with the objective of defining the procedure to manage and regulate the standards of labour and working conditions for the labourers hired by project and its contractors.

In the context of the project, requires a management plan that could provide guidance and become monitoring tool to assess and align the labour and working conditions as per IFC PS 2.

Scope

This plan applies to the construction and operational phases of the Project. This plan will be applicable for project and its contractors and their workers that are going to be engaged in the two (2) phases (construction and operation) of the Project.

Aspects for Ensuring Proper Labour Management

There shall be a well-document set of policies defined for the Project and the workforce to be engaged for it. The indicative set of policies to be developed is entitled below:

- Human resource Policy
- Working Relationship Policy
- Working Conditions & Terms of Employment Policy
- Workers' Organizations
- Non-Discrimination & Equal Opportunity
- Retrenchment
- Grievance Mechanism
- Child Labour
- Forced Labour
- Occupational Health & Safety
- Non-Employee Workers

Applicable Legislations

There is a wide array of central and state level regulations that cover every aspect of labour related issues. These Acts are further supplemented by rules, notifications and standing orders of the central and state governments. Aspects like minimum wage rate, working hours, and welfare benefits get revised and updated from time to time. Therefore, it is important to keep track for the most recent developments in amendments of labour laws and rules. Acts and regulations pertaining to the migrant workers assume much more importance especially in the Indian context, wherein migrant workers constitute a huge section of the building and construction activities, or for that matter any form of labour-intensive activity. The plan, therefore, captures almost all the key laws and regulations pertaining to the management of labour issues in the country

National & State Legislations regarding contractor labour relationship

There are several laws and rules governing labour issues in India. The local legislations likely to get triggered for the contractual labour relations are:

- The Contract Labour (Regulation and Abolition) Act, 1970 and Rules
- The Child labour (Prohibition and Regulation) Act, 1986
- The Bonded Labour (Abolition) Act, 1976

- The Trade Union Act, 1926
- Workmen's Compensation Act, 1923
- Minimum Wages Act, 1948
- The Payment of Wages Act, 1936, amended in 2005
- The E.P.F. and Miscellaneous Provisions Act, 1952
- Public Provident Fund Act, 1968
- Payment of Gratuity Act, 1972
- Employees State Insurance Act, 1948
- Employer's Liability Act, 1938 (as amended)
- The Industrial Employment (Standing Orders) Act, 1946 (as amended)
- The Industrial Dispute Act, 1947
- Payment of Bonus Act, 1965 and Amendment Act No. 43 of 1977 and No. 48 of 1978 and amendments
- The Personal Injuries (Compensation Insurance) Act, 1963 (as amended)
- Shops and Establishment Act
- Interstate Migrant Workers Act, 1979
- Maternity Benefits Act, 1961
- Equal Remuneration Act, 1976
- Building and Other Construction Workers Act, 1996, amended in 2020

Rules include:

- Industrial Disputes (Central) Rules, 1957
- Minimum Wages (Central) Rules, 1950
- Payment of Bonus Rules, 1975
- The Personal Injuries (Compensation Insurance) Rules, 1972
- Standing Orders Rules, 1946
- ILO's eleven (11) fundamental instruments:
- Freedom of Association and Protection of the Right to Organize Convention
- Right to Organize and Collective Bargaining Convention
- Forced Labour Convention
- Abolition of Forced Labour Convention
- Minimum age convention
- Worst Form of Child Labour Convention
- Equal Remuneration Convention
- Discrimination (Employment and Occupation) Convention
- Occupational Safety and Health Convention

Contractor and Labour Management – Specific Issues

The challenges that the project is likely to encounter during construction and operational phases regarding the maintenance of labour standards could be:

- Lack of defined terms of employment for some worker or labour by sub-contractors might be possible
- Likelihood of child labour at varying scale, particularly during development/construction phase on account of migrant labour
- Discrimination in remuneration between male and female labour or between local and outside labour
- Inappropriate living arrangement in labour camp
- Conflict with local population

Defined Human Resource Policy, working conditions and terms of employment

Management Plan

Project and its contractor shall require taking the following mentioned measures to regulate and manage the workforce engaged during construction as well as the operational phase of the Project.

- Adequately cover the contract labourers that will be engaged in the construction phase of the Project within the HR policy
- Maintain consistency with the applicable labor laws
- The Policy should be commensurate with the size and type of workforce
- Policy should be clear and, in a language, understandable to workers
- Procedure to make provisions of the policy very clear to each worker at the outset of joining
- Working condition90 and terms of employment91 should be document and communicated properly to all workers
- Wage and benefits must be clearly communicated and understood by workers
- Provide all workers with a contract in a language understood by them
- Routinely provide workers with a clear record of wage calculation and deduction
- Ongoing internal verification that all workers are receiving wages and benefits as prescribed by law
- Ongoing communication and training on legal labour rights and company personnel policies
- Worker representatives meet regularly with HR and project management
- Training on minim legal benefits for all workers, including contractors, and employment agencies

Monitoring Mechanism

The project shall implement the monitoring based on the monitoring indicators provided in the table below:

[90] Working Condition is defined as the conditions in the workplace and treatment of workers. Condition in workplace include the physical environment, health and safety precautions, and access to sanitary facilities. Treatment of workers includes disciplinary practices, reason and process for termination of workers and respect for workers personal dignity

[91] Terms of employment includes wages and benefits, wage deduction, hours of worker, rest days, overtime arrangements, overtime compensation, medical insurance, pension, leave for illness, vacation, maternity and so on

Table Aspects for Ensuring Proper Contractor and Labour Management

Sr. No.	Guiding Principles	Desired Actions	Special Remarks and Suggestions	Monitoring Indicators
Human Resource Policies				
1.	• Project and its contractor shall have a documented policy and procedure related to human resources • Project and its contractor will inform workers of their rights under national labour and employment laws • Policy must be clear and understandable to all workers	• Centrally organize all policies and procedures • Identify and record responsible person and last date modified • Conduct an annual review of all policies and procedures • Prominently display policies and procedures in all local languages, especially which the staffs and workers understand • Appoint a person responsible for monitoring policies and procedures related to labour law implementation • Implement standardized routine training	• Contractor shall be required to put in place a well-defined and documented Human Resource policy at the outset of the project in order to ensure efficient and fair management of workers engaged in the overall process of work. In case the contractor has existing GR policy, the same can be made applicable for the workers to be engaged for the Project	• Complete review of all policies and procedures • Review of management – worker committee meeting minutes • Communication (memos, letters, etc.) to workers, suppliers, contractors and multi-stakeholder groups • Interviews with management and workers • Interviews with external stakeholders • Budget related to implementing labour policy • Training curricula and logs
Working Relationship Policy				
2.	• Project & its contractors will document and communicate working conditions	• Provide all workers with a contract in their native language	• The working relationship policy can be a separate document, or it can be integrated with the HR	• Contracts for all workers • Policies and procedures

	and terms of employment to all workers • Wages and benefits must be clearly communicated and understood by all workers	• Provide documented training on contracts, wages, benefits and deductions for all workers • Routinely provide workers with a clear record of pay calculations in the form of wage slips	policy. The working relationship policy will essentially ensure • Coverage of each category of workers including direct workers, contract workers and supply chain workers who will be engaged in operation • Consistent with regulatory requirements on labour as per the national and state labour regulations:	related to worker contracts and wages • Communication and training on wage calculation, including local laws • Payroll records, time sheets • Piece rate or performance pay calculations verified against minimum wage • Worker interviews
Working Condition and Terms of employment				
3.	• If there is a collective bargaining agreement, project & its contractors will respect its terms • Project & its contractors must provide reasonable working conditions and terms of employment, at a minimum complying with the various local laws as described in this plan	• On-going internal verification that all workers are receiving wages and benefits as prescribed by law • On-going communication and training on legal labour rights and company personnel policies • Worker representatives meets regularly with HR and company management • Training on minimum legal benefits for all workers, including contractors, and employment agencies	• Defined Terms of Employment and procedure for sharing the same with each new worker in a transparent manner • Procedure for establishing and updating records of employment relationship conditions.	• Collective bargaining agreement (if one exists) • Worker contracts • Policies and procedures related to wages, benefits, hours and leave • Wage calculations as they relate to local laws • Worker and external stakeholder interviews • National law as it relates to wage and benefit minimums

				• Employment and termination records
Workers' Organization				
4.	• Project & its contractors will recognize workers' rights to form and to join workers' organizations • Project & its contractors cannot interfere with or discriminate against workers who choose to organize • Worker representatives must have access to management • Worker organizations are expected to fairly represent the workforce	• Clear communication to workers on their rights to collective bargaining • Allow workers to raise workplace related issues • Regular training on worker-manager communications • Regular meetings of management and worker representatives • Periodic documented communication with local unions and NGOs	• The purpose of forming a trade union/workers organization is to create a platform for collective bargaining to protect the interest and rights of the workers with regard to working conditions and the terms of employment. The contractors will have to abide by the Indian regulations on provision for trade union and the workers should not be restricted by the contractors to form trade union if they wish. • The construction phase is likely to engage migrant labour and is expected to be over in 15-18 months after getting started. During this phase, the laborer should be provided a suitable mechanism to raise their grievances and genuine work-related issues, alternatively allow them to create a platform for collective bargaining. • During operational phase of the project, contractors will be required to consider following mentioned measures to ensure freedom of association for workers and provide them an	• Documented policy regarding collective bargaining • Minutes and records from collective bargaining sessions, reviews or other actions • Procedure for workers to select worker representative without management interference • Interviews with workers, NGOs and trade unions • Collective bargaining agreements • Grievance mechanism

			alternate grievance mechanism • The contractors shall have clear communication with the workers on their right to form trade union and collective bargaining • There will be regular trainings on worker-manager communications • There will be regular meetings of the contractor's management and their workers	
Non-discrimination and Equal Opportunity				
5.	• People should be hired, promoted and compensated solely based on their ability to do the job • All workers should have equal access to training, tools and opportunities for advancement • All workers should be free from harassment by management or other workers • Positive discrimination may be allowable in cases where it protects disadvantaged or excluded groups and provides them special opportunities	• Clearly define anti-discrimination policy in hiring, training, promotions and compensation • Regularly review worker and manager demographics • Develop long term remediation plan to address past discrimination • Provide regular training to workers and managers • Establish confidential and secure communication channels for workers to reach managers	• The contractors will be required to make employment decisions on the principle of equal opportunity and fair treatment and will not discriminate with respect to aspect of the employment relationship like recruitment and hiring, compensation, working conditions and terms of employment, promotion etc.	• Discrimination policy and related employment policies and procedures • Company policy and procedure to address and manage discrimination issues when found • Comparative demographics of workers and managers • Documentation of handled discrimination cases • Diversity training curriculum and attendance log • Interviews with workers and

		• Actively promote a harassment-free workplace		managers, including those who may be likely to be discriminated against • Interviews with local NGOs and trade unions • Hiring, promotion and termination records • Local laws related to discrimination • Hiring of the local residents/ PAFs in the various jobs
Retrenchment				
6.	• Project and its contractors will develop and implement a plan to mitigate the adverse impact of retrenchment if it anticipates a large number of layoffs • The plan will incorporate non-discrimination principles and include the input of workers, their organizations, where appropriate, the government	• Policy and procedure for workforce reduction, including worker selection • Analysis of alternatives to workforce reduction • Engage workers in discussions with workers related to workforce reduction as early as possible • Communication to all workers about why and how the reduction will take place • Discussions with local NGOs about how the	• The contractors may be asked to prepare such a lay off plan especially if the local community is engaged as laborer, as most of the migrant laborer are shifted to other sites for work by the contractor itself.	• Policy and procedure related to workforce reduction, severance and transition • Analysis of alternatives employed for workforce reduction. • Procedures for selecting workers impacted by workforce reduction • Documentation of prior instances of workforce reductions • Minutes from management

		community impact of workforce reduction could be minimized		meetings and discussions • Communications with workers related to workforce reduction • Communications with external stakeholders and community groups
Grievance Mechanism				
7.	• Project & its contractors will establish a transparent process for workers to express concerns and file grievances • There will be no retaliation or discrimination against those that express grievances • Project & its contractors will treat the grievances seriously and take appropriate action • Project & its contractors grievance mechanism does not replace other channels as defined by law or collective bargaining agreements	• Establish clear policies and procedures for grievances • Communicate the grievance process to all workers in a clear, understandable manner • Provide on-going training to all workers • Document all grievances and the resulting actions • Make worker representatives a key part of the process	• For a healthy work environment, contractors should create an atmosphere where workers feel safe expressing their concerns and the grievances are settled mostly through informal channel and workers don't feel the need to lodge the complaint. However, there should be a formal grievance redress mechanism which is simple and secure; free from fear of retaliation; responsive and fair and allow workers to file anonymous complaints as well. The grievance mechanism system should not impede the aggrieved to access to court in case he/she is not satisfied with the outcome derived from the formal system. • For an effective grievance redress system, the contractors will have to: o Establish clear policies and procedures for	• Documented policy and procedure for worker grievances • Worker and manager interviews • Training curriculum and log on grievance handling • Communications to workers, supervisors and managers • Records of complaints lodged, and actions taken on grievances • Employment and termination records

			grievances based on above outlined principles o Communicate the grievance process to all workers in a clear, understandable manner o Document all grievances and the resulting actions; and o Make worker representatives a key part of the grievance redressal process.	
Child Labour				
8.	• Project & its contractors will not employ workers under the minimum age for employment as defined by national law (.i.e. below 18 years of age) • Workers between the minimum age and 18 will not be employed in dangerous work or work that interferes with their education or development • The Indian regulation recognizes a person as a child who has not completed his/her 14 years of age.	• Write clearly defined policies and procedures for age verification – make them publicly available • Develop remediation plan for use in cases where children are unknowingly employed • Engage with local stakeholders to develop proactive plans to address child labour issues • Communicate child labour policies to projects suppliers and contractors – and provide them with the training and tools to address the issue	• The migrant contract laborer may be expected to bring their family along during the construction phase of the project. The family might also accompany the laborer to their workplace thus enhances the possibility of child labour at varying scale. Further during the operational phase of the project, the possibility of adolescent workers (between 14 to 18 years) entering hazardous working conditions cannot be ruled out. • The contractors will need to adopt suitable proactive mechanisms to prevent child labour in any form. Some of the measures in this regard could be as follows • Identify the types of activities during the	• Policies and procedures for age verification in hiring • Interviews with workers, local children, trade unions and NGOs • Visual observation • Pay records, medical records, birth certificates, panchayat certificate

			entire project operation that could have a possibility of child labour • Clearly defined policies and procedures for age verification • Visual observation and verification thereupon • Develop remediation plan for use in cases where children are unknowingly employed despite the clear policy and procedure of contractors on no-child labour.	
Forced Labour				
9.	• Project & its contractors will not employ forced labour • Workers have the right to retain their personal documents and money • Workers are free to leave the workplace after work • Workers have the right to resign	• Clearly define worker's freedom in employment contract • Provide employment contracts to all workers in their language - direct or contracted • Define and enforce policy regarding use of employment agencies and expectations • If employment agencies are used, audit relationship between the agency and the workers • Provide training for all workers to explain their rights	• Any involuntary work which is performed under threat of force or penalty, is considered as forced labour. It can be in form of bonded labour, indentured labour or similar labour arrangement, slavery or slavery like situation. There can be a possibility of forced labor by sub-contractors or petty contractors during the construction or operational phase of the project; however, the likelihood of forced labour is expected to be negligible for the regular workers during operational phase in view of hiring system structures in place and an adequate HR management department.	• Employment contracts in all appropriate languages • Contracts with employment or recruitment agencies • Payroll records, timesheets and wage deduction calculations • List of permanent workers and contracted workers at the Project • Worker IDs • Interviews with all workers, employment agencies and external stakeholders

		• Pay all job-related training and equipment expenses		• Interviews with security guards
Occupational Health and Safety				
1(	• Project & its contractors will take all reasonable precaution actions to protect the health and safety of workers • Ensure that workers are not exposed to unnecessary or unreasonable risks at the workplace, dormitories etc. • Implement an OHS management system consistent with international standards such as OHSAS 18001. • Systematically assess all OHS risks, conducting a comprehensive job safety or job hazard analyses. • implement preventive and protective measures according to the order of priority: Eliminating the hazard, Controlling the hazard at its source, Minimizing the hazard, Providing appropriate personal protective equipment • Document, investigate and	• Structuring an OHS team and an OHS accountability framework (including production area) • Conducting a comprehensive job safety or job hazard analyses • Developing a Corrective OHS Action Plan based on the likelihood and severity of the consequence of exposure to the identified hazards • Proper equipment design, maintenance and procedures, such as: Designing machines and equipment's like stairs, to eliminate trap hazards • Turning off, disconnecting, isolating, and de-energizing (Locked Out and Tagged Out) machinery with exposed or guarded moving parts or being serviced • Marking and checking all energized	• Projects and its contractors is expected to have its own OHS system. *Some examples of things to be done include:* • Integrity of Workplace Structures – reachable, easy to clean, fore resistant, floors • Workspace and exits – unobstructed, clearly marked, consider disabilities • Fire Precautions • Amenities- toilets, potable water, lighting • Safe Access –even pathways, falling objects, railings • First Aid- training • Fresh air supply • Physical Hazards- Working at heights, Vibrations, Electrical, Ergonomics, illumination • PPEs	• Visual observation • Exposure to hazardous agents monitoring log • Manager and worker interviews • Accident and medical treatment logs • Equipment maintenance logs • Fire and safety drill logs • Health and safety risk analysis • Health and safety inspection logs with test results • Government health inspection reports • Training curriculum and logs

	report all accidents and occupational diseases. • Investigate and identify the root causes of all accidents with working time loss, and implement appropriate corrective actions • Note: This can be done through the involved contractors also.	electrical devices, cords and lines with warning signs • Implementing proper monitoring systems of hazardous agents and proper control measures (eliminating risk, PPC, PPE) •	• Communication[92]- Induction orientation, training

APPENDIX 13: ENVIRONMENTAL AND SOCIAL MONITORING PLAN

With regards to sustainable development, GWVPL will carry out all its business activities in a way which causes minimum or insignificant impacts on environmental and social parameters in the project area or its surroundings.

Scope

The Environmental Monitoring Plan has been formulated to provide guidance to GWVPL on periodic measuring and monitoring of such E&S parameters in the projects' area of influence. The plan is applicable during the entire project cycle included works contractually assigned to third party agencies (contractors) adhere to this monitoring plan.

Timelines for Env Monitoring

Monitoring Type	Monitoring Frequency	No of Samples
Ambient Air Quality	Quarterly	Minimum 3
Point Air Emission	Quarterly	all air emission discharge points (e.g. process stacks, power generation stacks, DG sets etc.)
Ambient Noise	Quarterly	Minimum 3
Liquid Effluent & Sludge Discharge	Quarterly	Minimum 2 (Outlet)
Ground water sample	Quarterly	Can vary on the number of ground water abstraction structures
Soil Quality	Half Yearly	Minimum 3
Fly Ash Quality	Half Yearly	One sample each for Bottom Ash & Fly Ash
Leachate Monitoring	Half Yearly	One sample from the storage tank and One sample from the source (Either bunker or waste incoming bunker)
Odour Monitoring	Quarterly	2-4 locations within plant and 1 downwind at the nearest resident
Surface Water Quality	Half Yearly	Upstream and downstream of nearby surface water body (River Vishwamitri)
Analysis of Sludge	Half Yearly	1 sample

Records

Following records but not limited to the following shall be maintained by GWVPL.

- Environmental monitoring reports (air, noise, water and soil) as prescribed by the SPCB in the consents;
- Ash generation and its disposal;
- Waste water generated and treated;
- Waste register for recording the generation and disposal of various categories of waste produced at sites; and
- Environmental Statements reports.

The records will be kept for all initial, final and routine monitoring / inspections of construction and operation areas. These records will be stored in an agreed location within the plant and be available for internal and external monitoring as required; and

Record sheets will detail the date, location of inspection, frequency, findings, appropriate person/s notified and identified actions, as required.

Environment Monitoring

GWVPL is required to engage reputed and authorized laboratories to collect representative samples of ambient air/noise/water/flyash/leachate/point air emissions at an agreed number of locations within as well as outside the property boundary fence and submit collected samples for analysis and report the results to ACEL. The monitoring parameters and frequency for the concerned project will be as per the environmental clearances / consent issued by

regulatory authority or will be agreed upon by the GWVPL and ACEL at corporate level as per the IFC/World Bank/ WHO guidelines.

Ambient Air Quality

The ambient air quality monitoring shall be applicable to both construction and operation phases.

Sample Frequency (e.g. quarterly)	Ambient Air Quality Parameter	WHO Permissible Limits *	India Regulatory Limits and units *	Monitoring results (in comparable units) **
Particulate Matter (PM_{10})				
	Annual arithmetic mean	15 µg/m³	60 µg/m³	µg/m³
	Maximum 24 hour average	45 µg/m³	100 µg/m³	µg/m³
Particulate Matter ($PM_{2.5}$)				
	Annual arithmetic mean	5 µg/m³	40 µg/m³	µg/m³
	Maximum 24 hour average	15 µg/m³	60 µg/m³	µg/m³
Sulphur Dioxide (SO_2)				
	Annual arithmetic mean	µg/m³	50 µg/m³	µg/m³
	Maximum 24 hour average	40 µg/m³	80 µg/m³	µg/m³
Oxides of Nitrogen (NOx)				
	Annual arithmetic mean	10 µg/m³	50 µg/m³	µg/m³
	Maximum 24 hour average	25 µg/m³	80 µg/m³	µg/m³
Ozone (O_3)				
	8-hour daily maximum	100 µg/m³	100 µg/m³	µg/m³
	8-hour mean, peak season	80 µg/m³		µg/m³

* Current standards as per the latest WHO norms for ambient air pollution

** Monitoring results should be accompanied by reports submitted by laboratory.

Point Air Emissions Monitoring

Point air emission monitoring will be conducted during operation phase

Sample Frequency (e.g. quarterly)	Air Emission Parameter	Flue Gas emission standards as IFC EHS Guidelines for Thermal Power Plant	India Regulatory Limits and units	Monitoring results (in comparable units) **
	Particulate matter (PM_{10})	mg/Nm³	mg/Nm³	
	Sulphur Dioxide (SO_2)	mg/Nm³	mg/Nm³	
	Oxides of Nitrogen (NOx)	mg/Nm³	mg/Nm³	
	Carbon Monoxide	mg/Nm³	mg/Nm³	
	Particulate matter (PM2.5)	mg/Nm³	mg/Nm³	
	Cadmium as Cd	mg/Nm³	mg/Nm³	
	Lead (Pb)			

Sample Frequency (e.g. quarterly)	Air Emission Parameter	Flue Gas emission standards as IFC EHS Guidelines for Thermal Power Plant	India Regulatory Limits and units	Monitoring results (in comparable units) **
	Mercury (Hg)			
	Nickel (as Ni)			
	Arsenic as As			
	HCL			
	HF			
	Dioxin/Furan			

** Monitoring results should be accompanied by reports submitted by laboratory

Ambient Noise

Ambient Noise Monitoring is applicable during both construction and operation phases. The results should be maintained for each monitoring locations and sampling should be done during day and night for 48 hours.

Sample Frequency (e.g. quarterly)	Sample Location	Ambient Noise Parameters	Permissible WHO limits	Indian Regulatory Limits and Units	Monitoring results (in comparable units)**
		Residential, institutional, educational receptors, Daytime (07:00-22:00 hours)	L_{eq} (hourly), 55 dB(A)	55	dB(A)
		Residential, institutional, educational receptors, Nighttime (22:00-07:00 hours)	L_{eq} (hourly), 45 dB(A)	45	dB(A)
		Industrial, commercial receptors Daytime (07:00-22:00 hours)	L_{eq} (hourly), 70 dB(A)	75 for industrial 65 for commercial	dB(A)
		Industrial, commercial receptors, Nighttime (22:00-07:00 hours)	L_{eq} (hourly), 70 dB(A)	70 for industrial 55 for commercial	dB(A)

** Monitoring results should be accompanied by reports submitted by laboratory.

Liquid Effluent Discharges and Sludge

Applicable during construction as well as operation phase

- ❑ *Please describe the water course(s) which the effluent is discharged into (e.g. river, municipal system, sea).*
- ❑ *If the effluent is treated prior to discharge from the site please describe the level of treatment provided.*
- ❑ *If the effluent is discharged into a municipal system please confirm the level of treatment provided and where the municipal system discharges to.*

Sample Frequency (e.g. quarterly)	Treated Effluent Quality Parameters	WBG/IFC Permissible limits	Indian Regulatory Limits and Units *	Monitoring results in comparable units **
	pH	6-9		
	Biochemical oxygen demand (BOD_5)	50 mg/L		mg/L
	Chemical oxygen demand (COD)	250 mg/L		mg/L
	Oil and grease	10 mg/L		mg/L

Sample Frequency (e.g. quarterly)	Treated Effluent Quality Parameters	WBG/IFC Permissible limits	Indian Regulatory Limits and Units *	Monitoring results in comparable units **
	Total suspended solids (TSS)	50 mg/L		mg/L
	Total coliform bacteria, Most Probable Number (MPN) or plate count (PC)	400 /100 ml		/100 mls
	Ambient temperature of receiving waters at edge of zone where mixing with effluent takes place (if not defined, 100 meters from discharge point).	3^0C (maximum increase is 3^0C)		^{0}C
	Heavy Metals, Total	10 mg/L		mg/L
	(list other parameters)*	mg/L		mg/L

** Monitoring results should be accompanied by reports submitted by laboratory.

* List other parameters as well. The parameters listed are not detailed.

Indicative parameters for sludge includes the following. Please note, the sludge parameter and compliance requirements to be followed as mentioned in the CTO for the project.

S.No.	Parameters	Unit	Sludge Sample
1.	Temperature	^{o}C	
2.	pH	-	
3.	Alkalinity	-	
4.	BOD	mg/l	
5.	COD	mg/l	
6.	Total suspended solid	mg/l	
7.	Volatile Suspended Solid	mg/l	
8.	Moisture Content	%	
9.	Heavy metals	mg/l	

Ground Water Monitoring

Groundwater monitoring is applicable during both construction and operation phases.

Sample Frequency (e.g. quarterly)	Ground Water Quality Parameters	WBG/IFC Permissible limits	Indian Regulatory Limits and Units *	Monitoring results in comparable units **
	pH	6-9		
	Biochemical oxygen demand (BOD_5)	50 mg/L		mg/L
	Chemical oxygen demand (COD)	250 mg/L		mg/L
	Oil and grease	10 mg/L		mg/L
	Total suspended solids (TSS)	50 mg/L		mg/L
	Total coliform bacteria, Most Probable Number (MPN) or plate count (PC)	400 /100 ml		/100 mls
	Heavy Metals, Total	10 mg/L		mg/L
	(list other parameters)*	mg/L		mg/L

Sample Frequency (e.g. quarterly)	Ground Water Quality Parameters	WBG/IFC Permissible limits	Indian Regulatory Limits and Units *	Monitoring results in comparable units **

Soil Quality Monitoring

S.No	Sample Frequency Eg. Quarterly	Parameter	Units	Sample 1	Sample 2	Sample n
1.		pH Value (1:2.5) at 25℃	None			
2.		Texture	None			
3.		Electrical Conductivity (1:2.5) at 25℃	µs/cm			
4.		Permeability	Cm/hr.			
5.		Phosphate (as PO4)	mg/kg			
6.		Sand	%			
7.		Silt	%			
8.		Clay	%			
9.		Porosity	%			
10.		Nitrites (as NO2)	mg/kg			
11.		Nitrates (as NO3)	mg/kg			
12.		Total Petroleum Hydrocarbon as TPH	mg/kg			
13.		Iron (as Fe)	mg/kg			
14.		Lead (as Pb)	mg/kg			
15.		Manganese (as Mn)	mg/kg			
16.		Nickel (as Ni)	mg/kg			
17.		Barium (as Ba)	mg/kg			
18.		Zinc (as Zn)	mg/kg			
19.		Copper (as Cu)	mg/kg			
20.		Cadmium (as Cd)	mg/kg			
21.		Total Chromium (as Cr)	mg/kg			
22.		Arsenic (as As)	mg/kg			
23.		Mercury (as Hg)	mg/kg			
24.		Total Hydrocarbon	mg/kg			
25.		Cation Exchange Capacity	Meq/10			

Fly Ash Quality Monitoring

Fly Ash Quality Monitoring to be undertaken twice a year during operation phase to assess the quality of fly ash and to ensure that the fly ash Is not hazardous in nature.

The indicative parameters to be monitored as part of the fly ash monitoring are as follows.

S.No.	Parameters	Unit	Sample Results

1.	Silica	% by Mass
2.	Alumina	% by Mass
3.	Iron Oxide	% by Mass
4.	Titanium Oxide	% by Mass
5.	Calcium Oxide	% by Mass
6.	Magnesium Oxide	% by Mass
7.	Sodium Oxide	% by Mass
8.	Potassium Oxide	% by Mass
9.	Manganese Oxide	% by Mass
10.	Sulphate	% by Mass
11.	Phosphate	% by Mass
12.	Chloride	% by Mass
13.	Copper Oxide	% by Mass
14.	Zinc Oxide	% by Mass
15.	Strontium	% by Mass

Corrective Actions

If any of the WHO/World Bank Group/IFC or Indian regulatory standards in any of the above tables are exceeded please explain the cause and, if appropriate, describe the planned corrective actions to prevent re-occurrence.

Parameter Exceeded	Cause of Exceedance	Corrective Action and Completion Schedule

Monitoring

- The Project Head and EHS Manager will regularly inspect the monitoring reports to ensure compliance with the applicable standards;
- Plant level Site Manager/Supervisor will perform regular checks of plant and equipment to identify any exhaust gas leakages/ odor leakages/any leakages to confirm the condition of the plant;
- Regular checks for visual evidence of pollution, contamination, hygiene and safety will also be made in the plant premises and working areas;
- On site meetings/Inspections will be carried out as necessary to confirm the appropriate use of mitigation measures identified within the ACEL environmental plans relating to pollution control. These meetings/Inspections will highlight any further issues/measures which may be relevant either prior to commencement or during the works;
- Records will be kept of all inspections / findings for review for discussion during regular meetings; and

Training

- All employees, subcontractors, suppliers and visitors to the site will be notified via induction of the requirements on site for pollution prevention;

- Through tool box talks, site personnel and subcontractors will be educated on those aspects of environmental management as appropriate to the task assigned to them;
- Consultation meetings will include discussion on the works to be undertaken, review of other plans and agreement on required mitigation and pollution prevention measures. Measures agreed at such consultation meetings will be disseminated to the relevant employees, contractors, subcontractors, suppliers and other appropriate persons via tool box talks and formal communications (email / memo), particularly where required for record purposes (e.g. variations, auditing and monitoring records);
- ACEL will ultimately be responsible for overseeing and enforcing pollution prevention procedures such that potential adverse impacts to human health or the environment from any activities involving handling of potential pollutants are avoided or mitigated. For the avoidance of doubt, pollution prevention procedures include, but are not necessarily limited to all aspects of traffic, plant and materials management, air emission management, noise level management, surface water and drainage management.

Applicable Standards

Emission Standards for Boiler

- The emission from boiler from the facility shall meet the following standards

Table 6 (C) - Emission Guidelines (in mg/Nm³ or as indicated) for Boiler

Note:
- **Guideline values are applicable for new facilities**
- **Nationally legislated limits should be applied if they are more stringent**
- **EA may justify more stringent or less stringent guideline values due to environmental, community health, technical and economic considerations, whilst not exceeding nationally legislated limits In all cases, the EA should demonstrate that ambient impacts from emissions are in compliance with the requirements of Section 1.1 of the General EHS Guidelines.**
- **For fuels other than those specified below, the EA should justify the required emission guidelines taking account of environmental, community health, technical and economic considerations**
- **For projects to rehabilitate existing facilities, emission guidelines should be established by the EA considering (i) the existing emission levels and impacts on the environment and community health, and (ii) economic and technical feasibility of ensuring the existing emission levels meet the Guideline values for new facilities.**

Combustion Technology / Fuel	Particulate Matter (PM)		Sulfur Dioxide (SO_2)		Nitrogen Oxides (NO_x)		Excess Dry gas O_2 Content (%)
Boiler	NDA	DA	NDA	DA	NDA	DA	
Natural Gas	N/A	N/A	N/A	N/A	200	180	3
Other Gaseous Fuels	50	30	400	300	240	200	3
Liquid Fuels (Plant ≥50MWth to <600MWth)	50	30	400 – 1000[a]	400	400	200	3
Liquid Fuels (Plant ≥600MWth)	40	25	200 – 600[a]	200	400	200	3
Solid Fuels (Plant ≥50MWth to <600MWth)	50	30	400 – 1000[a]	400	500	200	6
Solid Fuels (Plant ≥600MWth)	40	25	200 – 600[a]	200			6

Notes:

(a) Targeting the lower guidelines values and recognizing variability in approaches to the management of SO_2 emissions (fuel quality vs. use of secondary controls) and the potential for higher energy conversion efficiencies. Selection of the emission level in the range is to be determined by EA taking account of environmental, community health, technical and economic considerations.

General notes:
- MWth = Megawatt thermal input on HHV basis.
- N/A = not applicable.
- NDA = Non-degraded airshed; DA = Degraded airshed; Airshed should be considered as degraded if relevant ambient air quality standards (as defined in the **General EHS Guidelines**) are exceeded; DA/NDA to be determined for each pollutant.
- Nm³ is at one atmospheric pressure, 0 degree Celsius, dry gas.
- MWth category is to apply to the entire facility consisting of multiple units.
- Guideline values apply to facilities operating more than a combined total of 500 hours per year (i.e., if multiple units are present, the combined total of all operational units at the facility).
- See Section 2.1 for information on how facility performance is compared with these emission guidelines. The use of fuels with a low volatile content may lead to higher emission levels of NOx which should be justified in the EA.
- In the event that natural gas contains elevated sulfur levels, SO_2 emissions should be no greater than that for liquid fuels.
- PM defined as total suspended particulates.

Comparison of the Guideline values with standards of selected countries / region (as of January 2017):
- Natural Gas-fired Boiler – NO_x
  - EU: 100mg/Nm³
  - US: 88ng/J gross energy output
  - China: 100mg/Nm³
- Solid Fuels-fired Boiler - PM
  - EU: 20mg/Nm³, 10 (> 300MWth for coal and lignite)
  - US: 11ng/J gross energy output
  - China: 30mg/Nm3
  - India: 350mg/Nm3 (<210MWth), 140mg/Nm3 (=>210MWth)
- Solid Fuels-fired Boiler – SO_2
  - EU: 400mg/Nm³ (50 – 100MWth), 200mg/Nm³ (>300MWth)
  - US: 130ng/J gross energy output or 97% reduction
  - China: 50 – 200mg/Nm³ (subject to location)

Source: EU (Directive 2010/75/EU), US (40 CFR Part 60 Subpart JJJJ), Final Rule – June 13, 2007), China (GB13223-2011), India (The Environment (Protection) Rules, 1986).

Standards for Incineration as per SWM Rule 2016

The emission from incinerator / thermal technologies in solid waste treatment/ disposal facility shall meet the following standards

Parameter	Emission standard	
(1)	(2)	(3)
Particulates	50 mg/Nm^3	Standard refers to half hourly average value
HCl	50 mg/Nm^3	Standard refers to half hourly average value
SO2	200 mg/Nm^3	Standard refers to half hourly average value
CO	100 mg/Nm^3	Standard refers to half hourly average value
	50 mg/Nm^3	Standard refers to daily average value
Total Organic Carbon	20 mg/Nm^3	Standard refers to half hourly average value
HF	4 mg/Nm^3	Standard refers to half hourly average value
NOx (NO and NO2 expressed as NO2)	400 mg/Nm^3	Standard refers to half hourly average value
Total dioxins and furans	0.1 ng TEQ/Nm^3	Standard refers to 6-8 hours sampling. Please refer guidelines for 17 concerned congeners for toxic equivalence values to arrive at total toxic equivalence.
Cd + Th + their compounds	0.05 mg/Nm^3	Standard refers to sampling time anywhere between 30 minutes and 8 hours.
Hg and its compounds	0.05 mg/Nm^3	Standard refers to sampling time anywhere between 30 minutes and 8 hours.
Sb + As + Pb + Cr + Co + Cu + Mn + Ni + V + their compounds	0.5 mg/Nm^3	Standard refers to sampling time anywhere between 30 minutes and 8 hours.

Note.- *All values corrected to 11% oxygen on a dry basis.*

National Ambient Air Quality Standards, CPCB 2009

Pollutant	Time Weighted Avg.	Concentration in Ambient Air	
		Industrial, Residential, Rural & Other Areas	Ecologically Sensitive Areas (notified by Central Government)
Sulphur dioxide (SO2) µg/m³	Annual Average*	50	20
	24 Hours**	80	80
Oxides of Nitrogen (NOx) µg/m³	Annual Average*	40	30
	24 Hours**	80	80
Particulate Matter (PM 10) µg/m³	Annual Average*	60	60
	24 Hours**	100	100
Particulate Matter (PM 2.5) µg/m3	Annual Average*	40	40
	24 Hours**	60	60
Ozone (O3) µg/m3	8 Hours**	100	100
	1 Hour**	180	180
Lead (Pb) µg/m3	Annual Average*	0.50	0.50
	24 Hours**	1.0	1.0
Carbon monoxide (CO) mg/m3	8 Hours**	02	02
	1 Hour**	04	04
Ammonia (NH3) µg/m3	Annual*	100	100
	24 Hours**	400	400
Benzene (C6H6) µg/m3	Annual*	05	05
Benzo(α)Pyrene-particulate phase ng/m3	Annual*	01	01
Nickel (Ni) ng/m3	Annual*	20	20
Arsenic (As) ng/m3	Annual*	06	06

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.

National Ambient Noise Standards

Area Code	Category of Area	Limits in dB(A) Leq	
		Day time*	Night Time
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone**	50	40

Note: *Daytime 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.

Source: Noise Pollution (Regulation and control) Rules, 2000

Soil Quality 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) (1 ppm = 640 mhos/cm)	Up to 1.00 Average 1.01-2.00 harmful to germination 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

IS10500:2012 Drinking Water Standards

S.N	Substance/ Characteristics	Requirement (Acceptable limit)	Permissible limit in absence of alternate source
1.	Colour, Hazen units, max	5	15
2.	Odor	Unobjectionable	-
3.	Taste	Agreeable	-
4.	Turbidity, NTU, max	5	5
5.	pH value	6.5 - 8.5	No Relaxation
6.	Total hardness (as CaCO3) mg/l, max	200	600
7.	Iron (as Fe) mg/l, max	0.3	No relaxation
8.	Chlorides (as Cl) mg/l, max	250	1000
9.	Free residual chlorine, mg/l, min	0.2	1
10.	Dissolved solids mg/l, max	500	2000
11.	Calcium (as Ca) mg/l, max	75	200
12.	Magnesium (as Mg) mg/l, max	30	100
13.	Copper (as Cu) mg/l, max	0.05	1.5
14.	Manganese (as Mn) mg/l, max	0.1	0.3
15.	Sulphate (as SO4) mg/l, max	200	400
16.	Nitrate (as NO3) mg/l, max	45	No relaxation
17.	Fluoride (as F) mg/l, max	1.0	1.5
18.	Phenolic compounds (as C6H6OH) mg/l, max	0.001	0.002
19.	Mercury (as Hg) mg/l, max	0.001	No relaxation
20.	Cadmium (as Cd) mg/l, max	0.003	No relaxation
21.	Selenium (as Se) mg/l, max	0.01	No relaxation
22.	Arsenic (as As) mg/l, max	0.01	0.05
23.	Cyanide (as CN) mg/l, max	0.05	No relaxation
24.	Lead (as Pb) mg/l, max	0.01	No relaxation
25.	Zinc (as Zn) mg/l, max	5	15
26.	Anionic detergents (as MBAS) mg/l, max	0.2	1.0
27.	Total Chromium (as Cr) mg/l, max	0.05	No relaxation
28.	Polynuclear aromatic hydrocarbons (as PAH) g/l, max	0.0001	No relaxation
29.	Mineral Oil mg/l, max	0.5	No relaxation
30.	Pesticide's mg/l, max	Absent	0.001
31.	Radioactive materials: a) Alpha emitters Bq/l, max b) Beta emitters pci/l, max	 0.1 1.0	 No relaxation No relaxation
32.	Total Alkalinity (as CaCO3), mg/l, max	200	600
33.	Aluminum (as Al) mg/l, max	0.03	0.2
34.	Boron, mg/l, max	0.5	1.0

35.	Ammonia (as total ammonia-N). mg/l, max	0.5	No relaxation
36.	Barium (as Ba), mg/l, max	0.7	No relaxation
37.	Chloramines (as Cl2), mg/l, max	4.0	No relaxation
38.	Silver (as Ag), mg/l, max	0.1	No relaxation
39.	Sulphide (as H2S), mg/l, max	0.05	No relaxation
40.	Molybdenum (as Mo), mg/l, max	0.07	No relaxation
41.	Nickel (as Ni), mg/l, max	0.02	No relaxation
42.	Polychlorinated biphenyls, mg/l, max	0.0005	No relaxation
43.	Trilomethanes: a) Bromoform, mg/l, max b) Dibromochloromethane, mg/l, max c) Bromodichloromethane, mg/l, max d) Chloroform, mg/l, max	0.1 0.1 0.06 0.2	No relaxation No relaxation No relaxation No relaxation
Bacteriological Quality			
1.	All water intended for drinking: a) E. coli or thermotolerant coliform bacteria	Shall not be detectable in any 100 ml sample	-
2.	Treated water entering the distribution system: a) E. coli or thermotolerant coliform bacteria b) Total coliform bacteria	Shall not be detectable in any 100 ml sample; Shall not be detectable in any 100 ml sample.	-
3.	Treated water in the distribution system: a) E. coli or thermotolerant coliform bacteria b) Total coliform bacteria	Shall not be detectable in any 100 ml sample; Shall not be detectable in any 100 ml sample.	-

Source: Central Pollution Control Board

General Standard for Treated waste water from STP

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

12	Chemical oxygen demand, mg/l max	250	-	-
13	Arsenic (as As) mg/l, max	0.2	0.2	0.2
14	Mercury (As Hg) mg/l max.	0.01	0.01	-
15	Lead (as Pb) mg/l, max	0.1	1.0	-
16	Cadmium (as Cd) mg/l, max	2.0	1.0	-
17	Hexavalent chromium (as Cr +6) mg/1 max	0.1	2.0	-
18	Total chromium (as Cr) mg/1 max	2.0	2.0	-
19	Copper (as Cu) mg/1, max	3.0	3.0	-
20	Zinc (as Zn)	5.0	15	-
21	Selenium (as Se)	0.05	0.05	-
22	Nickel (as Ni) mg/1,max	3.0	3.0	-
23	Cyanide (as CN) mg/1,max	0.2	2.0	0.2
24	Fluoride (as F) mg/1,max	2.0	15	-
25	Dissolved phosphates (as P) mg/1,max	5.0	-	-
26	Sulphide (as S) mg/1,max	2.0	-	-
27	Phenolic compounds (as C6H5OH) mg/1,max	1.0	5.0	-
28	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
29	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
30	Manganese	2 mg/1	2 mg/1	-
31	Iron (as Fe)	3mg/1	3mg/1	-
32	Vanadium (as V)	0.2 mg/1	0.2 mg/1	-
33	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.

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:

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.				

Standard for treated leachate as per SWM rules 2016

The disposal of treated leachate shall meet the following standards

S. No	Parameter	Standards (Mode of Disposal)		
		Inland surface water	Public sewers	Land disposal
(1)	(2)	(3)	(4)	(5)
1.	Suspended solids, mg/l, max	100	600	200
2.	Dissolved solids (inorganic) mg/l, max.	2100	2100	2100
3	pH value	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
4	Ammonical nitrogen (as N), mg/l, max.	50	50	-
5	Total Kjeldahl nitrogen (as N), mg/l, max.	100	-	-
6	Biochemical oxygen demand (3 days at 27^0 C) max.(mg/l)	30	350	100
7	Chemical oxygen demand, mg/l, max.	250	-	-
8	Arsenic (as As), mg/l, max	0.2	0.2	0.2
9	Mercury (as Hg), mg/l, max	0.01	0.01	-
10	Lead (as Pb), mg/l, max	0.1	1.0	-
11	Cadmium (as Cd), mg/l, max	2.0	1.0	-
12	Total Chromium (as Cr), mg/l, max.	2.0	2.0	-
13	Copper (as Cu), mg/l, max.	3.0	3.0	-
14	Zinc (as Zn), mg/l, max.	5.0	15	-
15	Nickel (as Ni), mg/l, max	3.0	3.0	-
16	Cyanide (as CN), mg/l, max.	0.2	2.0	0.2
17	Chloride (as Cl), mg/l, max.	1000	1000	600
18	Fluoride (as F), mg/l, max	2.0	1.5	-
19	Phenolic compounds (as C_6H_5OH) mg/l, max.	1.0	5.0	-

APPENDIX 14: OCCUPATIONAL HEALTH & SAFETY PLAN

This management plan is applicable to both construction and operation phases of the project. GWVPL will implement occupational health and safety management during construction activities, major maintenance works and routine operations and maintenance activities.

The procedures will include first aid management, health surveillance, general health and safety, permit to work system, etc. The EHS Manager of the project will be responsible for effective implementation of these procedures throughout the project lifecycle and will ensure that the requirements are abided by all the employees, contractors and their workers.

Scope

The plan developed shall be adhered to by the Contractors and the Sub-Contractors engaged during the lifecycle of the project. The following have been included in this OHS Plan.

- First Aid Management
- Health Surveillance
- Permit to Work
- General Health & Safety
- Hot work
- PPE enforcement & Verification
- Safety Requirements of Pressure Vessels
- Safety Requirements of Boilers
- Work at Height
- Confined Spaces
- Noise Management

Management Plan

1. First Aid Management

For the safety of workers and other staff, and any other contingency situation, medical service should be available at the project office. Following guidelines with respect to first aid requirements and responsibilities for the provision of immediate medical services will be adopted:

- First aid kits will be provided at the project site, as well as in vehicles used by staff for transportation of good and materials. First aid signs shall be displayed for assisting in easy locating of first aid equipment and facilities.
- One person from the SPV team will be nominated to maintain the first aid kits (a trained first aider). The person will undertake regular checks (after each use or, if the kit is not used, at least once every 12 months) to ensure the kit contains a complete set of the required items (an inventory list in the kit should be signed and dated after each check). At no time will over-the-counter medications be stored in the kits without the prior approval of a health care professional (where permitted by local legislation) and inclusion in the kit's listed inventory.
- The first aid kit should provide basic equipment for administering first aid for injuries including:
    - cuts, scratches, punctures, grazes and splinters
    - muscular sprains and strains
    - minor burns
    - amputations and/or major bleeding wounds
    - broken bones
    - eye injuries
    - Shock.
- The EHS In-charge shall identify and train an adequate number of staff/ workers to provide first aid during medical emergencies.
- First aid register will be maintained onsite

2. Health Surveillance

Effective health management is necessary for preventing disease or adverse health effects among employees, workers and labour. The following medical facilities shall be provided by SPV:

- Annual health check-ups shall be carried out for all SPV on roll employees and health records shall be maintained. Workers engaged through contractors shall also have periodic medical check-ups arranged through their respective contractors. Related records shall be furnished to the SPV.
- Information and awareness of communicable diseases, AIDS etc. shall be provided to contract workers.
- Records on reported medical cases amongst workers and staff shall be maintained by the EHS In-charge or HR & Admin Officer of the SPV.
- An ambulance shall be made available at the project site for transportation of injured persons to the nearest hospital or health centre. The ambulance will be supplied with first aid boxes, stretchers and oxygen cylinders.

3. Permit to Work

- A permit-to-work (PTW) system is a formal written system used to control certain types of work that are potentially hazardous such as hot work, work at height (above 2 m), confined space, excavation work, electrical maintenance (e.g., display panels, lighting systems, etc.) and chemical related work. The permit specifies the work to be done, and the precautions to be taken. Permits-to-work form an essential part of safe systems of work for many construction activities and routine maintenance work.
- During construction phase, the contractor shall either adopt this procedure or implement their own Permit to Work (PTW) System after taking an approval from the PM and SPV. Non-compliance with the requirements would result in disciplinary action.
- A work request shall be initiated whenever any potentially hazardous work / activity is required to be carried out by SPV employee or any contract workers, using Permit to Work Form and Energized Electrical Work Permit. The work permit will have a PTW number, date and completing section (1) Permit Description of PTW form: Location of Work, System/ Equipment ID, Description of Work, Estimated Time of Completion (approximate) etc.
- The SPV's EHS Manager shall be authorized to approve a PTW during routine maintenance activities, while during construction or major maintenance works, the contractor's EHS representative / site supervisor shall approve the PTW. The PTW will be issued only after ensuring that the person requesting for the permit is trained to perform the concerned work and has the necessary PPEs. A copy of PTW to be displayed at worksite and completed PTW will be kept in 'Active' folder till the completion of work. After completion of the work, the same issuing authority will close the PTW after ensuring all works have been satisfactorily and safely completed. All PTW records will be maintained by the SPV.

4. General health and safety

- Potable (drinking) water shall be made available free of cost to all workers and staff at the site office and toll plazas. Potable water outlets/ dispensers, if provided, shall be clearly labelled for identification. Periodic testing of water quality using external testing laboratories shall be carried out and records shall be maintained.
- Toilet facilities shall be available for all staff and workers. Separate facilities shall be provided for male and female employees and workers. Public toilets, if provided, will be maintained as per the good hygiene standards.
- All staff and workers will be issued personal protective equipment (PPE). The PPE shall be kept clean at all times and maintained in accordance with the manufacturer's requirements.
- The project site office, toll plazas and patrolling vehicles will be provided with portable extinguishers (such as CO2). Automated fire extinguishers shall be provided at strategic locations with a clear labelling of the extinguisher so the type of the extinguisher is easily identifiable. Automated fire detection system and fire alarms will be provided in the office buildings. Firefighting system shall be tested periodically for proper functioning. Toll plazas will be provided with public announcement (PA) system to notify the general public of any emergency situation such as fire.
- A safe assembly area will be identified near the toll plazas and site offices, and evacuation / emergency response procedures will be practiced regularly through mock drills.
- Safety measures in the form of Do's and Don'ts shall be displayed at strategic locations.
- In material storage areas, hazardous materials shall be stored based on their compatibility characteristics. Chemicals stored, if any, will be accompanied by material safety data sheet (MSDS).

5. PPE Enforcement and Verification:

- Employees shall wear the PPE identified for their job task. Supervisors shall enforce PPE use. If employees are not complying, then enforcement actions (verbal or written) shall be documented and forwarded to the Human Resources Department per local disciplinary agreement.

- No employee or worker shall enter into the construction or operation area without minimum mandatory PPEs such as safety shoes, safety helmet, high visibility vest etc.
- All personnel are responsible to ensure the proper PPE is being used for designated job tasks.
- PPE requirements for particular areas must be communicated with signs placed in such areas or by any feasible means of communication as determined by each site for those tasks that require PPE but are off site and/or temporary (e.g. short-term task.) This must be documented and put up as signage. The lack of signage for any reason must not be construed as an excuse for not wearing appropriate PPE.
- PPE distribution and maintenance register to be maintained.

6. Hot Work

- Prior to hot work activities being conducted by employees, the Person In charge (Contractor/Supervisor) should issue a Permit to Work- Hot Work to the employee who will carry out the hot work.
- The Person In charge shall ensure the requirements are met before beginning a hot work:
  - A Fire Watch must be maintained in: A fire watch will observe conditions in the immediate and adjacent areas to assure that hot work is performed safely.
  - Relocation of all movable combustible fire hazards in the vicinity to a safe location
  - Drains and Vents within 50 feet must be covered with a material suitable for preventing sparks from entering the drain
  - A fire extinguisher in the immediate vicinity.
- Activities requiring a Permit to Work include but not limited to:
  - Work on vessels, including tanks and pipes, that have contained flammable materials or are lined or coated with flammable or combustible materials,
  - Work in areas that contain flammable or combustible materials that cannot be protected by following the Safe Operating Procedure alone,
  - Work in locations that could expose other users of the area to hazards, e.g. work above building entrances or on circulation routes (unless this is a regular activity for which a Standard Operating Procedure is available).
- A work site must be ready for hot work when the requirements have been addressed, all signatures obtained and the Hot Work Permit has been posted on site. Work must be stopped in case of any leakage, spill or accident .The area must be reinspected and confirmed safe before the work may resume. Work also be stopped in case the fire watch leaves the site.
- A fire watch must remain in the area for 30 minutes after hot work has been completed to assure that all metal surfaces are cool and there are no smoldering materials.
- On completion of work, the supervisor in direct control of the employee shall acknowledge in writing that the work has been completed and all the persons employed have left the work area safely.
- The supervisor/contractor shall also conduct a fire check of the work area after the work has been completed to ensure the hot work area is completely safe.
- HSE Manager shall maintain Hot Work Permits in relation to the hot work after the completion of hot work and Training Records.

7. Safety Requirements of Pressure Vessels

- Pressure vessel inspections for licensing purposes are to be inspected by certified professionals. GWVPL to maintain a list of agencies who may be commissioned to perform boiler and pressure vessel inspections and employ individuals who have been certified.
- All pressure vessels shall be inspected for insurance and safety purposes after installation, at prescribed frequencies, and after any welding, alterations, repair or relocation
- The owner of a new or existing pressure vessel is responsible for maintaining the pressure vessel in accordance with the manufacturer's instructions
- Pressure vessels shall be rated to no less than 4 times the maximum allowable working pressure MAWP.
- Pressure sources shall be limited to the MAWP of the lowest rated system component by a regulator and relief device (valve or disk) downstream of the regulator.

- Gauges shall be graduated to the MAWP (but preferable 20% - 30% above MAWP). Materials shall be compatible with the fluid.
- Rupture disks, where used, shall be approved.
- Pressure control or any other switches which control pressure shall not be bypassed.
- Nonflexible metal pipe, tubing, fittings, and valves appropriate for the system fluid and rated at or above the system MAWP shall be used. Special flexible metal hose shall be used where flexing is required.
- Certificates must be turned in for pressure vessels that are no longer operational.

8. Safety Requirements of Boilers

- Proper registration: Contractors and inspectors should be registered with the appropriate regulatory agency (often at the state level) prior to installing or making any repairs or modifications to boilers.
- Review previous inspection reports and documents: GWVPL should make available all previous inspection reports and other documentation to the inspector for review prior to the date of inspection.
- Ensure proper construction and installation: High-pressure boilers should be constructed, stamped, and installed in accordance with the requirements outlined by Inspectorate of Boilers (IoB), GoA.
- Assess safety controls: Boilers installed require appropriate safety controls, safety limit switches, and burners, as well as electrical requirements, based on the applicable national or international standard.
- Assess remote shutdown: High-pressure boilers must have a manually operated remote shutdown switch, marked clearly for easy identification and positioned outside the boiler room door.
- Assess instruments, fittings, and controls: A variety of requirements related to gages, gage glass, operating pressure, shutoff valves, pressure-temperature ratings, water columns, connections, and other controls. Assess the boiler's instruments, fittings, and controls to ensure compliance with IoB.

9. Work at Height

- Person to work at height must be trained;
- Medical testing for people required to work at height should be conducted and the tests should include conditions such as vertigo or illness that may affect the person or the work;
- As much as possible, work from the ground;
- Ensure workers can get safely to and from where they work at height;
- Ensure equipment is suitable, stable and strong enough for the job, maintained and checked regularly;
- Take precautions when working on or near fragile surfaces;
- Provide protection from falling objects; and
- Consider emergency evacuation and rescue procedures.

10. Confined Spaces

- The engineering control commonly used in confined spaces is mechanical ventilation. The Entry Permit system is an example of an administrative control used in confined spaces. Personal protective equipment (respirators, gloves, ear plugs) is commonly used in confined spaces as well.
- The important thing to remember is that each time a worker plans to enter any work space, the worker should determine if that work space is considered a confined space. Be sure the confined space hazard assessment and control program has been followed.
- Before entering any confined space, a trained and experienced person should identify and evaluate all the existing and potential hazards within the confined space. Evaluate activities both inside and outside the confined space.
- Air quality testing: The air within the confined space should be tested from outside of the confined space before entry into the confined space. Care should be taken to ensure that air is tested throughout the confined space - side-to-side and top to bottom. A trained worker using detection equipment which has remote probes and sampling lines should do the air quality testing. Always ensure the testing equipment is properly calibrated and maintained. The sampling should show that:
- The oxygen content is within safe limits - not too little and not too much.
- A hazardous atmosphere (toxic gases, flammable atmosphere) is not present.
- Ventilation equipment is operating properly.
- The results of the tests for these hazards are to be recorded on the Entry Permit along with the equipment or method(s) that were used in performing the tests. Air testing may need to be ongoing depending on the nature of the potential hazards and the nature of the work.

- Implement permit to work system for confined space entry.

11. Noise Management

- All areas within the project premises which have a potential to be affected by noise and vibration shall be identified using and an inventory of such areas shall be maintained.
- Noise emissions shall be regularly monitored and recorded as appropriate
- Where necessary, vibration caused due to any machinery, equipment installed within GWVPL premises shall be monitored to ensure that no damage is being caused to adjacent buildings and services.
- Where any monitoring is being carried out, all records will be retained and reported as appropriate.
- All personnel on site will be made aware of their responsibilities to ensure noise is managed correctly.
- GWVPL shall provide noise control measures such as acoustic hoods, silencers, enclosures etc. on the sources of noise generation.
- Heavy construction activity shall be done during the day time.
- Working hour for worker working in high noise area shall be rotated. Hearing protection such as earplugs/muffs will be provided to those working very close to the noise generating machinery.
- Examples of high noise areas within premises include:
    - Construction sites
    - Maintenance work location
    - Transformer room
    - Boiler Area
    - Loading and unloading areas
- Employees or workers engaged through the contractors shall not be exposed to a noise level greater than 85 dB for duration of more than 8 hours per day without hearing protection. In addition, no unprotected ear should be exposed to a peak sound pressure level (instantaneous) of more than 140 dB.
- The use of hearing protection shall be enforced actively when the equivalent sound level over 8 hours reaches 85 dB, the peak sound levels reach 140 dB, or the average maximum sound level reaches 110dB. Hearing protective devices such as Earplugs/Muffs provided shall be capable of reducing sound levels at the ear to at least 85 dB
- Although hearing protection is preferred for any period of noise exposure in excess of 85 dB, an equivalent level of protection can be obtained, but less easily managed, by limiting the duration of noise exposure. For every 3 dB increase in sound levels, the 'allowed' exposure period or duration should be reduced by 50 percent.
- Prior to the issuance of hearing protective devices as the final control mechanism, use of acoustic insulating materials, isolation of the noise source, and other engineering controls should be investigated and implemented, where feasible.
- Periodic half yearly medical hearing checks i.e. audiometric test shall be conducted by a certified doctor on workers exposed to high noise level.

Incident Reporting

The accident/incident reporting and investigation procedure at the GWVPL (operation and construction phase) will cover, at minimum, the following:

- ***Accident***: An unplanned event which results in loss or damage to the person, the property or on or off site environmental harm.
- ***Incident***: An unplanned event which results in loss or damage to the property or environment. It includes incidences of fire, natural disasters. Incident is referred as unusual occurrences on the site.
- ***Near Miss***: Incidences that cause no actual harm but could cause harm if repeated.
- ***Lost Time Injury***: Where injured person is unable to attend work for one or more days because of accident or illness. This does not include absence on the day or shift of the accident.
- ***Reportable Lost Time Injury***: Lost time injury which prevent employee from working for a period of 48 hours or more following the day of accident, under Factory Act 1948.
- ***Dangerous Occurrences***: Events such as explosions, collapse, fire, bursting out etc.
- ***Investigation***: Systematic & scientific evaluation of the event to identify root causes, probable solutions & actions planning to implement the optimum solution to avoid reoccurrence.

Procedure for reporting accidents/incidents

- All accidents/incidents including first aid cases must be reported to ensure prompt medical treatment to injured person, timely investigation with root cause analysis to avoid reoccurrence;
- Project Manager/ Service Engineer/ Project Management representative at site should fill up the appropriate information of accident/ incident report & send it to Project Manager within 24hrs of the accident/ incident;
- Site Safety/EHS Officer should initiate the investigation by involving Project Manager / Service Engineer/ Project Management representative within 24 hours of the accident/incident;
- Investigation should be completed within 7 days of the event, in case of complex situation interim report must be submitted within 7 days;
- Involve affected employees, employee group & subject matter expert during the investigation;
- Select the cause of the accident identify the unsafe practices & unsafe conditions;
- Identify corrective measures to be implemented.

Procedure for Investigation of Accidents/Incidents

- All accidents / incidents must be investigated. The scale of investigation will depend on the actual or potential seriousness of the event;
- Key personnel undertaking the investigation must be adequately trained;
- Involve employees, subject matter experts, Site Safety/EHS Manager during the investigation;
- Carry out EHS risk assessment for the probable solutions before implementation;
- If the root cause elimination is a long term action plan, interim corrective measures should be implemented e.g. use of PPE, additional control, supervision etc.;
- Investigations must focus on identifying systemic root cause rather than targeting affected employee or employee groups.

Reporting guidelines covering:

- Notifications about injury/incident;
- Accident/incident site visit;
- Meeting/ discussion with injured/witness/ who provided assistance;
- Recording the facts;
- Investigation covering the following (though not limited to):
    - Determining the underlying cause/factor that may have caused/ contributed to occurrence of accident/incident;
    - Analyzing the cause to be immediate/ basic /root cause;
    - Identifying need for corrective action;
    - Identifying the opportunities for preventive action;
    - Identifying the opportunities for continual improvement.

Responsibilities

Following people at GWVPL projects will be made responsible for incident investigation and reporting

- ***Project Manager:*** Responsible for resource allocation, ensure compliance and approvals
- ***Site Safety/EHS Officer:*** Responsible for ensuring incident investigation and implementation of corrective actions.
- ***Service Engineer*** would be responsible for investigation related to maintenance activities during operation phase.
- ***Project Management representative*** would be responsible in investigations related to module cleaning activities.

Records

Incident and Accident Reporting Format

Incident/ Accident Report Form	
1.	Site/Plant Name:
2.	Site/Plant Address:
3.	Capacity:

4.	Site Manager/Service Engineer/another reporter:
5.	Construction Contractor/Cleaning Contractor
6.	Date of Incident: Time of Incident:
7.	Specify the Incident: □ Accident (Personnel Injury, property, environmental damage) □ Near miss (No Personnel Injury, property, environmental damage) □ Incident (loss or damage to the property or environment due to fire, natural disaster or any other unusual occurrences on the site)
8.	Location of the Incident:
9.	Who was involved in the incident: □ Employee □ Contractor Worker □Public □ Visitor □ Other
10.	Name of Person(s) involved in an incident:
11.	Name and Contact details of any witness of the incident:
12.	Incident Description including any events leading to or immediately following the incident:
13.	Root cause of the accident/incident:
14.	Attach Photograph of the Incident:
15.	Immediate Corrective Measures:
Signature of Reporter:	Date:
Name of Reporter:	
Signature of Reviewer:	Date:
Name of Reviewer:	

APPENDIX 15: DETAILED AEROMOD RESULTS

Normal Scenario

Worst Case Scenario

PM10

Result summary of 24 hour averaging period at Normal Condition

Results Summary

C:\Users\Aplinka\Desktop\2) Abellon Clean Energy Limited\2) VARODARA

PM10 - Concentration - Source Group: ALL

Averaging Period	Rank	Peak	Units	X (m)	Y (m)	ZELEV (m)	ZFLAG (m)	ZHILL (m)	Peak Date, Start Hour
24-HR	1ST	1.83912	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	11-10-2022, 24
24-HR	2ND	1.53758	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	18-02-2022, 24
24-HR	3RD	1.39542	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	06-01-2022, 24
24-HR	4TH	1.20863	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	07-11-2022, 24
24-HR	5TH	1.07292	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	25-02-2022, 24
24-HR	6TH	1.05353	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	29-01-2022, 24
24-HR	7TH	1.02214	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	05-02-2022, 24
24-HR	8TH	1.00687	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	06-11-2022, 24
24-HR	9TH	0.97604	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	03-04-2022, 24
24-HR	10TH	0.96821	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	16-02-2022, 24
24-HR	11TH	0.92244	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	09-11-2022, 24
24-HR	12TH	0.90206	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	02-02-2022, 24
24-HR	13TH	0.88582	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	12-02-2022, 24
24-HR	14TH	0.87932	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	27-10-2022, 24
24-HR	15TH	0.86978	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	19-10-2022, 24
24-HR	16TH	0.85327	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	10-09-2022, 24
24-HR	17TH	0.85161	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	08-11-2022, 24
24-HR	18TH	0.82701	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	01-04-2022, 24
24-HR	19TH	0.81169	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	17-02-2022, 24
24-HR	20TH	0.79411	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	29-10-2022, 24
24-HR	21ST	0.78705	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	12-10-2022, 24
24-HR	22ND	0.77566	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	01-02-2022, 24
24-HR	23RD	0.75198	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	17-01-2022, 24
24-HR	24TH	0.74901	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	02-04-2022, 24
ANNUAL		0.34507	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	

Result summary of 24 hour averaging period at Worst Condition

Results Summary

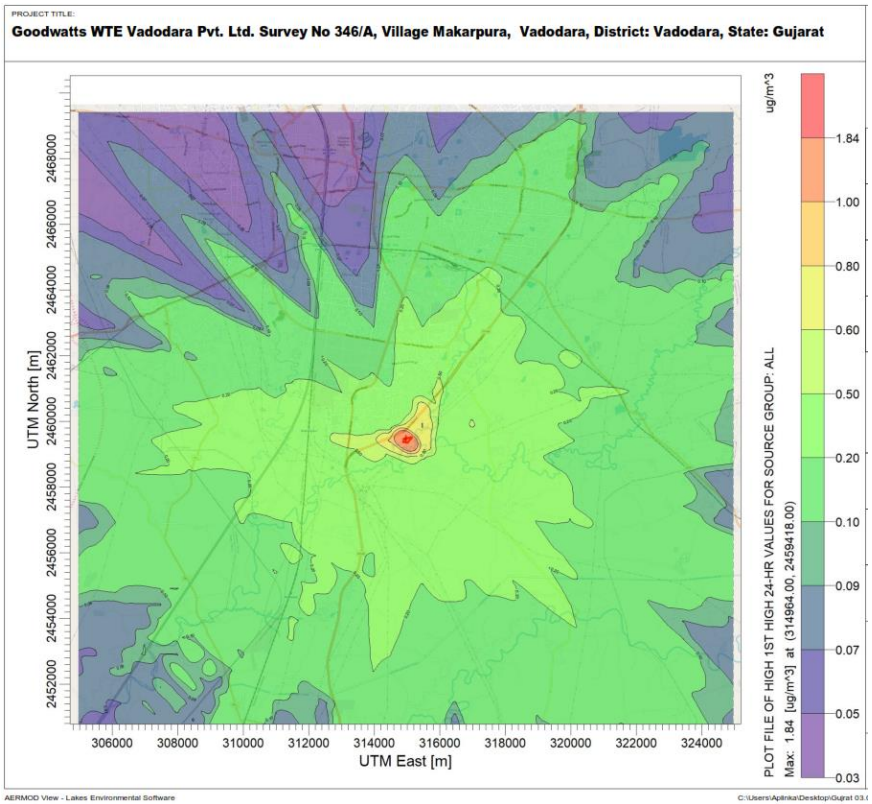
C:\Users\Aplinka\Desktop\2) Abellon Clean Energy Limited\2) VARODARA

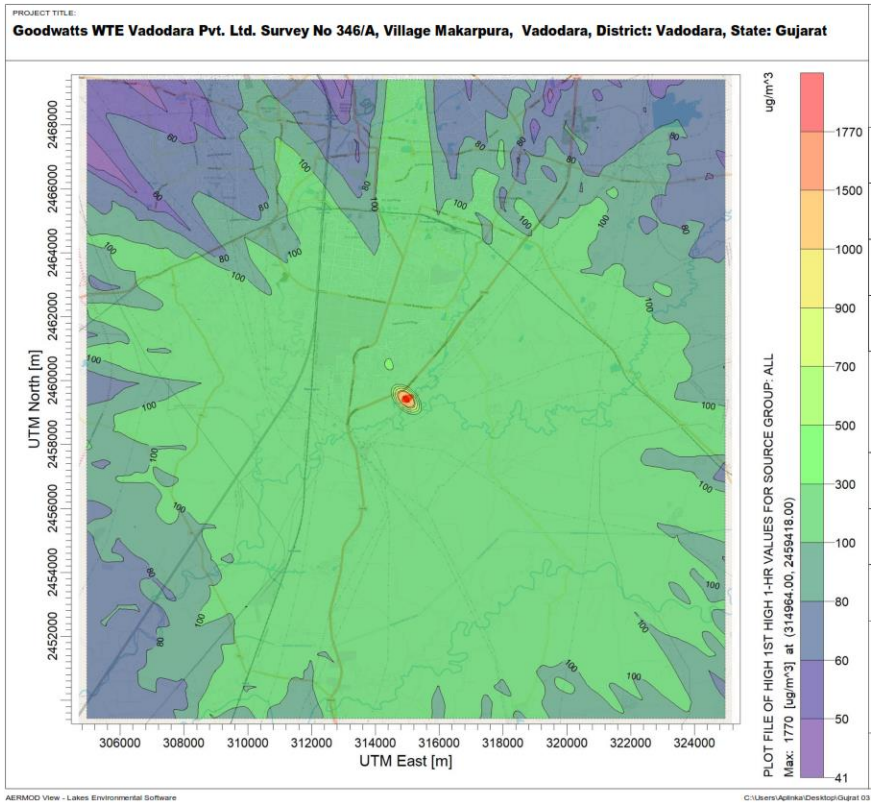
PM10 - Concentration - Source Group: ALL

Averaging Period	Rank	Peak	Units	X (m)	Y (m)	ZELEV (m)	ZFLAG (m)	ZHILL (m)	Peak Date, Start Hour
1-HR	1ST	1770.40739	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	18-02-2022, 13
24-HR	1ST	104.01372	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	18-02-2022, 24
ANNUAL		15.72764	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	

Isopleth For Normal Conditions ("First highest") 24 hour concentration (PM_{10})

Isopleth For Worst Conditions ("First highest") 1 hour concentration (PM10)





PM2.5

Result summary of 24 hour averaging period at Normal Condition

Result summary of 24 hour averaging period at Worst Condition

Results Summary

C:\Users\Aplinka\Desktop\2) Abellon Clean Energy Limited\2) VARODARA

PM2.5 - Concentration - Source Group: ALL

Averaging Period	Rank	Peak	Units	X (m)	Y (m)	ZELEV (m)	ZFLAG (m)	ZHILL (m)	Peak Date, Start Hour
1-HR	1ST	1770.40739	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	18-02-2022, 13
24-HR	1ST	104.01372	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	18-02-2022, 24
ANNUAL		15.72764	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	

Results Summary

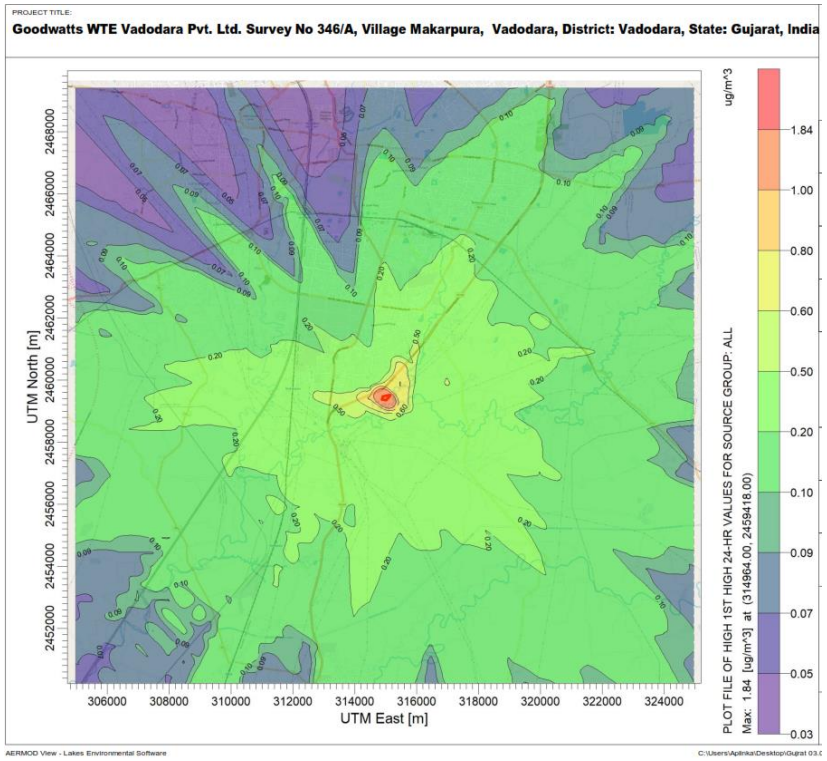
C:\Users\Aplinka\Desktop\2) Abellon Clean Energy Limited\2) VARODARA

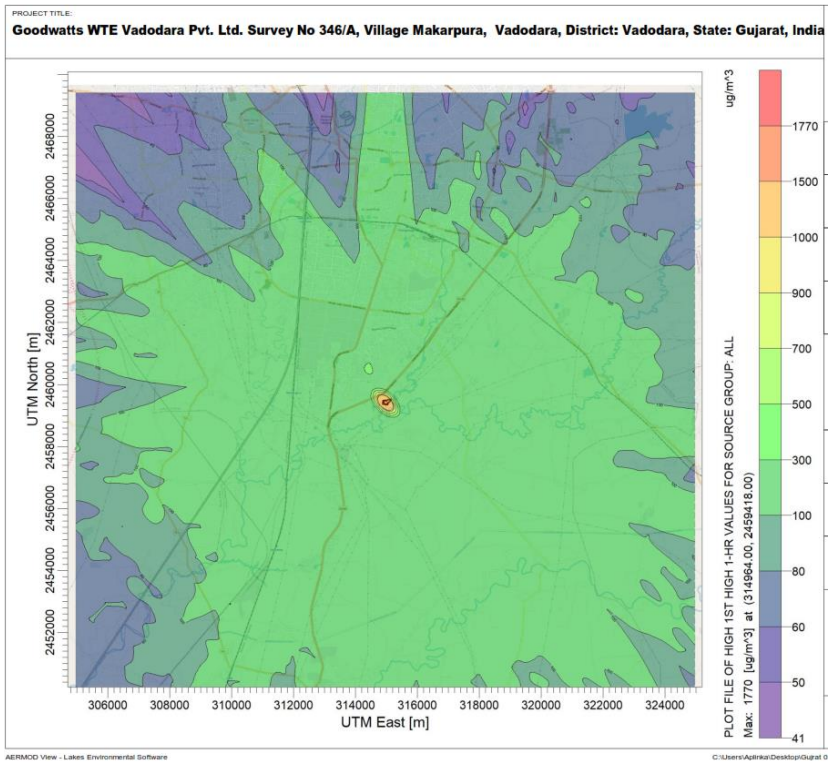
PM2.5 - Concentration - Source Group: ALL

Averaging Period	Rank	Peak	Units	X (m)	Y (m)	ZELEV (m)	ZFLAG (m)	ZHILL (m)	Peak Date, Start Hour
24-HR	1ST	1.83912	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	11-10-2022, 24
24-HR	2ND	1.53758	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	18-02-2022, 24
24-HR	3RD	1.39542	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	06-01-2022, 24
24-HR	4TH	1.20863	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	07-11-2022, 24
24-HR	5TH	1.07292	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	25-02-2022, 24
24-HR	6TH	1.05353	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	29-01-2022, 24
24-HR	7TH	1.02214	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	05-02-2022, 24
24-HR	8TH	1.00687	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	06-11-2022, 24
24-HR	9TH	0.97604	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	03-04-2022, 24
24-HR	10TH	0.96821	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	16-02-2022, 24
24-HR	11TH	0.92244	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	09-11-2022, 24
24-HR	12TH	0.90206	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	02-02-2022, 24
24-HR	13TH	0.88582	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	12-02-2022, 24
24-HR	14TH	0.87932	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	27-10-2022, 24
24-HR	15TH	0.86978	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	19-10-2022, 24
24-HR	16TH	0.85327	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	10-09-2022, 24
24-HR	17TH	0.85161	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	08-11-2022, 24
24-HR	18TH	0.82701	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	01-04-2022, 24
24-HR	19TH	0.81169	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	17-02-2022, 24
24-HR	20TH	0.79411	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	29-10-2022, 24
24-HR	21ST	0.78705	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	12-10-2022, 24
24-HR	22ND	0.77566	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	01-02-2022, 24
24-HR	23RD	0.75198	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	17-01-2022, 24
24-HR	24TH	0.74901	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	02-04-2022, 24
ANNUAL		0.34507	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	

Isopleth For Normal Conditions (“First highest”) 24 hour concentration

Isopleth For Worst Conditions (“First highest”) 1 hour concentration





SO2

Result summary of 24 hour averaging period at Normal Condition

Result summary of 24 hour averaging period at Worst Condition

Results Summary

C:\Users\Aplinka\Desktop\2) Abellon Clean Energy Limited\2) VARODARA

SO2 - Concentration - Source Group: ALL

Averaging Period	Rank	Peak	Units	X (m)	Y (m)	ZELEV (m)	ZFLAG (m)	ZHILL (m)	Peak Date, Start Hour
1-HR	1ST	177.08141	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	18-02-2022, 13
24-HR	1ST	10.64490	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	18-02-2022, 24
ANNUAL		1.60042	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	

Results Summary

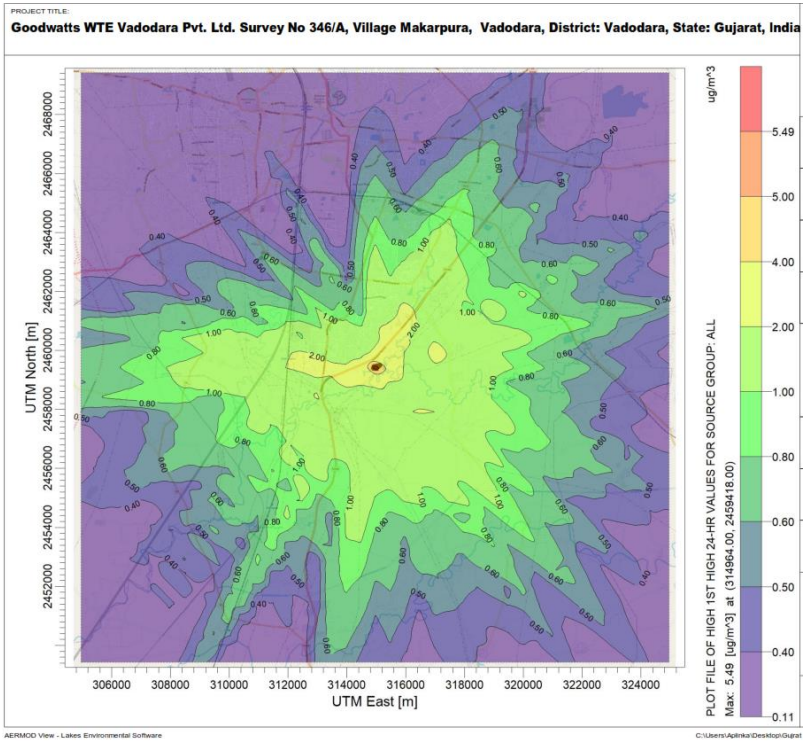
C:\Users\Aplinka\Desktop\2) Abellon Clean Energy Limited\2) VARODARA

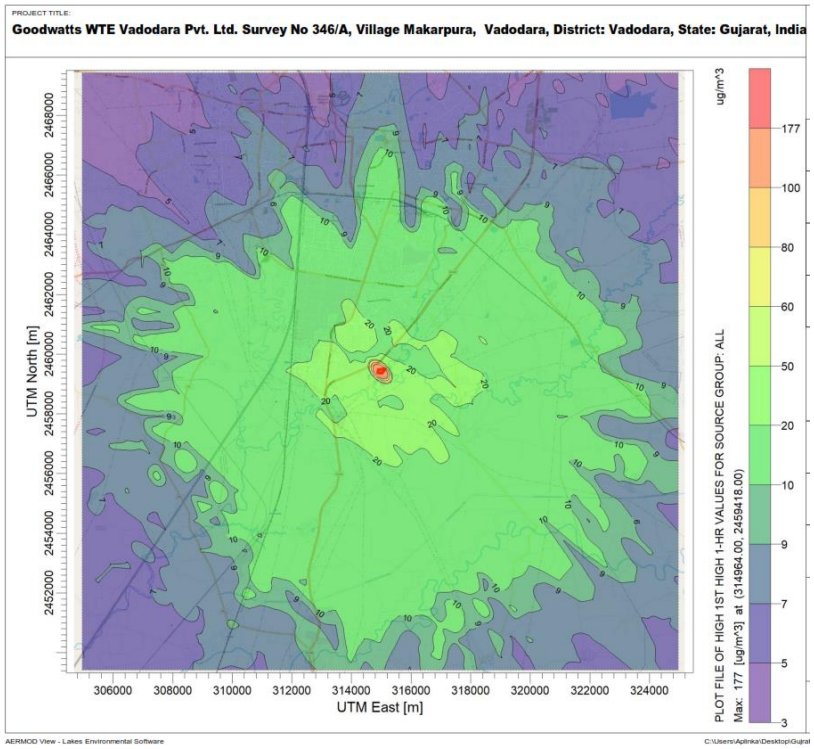
SO2 - Concentration - Source Group: ALL

Averaging Period	Rank	Peak	Units	X (m)	Y (m)	ZELEV (m)	ZFLAG (m)	ZHILL (m)	Peak Date, Start Hour
24-HR	1ST	5.49196	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	18-02-2022, 24
24-HR	2ND	4.92059	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	11-10-2022, 24
24-HR	3RD	4.30252	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	06-01-2022, 24
24-HR	4TH	3.45216	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	25-02-2022, 24
24-HR	5TH	3.30532	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	03-06-2022, 24
24-HR	6TH	3.27187	ug/m^3	315464.00	2459918.00	45.00	0.00	45.00	15-06-2022, 24
24-HR	7TH	3.24823	ug/m^3	315464.00	2459918.00	45.00	0.00	45.00	01-07-2022, 24
24-HR	8TH	3.15846	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	02-06-2022, 24
24-HR	9TH	3.12848	ug/m^3	315464.00	2459918.00	45.00	0.00	45.00	29-06-2022, 24
24-HR	10TH	3.11289	ug/m^3	315464.00	2459918.00	45.00	0.00	45.00	19-06-2022, 24
24-HR	11TH	3.08339	ug/m^3	315464.00	2459918.00	45.00	0.00	45.00	12-06-2022, 24
24-HR	12TH	2.87737	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	20-09-2022, 24
24-HR	13TH	2.86043	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	13-05-2022, 24
24-HR	14TH	2.84302	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	26-05-2022, 24
24-HR	15TH	2.82547	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	29-07-2022, 24
24-HR	16TH	2.76407	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	25-05-2022, 24
24-HR	17TH	2.74082	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	29-08-2022, 24
24-HR	18TH	2.70785	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	30-07-2022, 24
24-HR	19TH	2.69760	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	19-05-2022, 24
24-HR	20TH	2.69614	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	18-05-2022, 24
24-HR	21ST	2.61135	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	04-05-2022, 24
24-HR	22ND	2.51538	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	17-05-2022, 24
24-HR	23RD	2.51503	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	03-08-2022, 24
24-HR	24TH	2.46665	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	01-05-2022, 24
ANNUAL		0.82195	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	

Isopleth For Normal Conditions (“First highest”) 24 hour concentration

Isopleth For Worst Conditions (“First highest”) 1 hour concentration





NOx

Result summary of 24 hour averaging period at Normal Condition

Result summary of 24 hour averaging period at Worst Condition

Results Summary

C:\Users\Aplinka\Desktop\2) Abellon Clean Energy Limited\2) VARODARA

NOX - Concentration - Source Group: ALL

Averaging Period	Rank	Peak	Units	X (m)	Y (m)	ZELEV (m)	ZFLAG (m)	ZHILL (m)	Peak Date, Start Hour
1-HR	1ST	715.14336	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	18-02-2022, 13
24-HR	1ST	43.10524	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	18-02-2022, 24
ANNUAL		6.48462	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	

Results Summary

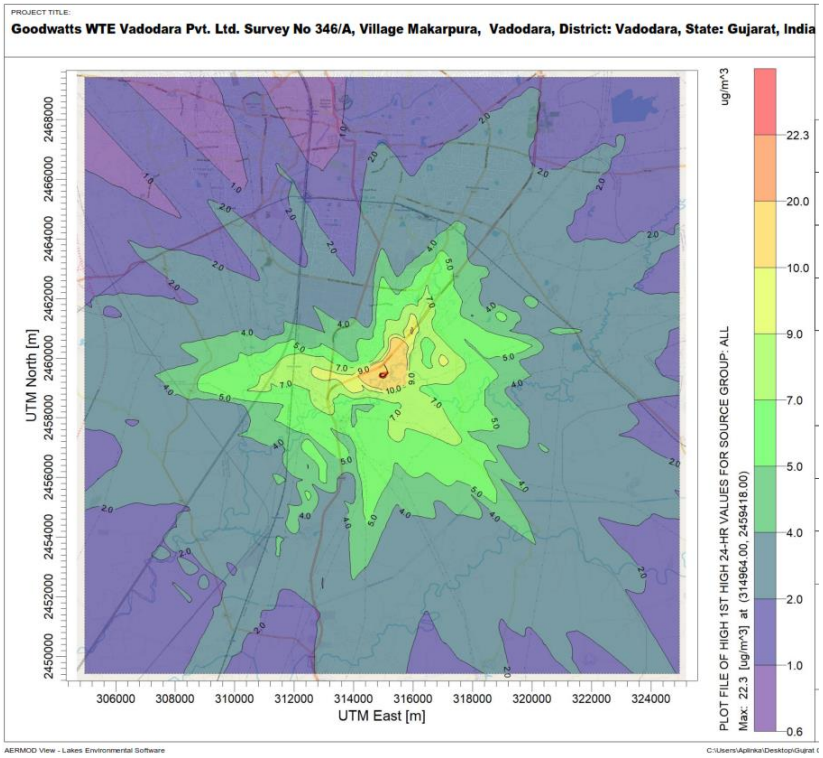
C:\Users\Aplinka\Desktop\2) Abellon Clean Energy Limited\2) VARODARA

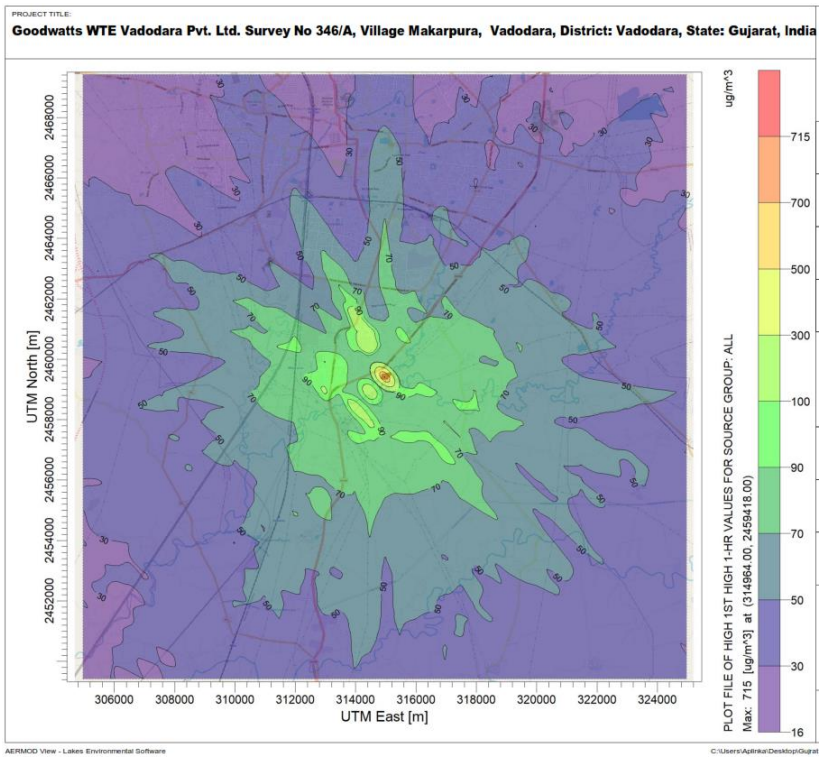
NOX - Concentration - Source Group: ALL

Averaging Period	Rank	Peak	Units	X (m)	Y (m)	ZELEV (m)	ZFLAG (m)	ZHILL (m)	Peak Date, Start Hour
24-HR	1ST	22.34794	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	18-02-2022, 24
24-HR	2ND	20.08288	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	11-10-2022, 24
24-HR	3RD	17.55206	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	06-01-2022, 24
24-HR	4TH	14.06553	ug/m^3	314964.00	2459418.00	45.00	0.00	45.00	25-02-2022, 24
24-HR	5TH	13.31442	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	03-06-2022, 24
24-HR	6TH	13.21595	ug/m^3	315464.00	2459918.00	45.00	0.00	45.00	15-06-2022, 24
24-HR	7TH	13.16487	ug/m^3	315464.00	2459918.00	45.00	0.00	45.00	01-07-2022, 24
24-HR	8TH	12.80888	ug/m^3	315464.00	2459918.00	45.00	0.00	45.00	21-07-2022, 24
24-HR	9TH	12.65864	ug/m^3	315464.00	2459918.00	45.00	0.00	45.00	29-06-2022, 24
24-HR	10TH	12.55212	ug/m^3	315464.00	2459918.00	45.00	0.00	45.00	19-06-2022, 24
24-HR	11TH	12.48471	ug/m^3	315464.00	2459918.00	45.00	0.00	45.00	12-06-2022, 24
24-HR	12TH	11.64753	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	20-09-2022, 24
24-HR	13TH	11.51676	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	13-05-2022, 24
24-HR	14TH	11.47538	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	26-05-2022, 24
24-HR	15TH	11.42469	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	29-07-2022, 24
24-HR	16TH	11.14830	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	25-05-2022, 24
24-HR	17TH	11.11200	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	29-08-2022, 24
24-HR	18TH	10.96950	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	30-07-2022, 24
24-HR	19TH	10.92757	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	19-05-2022, 24
24-HR	20TH	10.86893	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	18-05-2022, 24
24-HR	21ST	10.52701	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	04-05-2022, 24
24-HR	22ND	10.18088	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	03-08-2022, 24
24-HR	23RD	10.14076	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	17-05-2022, 24
24-HR	24TH	9.95708	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	21-09-2022, 24
ANNUAL		3.34496	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	

Isopleth For Normal Conditions (“First highest”) 24 hour concentration

Isopleth For Worst Conditions (“First highest”) 1 hour concentration





CO

Result summary of 8 hour averaging period at Normal Condition

Results Summary

C:\Users\Aplinka\Desktop\Delloitte Line and point source modelling\1

CO - Concentration - Source Group: ALL

Averaging Period	Rank	Peak	Units	X (m)	Y (m)	ZELEV (m)	ZFLAG (m)	ZHILL (m)	Peak Date, Start Hour
8-HR	1ST	8.52261	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	30-07-2022, 16
8-HR	2ND	8.38261	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	13-05-2022, 16
8-HR	3RD	8.20264	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	31-05-2022, 16
8-HR	4TH	7.94064	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	01-05-2022, 16
8-HR	5TH	7.79513	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	08-06-2022, 16
8-HR	6TH	7.75814	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	26-05-2022, 16
8-HR	7TH	7.71378	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	15-04-2022, 16
8-HR	8TH	7.68633	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	28-07-2022, 16
ANNUAL		0.99317	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	

Result summary of 1 hour averaging period at Worst Condition

Results Summary

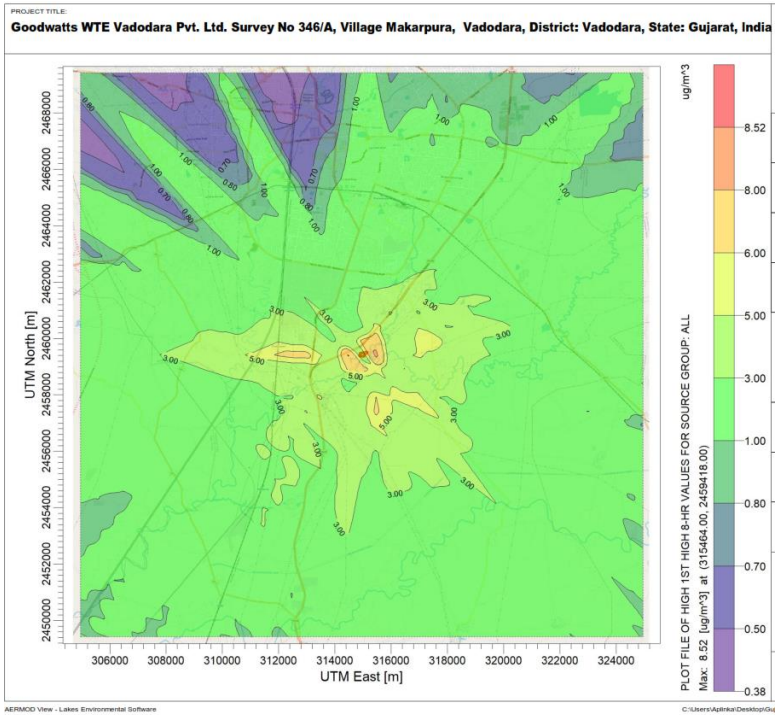
C:\Users\Aplinka\Desktop\2) Abellon Clean Energy Limited\2) VARODARA

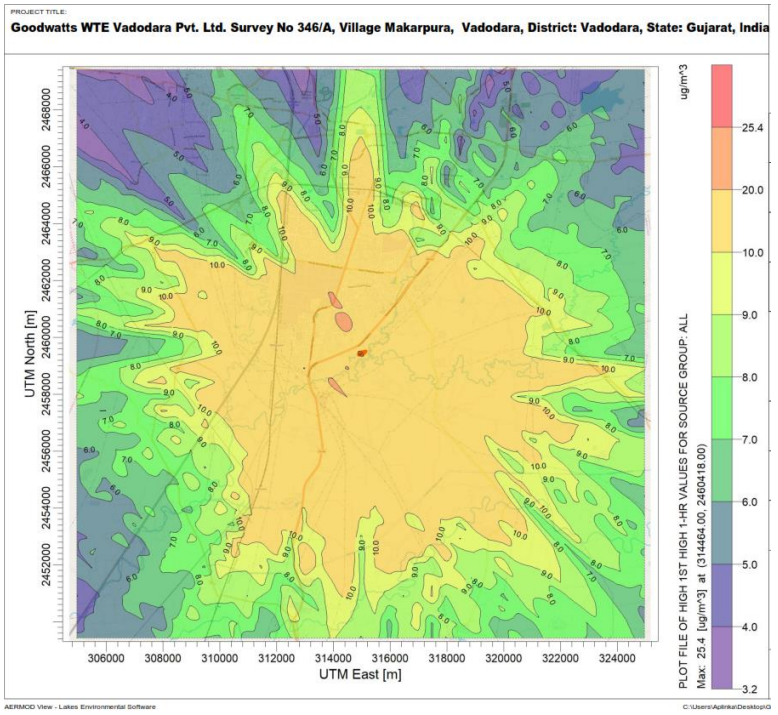
CO - Concentration - Source Group: ALL

Averaging Period	Rank	Peak	Units	X (m)	Y (m)	ZELEV (m)	ZFLAG (m)	ZHILL (m)	Peak Date, Start Hour
1-HR	1ST	25.41200	ug/m^3	314464.00	2460418.00	45.00	0.00	45.00	06-11-2022, 24
8-HR	1ST	12.52815	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	30-07-2022, 16
ANNUAL		1.41643	ug/m^3	315464.00	2459418.00	45.00	0.00	45.00	

Isopleth For Normal Conditions (“First highest”) 8 hour concentration

Isopleth For Worst Conditions (“First highest”) 1 hour concentration





APPENDIX 16: COMMUNITY HEALTH & SAFETY

The receptors for impacts on community health and safety will include settlements located in proximity to the project site, access roads, water pipeline and transmission route. The Community Health & Safety plan to be updated by GWVPL basis the hazard analysis or HIRA to be undertaken prior to the construction & operation phase. Threats to community health and safety due to Project activities are as follows:

- Trips and falls;
- Road accidents;
- Electrocution;
- Increased level of noise;
- Soil erosion and impact on ambient air quality;
- Transportation of waste by VMC
- Groundwater pollution due to mismanagement of waste, especially hazardous.

The increased number of vehicles used to deliver materials and supplies for construction and operational phase may result in a higher number of injuries and mortalities from traffic accidents, as well as spills of hazardous materials being transported. During construction, the potential for traffic accidents may be exacerbated by low community awareness and low exposure to increased volumes of traffic in the area. Construction activities will also limit access to natural resources in the Project area, thereby influencing income generating / subsistence opportunities from these livelihoods. Furthermore, influx of migrant workers may cause an increase in vector borne and communicable disease, community conflict over land and resources, etc.

Control Measures to be adopted during construction and operation phase

- Labour management plan (comprising of measures for maintaining relations with labour and community) will be developed and implemented
- As part of the stakeholder engagement, the community will be provided with an understanding of the activities to be undertaken during construction phase and the precautions taken for safety.
- The project will also propagate emergency scenarios and health awareness amongst the community including pregnant women, infants and senior citizens.
- Measures to avoid respiratory and hearing problem among community residing in proximity to the proposed project will be adopted
- Traffic Management: To ensure selection of routes and timings to decrease community threat to accidents and incident. This will be done through a Traffic Management Plan (please refer to the site-specific Traffic Management Plan);
- The traffic movement for the project in the area will be regulated to ensure road and pedestrian (including livestock) safety.
- Waste Management: To ensure management of solid, hazardous and non-hazardous waste disposal in a manner that does not lead to littering and land and groundwater pollution. This will be done through a Waste Management Plan (please refer to the site specific Waste Management Plan);
- Grievance Redressal Mechanism: To ensure all grievances of the community are heard and recorded, and mitigation measures for the same are implemented. This will be done through establishment and implementation of a grievance redressal mechanism (please refer to the site specific Grievance Redressal Mechanism for the Community);
- Community Liaison Officer: A Community Liaison Officer will need to be nominated by project SPV to ensure Liaoning with nearby community. The Officer will be s single point of contact for the community;
- Project should conduct hazard analysis to identify areas of influence in case of accident in light of the distance to the nearest community area and action items as per the hazard analysis should be implemented and communicated to the nearby settlements.
- A fire safety plan and an onsite and offsite emergency response plan should be developed and implemented onsite.
- The onsite and offsite emergency response plan should be communicated to the nearby Community and they should be involved in mock drills and other emergency drills.
- Community located within 100 m of the project boundary to be involved in emergency mock drills and communication protocol to be communicated. In case, multiple residences are located within 100 m of the project, fire marshals to be designated and trained from the community

- Dedicated safety sign boards in local language should be provided around the project site and under construction transmission tower location and water pipeline.
- Vehicles sourcing construction materials, and waste (during operation phase) should be covered to avoid dust emission.
- The consequences of emergency events are likely to extend beyond the project boundary and it can also affect community health and safety due to labour influx. Emergency Response Plan developed for the Project should be communicated to the nearby community.
- Ensure pollution norms compliant vehicles are used for transportation.
- Any road diversions and closures will be informed in advance to the local community. Usage of horns by project vehicles will be restricted near sensitive receptors such as schools, settlements etc.
- Adequate training on traffic and road safety operations will be imparted to the drivers of project vehicles. Road safety awareness programs will be organized in coordination with local authorities to sensitize target groups viz. school children, commuters on traffic safety rules and signage.
- Barricades and Boundary: GWVPL will be required to install barricades and boundaries around all of the construction sites and operational sites, such as the WtE plant and pooling substation, ash silos, to ensure that the community does not enter said sites and increase exposure to associated hazards and risks.
- Warning signs: GWVPL will need to install warning and danger signs at the construction site, areas with risk of electrocution and other relevant areas. Project SPV will also need ensure that signage and boards are provided at the gates and approach roads to the site so that the nearby community and road users are aware of the location of the construction/operational Project site.
- Behavioral training for site security: Behavioral training will be provided to the site security team to ensure that the security team manages any conflicts with the nearby community in a way that it does not affect community health and safety

APPENDIX 17: LABOUR CAMPS / WORKERS' ACCOMMODATION MANAGEMENT PLAN

The requirement of workers' accommodation stems from the type of workforce that will be required during the development and operational phase of the Project. Below guidelines are made with due consideration of European Bank for Reconstruction and Development (EBRD) and International Finance Corporation (IFC) guidelines on workers' accommodation[93], and the Building and Other Construction (Regulations of Employment and Condition of Service) (BOCW) Act, 1996, which will be followed for accommodation facilities.

Code of Conduct for Workers in Labour Accommodation

Project and its contractor would be recommended to process of addressing issues raised by workers' accommodation. These are:

- Assessing whether housing is needed for the Project and is so, what sort
- Assessing impacts on local communities and planning mitigation of potential negative impacts

If there is no alternative and it is necessary to provided accommodation to workers, then project and its contractors will rent or construct workers' accommodation (labor camp) facilities for the construction and operation workers, away from the existing local community so as to have a minimum possible adverse impact upon the local community. The code of conduct will maintain for worker accommodation. The details of code of conduct are delineated below:

- Renting arrangement should be fair or free of cost. If it is charged then, adequate, and decent housing should not cost the workers more than a reasonable proportion of their income and should never include a speculative profit
- Worker should not be mandatory required to stay in the accommodation provided by project or its contractor but should be free to choses their own if they wish to do so
- Project and its contractor should help to ensure that, where workers obtain their accommodation, they are not being exploited, and offer advice and help as requested
- Project and its contractor should ensure that accommodation which is provided is not overcrowded and does not pose a risk to the health and safety of the workers living there
- Project and its contractor should be entitled to repossess the accommodation within n a reasonable time in the event of the termination of the workers' contract of employment, and the workers should be entitled to a reasonable period of continued occupancy and/or fair compensation when he/she ceases to exercise his/her employment
- During the time workers spend in the workers' accommodation they should enjoy their fundamental human rights. Workers' accommodation arrangements should not restrict workers' right and freedoms

Further, as per the BOCW Act, 1996, project and its contractor shall provide temporary accommodation facilities to the construction laborer free of cost and as soon as construction work is over, the employer at his own cost will remove the temporary structure and restore ground in as it was before.

Dos and Don'ts of Workers' Accommodation (Labour camp)

Project and its contractors shall abide by all applicable rules and regulations pertaining to the design and construction of the workers' accommodation building or structure as well as facilities to be provided therein while planning for the accommodation. Further, as suggestive guideline for workers accommodation arrangement based on the EBRD and IFC's guidelines on worker accommodation and BOCW Act as prescribed below:

[93] https://www.ebrd.com/downloads/about/sustainability/Workers_accomodation.pdf (Accessed on October 13, 2022)

Table Standards for Workers' Accommodation

Standard Parameter	Requirement as well monitoring indicators
Location	• Reasonable distance from the project site • Adequate transportation arrangement • Reasonable distance from the vulnerable local community
Rooms/Dormitory facilities	• Rooms/dormitories are aired and cleaned at regular intervals • Sanitary facilities are located within the same building and provided separately for male and female workers' • Density standards are express wither in terms of minimal volume per resident or of minimal floor space. Usual standards range from 10 to 12.5 cubic meters (volume) or 4 to 5.5 square meters (surface) • A minimum ceiling height of 2.10 meters shall be provided • In case of collective room or dormitory, reasonable number of workers allowed – 2 to 8 workers per room • Rooms should be adequate ventilated and lit
Drainage	• Proper drainage system • Avoid Accumulation of stagnant water
Ventilation and lighting	• Adequate ventilation or air condition system shall be provided • Natural Lighting (if available) shall be provided • Artificial lighting shall be provided • Emergency lighting shall be provided Note: As a best practise the window area shall represent not less than 5% to 10% of the floor area
Water	• - Adequate and convenient water supply • Drinking water meeting national and WHO standards • Regular monitoring of drinking water Note: Depending on climate, weather conditions and accommodation standards – 80 to 180 litre per person per day should be available
Wastewater	• Proper discharge of wastewater and sewage • Establish Sewage Treatment Plant (STP) if required • Solid Waste Management System • Pest Control Mechanism Note: In addition, it is best practice to locate rubbish containers 30 meters from each shelter on a wooden, metal, or concrete stand. Such containers must be emptied at regular intervals (to determined based on temperatures and volumes generate) to avoid unpleasant odours associated with decaying organic materials
Toilet Facilities	• Adequate number of toilets • Convenient location • Construction of good materials that are easily cleanable • Facilities are cleaned frequently and kept in working conditions • Separate for male and female except for family accommodation Note on Toilet construction • An adequate number of toilets is provided to workers. Standard range from 1 unit for 15 persons to 1 unit to 6 persons • For urinal, usual standards are 1 unit for 15 persons • Standards distance are from 30 to 60 meters from rooms/dormitories
Bathrooms and other Sanitary Facilities	• Made of anti-slip washable materials • Adequate number of bathroom and hand wash facilities • Tapes are kept in working condition • Convenient location: Separate for male and female except for family accommodation • Adequate availability of hot and cold running water

	Note: Adequate number of shower/bathroom facilities – range from 1 unit to 15 persons to 1 unit per 6 persons
Canteen and cooking arrangement	• Adequate space • Constructed of good and easy to clean material • Option for separate cooking facilities • Separate kitchen space shall be provided from sleeping area • Hygiene in canteen/dining halls and cooking facilities • Adequate facilities for cleaning, disinfecting and storage of cooking utensils and equipment's • Adequate food waste disposal **Note:** canteen shall have a reasonable amount of space per workers. Standard range from 1 square meter to 1.5 square meters
Laundry	• Provide Laundry facility • Facilities shall be built in adequate and easy to clean materials
Medical Facilities	• Adequate number of first aid kits to the number of residents (workers) • Where possible a 24x7 first aid service/facility shall be made available • An adequate number of staff/workers shall be employed to provide first aid
Workers' rights, rules and regulations on workers' accommodation	• Restriction of workers' freedom of movement to and from the site is limited and duly justified. It is good practice to provide workers 24/7 access to the accommodation site. Any restrictions based on security reasons should be balanced by the necessity to respect workers' freedom of movement • Where possible, an adequate transport system to surrounding communities is provided. It is good practice to provide workers with free transportation to project location and from accommodation facility • Withholding workers' ID papers is prohibited • Workers' gender and religious, cultural and social backgrounds are respected. In particular, workers should be provided with the possibility of celebrating religious holidays and observances

Checklist on workers' accommodation monitoring

Detail checklist of workers' accommodation monitoring is provided below:

Table Checklist on workers' accommodation

Aspects	Yes	No	Not Applicable (N/A)	Comments
Assessing the need for workers' accommodation				
Has there been an assessment of workers' availability in the neighbouring communities?				
Has there been an assessment of the skills and competencies of the local workforce and how do those skills and competencies fit the project's need?				
Has there been an assessment of the possibility of training a local workforce in order to fulfil the project's needs?				
Availability of housing				

Aspects	Yes	No	Not Applicable (N/A)	Comments
Has there been a comprehensive assessment of the different type of housing available in the surrounding communities prior to building any workers' accommodation?				
Has there been an assessment of the impact on the communities of using existing housing opportunities?				
Have measures to mitigate adverse impacts on the local housing market been identified?				
Assessing Impacts of workers' accommodation on communities				
Have the potential health and safety impacts and consequences of land acquisition and involuntary resettlement occurring during the construction phase of the workers' accommodation been included in the assessment?				
Have the impacts of workers' accommodation on community infrastructures, services and facilities been included in the assessment?				
Have the impacts on local community's businesses and local employment been included in the assessment?				
Have general impacts of workers' accommodation on communities' health, (notably the increased risk of road accidents and of communicable diseases), and community social cohesion been included in the assessment?				
Does the assessment include appropriate mitigation measures to address any adverse impacts identified?				
Types of workers' accommodation				
Has consideration been given to provision of family accommodation?				
Are individual accommodations comprising bedrooms, sanitary and cooking facilities provided as part of the family accommodation?				
Are adequate nursery/school facilities provided?				
Is special attention paid to providing adequate safety for children?				
Standards for workers' accommodation				
Have the relevant national/local regulations been identified and implemented?				
Is the location of the facilities designed to avoid flooding or other natural hazards?				
Are the living facilities located within a reasonable distance from the worksite?				
Is transport provided to worksite safe and free?				
Are the living facilities built using adequate materials, kept in good repair and kept clean and free from rubbish and other refuse?				

Aspects	Yes	No	Not Applicable (N/A)	Comments
Is the site adequately drained?				
Depending on climate are living facilities provided with adequate heating, ventilation, air conditioning and light systems including emergency lighting?				
Do workers have easy access to a supply of clean/ potable water in adequate quantities?				
Does the quality of the water comply with national/local requirements or WHO standards?				
Are tanks used for the storage of drinking water constructed and covered to prevent water stored therein from becoming polluted or contaminated?				
Is the quality of the drinking water regularly monitored?				
Are wastewater, sewage, food and any other waste materials adequately discharged in compliance with local or World Bank standards and without causing any significant impacts on camp residents, the environment or surrounding communities?				
Are specific containers for rubbish collection provided and emptied on a regular basis?				
Are pest extermination, vector control and disinfection undertaken throughout the living facilities?				
Are the rooms/dormitories kept in good condition?				
Are the rooms/dormitories aired and cleaned at regular intervals?				
Are the rooms/dormitories built with easily cleanable flooring material?				
Are the rooms/dormitories and sanitary facilities located in the same buildings?				
Are residents provided with enough space?				
Is the ceiling height high enough?				
Is the number of workers sharing the same room/dormitory minimized?				
Are the doors and windows lockable and provided with mosquito screens when necessary?				
Are mobile partitions or curtains provided?				
Is suitable furniture such as table, chair, mirror, bedside light provided for every worker?				
Are separate sleeping areas provided for men and women?				
Is there a separate bed provided for every worker?				
Is there a minimum space of 1 meter between beds?				
When double deck bunks are in use, is there enough clear space between the lower and upper bunk of the bed?				

Aspects	Yes	No	Not Applicable (N/A)	Comments
Are triple deck bunks prohibited?				
Are adequate facilities for the storage of personal belongings provided?				
Are sanitary and toilet facilities constructed from materials that are easily cleanable?				
Are sanitary and toilet facilities cleaned frequently and kept in working condition?				
Are toilets, showers/bathrooms and other sanitary facilities designed to provide workers with adequate privacy including ceiling to floor partitions and lockable doors?				
Are separate sanitary and toilet facilities provided for men and women?				
Is there an adequate number of toilets and urinals?				
Are toilet facilities conveniently located and easily accessible?				
Is the shower flooring made of anti-slip hard washable materials?				
Is there an adequate number of hand wash basins and showers/bathrooms facilities provided?				
Are the sanitary facilities conveniently located?				
Are shower facilities provided with an adequate supply of cold and hot running water?				
Are canteen, cooking and laundry facilities built with adequate and easy to clean materials?				
Are the canteen, cooking and laundry facilities kept in clean and sanitary condition?				
If workers cook their own meals, is kitchen space provided separately from the sleeping areas?				
Are adequate facilities for washing and drying clothes provided?				
Are workers provided with enough space in the canteen?				
Are canteens adequately furnished?				
Are kitchens provided with the facilities to maintain adequate personal hygiene?				
Are first aid kits provided in adequate numbers?				
Are first-aid kits adequately stocked?				
Is there an adequate number of staff/workers trained to provide first aid?				
Are there any other medical facilities/services provided on site? If not, why?				
Are workers provided with dedicated places for religious observance?				

Aspects	Yes	No	Not Applicable (N/A)	Comments
Management and Staff				
Are there carefully designed worker camp management plans and policies especially in the field of health and safety (including emergency responses), security, workers' rights and relationships with the communities?				
Where contractors are used, have they clear contractual management responsibilities and duty to report?				
Does the person appointed to manage the accommodation have the required background, competency and experience to conduct his mission and is he/ she provided with the adequate responsibility and authority to do so?				
Is there enough staff to ensure the adequate implementation of housing standards (cleaning, cooking and security in particular)?				
Are staff members recruited from surrounding communities?				
Have the staff received basic health and safety training?				
Are the persons in charge of the kitchen particularly trained in nutrition and food handling and adequately supervised?				
Charging fees for accommodation and services				
Are the renting arrangements fair and transparent?				
Are workers provided with adequate information about payment made?				
Where appropriate, are renting arrangements and regulations clearly included in workers' employment contracts?				
Are food and other services provided for free or reasonably priced, that is, not above the local market price?				
Is the payment in kind for accommodation and services prohibited?				
Health and Safety on Site				
Have health and safety management plans including electrical, mechanical, structural and food safety been designed and implemented?				
Has the accommodation manager a duty to report to the health authority specific diseases, food poisoning or casualties?				
Is there an adequate number of staff/workers trained in providing first aid?				
Has a specific and adequate fire safety management plan been designed and implemented?				
Is guidance on alcohol, drug and HIV/AIDS and other health risk-related activities provided to workers?				
Do workers have an easy access to medical facilities and medical staff, including female doctors/nurses where appropriate?				
Have emergency plans on health and fire safety been prepared?				

Aspects	Yes	No	Not Applicable (N/A)	Comments
Depending on circumstances, have specific emergency plans (earthquakes, floods, tornadoes) been prepared?				
Security on workers' accommodation				
Has a security plan including clear measures to protect workers against theft and attack been designed and implemented?				
Has a security plan including clear provisions on the use of force been designed and implemented?				
Have the backgrounds of security staff been checked for previous crimes or abuses?				
Has the recruitment of security staff from both genders been considered?				
Have security staff received clear instruction about their duty and responsibility?				
Have security staff been adequately trained in dealing with domestic violence and the use of force?				
Are body searches only performed in exceptional circumstances by specifically trained security staff of both genders?				
Do security staff have a good understanding about the importance of respecting workers' rights and the rights of the surrounding communities and adopt appropriate conduct?				
Do workers and communities have specific means to raise concerns about security arrangements and staff?				
Workers' rights, rules and regulations on workers' accommodation				
Are limitations on workers' freedom of movement limited and justified?				
Is an adequate transport system to the surrounding communities provided?				
Is the practice of withholding workers' ID papers prohibited?				
Is freedom of association expressly respected?				
Are workers' religious, cultural and social backgrounds respected?				
Are workers made aware of their rights and obligations and provided with a copy of the accommodations' internal rules, procedures and sanction mechanisms in a language or through a media they understand?				
Are house regulations nondiscriminatory, fair and reasonable?				
Are regulations on alcohol, tobacco and third parties' access to the camp clear and communicated to workers?				
Is a fair and non-discriminatory procedure to implement disciplinary procedures, including the right for workers to defend themselves, set up?				
Consultation and Grievance mechanism				

Aspects	Yes	No	Not Applicable (N/A)	Comments
Have mechanisms for workers' consultation been designed and implemented?				
Have workers subjected to disciplinary proceedings arising from conduct in the accommodation had access to a fair and transparent hearing with the possibility to appeal the decision?				
Are there fair conflict resolution mechanisms in place?				
In cases where serious offences occur, are there mechanisms to ensure full cooperation with police authorities?				
Management of community relations				
Have community relation management plans addressing issues around community development, community needs, community health and safety and community social and cultural cohesion been designed and implemented?				
Do community relation management plans include the setting up of liaison mechanisms to allow a constant exchange of information and consultation of the surrounding communities?				
Is there a senior manager in charge of implementing the community relation management plan?				
Is there a senior manager in charge of liaising with the surrounding communities?				
Are the impacts generated by workers' accommodation periodically reviewed, mitigated or enhanced?				
Are community representatives provided with easy means to voice their opinions and lodge complaints?				
Source: Workers' Accommodation: process and Standards – A guidance note by IFC and the EBRD ***Note: A above checklist shall be adopted by the project to undertake workers' accommodation audits.***				

APPENDIX 18: AVIFAUNA REPORTED FROM THE REGION

S.N.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
1	Cotton Pygmy-Goose	*Nettapus coromandelianus*	R	Least Concern	Schedule I
2	Rock dove	*Columba livia*	R	Least Concern	Schedule IV
3	Eurasian Coot	*Fulica atra*	M	Least Concern	Schedule IV
4	Gray-headed Swamphen	*Porphyrio poliocephalus*	R	Least Concern	Schedule IV
5	Red-wattled Lapwing	*Vanellus indicus*	R	Least Concern	Schedule IV
6	Pheasant-tailed Jacana	*Hydrophasianus chirurgus*	R	Least Concern	Schedule IV
7	Bronze-winged Jacana	*Metopidius indicus*	R	Least Concern	Schedule IV
8	Purple Heron	*Ardea purpurea*	R	Least Concern	Schedule IV
9	White-throated Kingfisher	*Halcyon smyrnensis*	R	Least Concern	Schedule IV
10	Alpine Swift	*Apus melba*	R	Least Concern	Schedule IV
11	Asian Green Bee-eater	*Merops orientalis*	R	Least Concern	Schedule IV
12	Blue-tailed Bee-eater	*Merops philippinus*	M	Least Concern	Schedule IV
13	Rose-ringed Parakeet	*Psittacula krameri*	R	Least Concern	Schedule IV
14	Indian Golden Oriole	*Oriolus kundoo*	R	Least Concern	Schedule IV
15	Black Drongo	*Dicrurus macrocercus*	R	Least Concern	Schedule IV
16	Red-vented Bulbul	*Pycnonotus cafer*	R	Least Concern	Schedule IV
17	Common Myna	*Acridotheres tristis*	R	Least Concern	Schedule IV
18	Intermediate Egret	*Ardea intermedia*	R	Least Concern	Schedule IV
19	Cattle Egret	*Bubulcus ibis*	R	Least Concern	Schedule IV
20	Indian Pond-Heron	*Ardeola grayii*	R	Least Concern	Schedule IV
21	Red-naped Ibis	*Pseudibis papillosa*	R	Least Concern	Schedule IV
22	Common Tailorbird	*Orthotomus sutorius*	R	Least Concern	Schedule IV
23	Jungle Babbler	*Argya striata*	R	Least Concern	Schedule IV
24	Common Babbler	*Argya caudata*	R	Least Concern	Schedule IV
25	Bank Myna	*Acridotheres ginginianus*	R	Least Concern	Schedule IV
26	Oriental Magpie-Robin	*Copsychus saularis*	R	Least Concern	Schedule IV
27	Indian Peafowl	*Pavo cristatus*	R	Least Concern	Schedule I
28	Gray Francolin	*Ortygornis pondicerianus*	R	Least Concern	Schedule IV
29	Laughing Dove	*Spilopelia senegalensis*	R	Least Concern	Schedule IV
30	Yellow-footed Green-Pigeon	*Treron phoenicopterus*	R	Least Concern	Schedule IV
31	Greater Coucal	*Centropus sinensis*	R	Least Concern	Schedule IV
32	Asian Koel	*Eudynamys scolopaceus*	R	Least Concern	Schedule IV
33	Gray-bellied Cuckoo	*Cacomantis passerinus*	R	Least Concern	Schedule IV

S.N.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
34	Common Hawk-Cuckoo	*Hierococcyx varius*	R	Least Concern	Schedule IV
35	White-breasted Waterhen	*Amaurornis phoenicurus*	R	Least Concern	Schedule IV
36	Black-headed Ibis	*Threskiornis melanocephalus*	R	Near Threatened	Schedule IV
37	Coppersmith Barbet	*Psilopogon haemacephalus*	R	Least Concern	Schedule IV
38	Common Woodshrike	*Tephrodornis pondicerianus*	R	Least Concern	Schedule IV
39	Spot-breasted Fantail	*Rhipidura albogularis*	R	Least Concern	Schedule IV
40	White-eared Bulbul	*Pycnonotus leucotis*	R	Least Concern	Schedule IV
41	White-browed Bulbul	*Pycnonotus luteolus*	R	Least Concern	Schedule IV
42	Large Gray Babbler	*Argya malcolmi*	R	Least Concern	Schedule IV
43	Indian Robin	*Copsychus fulicatus*	R	Least Concern	Schedule IV
44	Thick-billed Flowerpecker	*Dicaeum agile*	R	Least Concern	Schedule IV
45	Pale-billed Flowerpecker	*Dicaeum erythrorhynchos*	R	Least Concern	Schedule IV
46	Purple-rumped Sunbird	*Leptocoma zeylonica*	R	Least Concern	Schedule IV
47	Purple Sunbird	*Cinnyris asiaticus*	R	Least Concern	Schedule IV
48	Indian Silverbill	*Euodice malabarica*	R	Least Concern	Schedule IV
49	Scaly-breasted Munia	*Lonchura punctulata*	R	Least Concern	Schedule IV
50	House Sparrow	*Passer domesticus*	R	Least Concern	Schedule IV
51	Large-billed Crow	*Corvus macrorhynchos*	R	Least Concern	Schedule IV
52	Indian White-eye	*Zosterops palpebrosus*	R	Least Concern	Schedule IV
53	Brahminy Starling	*Sturnia pagodarum*	R	Least Concern	Schedule IV
54	Jerdon's Leafbird	*Chloropsis jerdoni*	R	Least Concern	Schedule IV
55	Lesser Whistling-Duck	*Dendrocygna javanica*	R	Least Concern	Schedule IV
56	Knob-billed Duck	*Sarkidiornis melanotos*	R	Least Concern	Schedule IV
57	Pied Cuckoo	*Clamator jacobinus*	R	Least Concern	Schedule IV
58	Eurasian Moorhen	*Gallinula chloropus*	R	Least Concern	Schedule I
59	Black-winged Stilt	*Himantopus himantopus*	R	Least Concern	Schedule IV
60	Wood Sandpiper	*Tringa glareola*	M	Least Concern	Schedule IV
61	Little Cormorant	*Microcarbo niger*	R	Least Concern	Schedule IV
62	Yellow Bittern	*Ixobrychus sinensis*	R	Least Concern	Schedule IV
63	Cinnamon Bittern	*Ixobrychus cinnamomeus*	R	Least Concern	Schedule IV
64	Little Egret	*Egretta garzetta*	R	Least Concern	Schedule IV
65	Glossy Ibis	*Plegadis falcinellus*	R	Least Concern	Schedule IV
66	Small Minivet	*Pericrocotus cinnamomeus*	R	Least Concern	Schedule IV
67	White-browed Fantail	*Rhipidura aureola*	R	Least Concern	Schedule IV
68	House Crow	*Corvus splendens*	R	Least Concern	Schedule IV
69	Plain Prinia	*Prinia inornata*	R	Least Concern	Schedule IV

S.N.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
70	Wire-tailed Swallow	*Hirundo smithii*	R	Least Concern	Schedule IV
71	Indian Pied Starling	*Gracupica contra*	R	Least Concern	Schedule IV
72	Baya Weaver	*Ploceus philippinus*	R	Least Concern	Schedule IV
73	Red Avadavat	*Amandava amandava*	R	Least Concern	Schedule IV
74	Indian Spot-billed Duck	*Anas poecilorhyncha*	R	Least Concern	Schedule IV
75	Ashy Prinia	*Prinia socialis*	R	Least Concern	Schedule IV
76	Little Swift	*Apus affinis*	R	Least Concern	Schedule IV
77	Common Kingfisher	*Alcedo atthis*	R	Least Concern	Schedule IV
78	Eurasian Collared-Dove	*Streptopelia decaocto*	R	Least Concern	Schedule IV
79	Red Collared-Dove	*Streptopelia tranquebarica*	R	Least Concern	Schedule IV
80	Spotted Dove	*Spilopelia chinensis*	R	Least Concern	Schedule IV
81	Greater Painted-Snipe	*Rostratula benghalensis*	R	Least Concern	Schedule IV
82	Barred Buttonquail	*Turnix suscitator*	R	Least Concern	Schedule IV
83	Painted Stork	*Mycteria leucocephala*	R	Near Threatened	Schedule IV
84	Gray Heron	*Ardea cinerea*	R	Least Concern	Schedule IV
85	Great Egret	*Ardea alba*	R	Least Concern	Schedule IV
86	Shikra	*Accipiter badius*	R	Least Concern	Schedule IV
87	Spotted Owlet	*Athene brama*	R	Least Concern	Schedule IV
88	Common Iora	*Aegithina tiphia*	R	Least Concern	Schedule IV
89	Indian Paradise-Flycatcher	*Terpsiphone paradisi*	R	Least Concern	Schedule IV
90	Rufous Treepie	*Dendrocitta vagabunda*	R	Least Concern	Schedule IV
91	Brown Crake	*Zapornia akool*	R	Least Concern	Schedule IV
92	Asian Openbill	*Anastomus oscitans*	R	Least Concern	Schedule IV
93	Dusky Crag-Martin	*Ptyonoprogne concolor*	R	Least Concern	Schedule IV
94	Black-breasted Weaver	*Ploceus benghalensis*	R	Least Concern	Schedule IV
95	Paddyfield Pipit	*Anthus rufulus*	R	Least Concern	Schedule IV
96	Oriental Honey-buzzard	*Pernis ptilorhynchus*	R	Least Concern	Schedule IV
97	Yellow-eyed Babbler	*Chrysomma sinense*	R	Least Concern	Schedule IV
98	Tawny-bellied Babbler	*Dumetia hyperythra*	R	Least Concern	Schedule IV
99	Indian Gray Hornbill	*Ocyceros birostris*	R	Least Concern	Schedule IV
100	Ashy-crowned Sparrow-Lark	*Eremopterix griseus*	R	Least Concern	Schedule IV
101	Gray-breasted Prinia	*Prinia hodgsonii*	R	Least Concern	Schedule IV
102	Asian Woolly-necked Stork	*Ciconia episcopus*	R	Near Threatened	Schedule IV
103	Yellow-wattled Lapwing	*Vanellus malabaricus*	R	Least Concern	Schedule IV
104	Black Kite	*Milvus migrans*	R	Least Concern	Schedule I
105	Alexandrine Parakeet	*Psittacula eupatria*	R	Near Threatened	Schedule IV

S.N.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
106	Pied Kingfisher	*Ceryle rudis*	R	Least Concern	Schedule IV
107	Black-rumped Flameback	*Dinopium benghalense*	R	Least Concern	Schedule IV
108	Black-crowned Night-Heron	*Nycticorax nycticorax*	R	Least Concern	Schedule IV
109	Greater Flamingo	*Phoenicopterus roseus*	M	Least Concern	Schedule IV
110	River Tern	*Sterna aurantia*	R	Vulnerable	Schedule I
111	Eurasian Spoonbill	*Platalea leucorodia*	R	Least Concern	Schedule I
112	Asian Palm Swift	*Cypsiurus balasiensis*	R	Least Concern	Schedule IV
113	White-browed Wagtail	*Motacilla maderaspatensis*	R	Least Concern	Schedule IV
114	Indian Cormorant	*Phalacrocorax fuscicollis*	R	Least Concern	Schedule IV
115	Yellow-throated Sparrow	*Gymnoris xanthocollis*	M	Least Concern	Schedule IV
116	Oriental Darter	*Anhinga melanogaster*	R	Near Threatened	Schedule IV
117	Tickell's Blue Flycatcher	*Cyornis tickelliae*	R	Least Concern	Schedule IV
118	Black-winged Kite	*Elanus caeruleus*	R	Least Concern	Schedule I
119	Oriental Pratincole	*Glareola maldivarum*	M	Least Concern	Schedule IV
120	Zitting Cisticola	*Cisticola juncidis*	R	Least Concern	Schedule IV
121	Rufous-tailed Lark	*Ammomanes phoenicura*	R	Least Concern	Schedule IV
122	Little Grebe	*Tachybaptus ruficollis*	R	Least Concern	Schedule IV
123	Great Thick-knee	*Esacus recurvirostris*	R	Near Threatened	Schedule IV
124	Green Sandpiper	*Tringa ochropus*	M	Least Concern	Schedule IV
125	Small Pratincole	*Glareola lactea*	M	Least Concern	Schedule IV
126	Great Cormorant	*Phalacrocorax carbo*	R	Least Concern	Schedule IV
127	Eurasian Hoopoe	*Upupa epops*	R	Least Concern	Schedule IV
128	Indian Roller	*Coracias benghalensis*	R	Least Concern	Schedule IV
129	Bay-backed Shrike	*Lanius vittatus*	R	Least Concern	Not listed
130	Rosy Starling	*Pastor roseus*	M	Least Concern	Schedule IV
131	Brown Rock Chat	*Oenanthe fusca*	R	Least Concern	Schedule IV
132	Plum-headed Parakeet	*Psittacula cyanocephala*	R	Least Concern	Schedule IV
133	Indian Pitta	*Pitta brachyura*	M	Least Concern	Schedule IV
134	Ruddy-breasted Crake	*Zapornia fusca*	R	Least Concern	Schedule IV
135	Black-tailed Godwit	*Limosa limosa*	M	Near Threatened	Schedule IV
136	Streak-throated Swallow	*Petrochelidon fluvicola*	R	Least Concern	Schedule IV
137	Red-rumped Swallow	*Cecropis daurica*	R	Least Concern	Schedule IV
138	Little Ringed Plover	*Charadrius dubius*	M	Least Concern	Schedule IV
139	Collared Pratincole	*Glareola pratincola*	M	Least Concern	Schedule IV
140	Clamorous Reed Warbler	*Acrocephalus stentoreus*	R	Least Concern	Schedule IV
141	Black Bittern	*Ixobrychus flavicollis*	R	Least Concern	Schedule IV

S.N.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
142	Yellow-crowned Woodpecker	*Leiopicus mahrattensis*	R	Least Concern	Schedule IV
143	Tricolored Munia	*Lonchura malacca*	R	Least Concern	Schedule IV
144	Jungle Prinia	*Prinia sylvatica*	R	Least Concern	Schedule IV
145	Large Cuckooshrike	*Coracina macei*	R	Least Concern	Schedule IV
146	Barn Swallow	*Hirundo rustica*	R	Least Concern	Schedule IV
147	Indian Scops-Owl	*Otus bakkamoena*	R	Least Concern	Schedule IV
148	Indian Thick-knee	*Burhinus indicus*	R	Least Concern	Schedule IV
149	Crested Lark	*Galerida cristata*	R	Least Concern	Schedule IV
150	White Wagtail	*Motacilla alba*	R	Least Concern	Schedule IV
151	Blyth's Reed Warbler	*Acrocephalus dumetorum*	M	Least Concern	Schedule IV
152	Western Reef-Heron	*Egretta gularis*	M	Least Concern	Schedule IV
153	Long-tailed Shrike	*Lanius schach*	R	Least Concern	Schedule IV
154	Sarus Crane	*Antigone antigone*	R	Vulnerable	Schedule I
155	Temminck's Stint	*Calidris temminckii*	M	Least Concern	Schedule IV
156	Common Sandpiper	*Actitis hypoleucos*	M	Least Concern	Schedule IV
157	Whiskered Tern	*Chlidonias hybrida*	M	Least Concern	Schedule IV
158	Eurasian Marsh-Harrier	*Circus aeruginosus*	M	Least Concern	Schedule I
159	Eurasian Sparrowhawk	*Accipiter nisus*	M	Least Concern	Schedule I
160	Western Yellow Wagtail	*Motacilla flava*	M	Least Concern	Schedule IV
161	Green-winged Teal	*Anas crecca*	M	Least Concern	Schedule IV
162	Black-headed Bunting	*Emberiza melanocephala*	M	Least Concern	Schedule IV
163	Garganey	*Spatula querquedula*	M	Least Concern	Schedule IV
164	Marsh Sandpiper	*Tringa stagnatilis*	M	Least Concern	Schedule IV
165	Ashy Woodswallow	*Artamus fuscus*	R	Least Concern	Schedule IV
166	Siberian Stonechat	*Saxicola maurus*	M	Least Concern	Schedule IV
167	Gray Wagtail	*Motacilla cinerea*	R	Least Concern	Schedule IV
168	Red-headed Bunting	*Emberiza bruniceps*	M	Least Concern	Schedule IV
169	Common Greenshank	*Tringa nebularia*	M	Least Concern	Schedule IV
170	Citrine Wagtail	*Motacilla citreola*	M	Least Concern	Schedule IV
171	Ruddy Shelduck	*Tadorna ferruginea*	M	Least Concern	Schedule IV
172	Ashy Drongo	*Dicrurus leucophaeus*	R	Least Concern	Schedule IV
173	Sykes's Warbler	*Iduna rama*	M	Least Concern	Schedule IV
174	Lesser Whitethroat	*Curruca curruca*	M	Least Concern	Schedule IV
175	Ruff	*Calidris pugnax*	M	Least Concern	Schedule IV
176	Common Redshank	*Tringa totanus*	M	Least Concern	Schedule IV

S.N.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
177	Red-breasted Flycatcher	*Ficedula parva*	R	Least Concern	Schedule IV
178	Booted Warbler	*Iduna caligata*	R	Least Concern	Schedule IV
179	White-tailed Lapwing	*Vanellus leucurus*	M	Least Concern	Schedule IV
180	Eurasian Wryneck	*Jynx torquilla*	M	Least Concern	Schedule IV
181	Indian Bushlark	*Mirafra erythroptera*	R	Least Concern	Schedule IV
182	Bluethroat	*Luscinia svecica*	M	Least Concern	Schedule IV
183	Gadwall	*Mareca strepera*	M	Least Concern	Schedule IV
184	Eurasian Wigeon	*Mareca penelope*	M	Least Concern	Schedule I
185	Green Warbler	*Phylloscopus nitidus*	M	Least Concern	Schedule IV
186	Greenish Warbler	*Phylloscopus trochiloides*	M	Least Concern	Schedule IV
187	Black Redstart	*Phoenicurus ochruros*	R	Least Concern	Schedule IV
188	Desert Wheatear	*Oenanthe deserti*	M	Least Concern	Schedule IV
189	Common Chiffchaff	*Phylloscopus collybita*	M	Least Concern	Schedule IV
190	Northern Shoveler	*Spatula clypeata*	M	Least Concern	Schedule IV
191	Gull-billed Tern	*Gelochelidon nilotica*	M	Least Concern	Schedule I
192	Common Snipe	*Gallinago gallinago*	R	Least Concern	Schedule IV
193	Northern Pintail	*Anas acuta*	M	Least Concern	Schedule IV
194	Tufted Duck	*Aythya fuligula*	M	Least Concern	Schedule IV
195	Pallid Harrier	*Circus macrourus*	M	Near Threatened	Schedule I
196	Paddyfield Warbler	*Acrocephalus agricola*	M	Least Concern	Schedule IV
197	Eastern Orphean Warbler	*Curruca crassirostris*	M	Least Concern	Schedule IV
198	Tawny Pipit	*Anthus campestris*	R	Least Concern	Schedule IV
199	Barn Owl	*Tyto alba*	R	Least Concern	Schedule I
200	Graylag Goose	*Anser anser*	M	Least Concern	Schedule IV
201	Pacific Golden-Plover	*Pluvialis fulva*	M	Least Concern	Schedule IV
202	Little Stint	*Calidris minuta*	M	Least Concern	Schedule IV
203	Spotted Redshank	*Tringa erythropus*	M	Least Concern	Schedule IV
204	Greater Spotted Eagle	*Clanga clanga*	R	Vulnerable	Schedule I
205	Sulphur-bellied Warbler	*Phylloscopus griseolus*	R	Least Concern	Schedule IV
206	Pied Bushchat	*Saxicola caprata*	R	Least Concern	Schedule IV
207	Black-headed Gull	*Chroicocephalus ridibundus*	M	Least Concern	Schedule IV
208	Bar-headed Goose	*Anser indicus*	M	Least Concern	Schedule IV
209	Red-crested Pochard	*Netta rufina*	M	Least Concern	Schedule IV
210	Common Pochard	*Aythya ferina*	M	Vulnerable	Schedule I
211	Ferruginous Duck	*Aythya nyroca*	M	Near Threatened	Schedule I
212	Common Quail	*Coturnix coturnix*	R	Least Concern	Schedule IV

S.N.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
213	Mallard	*Anas platyrhynchos*	M	Least Concern	Schedule IV
214	Short-toed Snake-Eagle	*Circaetus gallicus*	R	Least Concern	Schedule I
215	Booted Eagle	*Hieraaetus pennatus*	M	Least Concern	Schedule I
216	Tree Pipit	*Anthus trivialis*	R	Least Concern	Schedule IV
217	Osprey	*Pandion haliaetus*	R	Least Concern	Schedule I
218	Gray-headed Canary-Flycatcher	*Culicicapa ceylonensis*	R	Least Concern	Schedule IV
219	Caspian Tern	*Hydroprogne caspia*	M	Least Concern	Schedule IV
220	Delicate Prinia	*Prinia lepida*	R	Least Concern	Schedule IV
221	Bank Swallow	*Riparia riparia*	M	Least Concern	Schedule IV
222	Rock Bush-Quail	*Perdicula argoondah*	R	Least Concern	Schedule IV
223	Black-necked Stork	*Ephippiorhynchus asiaticus*	R	Near Threatened	Schedule IV
224	Lesser Sand-Plover	*Charadrius mongolus*	M	Least Concern	Schedule IV
225	Taiga Flycatcher	*Ficedula albicilla*	M	Least Concern	Schedule IV
226	White-eyed Buzzard	*Butastur teesa*	R	Least Concern	Schedule IV
227	Isabelline Shrike	*Lanius isabellinus*	M	Least Concern	Schedule IV
228	Kentish Plover	*Charadrius alexandrinus*	M	Least Concern	Schedule IV
229	Mottled Wood-Owl	*Strix ocellata*	R	Least Concern	Schedule IV
230	Crested Serpent-Eagle	*Spilornis cheela*	M	Least Concern	Schedule IV
231	Black-bellied Tern	*Sterna acuticauda*	M	Endangered	Schedule I
232	Eurasian Kestrel	*Falco tinnunculus*	M	Least Concern	Schedule IV
233	Brown-headed Gull	*Chroicocephalus brunnicephalus*	M	Least Concern	Schedule IV
234	Pallas's Gulll	*chthyaetus ichthyaetus*	M	Least Concern	Schedule IV
235	Common Grasshopper Warbler	*Locustella naevia*	R	Least Concern	Schedule IV
236	Blue-cheeked Bee-eater	*Merops persicus*	M	Least Concern	Schedule IV
237	Eurasian Hobby	*Falco subbuteo*	M	Least Concern	Schedule IV
238	Crested Bunting	*Emberiza lathami*	M	Least Concern	Schedule IV
239	Peregrine Falcon	*Falco peregrinus*	M	Least Concern	Schedule IV
240	Gray-throated Martin	*Riparia chinensis*	M	Least Concern	Schedule IV
241	Hume's Warbler	*Phylloscopus humei*	R	Least Concern	Schedule IV
242	Common Cuckoo	*Cuculus canorus*	R	Least Concern	Schedule IV
243	White-bellied Drongo	*Dicrurus caerulescens*	R	Least Concern	Schedule IV
244	Rain Quail	*Coturnix coromandelica*	R	Least Concern	Schedule IV
245	Red-necked Falcon	*Falco chicquera*	R	Least Concern	Schedule IV
246	Jungle Nightjar	*Caprimulgus indicus*	R	Least Concern	Schedule IV

S.N.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
247	Tawny Lark	*Galerida deva*	R	Least Concern	Schedule IV
248	Black-headed Cuckooshrike	*Lalage melanoptera*	R	Least Concern	Schedule IV
249	European Roller	*Coracias garrulus*	M	Least Concern	Schedule IV
250	Watercock	*Gallicrex cinerea*	R	Least Concern	Schedule IV
251	Fork-tailed Drongo-Cuckoo	*Surniculus dicruroides*	R	Least Concern	Schedule IV
252	Red-whiskered Bulbul	*Pycnonotus jocosus*	R	Least Concern	Schedule IV
253	Striated Heron	*Butorides striata*	R	Least Concern	Schedule IV
254	Orange-headed Thrush	*Geokichla citrina*	M	Least Concern	Schedule IV
255	Indian Nightjar	*Caprimulgus asiaticus*	R	Least Concern	Schedule IV
256	Baillon's Crake	*Zapornia pusilla*	M	Least Concern	Schedule IV
257	Lesser Flamingo	*Phoeniconaias minor*	M	Near Threatened	Schedule IV
258	Amur Falcon	*Falco amurensis*	R	Least Concern	Schedule I
259	Savanna Nightjar	*Caprimulgus affinis*	M	Least Concern	Schedule IV
260	Brown Fish-Owl	*Ketupa zeylonensis*	R	Least Concern	Schedule I
261	Chestnut-bellied Sandgrouse	*Pterocles exustus*	R	Least Concern	Schedule IV
262	Slender-billed Gull	*Chroicocephalus genei*	M	Least Concern	Schedule IV
263	Brown-headed Barbet	*Psilopogon zeylanicus*	R	Least Concern	Schedule IV
264	Common Rosefinch	*Carpodacus erythrinus*	M	Least Concern	Schedule IV
265	Great White Pelican	*Pelecanus onocrotalus*	M	Least Concern	Schedule IV
266	Dalmatian Pelican	*Pelecanus crispus*	M	Near Threatened	Schedule IV
267	Long-billed Pipit	*Anthus similis*	M	Least Concern	Schedule IV
268	Isabelline Wheatear	*Oenanthe isabellina*	M	Least Concern	Schedule IV
269	Cinereous Tit	*Parus cinereus*	M	Least Concern	Schedule IV
270	Gray-necked Bunting	*Emberiza buchanani*	M	Least Concern	Schedule IV
271	Egyptian Vulture	*Neophron percnopterus*	R	Endangered	Schedule I
272	Brown Shrike	*Lanius cristatus*	R	Least Concern	Schedule IV
273	European Starling	*Sturnus vulgaris*	M	Least Concern	Schedule IV
274	Common Buzzard	*Buteo buteo*	R	Least Concern	Schedule I
275	Eurasian Curlew	*Numenius arquata*	M	Near Threatened	Schedule IV
276	Steppe Eagle	*Aquila nipalensis*	R	Endangered	Schedule I
277	Greater Short-toed Lark	*Calandrella brachydactyla*	M	Least Concern	Schedule IV
278	Brown Boobook	*Ninox scutulata*	M	Least Concern	Schedule IV
279	Black-naped Monarch	*Hypothymis azurea*	M	Least Concern	Schedule IV
280	Indian Scimitar-Babbler	*Pomatorhinus horsfieldii*	M	Least Concern	Schedule IV

S.N.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
281	Brown-capped Pygmy Woodpecker	*Yungipicus nanus*	R	Least Concern	Schedule IV
282	Brahminy Kite	*Haliastur indus*	R	Least Concern	Schedule I
283	Sirkeer Malkoha	*Taccocua leschenaultii*	R	Least Concern	Schedule IV
284	Spotted Crake	*Porzana porzana*	R	Least Concern	Schedule IV
285	Variable Wheatear	*Oenanthe picata*	M	Least Concern	Schedule IV
286	Common Crane	*Grus grus*	M	Least Concern	Schedule I
287	Ultramarine Flycatcher	*Ficedula superciliaris*	M	Least Concern	Schedule IV
288	Water Rail	*Rallus aquaticus*	M	Least Concern	Schedule IV
289	Pied Avocet	*Recurvirostra avosetta*	M	Least Concern	Schedule IV
290	Montagu's Harrier	*Circus pygargus*	M	Least Concern	Schedule IV
291	Long-legged Buzzard	*Buteo rufinus*	M	Least Concern	Schedule IV
292	Greater White-fronted Goose	*Anser albifrons*	M	Least Concern	Schedule IV
293	Great Gray Shrike	*Lanius excubitor*	R	Least Concern	Schedule IV
294	Western Crowned Warbler	*Phylloscopus occipitalis*	M	Least Concern	Schedule IV
295	Blue Rock-Thrush	*Monticola solitarius*	M	Least Concern	Schedule IV
296	Demoiselle Crane	*Anthropoides virgo*	M	Least Concern	Schedule I
297	Rufous-fronted Prinia	*Prinia buchanani*	R	Least Concern	Schedule IV
298	Lesser Black-backed	*GullLarus fuscus*	R	Least Concern	Schedule IV
299	Indian Courser	*Cursorius coromandelicus*	R	Least Concern	Schedule IV
300	Fulvous Whistling-Duck	*Dendrocygna bicolor*	M	Least Concern	Schedule IV
301	Little Crake	*Zapornia parva*	R	Least Concern	Schedule IV
302	Indian Spotted Eagle	*Clanga hastata*	R	Vulnerable	Schedule I
303	Bonelli's Eagle	*Aquila fasciata*	R	Least Concern	Schedule I
304	Sykes's Nightjar	*Caprimulgus mahrattensis*	M	Least Concern	Schedule IV
305	Great Crested Grebe	*Podiceps cristatus*	M	Least Concern	Schedule IV
306	Great Bittern	*Botaurus stellaris*	R	Least Concern	Schedule IV
307	Indian Vulture	*Gyps indicus*	R	Critically Endangered	Schedule I
308	Slaty-breasted Rail	*Lewinia striata*	R	Least Concern	Schedule IV
309	White-rumped Vulture	*Gyps bengalensis*	R	Critically Endangered	Schedule I
310	Short-eared Owl	*Asio flammeus*	R	Least Concern	Schedule I
311	Black Stork	*Ciconia nigra*	R	Least Concern	Schedule IV
312	Eurasian Griffon	*Gyps fulvus*	M	Least Concern	Schedule I
313	Pale Sand Martin	*Riparia diluta*	M	Least Concern	Schedule IV
314	Blue-faced Malkoha	*Phaenicophaeus viridirostris*	R	Least Concern	Schedule IV

S.N.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
315	Rock Eagle-Owl	*Bubo bengalensis*	R	Least Concern	Schedule IV

APPENDIX 19: STATUS OF APPLICABLE E&S PERMITS

S. No	Applicable Policies and Regulations	Institution Responsible	Applicability/Coverage	Recommendation
1.	The Environmental (Protection) Act 1986; EIA Notification 2020	MoEF&CC	***Not Applicable*** According to EIA Notification 2006 and amendment dated 25.06.2014, the Thermal Power plant up to 15MW, based on non-hazardous municipal waste and using auxiliary fuel such as coal / lignite / petroleum products up to 15% are exempted from prior environmental clearance. Additionally, Thermal Power plants using waste heat boiler without any auxiliary fuel are exempted from prior environmental clearance. Since the capacity of the project is 14.9 MW and MSW will be used as fuel for the boiler, therefore, environmental clearance is not applicable to the project	Nil
2.	Consent to Establish (CTE) under the air (Prevention and control of pollution) Act 1981 (the Air Act 1981) the water (Prevention and control of pollution) Act, 1974 9the Water Act, 1974	Gujarat Pollution Control Board	***Applicable*** The project has received Consent to Establish (CTE) under Air Act, 1981, Water Act 1974 dated 21.03.2020 valid till 19.01.2027. As per the conditions of the CTE, the project is entitled to use 800 TPD MSW Refuse Derived Fuel (RDF) as fuel for the WTE plant. However, based on discussion with GWVPL, it is understood that approximately 1000 TPD MSW will be required for the operation of the WTE plant which is not aligned to the condition of the CTE.	The Project should update the existing CTE and ensure future CTO include procurement of 1000 TPD MSW for operation of the project instead of 800 TPD mentioned in the CTE.
3.	Hazardous and other waste (Management & Transboundary Movement Rules) 2016 as amended	Gujarat Pollution Control Board	***Applicable during operation Phase*** The project will generate, store, and handle hazardous wastes such as used oil from operating equipment and DG sets etc. during operational phase which shall require hazardous waste authorization under Hazardous and other waste (Management & Transboundary Movement Rules) 2016	The Project should ensure hazardous waste authorization is obtained prior to start of operation phase for the project.
4.	NOC for Ground water Abstraction	Central Groundwater Authority	***Applicable*** GWVPL has obtained No Objection Certificate (NOC) from CGWA on 02.11.2020 valid up to 01.11.2023. As per the NOC, the project can abstract 7.5 KLD water from one existing borewell within the project premises. Based on review of waterlog during site visit, it was observed that project has abstract up to 24.75 KLD water from the borewell which is non-compliance to the NOC obtained.	

S. No	Applicable Policies and Regulations	Institution Responsible	Applicability/Coverage	Recommendation
			However, based on recent waterlog shared by GWVPL, it was observed that GWVPL has reduced its water consumption to 7.5 KLD and it is compliant to the NOC obtained.	
5.	Fire NOC	Fire and Emergency Services, Vadodara Municipal Corporation	***Applicable during operation Phase*** The Project will apply for fire NOC or necessary approval (as applicable) for the project prior to start of operation phase	The Project should ensure to obtain necessary approvals/fire NOC (as applicable) prior to operation phase.
6.	Forest Clearance under The Forest (Conservation) Act, 1980 Wildlife Clearance under the Wildlife (Protection)Act, 1972	MoEF&CC and NBWL	**Not Applicable** Since there are no protected areas such as national parks, wildlife sanctuaries, biosphere reserved within 10 km of the project area. Forest clearance and wildlife clearance is not applicable to the project.	Nil
7.	Building and other Construction Worker (BOCW) registration	Assistant Labour Commissioner Officer	**Applicable** GWVPL has obtained BOCW registration with registration number JDISH/BRD/BOCW/106/2022 dated 11.05.2022. The registration is valid till 31.12.2023	Nil
8.	Principle Employers' Registration as per the section 7 of the Contract Labour (Regulation and Abolition) Act, 1970	Assistant Labour Commissioner Office	**Applicable** GWVPL has obtained the principal employer license with the registration number BRD/2020/CLRA/55. The license has covered both the contractors employed at the project – 1. Golden Crown Security Allied Services 2. Active Infrastructure However, the project has appointed a new construction activity contractor named M/s Dave Construction & Engineering Company in place of M/s Active Infrastructure. Further, to remain in compliance with the applicable regulation, the project has submitted the application (vide application number 2023/43) for updating the obtained principal labour license to include the M/s Dave Construction & Engineering Company.	The project shall regularly follow-up with applicable government authority to obtain the updated principal labour licence.
9.	Contract Labour License under the Contract Labour (Regulation & Abolition) Act 1970	Assistant Labour Commissioner Office	**Applicable on Dave Construction & Engineering Company** Dave Construction & Engineering Company has obtained the contract labour license vide license number CLRA/License/CLRA/BRD/2023/CLL/90 dated 13.03.2023. The license is valid till 31.03.2024.	Nil

S. No	Applicable Policies and Regulations	Institution Responsible	Applicability/Coverage	Recommendation
	And		**Not Applicable on Golden Crown Security Allied Services** The number of security personnel employed (which is 5) by the agency are below the mandatory applicability limit of 50 workers as per the Act. Therefore, as per the section 4 of the Act, the contractor labour license is not applicable on the agency. **Note: A**ccording to the Contract Labour (Regulation and Abolition) (Gujarat Amendment) Act, 2020, the Contract Labour (Regulation and Abolition) Act, 1970 in Gujarat is now apply to establishments and contractors which employ 50 or more workmen as opposed to the earlier threshold of 20. Therefore, the contractor labour license is not applicable on Dave Construction and Engineering Company.	
10.	Registration under Gujarat. Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) Rules, 1983, The Inter-State Migrant Workmen (Regulation of Employment And Conditions Of Service) Act, 1979	Office of the licensing officer, Government of India	**Applicable** The Act is not applicable to Dave Construction and Engineering Company. The contractor's employed workers does not fall under the category of Inter-state migrant workmen[94].	Nil
11.	The Child Labour (Prohibition and Regulation) Amendment Act, 2016	Labour Commissioner Officer	**Applicable** The project has not employed any child labour, as observed the review of personal files. This demonstrates a commitment to complying with the provisions of the Child Labour (Prohibition and Regulation) Amendment Act, 2016. Additionally, as a good practise, the project asks potential workers to submit a copy of their age proof document prior to employment. This helps in ensuring that only eligible workers above the legal age are employed and further strengthens the project's compliance with labour regulations. By implementing these measures, the project is taking proactive steps to prevent child labour and uphold the rights and welfare of workers. It is important to continue monitoring and maintaining	Nil

[94] Inter-state migrant workmen mean any person who is recruited by or through a contractor in one State under an agreement or other arrangement for employment in an establishment in another State, whether with or without the knowledge of the principal employer in relation to such establishment

<table>
<tr><th>S. No</th><th>Applicable Policies and Regulations</th><th>Institution Responsible</th><th>Applicability/Coverage</th><th>Recommendation</th></tr>
<tr><td></td><td></td><td></td><td>such practise to ensure ongoing compliance with applicable laws and regulations related to labour and child protection.</td><td></td></tr>
<tr><td>12.</td><td>The Bonded Labour System (Abolition) Act, 1976</td><td>Labour Commissioner Office</td><td>Applicable

Based on the consultation with the workers, it has been confirmed that there is no form of bonded labour employed at the Project level. Additionally, it is important to note that no workers have taken any form of debt from the contractor or the project, which would require them to work at the project as a means of repayment.

This observation aligns with the provisions of the Bonded Labour System (Abolition) Act, 1976, which prohibits the practice of bonded labour. It is crucial to ensure that workers are not subjected to any form of forced labour or exploitation and that their rights are respected and protected.

By complying with the Act and ensuring the absence of bonded labour, the project demonstrates a commitment to ethical and lawful practices in worker management. It is essential to maintain vigilance and regularly assess labour practices to prevent any potential instances of bonded labour and uphold the rights and dignity of all workers involved in the project.</td><td>Nil</td></tr>
<tr><td>13.</td><td>The Minimum Wages Act, 1948

The Payment of Gratuity Act, 1972</td><td>Labour Commissioned Office</td><td>Applicable

It has been confirmed through consultation and a review of the wage register that all workers and security personnel at the project are receiving wages equivalent to the minimum wages prescribed by the Gujarat state notification[95], it indicates the compliance with the provisions of the Minimum Wages Act, 1948.

The review of sample of wages received by the workers are provided below:

<table><tr><th>Workers</th><th>Employment</th><th>Wages Received</th><th>Class of employee</th><th>Wages as per notification</th></tr><tr><td>Workers 1</td><td>Construction workers</td><td>700/day</td><td>Skilled</td><td>474</td></tr><tr><td>Workers 2</td><td>Helper in construction activities</td><td>500-600/day</td><td>Semi-skilled and unskilled</td><td>462</td></tr><tr><td>Workers 3</td><td>Security personnel</td><td>15,000/month and 577/day</td><td>Skilled</td><td>474</td></tr></table></td><td>Nil

(As a future looking recommendation, the project intends to ensure that all workers receive wages above and beyond the updated minimum wages notification issued by the state government. Paying workers' wages higher than the minimum wage demonstrates a commitment to fair compensation and upholding workers' rights).</td></tr>
</table>

[95] https://col.gujarat.gov.in/Portal/News/998_3_minimum_wages_46_Schedule_Employment_27.03.2023.pdf (Accessed on May 27, 2023)

<table>
<tr><th>S. No</th><th>Applicable Policies and Regulations</th><th>Institution Responsible</th><th>Applicability/Coverage</th><th>Recommendation</th></tr>
<tr><td>14.</td><td>Registration under the Private security Agencies (Regulation) Act, 2005</td><td>Department of Police</td><td>Applicable

Golden Crown Security and Allied Services – the private security providing agency has obtained the PSARA license vide license number 19083828 and is valid till 19.08.2024.</td><td>Nil</td></tr>
<tr><td>15.</td><td>Registration under the Employees' Provident Funds and Miscellaneous Provisions Act, 1952</td><td>Employees' Provident Fund Organisation</td><td>Applicable

The applicability and status of the registration of contractor and security personnel are provided below:

<table><tr><th>Contractor/Project SPV</th><th>Applicability Status</th><th></th></tr><tr><td>Dave Construction & Engineering Company</td><td>Not Applicable on the contractor</td><td>As per the Act, an employee whose salary applicable for PF is more than INR 15,000 per month and first time covered under the Act, is an Excluded employee.

Note: All the workers employed by the contractor are earning more than INR 15,000 per month and have not been covered under the Act before employing at the Project.</td></tr><tr><td>Golden Crown Security Allied Services</td><td>The Act is applicable on the contractor</td><td>The security agency has obtained the PF registration vide establishment code GJAH1910947000.

Further, based on the consultation with security personnel, they are receiving benefits as per the Act.</td></tr></table></td><td>The contractor shall obtain the Registration under the Employees' Provident Funds and Miscellaneous Provisions Act, 1952</td></tr>
<tr><td>16.</td><td>Registration under the Employees' State Insurance Act, 1948</td><td>Employees' State Insurance Corporation</td><td>Not Applicable – construction workers

Based on Hon'ble Supreme Court of India order dated 06.07.2018, ESIC is not applicable on the construction workers during the stay order. However, till date the stay order is applicable across India. Further, Employees State Insurance Corporation through its letter no. T.11/13/03/2015 Rev.II dated 26.09.2018 – also clarifies that no ESIC contribution may be collected from construction site workers.

Applicable – Security personnel</td><td>Nil</td></tr>
</table>

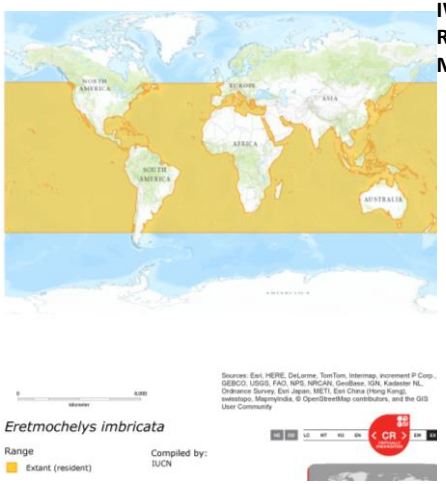
S. No	Applicable Policies and Regulations	Institution Responsible	Applicability/Coverage	Recommendation
			Golden Crown Security and Allied Services has obtained the ESIC registration, and the employee code of the agency is 37001136390001018	

APPENDIX 20: CRITICAL HABITAT SCREENING

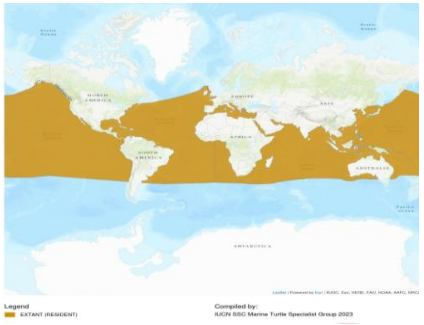
Appendix 20: Critical Habitat Screening (Vadodara Site)

S.N.	Common English Name (Binomial Scientific Name) Distribution Map	IUCN[1] Categories IWP[2] Schedules Endemicity Migratory Status	CHA Criteria	Screening Argument	Screened In or Out
Plants					
1	Sulati-khutti (*Ceropegia odorata*) 	**IUCN:** Critically Endangered **IWP:** Not Available **Restricted range:** No **Migratory:** No	1 a, c	*Ceropegia odorata* is endemic to western India. After its type collection (in 1839) it was reported from Pavagadh hill of Gujarat[3]; Mount Abu, Rajasthan[4]; Toranmal forests in Maharashtra[5]; Nepanagar in Madhya Pradesh[6]; Kasara Ghat, Murbad & Karjat region of Maharashtra[7]; Bhoste Ghat (Khed), Matwan (Dapoli) & Hatiwale (Rajapur) in Ratnagiri District of Maharashtra[8]; and recently Patel et al. (2017)[9] collected it from Vijaynagar forest in Gujarat. At present no individuals are known from the Pavagadh Hills or Mount Abu. It is poorly represented in Indian herbaria[10]. During field surveying, less than 100 individuals were located, distributed sporadically in varied small subpopulations. The largest subpopulation of Matwan near Dapoli in Maharashtra consists of 25 individuals. This plant grows in rocky areas amidst grasses and around the bushes in association with *Chlorophytum tuberosum* (Roxb.) Baker, *Dendrocalamus strictus* (Roxb.) Nees, *Terminalia elliptica* Willd., *Tylophora fasciculata* Buch.-Ham. ex Wight and *Wrightia tinctoria* R.Br.[11]. In Gujarat, the species has records from the Pavagadh hill and hill forests of Vijayanagar. It was reported from Pavagadh during 1971 after that there is no record of the species from the area. As per the current available information about its distribution in Gujarat[12, 13] the	Screened Out

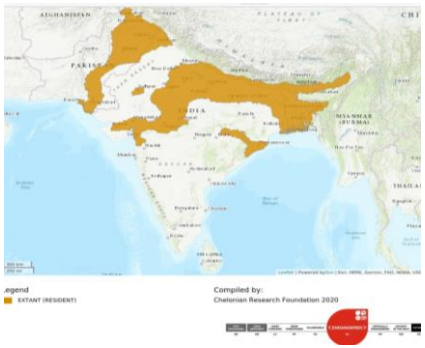
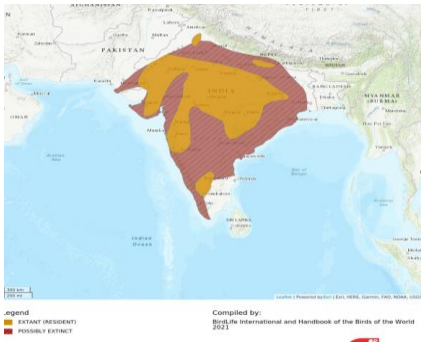
[1] IUCN RedList - Online Version 2023-1
[2] Indian Wildlife (Protection) Act. 1972
[3] Sabnis, S.D. and Bedi, S.J. 1971. Ceropegia odorata Hook.f. (Asclepiadaceae): a little-known plant of western India. Kew Bulletin 25(1): 57–59.
[4] Ansari, M.Y. 1984. Flora of India: Fascicle 16. Asclepiadaceae: Genus - Ceropegia. Fascicles of Botanical Survey of India, Kolkata. Fascicle 16: 33.
[5] Jagtap, A.P. and Das, S.K.D. 2001. Asclepiadaceae. In: N.P Singh, S. Lakshminarasimhan, S. Karthikeyan and P.V. Prasanna (eds), Flora of Maharashtra State, Dicotyledons, pp. 345–357. Botanical Survey of India, Kolkata.
[6] Mujaffar, S., Kambale, S.S. and Yadav, S.R. 2015. An extended distribution of Ceropegia odorata Nimmo ex J. Graham (Apocynaceae: Asclepiadoideae) to the state of Madhya Pradesh, India. Journal of Threatened Taxa 07(01): 6830–6832.
[7] Kambale, S.S. and Yadav, S.R. 2013. Ceropegias of the Western Ghats: Diversity, Problems and Prospects. Asklepios 116: 27-40.
[8] Singh, R.K., Patil, S. and Jalal, J.S. 2014. Resurrecting the type locality of Ceropegia odorata (Apocynaceae) after 175 years. Taprobanica 06(02): 79–82.
[9] Patel, S.K., Punjani, B.L., Desai, P.R., Pandey, V.B., Chaudhary, Y.S. and Joshi, P.N. 2017. Additional record and conservation measures of Ceropegia odorata Nimmo ex J. Graham from Gujarat State, India. Journal of Threatened Taxa 09(08): 10618–10622.
[10] Sharad Suresh Kambale. 2015. Taxonomic Revision of Genus Ceropegia L in India. Department of Botany, Shivaji University.
[11] Sharad Suresh Kambale. 2015. Taxonomic Revision of Genus Ceropegia L in India. Department of Botany, Shivaji University.
[12] https://www.gbif.org/species/3574019
[13] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=938628

	https://www.iucnredlist.org/species/120413156/120413178			species has presence in the hill forests of Vijayanagar, which is about 170 km away from the EAAA. Thus, the presence of this floral species in the EAAA is unlikely.	
Herpetofauna					
2	Hawksbill Turtle (*Eretmochelys imbricata*)  https://www.iucnredlist.org/species/8005/12881238	**IUCN:** Critically Endangered **IWP:** Schedule I **Restricted range:** No **Migratory:** Yes	1 a, c	The Hawksbill Turtle has a circumglobal distribution throughout tropical and, to a lesser extent, subtropical waters of the Atlantic Ocean, Indian Ocean, and Pacific Ocean. In India, hawksbills are found in the Lakshadweep islands, Andaman Islands, and few beaches in the Nicobar islands such as Indira Point at the southern tip of Great Nicobar (here turtles often have to crawl over reefs and rocks to reach the nesting beach)[14]. Hawksbills nest on insular and mainland sandy beaches throughout the tropics and subtropics. At that point they recruit into a neritic developmental foraging habitat that may comprise coral reefs or other hard bottom habitats, sea grass, algal beds, or mangrove bays and creeks or mud flats[15]. Although the species distribution map includes all the coasts of the country (India), however the as per the available secondary information, the species has not been reported from the Gujarat state[16, 17]. The species has also not been reported from the surroundings of Vadodara city[18].	Screened Out
3	Green Turtle (*Chelonia mydas*)	**IUCN:** Endangered **IWP:** Schedule I **Restricted range:** No **Migratory:** Yes	1 a, c	The Green Turtle has a circumglobal distribution, occurring throughout tropical and, to a lesser extent, subtropical waters (Atlantic Ocean - eastern central, northeast, northwest, southeast, southwest, western central; Indian Ocean – eastern, western; Mediterranean Sea; Pacific Ocean – eastern central, northwest, southwest, western central). Green turtles are highly migratory, and they undertake complex movements and migrations through geographically disparate habitats. [19]	Screened Out

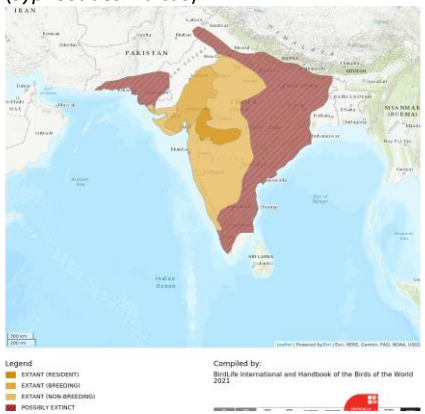
[14] https://www.seaturtlesofindia.org/about/species/hawksbill/#:~:text=In%20India%2C%20hawksbills%20are%20found,to%20reach%20the%20nesting%20beach).
[15] Musick, J.A. and Limpus, C.J. 1997. Habitat utilization and migration in juvenile sea turtles. In: P.L. Lutz and J.A. Musick (eds) The Biology of Sea Turtles, pp. 137-164. CRC Press, Boca Raton, Florida.
[16] https://www.seaturtlesofindia.org/about/distribution/gujarat/
[17] https://www.researchgate.net/publication/237308904_The_status_of_sea_turtle_populations_on_the_Gujarat_coast_of_India
[18] https://www.inaturalist.org/observations?iconic_taxa=Amphibia,Reptilia&lat=22.486977569578578&lng=70.06248615708378&place_id=any&radius=25.85506205566563&subview=map
[19] Hirth, H.F. 1997. Synopsis of the biological data on the green turtle, Chelonia mydas (Linnaeus 1758).
United States Fish and Wildlife Service Biological Report 97-1. 120 pp.

	 https://www.iucnredlist.org/species/2203530 80/220353155			In India, Green Turtles are found in Andaman Island, Gujarat, Lakshwadeep Island, Nicobar Island.[20] Their movements within the marine environment are less understood but it is believed that green turtles inhabit coastal waters of over 140 countries[21] It has been hypothesized that hatchlings begin an oceanic phase[22], perhaps floating passively in major current systems (gyres) that serve as open-ocean developmental grounds.[23] After a number of years in the oceanic zone, these turtles recruit to neritic developmental areas rich in seagrass and/or marine algae where they forage and grow until maturity.[24] Upon attaining sexual maturity green turtles commence breeding migrations between foraging grounds and nesting areas that are undertaken every few years.[25] As per the available secondary information, the species has been reported from the Gujarat state[26]; however, no record of the species is available from the Vadodara city[27, 28].	
4	Indian Softshell Turtle (*Nilssonia gangetica*)	**IUCN:** Endangered **IWP:** Schedule I **Restricted range:** No **Migratory:** No	1 a, c	Indian Softshell Turtle occurs throughout the northern plains of the Indian Subcontinent, in the Indus, Ganga, Narmada and Mahanadi basins[29] They inhabit mostly in rivers, and large canals, preferably with turbid water, muddy bottom and some current. Lakes, oxbows, ponds and temporary waterbodies are used occasionally. It basks on riverine sandbanks[30] and feeds on a variety of items, including animal matter (actively predating birds, reptiles, fish and invertebrates as well as eating carrion) and aquatic plants[31]. They can be found to occupy various types of habitats such as the sea (marine turtles), land (terrestrial turtles), and around lakes, ponds and streams (freshwater turtles). Freshwater testudines feed on algal bloom and some even on dead matter, keeping our water clean. These animals are also known to contribute to seed dispersal and germination.[32]	Screened Out

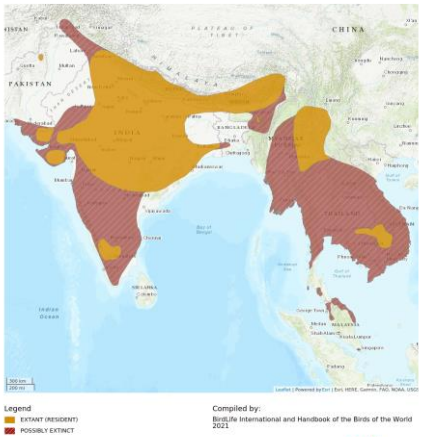
[20] https://www.seaturtlesofindia.org/about/species/green/
[21] Groombridge, B. and Luxmoore, R. 1989. The Green Turtle and Hawksbill (Reptilia: Cheloniidae): World Status, Exploitation and Trade. Secretariat of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, Lausanne, Switzerland, 601 pp.
[22] Carr, A. 1987. New perspectives on the pelagic stage of sea turtle development. Conservation Biology 1: 103.
[23] Carr, A. and Meylan, A.B. 1980. Evidence of passive migration of green turtle hatchlings in Sargassum. Copeia 1980: 366-368
[24] Chaloupka, M.Y. and Musick, J.A. 1997. Age, growth, and population dynamics. In: P.L. Lutz and J.A. Musick (eds) The Biology of Sea Turtles, pp. 233-273. CRC Press, Boca Raton, Florida.
[25] Hirth, H.F. 1997. Synopsis of the biological data on the green turtle, Chelonia mydas (Linnaeus 1758).
[26] https://www.seaturtlesofindia.org/about/distribution/gujarat/
[27] https://www.gbif.org/species/2442225
[28] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=39659
[29] www.iucnredlist.org/species/pdf/2930943
[30] Minton Jr., S.A. 1966. A contribution to the herpetology of West Pakistan. Bulletin of the American Museum of Natural History 134(2): 27-184.
[31] Bhupathy, S. 1990. Observations on the food of the Ganges softshell turtle Trionyx gangeticus in Keoladeo National Park, Bharatpur. Journal of the Bombay Natural History Society 87: 460–461.
[32] https://wildlifesos.org/anti-poaching/introducing-the-indian-softshell-turtle/

	 https://www.iucnredlist.org/species/39618/29930943			Although the species distribution map includes its presence in the coasts of the country (India) i.e. West Bengal, Odisha, and Gujrat. In Gujrat, its distribution restricted in the Gujrat mainland, portion of Saurashtra and coast of Gulf of Khambhat. As per the available secondary information[33, 34], few records of the species are available from the Vadodara district. Overall, 17 counts[35] of the species have been reported from the area, which may not meet the threshold (≥1 percent of the global population) for the EAAA.	
Birds					
5	Indian Vulture (*Gyps indicus*)  https://www.iucnredlist.org/species/22729731/204672586	**IUCN:** Critically Endangered **IWP:** Schedule I **Restricted range:** No **Migratory:** No	1 a, c	Indian Vulture is found in cities, towns and villages near cultivated areas, and in open and wooded areas. This species feeds almost entirely on carrion, and often associates with White-rumped Vulture (*Gyps bengalensis*) when scavenging at carcass dumps and slaughterhouses. It nests almost exclusively in colonies on cliffs and ruins, and although reported nesting in trees, where cliffs are absent[36]. It was common until very recently, but since the mid-1990s has suffered a catastrophic decline (over 97%) throughout its range (peninsular India, south of the Gangetic plain, north to Delhi, east through Madhya Pradesh, south to the Nilgiris, and occasionally further south)[37]. Although the species distribution map includes Gujrat state (Banni Grassland and Chhari Dhand, Gir National Park and Wildlife Sanctuary, Rampura Grassland, Thol Lake Bird Sanctuary, Velavadar National Park, Wild Ass Wildlife Sanctuary & Nanda Island and Nikol-Samadhiyala-Malan Wetlands Complex)[38], but the Vadodara and surrounding area comes under the area where the species has been possibly extinct i.e. not recorded since long time; however a single observation of the species was recently reported during Feb 2023 from the surroundings of Pavagadh hills area[39]. Thus, is less	Screened Out

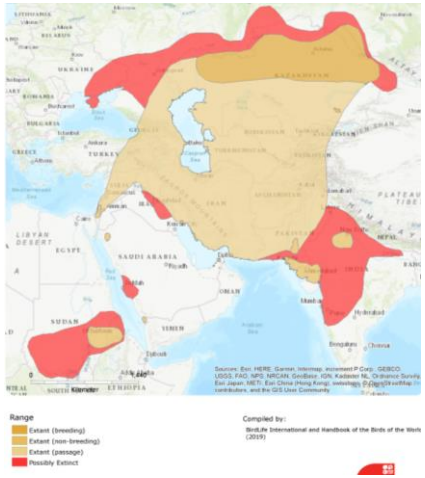
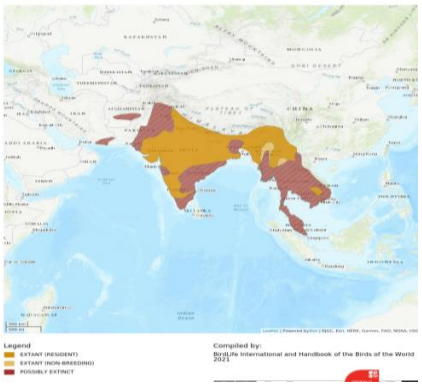
[33] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=73648
[34] https://www.gbif.org/species/2442542
[35] https://indiabiodiversity.org/species/show/238650
[36] BirdLife International. 2021. Gyps indicus. The IUCN Red List of Threatened Species 2021: e.T22729731A204672586
[37] Collar, N., Chen, H. and Crosby, M. 2001. Threatened Birds of Asia: the BirdLife International Red Data Book. BirdLife International, Cambridge, UK.
[38] 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.). Pp. 1992 + xii
[39]https://www.inaturalist.org/observations/149390998; https://www.inaturalist.org/observations/149390999

				likely to meet the threshold i.e. 50-150 (≥1 percent of the global population[40]) for the EAAA.	
6	Lesser Florican (*Sypheotides indicus*)  https://www.iucnredlist.org/species/22692024/199959007	**IUCN:** Critically Endangered **IWP:** Schedule I **Restricted range:** No **Migratory:** No	1 a, c	Lesser Florican breeds in India in Gujarat, Rajasthan, Maharashtra, Madhya Pradesh and Andhra Pradesh, with some dispersal to south-east India in the non-breeding season. It is a very rare summer visitor (<10 birds) to the terai of Nepal[41]. In India, the total population has been calculated from a recent and robust survey over most of the range which estimated 340 displaying males (95% CI 162–597)[42]. The Lesser Florican occurs in dry grasslands with scattered bushes, scrub and to a lesser extent in tall crops of millet and cotton. The species is a local migrant with movements apparently determined by rainfall patterns. As such migration is considered partial and opportunistic with birds concentrating in areas that receive more rainfall, however there is believed to be a high level of site fidelity among males[43]. Breeding coincides with the south-west monsoon, May-September, with birds congregating in north-central and west India for males to perform extraordinary leaping aerial displays. Sufficient grass cover is particularly important during the breeding season. As per the Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated Edition - 2016) [44], the species is reported from Banni Grassland & Chhari Dhand, Bhal Area, Gir National Park and Wildlife Sanctuary, Naliya Grassland (Wildlife Kutch Bustard Sanctuary), Rampura Grassland, Velavadar National Park and Wild Ass Wildlife Sanctuary & Nanda Island. All the above-mentioned areas are away from the Vadodara and the available secondary data[45, 46] also indicates unlikelihood of this species in Vadodara and surrounding area.	Screened Out
7	Red-headed Vulture (*Sarcogyps calvus*)	**IUCN:** Critically Endangered **IWP:** Schedule I **Restricted range:** No **Migratory:** No	1 a, c	Red-headed Vultures are widely distributed across India, Indian subcontinent, China, Thailand, Laos, Viet Nam, Cambodia, Malaysia, and Singapore. Historical reports indicate that it was widespread and generally abundant, but it has undergone a massive population and range decline in recent decades. Recent information indicates that in India the species started undergoing a rapid decline (41% per year) in about 1999 and declined by 91% between the early 1990s and 2003[47].	Screened Out

[40] https://www.iucnredlist.org/species/22729731/204672586#population
[41] BirdLife International. 2021. Sypheotides indicus. The IUCN Red List of Threatened Species 2021: e.T22692024A199959007
[42] Dutta, S., Narwade, S., Bipin, C. M., Gadhavi, D., Uddin, M., *et. al*. 2018. Status of the Lesser Florican Sypheotides indicus and implications for its conservation. Dehradun: Wildlife Institute of India.
[43] Dutta, S., Narwade, S., Bipin, C. M., Gadhavi, D., Uddin, M., et. al. 2018. Status of the Lesser Florican Sypheotides indicus and implications for its conservation. Dehradun: Wildlife Institute of India.
[44] 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.). Pp. 1992 + xii
[45] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=
[46] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=130
[47] Cuthbert, R.; Green, R.E.; Ranade, S.; Saravanan, S.; Pain, D.J.; Prakash, V.; Cunningham, A. A. 2006. Rapid population declines of Egyptian Vulture (Neophron percnopterus) and Red-headed Vulture (Sarcogyps calvus) in India. Animal Conservation 9(3): 349-354.

	 https://www.iucnredlist.org/species/22695254/205031246			It frequents open country usually away from human habitation, well-wooded hills and dry deciduous forest with rivers, usually below 2,500 m. Nesting has been recorded in tall trees[48] In Gujrat state, the species has been reported from Banni Grassland and Chhari Dhand, Gir National Park and Wildlife Sanctuary, Khijadia Bird Sanctuary, Wild Ass Wildlife Sanctuary & Nanda Island and Nikol-Samadhiyala-Malan Wetlands Complex[49]. In Saurashtra region, the species has stray records from Junagarh, Gir Somnath, Amreli and Bhavnagar districts[50]; however, there is no record of the species from the city and this area also comes under the area where the species has been possibly extinct i.e. not recorded since long time[51, 52].	
8	Sociable Lapwing (*Vanellus gregarious*)	**IUCN:** Critically Endangered **IWP:** Schedule I **Restricted range:** No **Migratory:** Yes	1 a, c	Sociable Lapwing breeds in northern and central Kazakhstan and south-central Russia (and, at least formerly, Xinjiang province, western China[53], dispersing through Kyrgyzstan, Tajikistan, Uzbekistan, Turkmenistan, Afghanistan, Armenia, Georgia, Azerbaijan, Iran, Iraq, Saudi Arabia, Syria, Turkey and Egypt for wintering in Sudan, Saudi Arabia, Oman, UAE, Pakistan, and north-west India (45 birds in the Little Rann of Kutch in November 2007[54], 30 at Great Rann of Kutch in November 2008 and 2012[55]. Sociable lapwing uses dry wastelands, cultivated, ploughed and stubble fields[56]. It winters in Sudan, Eritrea, Israel, Arabian Peninsula, Pakistan and India, possibly also in Iraq and Iran[57].	Screened Out

[48] BirdLife International. 2021. Sarcogyps calvus. The IUCN Red List of Threatened Species 2021: e.T22695254A205031246
[49] 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.). Pp. 1992 + xii
[50] https://ebird.org/species/rehvul1
[51]https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=
[52]https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=5420
[53] Kamp, J.; Koshkin, M. A.; Sheldon, R. D. 2010. Historic breeding of Sociable Lapwing (Vanellus gregarius) in Xinjiang. Chinese Birds 1(1): 70-73.
[54] Deomurari, A. 2007. Western India: Gujarat Kutch Birding and Wildlife Tour, November 2007.
[55] Sheldon, R. 2013. The Sociable Lapwing - Interim short report to the BirdLife International Preventing Extinctions Programme. BirdLife International Preventing Extinctions Programme.
[56] https://www.iucnredlist.org/species/22694053/155545788#habitat-ecology
[57] https://birdsoftheworld.org/bow/species/soclap1/cur/introduction?login

	 https://www.iucnredlist.org/species/22694053/155545788			As per the Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated Edition - 2016)[58], the species is reported from Flamingo City and Naliya Grassland (Wildlife Kutch Bustard Sanctuary). Both the IBAs are located in the Kutch region, and there is no record of this Migratory species from the Vadodara and surrounding areas[59, 60] because this area also comes under the area where the species has been possibly extinct i.e. not recorded since long time (as per the IUCN map of species distribution)[61].	
9	White-rumped Vulture (*Gyps bengalensis*) 	**IUCN:** Critically Endangered **IWP:** Schedule I **Restricted range:** No **Migratory:** No	1 a, c	White-rumped Vulture is seen in Pakistan, India, Bangladesh, Nepal, Bhutan, Myanmar, Thailand, Laos, Cambodia and southern Viet Nam, and may be extinct in southern China and Malaysia[62]. It has been recorded from south-east Afghanistan and Iran where its status is currently unknown. They are found mostly in plains and less frequently in hilly regions where it utilises light woodland, villages, cities, and open areas. They feed on carrion, both putrid and fresh. While feeding considerable aggregations can form, and regular communal roost sites are used[63]. This species suffered dramatic population declines during the 1990s across its range. The total population is therefore estimated to be c. 6,000-9,000 individuals, equating to 4,000-6,000 mature individuals. There are now an estimated c.6,000 individuals in India[64]. Declines in the major part of the population throughout the Indian Subcontinent probably began in the 1990s and were very rapid, resulting in an overall population decline of greater than 99% over a 10-15 year period.	Screened Out

[58] 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.). Pp. 1992 + xii

[59] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=

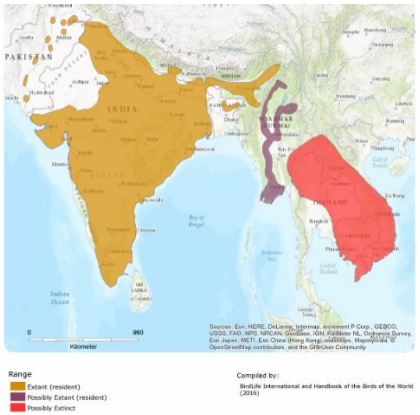
[60] https://www.inaturalist.org/observations?iconic_taxa=Aves&place_id=32168&subview=map&view=species

[61]https://www.iucnredlist.org/species/22694053/155545788

[62] BirdLife International. 2001. Threatened birds of Asia: the BirdLife International Red Data Book. BirdLife International, Cambridge, U.K.

[63] BirdLife International. 2021. Gyps bengalensis. The IUCN Red List of Threatened Species 2021: e.T22695194A204618615

[64] BirdLife International. 2021. Gyps bengalensis. The IUCN Red List of Threatened Species 2021: e.T22695194A204618615

	https://www.iucnredlist.org/species/22695194/204618615			Although the species distribution map includes the entire Gujarat state (Banni Grassland and Chhari Dhand, Charakla Saltworks, Gir National Park and Wildlife Sanctuary, Nalsarovar Wildlife Sanctuary, Rampura Grassland, Salt Pans of Bhavnagar, Thol Lake Bird Sanctuary, Velavadar National Park, Wild Ass Wildlife Sanctuary & Nanda Island, Bhaskarapra wetland and Nikol-Samadhiyala-Malan Wetlands Complex)[65]. Lastly the species (6-15) was reported from the Vadodara city (Zoo area) in 1994[66], after that in the past 30 years no individual of the species was reported from the Vadodara city. However, another observation was recorded about 25 km away from the city in June 2018, which was the last report the species from the Vadodara region[67]. This all indicates unlikelihood of this species in Vadodara area as well as EAAA.	
10	Black-bellied Tern (*Sterna acuticauda*)  https://www.iucnredlist.org/species/22694711/207933556	**IUCN:** Endangered **IWP:** Schedule I **Restricted range:** No **Migratory:** No	1 a, c	The Black-bellied Tern is widespread throughout India, but there are signs of local decline and regional extinction. It is found on large rivers (usually breeding on sand spits and islands) and marshes, occasionally on smaller pools and ditches, in lowlands (but not on the coast), up to 730 m[68]. The presence of Black-bellied Tern is uncertain, as per the Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated Edition - 2016) [69], the species is reported from Khijadia Bird Sanctuary, Nalsarovar Wildlife Sanctuary, Thol Lake Bird Sanctuary, Gosabara (Mokarsar) Wetland Complex, and Nikol-Samadhiyala-Malan Wetlands Complex. The species also has a good presence in the Bharuch area[70], which is about 60 km from the Vadodara city as well as from the project area. Most recently (in 2022), 5 individuals of the species were reported from the Karjan area[71], which is about 25 km from the Vadodara city and project site. This all indicates less likelihood of this species in Vadodara city as well as EAAA.	Screened Out

[65] 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.). Pp. 1992 + xii

[66] https://ebird.org/india/checklist/S33477355

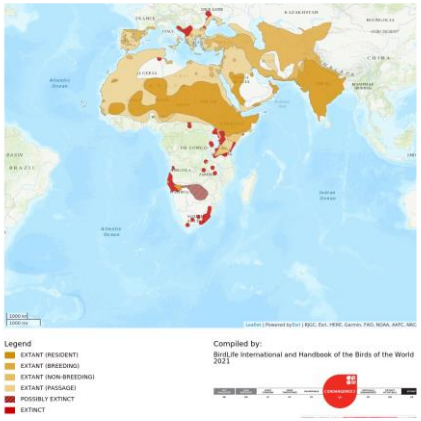
[67] https://ebird.org/checklist/S46613727

[68] https://www.iucnredlist.org/species/22694711/207933556

[69] 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.). Pp. 1992 + xii

[70] https://ebird.org/map/blbter1?neg=true&env.minX=71.77370535326625&env.minY=21.50086923400874&env.maxX=74.58620535326625&env.maxY=22.633537917591244&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

[71] https://ebird.org/india/checklist/S133570115

11	Egyptian Vulture (*Neophron percnopterus*)  https://www.iucnredlist.org/species/22695180/205187871	**IUCN:** Endangered **IWP:** Schedule I **Restricted range:** No **Migratory:** No	1 a, c	Egyptian Vulture occupies a large range with isolated resident populations in the Cabo Verde and Canary Islands in the west. In Europe, the breeding population is estimated to number 3,000-4,500 breeding pairs, equating to 6,100-9,000 mature individuals. Europe forms 25-49% of the global range, so a very preliminary estimate of the global population size is 12,400-36,000 mature individuals, roughly equating to 18,600-54,000 individuals, although further validation of this estimate is needed[72]. Egyptian Vulture forages in lowland and montane regions over open, often arid, country, and also scavenges at human settlements. It has a broad diet including carrion, tortoises, organic waste, insects, young vertebrates, eggs and even faeces[73, 74, 75]. Usually solitary, individuals congregate at feeding sites, such as rubbish tips, or vulture restaurants (i.e. supplementary feeding stations), and form roosts of nonbreeding birds[76]. As per the Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated Edition - 2016) [77], the species is reported from Banni Grassland & Chhari Dhand, Bhal Area, Gir National Park and Wildlife Sanctuary, Khijadia Bird Sanctuary, Nalsarovar Wildlife Sanctuary, Velavadar National Park, and Wild Ass Wildlife Sanctuary & Nanda Island. Undoubtedly the species has a presence in the surroundings of Vadodara[78], however based on available secondary information extracted from eBird Database[79] (which reports maximum 2 individuals from the Vadodara Zoo in 1996[80], and from Kanjari area in 2018[81]; while the most resent, one individual was reported from the Valvod Island in 2022[82]). Thus, it is less likely to meet the threshold i.e. 186-540 (≥1 percent of the global population[83]) for the EAAA.	Screened Out

[72] BirdLife International. 2021. Neophron percnopterus. The IUCN Red List of Threatened Species 2021: e.T22695180A205187871

[73] Margalida, A.; Benitez, J. R.; Sanchez-Zapata, J. A.; Ávila, E.; Arenas, R.; Donázar, J. A. 2012. Long-term relationship between diet breadth and breeding success in a declining population of Egyptian Vultures Neophron percnopterus. Ibis 154: 184-188.

[74] Dobrev, V.; Boev, Z.; Oppel, S.; Arkumarev, V.; Dobrev, D.; Kret, E.; Vavylis, D.; Saravia, V.; Bounas, A.; Nikolov, S. C. 2015. Diet of the Egyptian vulture (Neophron percnopterus) in Bulgaria and Greece (2005-2013). Technical report under action A5 of the LIFE+ project "The Return of the Neophron" (LIFE10NAT/BG/000152). BSPB.

[75] Dobrev, V.; Boev, Z.; Arkumarev, V.; Dobrev, D.; Kret, E.; Saravia, V.; Bounas, A.; Vavylis, D.; Nikolov, S. C.; Oppel, S. 2016. Diet is not related to productivity but to territory occupancy in a declining population of
Egyptian Vultures Neophron percnopterus. Bird Conservation International (in press).

[76] Ceballos, O.; Donázar, J. A. 1990. Roost-tree characteristics, food habits and seasonal abundance of roosting Egyptian Vultures in northern Spain. Journal of Raptor Research 24: 19-25.

[77] 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.). Pp. 1992 + xii

[78] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=

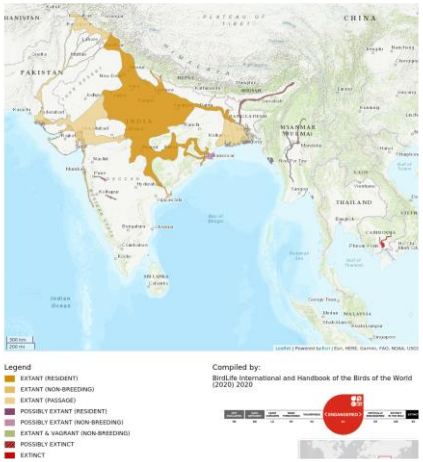
[79] https://ebird.org/map/egyvul1?neg=true&env.minX=72.96040721661194&env.minY=21.971868749158293&env.maxX=73.31196971661194&env.maxY=22.113479910147987&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

[80] https://ebird.org/checklist/S31565762

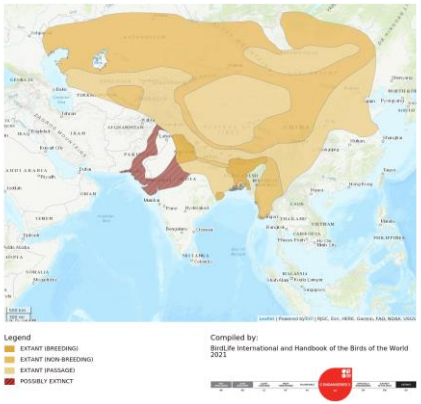
[81] https://ebird.org/checklist/S46292231

[82] https://ebird.org/checklist/S100341479

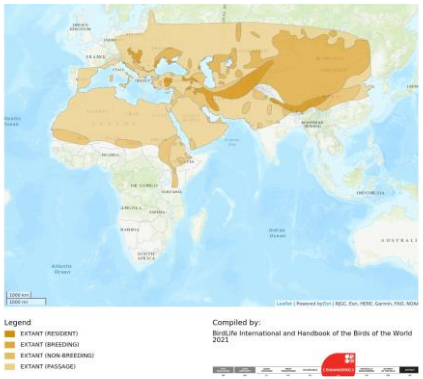
[83] https://www.iucnredlist.org/species/22696027/203868747#population

12	Indian Skimmer (*Rynchops albicollis*)  https://www.iucnredlist.org/species/22694268/178970109	**IUCN:** Endangered **IWP:** Schedule I **Restricted range:** No **Migratory:** Yes	1 a, c	Indian Skimmer was formerly widely distributed across the Indian Subcontinent, but now almost completely restricted to India as a breeding bird, with only occasional breeding in western Bangladesh[84]. The recent population decline has been accompanied by a range contraction and there are no recent confirmed breeding records from Pakistan or Myanmar[85]. The population is estimated at 2,450-2,900 mature individuals, based on the compilation of counts and expert estimates from across the species's range. In India, most observations during the non-breeding season are of few birds but larger congregations are also known from a handful of key sites, ca. 150 from Jamnagar in Gujarat[86], ca. 100-300 from Yamuna & Ganges rivers[87], while on the east coast between 200 - 400 have been recorded at Satkosia on the River Mahanadi in Odisha[88] and around 120 at Coringa Wildlife Sanctuary and Kakinada in Andhra Pradesh[89]. It occurs primarily on larger, sandy, lowland rivers, around lakes and adjacent marshes and, in the nonbreeding season, estuaries and coasts. It breeds colonially on large, exposed sand-bars and islands, requiring water levels to drop sufficiently to expose the islands and not threaten flooding the nest but not to drop so far as to allow land-based predators access to the colonies[90, 91, 92]. The Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated Edition - 2016)[93], reports the presence of Indian Skimmer in Banni Grassland & Chhari Dhand, Flamingo City, Gir National Park and Wildlife Sanctuary, Khijadia Bird Sanctuary, Marine National Park and Wildlife Sanctuary, Nalsarovar Wildlife Sanctuary, Salt Pans of Bhavnagar, Thol Lake Bird Sanctuary, Wetlands of Kheda, Wild Ass Wildlife Sanctuary & Nanda Island, and Bhaskarapra wetland.	Screened Out

[84] Kabir, M. T., Chowdhury, S. U., Tareq, O., Alam, A. B. M. S., Ahmed, S., Shahadat, O. & Foysal, M. 2016. New breeding records of riverine birds in Bangladesh. BirdingASIA 26: 39-42.
[85] BirdLife International. 2020. Rynchops albicollis. The IUCN Red List of Threatened Species 2020: e.T22694268A178970109.
[86] eBird. 2020. eBird: An online database of bird distribution and abundance [web application]. Ithaca, NY, USA Available at: http://www.ebird.org
[87] Shaikh, P.A. 2020. Status and distribution of Indian Skimmer Rynchops albicollis in India, with focus on breeding population in the National Chambal Sanctuary, India. Final Report submitted to BirdLife International.
[88] Debata, S. 2019. Impact of cyclone Fani on the breeding success of sandbar-nesting birds along the Mahanadi River in Odisha, India. Journal of Threatened Taxa 11(14): 14895–14898.
[89] Wetlands International South Asia. 2020. Asian Waterbird Census: Results for Coordinated January Counts for India 2006-2015. Wetlands International New Delhi, India.
[90] Debata, S. 2019. Impact of cyclone Fani on the breeding success of sandbar-nesting birds along the Mahanadi River in Odisha, India. Journal of Threatened Taxa 11(14): 14895–14898.
[91] Shaikh, P.A. & Mendis, A. 2019. Status and distribution of Indian Skimmer Rynchops albicollis breeding population in the National Chambal Sanctuary, India. Progress Report submitted to BirdLife International.
[92] Shaikh, P.A. 2020. Status and distribution of Indian Skimmer Rynchops albicollis in India, with focus on breeding population in the National Chambal Sanctuary, India. Final Report submitted to BirdLife International.
[93] 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.). Pp. 1992 + xii

				All the above-mentioned IBAs are located away from the Vadodara area, and there is no record of this Endangered Migratory species from the Vadodara and surrounding areas[94, 95]. Thus, the presence of this species in Vadodara as well as EAAA is less likely.	
13	Pallas's Fish-eagle (*Haliaeetus leucoryphus*)  https://www.iucnredlist.org/species/22695130/199521572	**IUCN:** Endangered **IWP:** Schedule I **Restricted range:** No **Migratory:** Yes	1 a, c	Pallas's Fish-eagle previously thought to be a migratory breeder north of the Himalayas, with a stronghold in Mongolia, and a resident population in the Indian subcontinent, recent evidence and re-evaluation of historical data has since suggested that this is not, and may never have been, the case. The species may instead breed only in northern India (apparent strongholds in Assam and Uttarakhand), Bangladesh and Myanmar, with very small numbers in Bhutan, dispersing north of the Himalayas to Kazakhstan, Russia and Mongolia in its non-breeding season (May to September)[96]. Based on surveys and available data from across the species's extant distribution, the population is estimated to fall in the band 1,000-2,499 mature individuals[97]. It is closely associated with wetlands, principally large lakes and rivers, from the lowlands to 5,000 m. It generally nests in trees near water. Breeding takes place from September-February in northern India and Myanmar[98] and in Bangladesh it returns to nest sites in late August[99]. Although the species was historically reported from Khijadia Bird Sanctuary and Nalsarovar Wildlife Sanctuary[100]; however, the species has not been reported from Gujrat since long time[101, 102] and this area also comes under the area where the species has been possibly extinct i.e. not recorded since long time (as per the IUCN map of species distribution)[103].	Screened Out
14	Saker Falcon (*Falco cherrug*)	**IUCN:** Endangered **IWP:** Schedule I **Restricted range:** No **Migratory:** Yes	1 a, c	Saker Falcon occurs in a wide range across the Palearctic region from eastern Europe to western China, breeding in Armenia, Austria, Bulgaria, Croatia, Czechia, Hungary, Moldova, Romania, Russia, Serbia, Slovakia, Turkey, Ukraine, Iran (Islamic Republic of), Uzbekistan, Tajikistan, Kyrgyzstan, Kazakhstan, Mongolia and China, occasionally in Georgia, and at least formerly in Turkmenistan and probably Afghanistan, possibly Iraq and India (Ladakh), with wintering or passage populations regularly in Italy, Malta,	Screened Out

[94] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=
[95] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=4498
[96] BirdLife International. 2021. Haliaeetus leucoryphus. The IUCN Red List of Threatened Species 2021: e.T22695130A199521572
[97] Steele, M. L. 2017. Where in the World are Pallas's Fish Eagles? Migration and Ecology of Haliaeetus leucoryphus in Asia. Theses and Dissertations. 2015.
[98] BirdLife International. 2001. Threatened birds of Asia: the BirdLife International Red Data Book. BirdLife International, Cambridge, U.K.
[99] Sourav, M.S.H., Ahmed, B. & Thompson, P. 2011. Pallas's Fish Eagle Haliaeetus leucoryphus in Bangladesh. BirdingASIA 16: 101-105.
[100] 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.). Pp. 1992 + xii
[101] https://ebird.org/map/pafeag1?neg=true&env.minX=69.91982114224402&env.minY=21.188626630240094&env.maxX=75.54482114224402&env.maxY=23.449755903684757&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[102] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=5312
[103] https://www.iucnredlist.org/species/22695130/199521572

	 https://www.iucnredlist.org/species/22696495/204182473			Cyprus, Israel, Jordan, Egypt, Libya, Sudan, South Sudan, Tunisia, Ethiopia, Kenya, Saudi Arabia, Yemen, Oman, U.A.E., Bahrain, Kuwait, Iran, Pakistan, India, Nepal, Afghanistan and Azerbaijan[104]. A total population of c.6,100-14,900 pairs (median c.10,500), equating to 12,200-29,800 mature individuals, was calculated as part of the Saker Falcon Action Plan[105]. Saker Falcon is physically adapted to hunting close to the ground in open terrain, combining rapid acceleration with high manoeuvrability, thus specialising on mid-sized diurnal terrestrial rodents (especially ground squirrels Spermophilus) of open grassy landscapes such as desert edge, semi-desert, steppes, agricultural and arid montane areas. Gir National Park and Wildlife Sanctuary, Salt Pans of Bhavnagar, and Gosabara (Mokarsar) Wetland Complex are the possible habitats for this migratory species in Gujarat[106]. All the above mentioned IBAs are located away from the Vadodara city and the available secondary data[107, 108] also supports the unlikelihood of this species in Vadodara and project's EAAA.	
15	Steppe Eagle (*Aquila nipalensis*)	**IUCN:** Endangered **IWP:** Schedule I **Restricted range:** No **Migratory:** Yes	1 a, c	Steppe Eagle breeds east of 43°E in European Russia from the Republic of Kalmykia, across Kazakhstan into Kyrgyzstan, China and Mongolia[109]. The global population of the species has been estimated below 37,000 (26,014-36,731) pairs[110]. It inhabits areas of steppe and semi-desert and is recorded breeding up to 2,300 m in mountainous regions[111]. It feeds mainly on small mammals on its breeding grounds, with susliks forming the vast majority of its diet in some areas[112].	Screened Out

[104] BirdLife International. 2021. Falco cherrug. The IUCN Red List of Threatened Species 2021: e.T22696495A204182473

[105] Kovács, A.; Williams, N. P.; Galbraith, C. A. 2014. Saker Falcon Falco cherrug Global Action Plan (SakerGAP), including a management and monitoring system, to conserve the species. Raptors MOU Technical Publication No. 2. CMS Technical Series No. 31. Coordinating Unit - CMS Raptors MOU, Abu Dhabi, United Arab Emirates.

[106] 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.). Pp. 1992 + xii

[107] https://ebird.org/map/sakfal1?neg=true&env.minX=59.07915156761513&env.minY=17.91177192850224&env.maxX=81.57915156761513&env.maxY=26.93767697091607&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

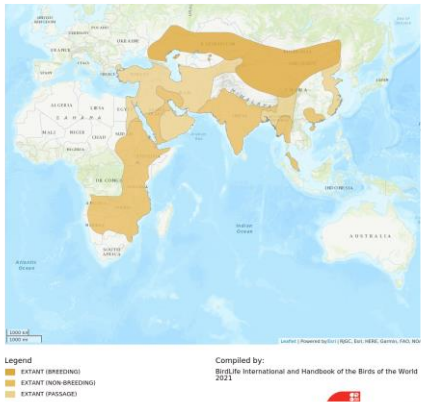
[108] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=4691

[109] Meyburg, B.U. and Boesman, P. 2013. Steppe Eagle (Aquila nipalensis). In: del Hoyo, J., Elliott, A., Sargatal, J., Christie, D.A. and de Juana, E. (eds), Handbook of the Birds of the World Alive, Lynx Edicions, Barcelona.

[110] Karyakin, I. V., Zinevich L. S., Schepetov D. M., Sorokina S.Y. 2016. Population Structure of the Steppe Eagle Range and Preliminary Data on the Population Genetic Diversity and Status of Subspecies. Raptors Conservation 32: 67-88.

[111] del Hoyo, J.; Elliott, A.; Sargatal, J. 1994. Handbook of the Birds of the World, vol. 2: New World Vultures to Guineafowl. Lynx Edicions, Barcelona, Spain.

[112] BirdLife International. 2021. Aquila nipalensis. The IUCN Red List of Threatened Species 2021: e.T22696038A205452572

	 https://www.iucnredlist.org/species/22696038/205452572			Undoubtedly the species has a presence in the surroundings of Vadodara[113], however based on available secondary information extracted from eBird Database[114] (which reports maximum 2 individuals from the Vadhavana Lake, Dabhoi[115]), it is less likely to meet the threshold i.e. 370 (≥1 percent of the global population) for the EAAA.	
16	Common Pochard (*Aythya ferina*)	**IUCN:** Vulnerable **IWP:** Schedule I **Restricted range:** No **Migratory:** Yes	3a	Common Pochard breeds from western Europe through central Asia to south-central Siberia and northern China[116]. The global population is estimated to number 760,000-790,000 mature individuals, which equates to 1,140,000- 1,180,000 million individuals in total[117]. This species requires well-vegetated eutrophic to neutral freshwater swamps, marshes, lakes and slow-flowing rivers with areas of open water and abundant emergent fringing vegetation[118]. Sometimes it also breeds on saline, brackish and soda lakes and occasionally even in sheltered coastal bays[119].	Screened Out

[113] https://ebird.org/barchart?r=IN-GJ-JA&yr=all&m=

[114] https://ebird.org/map/steeag1?neg=true&env.minX=65.52069438960507&env.minY=19.685900961910654&env.maxX=76.77069438960507&env.maxY=24.218779635291323&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

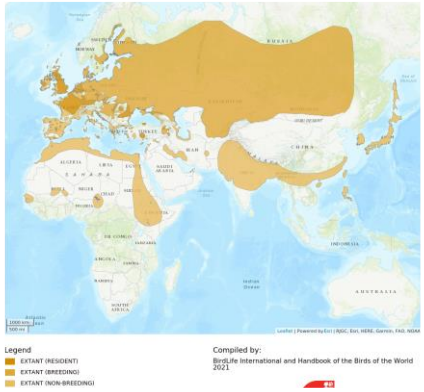
[115] https://ebird.org/checklist/S35149640

[116] Carboneras, C. and Kirwan, G.M. 2014. Common Pochard (Aythya ferina). In: J. del Hoyo, A. Elliott, J. Sargatal, D.A. Christie and E. de Juana (eds), Handbook of the Birds of the World Alive, Lynx Edicions, Barcelona.

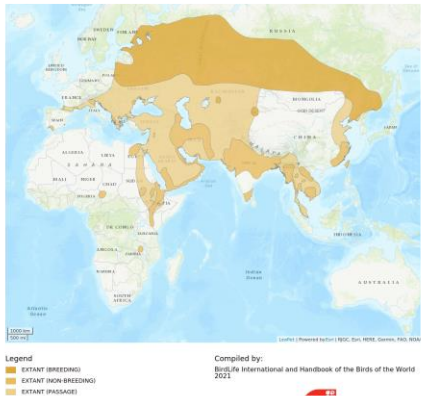
[117] https://www.iucnredlist.org/species/22680358/205288455#population

[118] BirdLife International. 2021. Aythya ferina. The IUCN Red List of Threatened Species 2021: e.T22680358A205288455

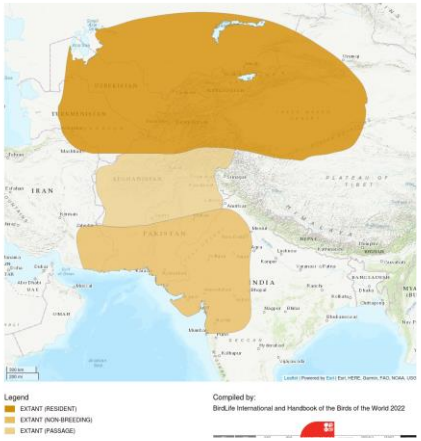
[119] Kear, J. 2005. Ducks, geese and swans volume 2: species accounts (Cairina to Mergus). Oxford University Press, Oxford, U.K.

	 https://www.iucnredlist.org/species/22680358/205288455			Undoubtedly the species has a presence in the surroundings of Vadodara[120, 121], however based on available secondary information extracted from eBird Database[122] (which reports maximum 200 individuals from Timbi Lake[123]), it is less likely to meet the threshold i.e. 11,400-11,800 (≥1 percent of the global population) for the EAAA.	
17	Greater Spotted Eagle (*Clanga clanga*)	**IUCN:** Vulnerable **IWP:** Schedule I **Restricted range:** No **Migratory:** Yes	3a	Greater Spotted Eagle occupies a fragmented range, breeding in Estonia, Lithuania, Finland, Poland, Belarus, Russia, Ukraine, Kazakhstan, mainland China and Mongolia[124]; and potentially in tiny numbers in Pakistan and north-west India[125]. It occurs in lowland forests near wetlands, nesting in different types of (generally tall) trees. Individuals wintering in the Mediterranean Basin preferentially use salt marshes, coastal lagoons and water courses[126]. It feeds on unretrieved quarry, small mammals, waterbirds, frogs and snakes, hunting over swamps, and wet meadows[127]. The Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated Edition - 2016)[128], reports the presence of the species in Banni Grassland & Chhari Dhand, Bhal Area, Flamingo City, Gir National Park and Wildlife Sanctuary, Kaj Lake (Pipalava Bhandharo), Khijadia Bird Sanctuary, Marine National Park and Wildlife Sanctuary, Nalsarovar Wildlife Sanctuary, Thol Lake Bird Sanctuary,	Screened Out

[120] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=
[121] https://www.inaturalist.org/observations?iconic_taxa=Aves&place_id=32168&subview=map&view=species
[122] https://ebird.org/map/compoc?neg=true&env.minX=71.49791613230674&env.minY=21.89089288273382&env.maxX=74.31041613230674&env.maxY=23.020422347785644&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[123] https://ebird.org/checklist/S157827071
[124] Meyburg, B.-U.; Haraszthy, L.; Strazds, M.; Schäffer, N. 1999. European species action plan for Greater Spotted Eagle (Aquila clanga).
[125] BirdLife International. 2001. Threatened birds of Asia: the BirdLife International Red Data Book. BirdLife International, Cambridge, U.K.
[126] Maciorowski, G., Galanaki, A., Kominos, T., Dretakis, M. and Mirski, P. 2019. The importance of wetlands for the Greater Spotted Eagle Clanga clanga wintering in the Mediterranean Basin. Bird Conservation International 29: 115-123.
[127] Lõhmus A, Väli Ü. 2001. Interbreeding of the Greater Aquila clanga and Lesser Spotted Eagle A. pomarina. Acta Ornithoecologica 4: 377–384.
[128] 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.). Pp. 1992 + xii

	 https://www.iucnredlist.org/species/22696027/203868747			Velavadar National Park, Wetlands of Kheda, Wild Ass Wildlife Sanctuary & Nanda Island, and Gosabara (Mokarsar) Wetland Complex. Undoubtedly the species has a presence in the surroundings of Vadodara[129, 130], however based on available secondary information extracted from eBird Database[131] (which reports maximum 2 individuals near Ankodiya road[132], from Timbi Lake[133], from Jetalpur road Flyover[134], and NISV-Diwalipura-Rajmahal Road[135]), it is less likely to meet the threshold i.e. 39-100 (≥1 percent of the global population[136]) for the EAAA.	
18	Yellow-eyed Pigeon (*Columba eversmanni*)	**IUCN:** Vulnerable **IWP:** Schedule I **Restricted range:** No **Migratory:** Yes	3a	Yellow-eyed Pigeon breeds in southern Kazakhstan, Uzbekistan, Turkmenistan, Tajikistan, Kyrgyzstan, Afghanistan, north-east Iran and extreme north-west China[137]. It winters in Pakistan and north-west India, historically as far east as Bihar, and southern Xinjiang and western Gansu, China. During the 19th & early 20th centuries, it was recorded in huge flocks in its wintering grounds, particularly in the Punjab, India[138]. The population size is preliminarily suspected to fall into the band 10,000-19,999 mature individuals[139]. This equates to 15,000-29,999 individuals in total, rounded here to 15,000-30,000 individuals. It breeds (during April to August) in holes in trees, buildings, cliffs, earth banks, and potentially on power lines in steppe, semi-arid and desert areas, including around human settlement and (at least in Kazakhstan) in woodland[140]. It may also occur on mountain	Screened Out

[129] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=
[130] https://www.inaturalist.org/observations?iconic_taxa=Aves&place_id=32168&subview=map&view=species
[131] https://ebird.org/map/grseag1?neg=true&env.minX=72.40497589111327&env.minY=22.01166152398619&env.maxX=73.81122589111327&env.maxY=22.577090293778337&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[132] https://ebird.org/checklist/S68850290
[133] https://ebird.org/checklist/S157062250
[134] https://ebird.org/checklist/S156779714
[135] https://ebird.org/checklist/S161371070
[136] https://www.iucnredlist.org/species/22696027/203868747#population
[137] BirdLife International. 2001. Threatened birds of Asia: the BirdLife International Red Data Book. BirdLife International, Cambridge, U.K.
[138] BirdLife International. 2022. Columba eversmanni. The IUCN Red List of Threatened Species 2022: e.T22690097A217014626
[139] Baptista, L. F., Trail, P. W., Horblit, H. M., de Huana, E., Boesman, P. F. D., and Garcia, E. F. J. 2020. Yellow eyed Pigeon (Columba eversmanni), version 1.0. In Birds of the World (J. del Hoyo, A. Elliott, J. Sargatal, D. A. Christie, and E. de Juana, Editors). Cornell Lab of Ornithology, Ithaca, NY, USA.
[140] BirdLife International. 2022. Columba eversmanni. The IUCN Red List of Threatened Species 2022:e.T22690097A217014626

	 https://www.iucnredlist.org/species/22690097/217014626			valleys close to water sources[141]. In winter, it occurs in open areas with scattered trees, often with agricultural crops, and in areas with suitable fruiting trees, where it roosts and feeds gregariously. It is reportedly on the rise in the western part of the Thar Desert where it experiences extreme temperatures, within a habitat of sparse thorny vegetation and grasses[142]. Last time, the species was recorded from Little Rann of Kachchh in 2005[143], after that there is no record of this migratory species from the Gujarat state [144, 145, 146].	
19	Bar-tailed Godwit (*Limosa lapponica*)	**IUCN:** Near Threatened **IWP:** Schedule IV **Restricted range:** No **Migratory:** Yes	3a	Bar-tailed Godwit breeds across the Arctic from northern Europe through Siberia to Alaska (U.S.A.), wintering along the coasts of western Europe, Africa, the Middle East, south- and south-east Asia, Australia and New Zealand. The global population is estimated to number c. 1,099,000-1,149,000 individuals[147]. The species breeds in marshy, swampy areas in lowland moss and shrub tundra, near wet river valleys, lakes and sedge bogs, as well as on swampy heathlands in the willow and birch zone near the Arctic treeline, in open larch Larix spp. woodland close to water, and occasionally on open bogs in the extreme north of the coniferous forest zone. It winters in intertidal areas along muddy coastlines, estuaries, inlets, mangrove-fringed lagoons and sheltered bays with tidal mudflats or sandbars[148].	Screened Out

[141] Baptista, L. F., Trail, P. W., Horblit, H. M., de Huana, E., Boesman, P. F. D., and Garcia, E. F. J. 2020. Yellow eyed Pigeon (Columba eversmanni), version 1.0. In Birds of the World (J. del Hoyo, A. Elliott, J. Sargatal, D. A. Christie, and E. de Juana, Editors). Cornell Lab of Ornithology, Ithaca, NY, USA.

[142] BirdLife International. 2022. Columba eversmanni. The IUCN Red List of Threatened Species 2022:e.T22690097A217014626

[143] https://ebird.org/hotspot/L3315807

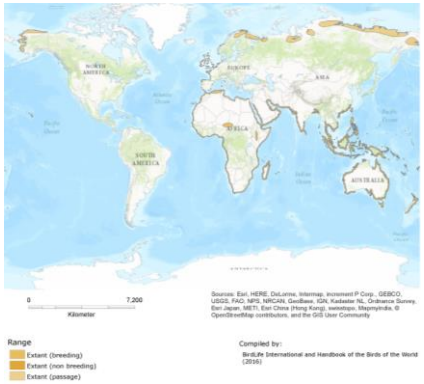
[144] Rahmani, A.R., Islam, M.Z. and Kasambe, R.M. (2016) Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated). Bombay Natural History Society, Indian Bird Conservation Network, Royal Society for the Protection of Birds and BirdLife International (U.K.).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

[145] https://ebird.org/map/pabpig1?neg=true&env.minX=68.93208043728741&env.minY=22.06850727071084&env.maxX=71.74458043728741&env.maxY=23.196590010623925&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

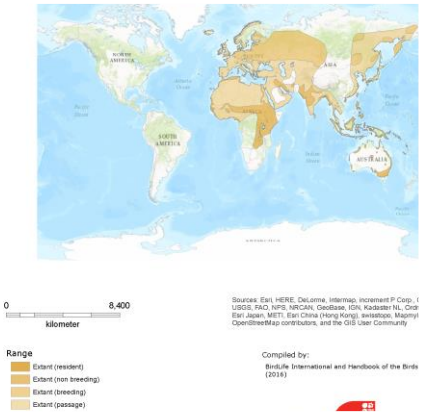
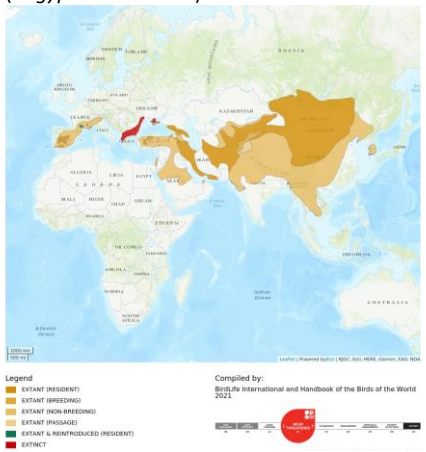
[146] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=3015

[147] https://www.iucnredlist.org/species/22693158/111221714#population

[148] BirdLife International. 2017. Limosa lapponica. The IUCN Red List of Threatened Species 2017: e.T22693158A111221714

	 https://www.iucnredlist.org/species/22693158/111221714			Undoubtedly the species has a presence in the surroundings districts of Vadodara, but not from the Vadodara city and its surroundings[149, 150]. Thus, it is less likely to meet the threshold i.e. 10,990-11,490 (≥1 percent of the global population) for the EAAA.	
20	Black-tailed Godwit (*Limosa limosa*)	**IUCN:** Near Threatened **IWP:** Schedule IV **Restricted range:** No **Migratory:** Yes	3a	Black-tailed Godwit has a large discontinuous breeding range extending from Iceland to the Russian far east, with wintering populations in Europe, Africa, the Middle East and Australasia[151]. The global population is estimated at 614,000-809,000 individuals[152]. Its breeding range it mostly inhabits areas with high but not dense grass and soft soil, occasionally using sandy areas; although other information suggests it may prefer short vegetation. Its preferred habitats include cattle pastures, hayfields, lowland wet grasslands, grassy marshland, raised bogs and moorland, lake margins and damp grassy depressions in steppes. It winter in saline habitats such as sheltered estuaries and lagoons with large intertidal mudflats, sandy beaches, salt-marshes and salt-flats[153]. Undoubtedly the species has a presence in the surroundings of Vadodara[154, 155], however based on available secondary information extracted from eBird Database[156](which reports maximum 100 individuals from Timbi Lake[157]), it is less likely	Screened Out

149
https://ebird.org/map/batgod?neg=true&env.minX=66.89707718184776&env.minY=19.8464414485371&env.maxX=78.14707718184776&env.maxY=24.37426167747339&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
150 https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=3951
151 Van Gils, J., Wiersma, P., Christie, D.A. & Garcia, E.F.J. 2017. Black-tailed Godwit (Limosa limosa). In: del Hoyo, J., Elliott, A., Sargatal, J., Christie, D.A. & de Juana, E (ed.), Handbook of the Birds of the World Alive. Lynx Edicions, Barcelona.
152 https://www.iucnredlist.org/species/22693150/111611637#population
153 BirdLife International. 2017. Limosa limosa. The IUCN Red List of Threatened Species 2017: e.T22693150A111611637
154 https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=
155 https://www.inaturalist.org/observations?iconic_taxa=Aves&place_id=32168&subview=map&view=species
156
https://ebird.org/map/bktgod?neg=true&env.minX=69.85777610147206&env.minY=22.450794378109606&env.maxX=70.20933860147206&env.maxY=22.591921571315474&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
157 https://ebird.org/checklist/S128840035

	 https://www.iucnredlist.org/species/22693150/111611637			to meet the threshold i.e. 6,140-8,090 (≥1 percent of the global population) for the EAAA.	
21	Cinereous Vulture (*Aegypius monachus*) 	**IUCN:** Near Threatened **IWP:** Schedule I **Restricted range:** No **Migratory:** Yes	3a	Cinereous Vulture breeds in Spain, Bulgaria, Greece, Turkey, Armenia, Azerbaijan, Georgia, Ukraine, Russia, Uzbekistan, Kazakhstan, Tajikistan, Turkmenistan, Kyrgyzstan, Iran, Afghanistan, north India, northern Pakistan[158], Mongolia and mainland China, with a small reintroduced population in France[159, 160]. There are wintering areas in Sudan, Saudi Arabia, Iran, Pakistan, north-west India, Nepal, Bhutan, Myanmar, Lao People's Democratic Republic, North Korea and South Korea[161]. The global population is estimated to number 8,400-11,400 pairs, equating to 16,800-22,800 mature individuals, or c. 25,200-34,200 individuals. This consists of 2,900-3,400 pairs in Europe and 5,500-8,000 pairs in Asia[162]. The population in Korea has been estimated at c.50-10,000 wintering individuals[163]. The species inhabits forested areas in hills and mountains at 300-1,400 m in Spain, but higher in Asia, where it also occupies scrub and arid and semi-arid alpine steppe and grasslands up to 4,500 m[164]. It forages over many kinds of open terrain, including forest, bare mountains, steppe and open grasslands. Nests are built in trees or on rocks (the	Screened Out

[158] BirdLife International. 2021. Aegypius monachus. The IUCN Red List of Threatened Species 2021: e.T22695231A154915043

[159] Heredia, B. 1996. Action plan for the Cinereous Vulture (Aegypius monachus) in Europe. In: Heredia, B.; Rose, L.; Painter, M. (ed.), Globally threatened birds in Europe: action plans, pp. 147-158. Council of Europe, and BirdLife International, Strasbourg.

[160] Heredia, B.; Yarar, M.; Parr, S. J. 1997. A baseline survey of Cinereous Vultures Aegypius monachus in Western Turkey.

[161] BirdLife International. 2021. Aegypius monachus. The IUCN Red List of Threatened Species 2021: e.T22695231A154915043

[162] BirdLife International. 2021. Aegypius monachus. The IUCN Red List of Threatened Species 2021: e.T22695231A154915043

[163] Brazil, M. 2009. Birds of East Asia: eastern China, Taiwan, Korea, Japan, eastern Russia. Christopher Helm, London.

[164] Thiollay, J.-M. 1994. Family Accipitridae (Hawks and Eagles). In: del Hoyo, J.; Elliott, A.; Sargatal, J. (ed.), Handbook of the birds of the world, pp. 52-205. Lynx Edicions, Barcelona, Spain.

	https://www.iucnredlist.org/species/22695231/154915043			latter extremely rarely in Europe but more frequently in parts of Asia), often aggregated in very loose colonies or nuclei. As per the Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated Edition - 2016)[165], the species is reported from Banni Grassland & Chhari Dhand, Bhal Area, Gir National Park and Wildlife Sanctuary, Nalsarovar Wildlife Sanctuary, and Wild Ass Wildlife Sanctuary & Nanda Island. All the above-mentioned areas are away from the Vadodara and the available secondary data[166, 167] also indicates unlikelihood of this species in Vadodara and surrounding area.	
22	Dalmatian Pelican (*Pelecanus crispus*)	**IUCN:** Near Threatened **IWP:** Schedule II **Restricted range:** No **Migratory:** Yes	3a	Dalmatian Pelican breeds in eastern Europe and east-central Asia, in Montenegro, Albania, Armenia, Greece, Romania, Bulgaria, Georgia, Russia, Azerbaijan, Turkey, Ukraine, Mongolia, Iran, Turkmenistan, Uzbekistan and Kazakhstan[168, 169]. European breeders winter in the eastern Mediterranean countries, Russian and central Asian breeders in Iran, Iraq and the Indian subcontinent, and Mongolian birds along the east coast of China[170], including Hong Kong (China). The population was previously estimated to number 4,350-4,800 individuals in the Black Sea and Mediterranean; 6,000-9,000 individuals in South-East Asia and south Asia, and 50 individuals in east Asia, totalling 10,000-13,900 individuals, which roughly equates to 6,700-9,300 mature individuals[171]. However, the total global population (mature individuals) has been estimated as 11400-13400[172]. It occurs mainly at inland, freshwater wetlands but also at coastal lagoons, river deltas & estuaries[173, 174, 175, 176], small islands in freshwater lakes[177] or in dense aquatic vegetation[178], and often in hilly terrain[179]. On migration, large lakes form important stop-	Screened Out

[165] 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.). Pp. 1992 + xii

[166] https://ebird.org/map/cinvul1?neg=true&env.minX=73.27044963836669&env.minY=22.306110506168665&env.maxX=73.29242229461669&env.maxY=22.314944357085285&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

[167] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=5382

[168] Crivelli, A. J. 1996. Action plan for the Dalmatian Pelican (Pelecanus crispus). In: Heredia, B.; Rose, L.; Painter, M. (ed.), Globally threatened birds in Europe: action plans, pp. 53-66. Council of Europe, and BirdLife International, Strasbourg.

[169] BirdLife International. 2015. European Red List of Birds. Office for Official Publications of the European Communities, Luxembourg.

[170] Mix, H. M.; Bräunlich, A. 2000. Dalmatian Pelican. In: Reading, R.P.; Miller, B. (ed.), Endangered animals: a reference guide to conflicting issues, pp. 78-83. Greenwood Press, London.

[171] BirdLife International. 2018. Pelecanus crispus (amended version of 2017 assessment). The IUCN Red List of Threatened Species 2018: e.T22697599A122838534

[172] https://www.iucnredlist.org/species/22697599/122838534#population

[173] del Hoyo, J., Elliot, A. and Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.

[174] Peja, N.; Sarigul, G.; Siki, M.; Crivelli, A. J. 1996. The Dalmatian Pelican, Pelecanus crispus, nesting in Mediterranean lagoons in Albania and Turkey. Colonial Waterbirds 19: 184-189.

[175] Crivelli, A. J.; Catsadorakis, G.; Hatzilacou, D.; Nazirides, T. 1997. Pelicanus crispus Dalmatian Pelican. Birds of the Western Palearctic Update 1(3): 149-153.

[176] Mix, H. M.; Bräunlich, A. 2000. Dalmatian Pelican. In: Reading, R.P.; Miller, B. (ed.), Endangered animals: a reference guide to conflicting issues, pp. 78-83. Greenwood Press, London.

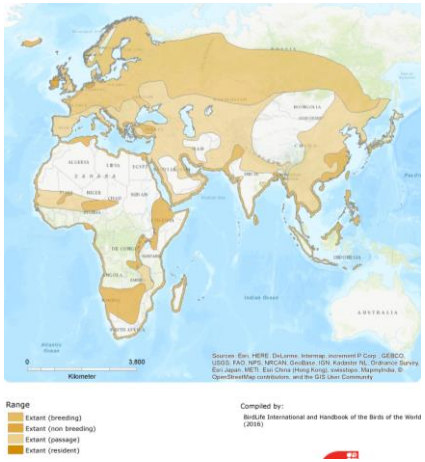
[177] del Hoyo, J., Elliot, A. and Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.

[178] del Hoyo, J., Elliot, A. and Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.

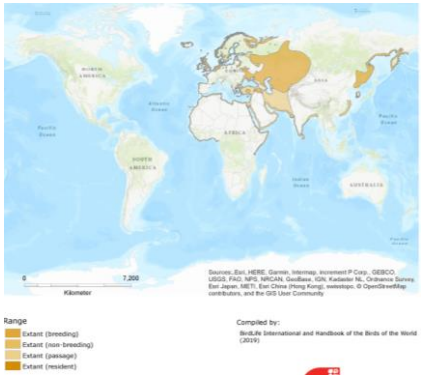
[179] Nelson, J. B. 2005. Pelicans, cormorants and their relatives. Pelecanidae, Sulidae, Phalacrocoracidae, Anhingidae, Fregatidae, Phaethontidae. Oxford University Press, Oxford, U.K.

	 https://www.iucnredlist.org/species/22697599/122838534			over sites[180]. It typically winters on *Jheels* and lagoons in India, and ice-free lakes in Europe[181]. It sometimes fishes inshore along sheltered coasts[182]. Banni Grassland and Chhari Dhand, Charakla Saltworks, Flamingo City, Gir National Park and Wildlife Sanctuary, Kaj Lake (Pipalava Bhandharo), Khijadia Bird Sanctuary, Marine National Park and Wildlife Sanctuary, Nalsarovar Wildlife Sanctuary, Salt Pans of Bhavnagar, Thol Lake Bird Sanctuary, Velavadar National Park, Wild Ass Wildlife Sanctuary & Nanda Island, Bhaskarapra wetland, and Gosabara (Mokarsar) Wetland Complex are the possible habitats for this migratory species in Gujarat[183]. Undoubtedly the species has a presence in the surroundings of Vadodara[184], however based on available secondary information extracted from eBird Database[185](which reports maximum 6 individuals from Vadhavana Lake, Dabhoi[186]), it is less likely to meet the threshold i.e. 114-134 (≥1 percent of the global population) for the EAAA.	
23	Eurasian Curlew (*Numenius arquata*)	**IUCN:** Near Threatened **IWP:** Schedule II **Restricted range:** No **Migratory:** Yes	3a	Eurasian Curlew is widely distributed, breeding across Europe from the British Isles, through north-western Europe and Scandinavia into Russia extending east into Siberia, east of Lake Baikal. It winters around the coasts of north-west Europe, the Mediterranean, Africa, the Middle East, the Indian Subcontinent, South-East Asia, Japan and the Sundas[187]. The global population is estimated to number c.835,000-1,310,000 individuals (Wetlands International 2016). The European population is estimated at 212,000-292,000 pairs, which equates to 425,000-584,000 mature individuals, and is roughly equivalent to 647,500-876,000 individuals[188].	Screened Out

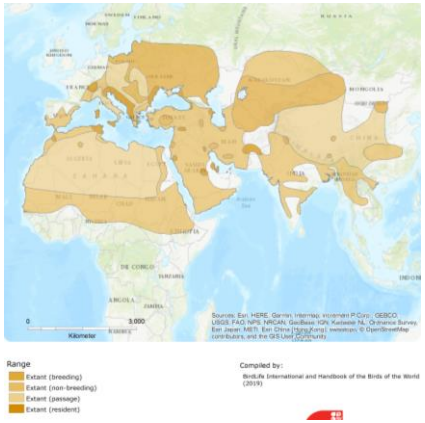
[180] Nelson, J. B. 2005. Pelicans, cormorants and their relatives. Pelecanidae, Sulidae, Phalacrocoracidae, Anhingidae, Fregatidae, Phaethontidae. Oxford University Press, Oxford, U.K.
[181] del Hoyo, J., Elliot, A. and Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[182] del Hoyo, J., Elliot, A. and Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[183] 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.). Pp. 1992 + xii
[184] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=
[185] https://ebird.org/map/dalpel1?neg=true&env.minX=71.68741431359848&env.minY=21.574925072979205&env.maxX=74.49991431359848&env.maxY=22.707001680619978zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[186] https://ebird.org/hotspot/L1979634
[187] BirdLife International. 2017. Numenius arquata. The IUCN Red List of Threatened Species 2017: e.T22693190A117917038
[188] BirdLife International. 2015. European Red List of Birds. Office for Official Publications of the European Communities, Luxembourg.

	 https://www.iucnredlist.org/species/22693190/117917038			The species breeds on upland moors, peat bogs, swampy and dry heathlands, fens, open grassy or boggy areas in forests, damp grasslands, meadows, dune valleys & coastal marshlands[189], and non-intensive farmland in river valleys[190]. During the winter the species frequents inland lakes & rivers, muddy coasts, bays & estuaries, wet grassland & arable fields[191], tidal mudflats & sandflats[192], rocky & sandy beaches with many pools, muddy shores of coastal lagoons, mangroves, saltmarshes[193, 194], and coastal meadows & pasture[195]. Banni Grassland and Chhari Dhand, Bhal Area, Charakla Saltworks, Gir National Park and Wildlife Sanctuary, Khijadia Bird Sanctuary, Marine National Park and Wildlife Sanctuary, Nalsarovar Wildlife Sanctuary, Salt Pans of Bhavnagar, Velavadar National Park, Wetlands of Kheda, Wild Ass Wildlife Sanctuary & Nanda, and Gosabara (Mokarsar) Wetland Complex are the possible habitats for this migratory species in Gujarat[196]. Undoubtedly the species has a presence in the surroundings of Vadodara[197, 198], however based on available secondary information extracted from eBird Database[199](which reports maximum 3 individuals from the Vadhavana Lake, Dabhoi [200]), it is less likely to meet the threshold i.e. 8,350-13,100 (≥1 percent of the global population) for the EAAA.	
24	Eurasian Oystercatcher (*Haematopus ostralegus*)	**IUCN:** Near Threatened **IWP:** Schedule II **Restricted range:** No **Migratory:** Yes	3a	Eurasian Oystercatcher has a wide range comprising three flyway populations. Out of which, *Haematopus ostralegus longipes* breeds from west and central Russia south to the Black, Caspian and Aral Seas, and east to western Siberia, and winters on coasts from East Africa through Arabia to India[201]. The global population is estimated to number c. 925,000-1,030,000 individuals, based on expert opinion (Wetlands International 2019), including three subspecies *Haematopus ostralegus ostralegus* (820,000), *Haematopus ostralegus longpipes* (100,000-200,000) and	Screened Out

[189] del Hoyo, J., Elliott, A., and Sargatal, J. 1996. Handbook of the Birds of the World, vol. 3: Hoatzin to Auks. Lynx Edicions, Barcelona, Spain.
[190] Hayman, P.; Marchant, J.; Prater, A. J. 1986. Shorebirds. Croom Helm, London.
[191] del Hoyo, J., Elliott, A., and Sargatal, J. 1996. Handbook of the Birds of the World, vol. 3: Hoatzin to Auks. Lynx Edicions, Barcelona, Spain.
[192] Snow, D.W. and Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[193] Johnsgard, P. A. 1981. The plovers, sandpipers and snipes of the world. University of Nebraska Press, Lincoln, U.S.A. and London.
[194] Snow, D.W. and Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[195] Navedo, J. G.; Arranz, D.; Herrera, A. G.; Salmón, P.; Juanes, J. A.; Masero, J. A. 2013. Agroecosystems and conservation of migratory waterbirds: importance of coastal pastures and factors influencing their use by wintering shorebirds. Biodiversity and Conservation 22(9): 1895-1907.
[196] 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.). Pp. 1992 + xii
[197] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=
[198] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=3896
[199] https://ebird.org/map/eurcur?neg=true&env.minX=71.71312999761724&env.minY=21.74754207501147&env.maxX=74.52562999761724&env.maxY=22.878231358542926&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[200] https://ebird.org/checklist/S27220453
[201] BirdLife International. 2019. Haematopus ostralegus. The IUCN Red List of Threatened Species 2019: e.T22693613A154998347

	 https://www.iucnredlist.org/species/22693613/154998347			*Haematopus ostralegus osculans* (5,000-10,000)[202]. This is roughly equivalent to 616,667-686,667 mature individuals. The species breeds (during April to July) on coastal saltmarshes, sand and shingle beaches, dunes, cliff-tops with short grass and occasionally rocky shores, as well as inland along the shores of lakes, reservoirs and rivers or on agricultural grass and cereal fields, often some distance from water[203, 204]. Outside of the breeding season the species is chiefly coastal, frequenting estuarine mudflats, saltmarshes & sandy & rocky shores[205]. In Gujarat the species has been mostly recorded along the coastal area or around the salt marshes. Although the global distribution map of the species includes Vadodara; however, no observation of the species has been reported from the district[206, 207]. Thus, the presence of the migratory species from the project's EAAA is less likelys.	
25	Ferruginous Duck (*Aythya nyroca*)	**IUCN:** Near Threatened **IWP:** Schedule II **Restricted range:** No **Migratory:** Yes	3a	Ferruginous Duck breeds principally in south-western Asia (east to China and south to Pakistan and India), central and eastern Europe, and north Africa[208, 209]. The wintering range overlaps with the breeding range and extends to the Middle East, north-east and West Africa and South-East Asia. The most recent population estimates c. 180,000–240,000 individuals based separate estimations from different regions[210]. The species shows a strong preference for fresh standing water and is very rarely found on flowing streams or rivers[211]. It requires shallow water 30-100 cm deep close to littoral vegetation for feeding and generally avoids large open areas[212, 213, 214]. It is also found on shallow mudflats, possibly as a result of more accessible and abundant invertebrate food sources in this habitat[215].	Screened Out

[202] Wetlands International. 2019. Waterbird Population Estimates. Available at: wpe.wetlands.org.
[203] Hayman, P.; Marchant, J.; Prater, A. J. 1986. Shorebirds. Croom Helm, London.
[204] del Hoyo, J.; Elliott, A.; Sargatal, J. 1996. Handbook of the Birds of the World, vol. 3: Hoatzin to Auks. Lynx Edicions, Barcelona, Spain.
[205] del Hoyo, J.; Elliott, A.; Sargatal, J. 1996. Handbook of the Birds of the World, vol. 3: Hoatzin to Auks. Lynx Edicions, Barcelona, Spain.
[206] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=
[207] https://www.inaturalist.org/observations?iconic_taxa=Aves&place_id=32168&subview=map&view=species
[208] Callaghan, D. A. 1999. European Union Species Action Plan: Ferruginous Duck (Althea nervosa). Council of Europe Publishing, Strasbourg.
[209] Vinicombe, K. E. 2000. Identification of Ferruginous Duck and its status in Britain and Ireland. British Birds 93: 4-21.
[210] https://www.iucnredlist.org/species/22680373/152620862#population
[211] Snow, D.W.; Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[212] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[213] Scott, D. A.; Rose, P. M. 1996. Atlas of Anatidae populations in Africa and western Eurasia. Wetlands International, Wageningen, Netherlands.
[214] Kear, J. 2005. Ducks, geese and swans volume 2: species accounts (Cairina to Mergus). Oxford University Press, Oxford, U.K.
[215] BirdLife International. 2019. Aythya nyroca. The IUCN Red List of Threatened Species 2019: e.T22680373A152620862

	 https://www.iucnredlist.org/species/22680373/152620862			Indeed, the species has a presence in the surroundings of Vadodara[216], however based on available secondary information extracted from eBird Database[217] (which reports maximum 45 individuals from Timbi Lake[218]), it is less likely to meet the threshold i.e. 1,800–2,400 (≥1 percent of the global population) for the EAAA.
26	Himalayan Griffon (Gyps himalayensis)	**IUCN:** Near Threatened **IWP:** Schedule I **Restricted range:** No **Migratory:** Yes	3a	Himalayan Griffon is distributed from western China, Kazakhstan, Uzbekistan, Kyrgyzstan, Tajikistan, Afghanistan and Pakistan, east through the Himalayan Mountain range in India, Nepal and Bhutan, to central China and Mongolia. Screened Out A very preliminary estimate of global population is c. 290,000[219]. It is placed in the band for 100,000-499,999 individuals, assumed to equate to c.66,000-334,000 mature individuals[220]. This species inhabits mountainous areas, mostly at 1,200-5,500 m, but has been recorded up to 6,000 m[221]. In winter it moves lower down into the plains. It feeds on carrion and regularly visits carcass dumps in South and South-East Asia[222]. The Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated Edition - 2016)[223], reports the presence of the species in Nikol-Samadhiyala-Malam Wetland Complex, Bhavnagar only. The available secondary

[216] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=

[217] https://ebird.org/map/ferduc?neg=true&env.minX=66.62351162720101&env.minY=19.609980058613843&env.maxX=77.87351162720101&env.maxY=24.145239091848037&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

[218] https://ebird.org/india/checklist/S51734283

[219] Lu, X., Ke, D., Zeng, X., Gong, G. & Ci, R. 2009. Status, Ecology, and Conservation of the Himalayan Griffon Gyps himalayensis (Aves, Accipitridae) in the Tibetan Plateau. Ambio 38(3): 166-173.

[220] https://www.iucnredlist.org/species/22695215/204643889#population

[221] Ferguson-Lees, J. and Christie, D.A. 2001. Raptors of the world. Christopher Helm, London.

[222] BirdLife International. 2021. Gyps himalayensis. The IUCN Red List of Threatened Species 2021: e.T22695215A204643889

[223] 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.). Pp. 1992 + xii

	 https://www.iucnredlist.org/species/22695215/204643889			data[224, 225] also indicates unlikelihood of this species in Vadodara city and project's EAAA.	
27	Lesser Flamingo (*Phoeniconaias minor*)	**IUCN:** Near Threatened **IWP:** Schedule IV **Restricted range:** No **Migratory:** Yes	3a	Lesser Flamingo breeds mainly in the Rift Valley lakes of East Africa in Ethiopia, Kenya and Tanzania. Three smaller breeding congregations occur in West Africa, in southern Africa, and in Rann of India and Pakistan. The global population has been estimated at c. 2,220,000-3,240,000 individuals. Regional estimates include 15,000-25,000 individuals in West Africa, 1,500,000-2,500,000 in East Africa, 55,000-65,000 in South Africa and Madagascar, and 650,000 in south Asia[226]. The species breeds on large undisturbed alkaline and saline lakes, salt pans or coastal lagoons, usually far out from the shore, after seasonal rains have provided the flooding necessary to isolate remote breeding sites from terrestrial predators and the soft muddy material for nest building[227, 228]. Indeed, the species has a presence in the surroundings of Vadodara[229], however based on available secondary information extracted from eBird Database[230] (which reports	Screened Out

[224] https://ebird.org/map/himgri1?neg=true&env.minX=72.47588124490782&env.minY=22.055724430536305&env.maxX=73.88213124490782&env.maxY=22.620975102110133&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

[225] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=5367

[226] BirdLife International. 2018. Phoeniconaias minor. The IUCN Red List of Threatened Species 2018: e.T22697369A129912906

[227] McCulloch, G.; Irvine, K. 2004. Breeding of Greater and Lesser Flamingos at Sua Pan, Botswana, 1998-2001. Ostrich 75: 236-242.

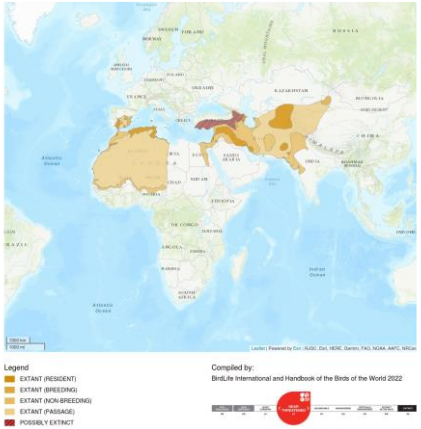
[228] BirdLife International. 2018. Phoeniconaias minor. The IUCN Red List of Threatened Species 2018: e.T22697369A129912906

[229] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=

[230] https://ebird.org/map/lesfla1?neg=true&env.minX=70.35826453258933&env.minY=21.071418932706408&env.maxX=75.98326453258933&env.maxY=23.334427437807193&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

	 https://www.iucnredlist.org/species/22697369/129912906			maximum 10 individuals from Valvod Island[231], and Vadhavana Lake[232]), it is less likely to meet the threshold i.e. 22,200-32,400 (≥1 percent of the global population) for the EAAA.	
28	Marbled Teal (*Marmaronetta angustirostris*)	**IUCN:** Near Threatened **IWP:** Schedule I **Restricted range:** No **Migratory:** Yes	3a	Marbled Teal has a fragmented distribution in the western Mediterranean (Spain, Morocco, Algeria, Libya, Tunisia, Italy (Sicily and Sardinia) wintering in north and Sub-Saharan west Africa), the eastern Mediterranean (Türkiye)[233, 234]; Israel, Jordan, Syria, wintering south to Egypt) and western and southern Asia (Azerbaijan, Armenia, Russia (where it is on the verge of extinction) [235]; Turkmenistan, Uzbekistan, Tajikistan, Kazakhstan, Iraq, Iran, Afghanistan, Pakistan, India and extreme northwest China, wintering in Iran, Pakistan and north-west India[236]. There are estimates of the species four flyway populations as follows: west Mediterranean and west Africa 6,000-7,500 individuals, Eastern Mediterranean 20-100 individuals, south-west Asia 46,000-50,000 individuals, and South Asia c. 5,000 individuals[237].	Screened Out

[231] https://ebird.org/checklist/S108890025
[232] https://ebird.org/checklist/S35149640
[233] Boyla, K.A., Sinav, L. and Dizdaroğlu D.E. 2019. Turkey Breeding Bird Atlas. WWF-Turkey, Wildlife Conservation Foundation, İstanbul.
[234] Keller, V., Herrando, S., Voříšek, P., Franch, M., Kipson, M., Milanesi, P., Martí, D., Anton, M., Klvaňová, A., Kalyakin, M.V., Bauer, H.-G. and Foppen, R.P.B. 2020. European Breeding Bird Atlas 2: Distribution, Abundance and Change. European Bird Census Council & Lynx Edicions, Barcelona.
[235] Van Impe, J. 2013. Esquisse de l'avifaune de la Sibérie Occidentale: une revue bibliographique. Alauda 81(4): 269-296.
[236] Green, A. J. 1996. International action plan for the Marbled Teal (Marmaronetta angustirostris). In: Heredia, B.; Rose, L.; Painter, M. (ed.), Globally threatened birds in Europe: action plans, pp. 99-117. Council of Europe, and BirdLife International, Strasbourg.
[237] Wetlands International. 2022. Waterbird Populations Portal. Available at: wpp.wetlands.org.

	 https://www.iucnredlist.org/species/22680339/205917761			It is adapted to temporary, unpredictable, Mediterranean-type wetlands[238, 239]; and breeds in fairly dry, steppe-like areas on shallow freshwater, brackish or alkaline ponds with well vegetated shorelines, rich emergent and submergent vegetation[240, 241, 242]; delta marshes where receding waters leave behind large areas of shallow water with abundant sedges and bulrushes[243]; slow rivers and saline coastal lagoons, & man-made wetlands including fish-rearing ponds, small reservoirs and sewage farms[244, 245]. It uses similar habitat during the non-breeding season, although may make more use of shallow, mixed zones of emergent and saltmarsh vegetation during the summer[246]. Banni Grassland and Chhari Dhand, and Nalsarovar Wildlife Sanctuary are the possible habitats for this migratory species in Gujarat[247]. Both the above mentioned IBAs are away from the Vadodara and the available secondary data[248, 249] also supports the unlikelihood of this species in the EAAA.	
29	Pallid Harrier (*Circus macrourus*)	**IUCN:** Near Threatened **IWP:** Schedule I **Restricted range:** No **Migratory:** Yes	3a	Pallid Harrier breeds primarily in the steppes of Asiatic Russia, Kazakhstan and north-west China[250]. The global population is estimated at 9,000-15,000 pairs[251], equating to 18,000-30,000 mature individuals.	Screened Out

[238] Green, A. J. 2000. The habitat requirements of the Marbled Teal (Marmaronetta angustirostris), Ménétr., a review. In: Comín, F. A.; Herrera, J. A.; Ramírez, J. (ed.), Limnology and aquatic birds: monitoring, modelling and management, pp. 147-163. Universidad Autónoma del Yucatán, Mérida.

[239] Green, A. J. 2007. Cerceta pardilla - Marmaronetta angustirostris. In: Carrascal, L. M.; Salvador, A. (ed.), Enciclopedia Virtual de los Vertebrados Españoles, Museo Nacional de Ciencias Naturales, Madrid.

[240] Green, A. J. 1993. The status and conservation of the Marbled Teal Marmaronetta angustirostris. International Waterfowl and Wetlands Research Bureau, Slimbridge, U.K.

[241] Kear, J. 2005. Ducks, geese and swans volume 2: species accounts (Cairina to Mergus). Oxford University Press, Oxford, U.K.

[242] Sebastián-González, E., Fuentes, C., Ferrández, M., Echevarrías, J. L., Green, A. J. 2013. Habitat selection of Marbled Teal and White-headed Duck during the breeding and wintering seasons in south-eastern Spain. Bird Conservation International 23(3): 344–359.

[243] Johnsgard, P.A. 1978. Ducks, geese and swans of the World. University of Nebraska Press, Lincoln and London.

[244] Green, A. J. 1993. The status and conservation of the Marbled Teal Marmaronetta angustirostris. International Waterfowl and Wetlands Research Bureau, Slimbridge, U.K.

[245] BirdLife International. 2022. Marmaronetta angustirostris. The IUCN Red List of Threatened Species 2022: e.T22680339A205917761

[246] Sebastián-González, E., Fuentes, C., Ferrández, M., Echevarrías, J. L., Green, A. J. 2013. Habitat selection of Marbled Teal and White-headed Duck during the breeding and wintering seasons in south-eastern Spain. Bird Conservation International 23(3): 344–359.

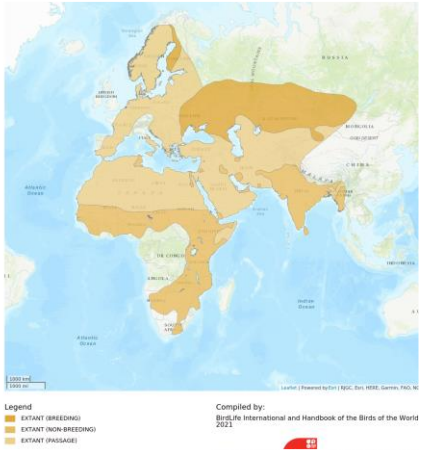
[247] Rahmani, A.R., Islam, M.Z. and Kasambe, R.M. (2016) Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated). Bombay Natural History Society, Indian Bird Conservation Network, Royal Society for the Protection of Birds and BirdLife International (U.K.).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

[248] https://ebird.org/map/martea1?neg=true&env.minX=72.44031957423941&env.minY=22.001629133031567&env.maxX=73.84656957423941&env.maxY=22.567098406374466&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

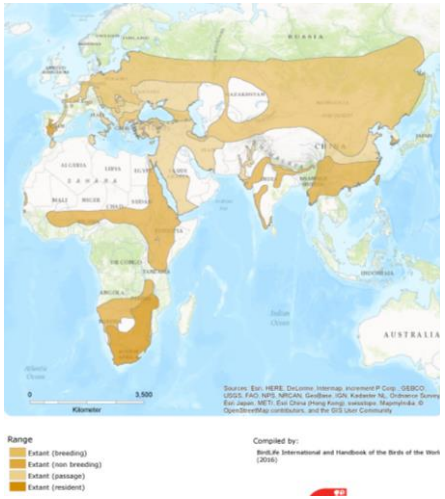
[249] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=7139

[250] BirdLife International. 2021. Circus macrourus. The IUCN Red List of Threatened Species 2021: e.T22695396A201209093

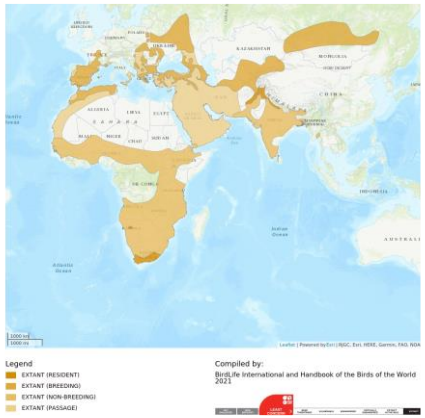
[251] Galushin, V.; Clarke, R.; Davygora, A. 2003. International Action Plan for the Pallid Harrier (Circus macrourus).

	 https://www.iucnredlist.org/species/22695396/201209093			It breeds in semi-desert, steppe and forest-steppe up to 2,000 m, where its favoured nesting sites are wet grasslands close to small rivers and lakes, and marshlands[252, 253]. The species has also been found to breed in agricultural areas, at least when agriculture is non intensive[254]. A minority of the population breeds in the boreal forest and tundra forest zones, north of its main breeding range[255], where it nests in clearings and other open areas[256]. The species is migratory, with most birds wintering in sub-Saharan Africa or south-east Asia, where they use mosaics of forest/ shrubland and grassland and, to a lesser extent, agricultural land for wintering[257]. Undoubtedly the species has a presence in the surroundings of Vadodara[258], however based on available secondary information extracted from eBird Database[259] (which reports maximum 3 individuals from the Vadhavana Lake[260]), it is less likely to meet the threshold i.e. to 180-300 (≥1 percent of the global population) for the EAAA.
30	Black Stork (*Ciconia nigra*)	**IUCN:** Least Concern 3a **IWP:** Schedule II **Restricted range:** No **Migratory:** Yes		Black Stork has a wide range of distribution from Spain to Russia to South Korea; Mali to Ethiopia and Egypt to South Africa; Arabian Peninsula to Indian Subcontinent to Taiwan[261]. Screened Out The global population is estimated to number c. 24,000-44,000 individuals[262]. The species inhabits old, undisturbed, open forests - from sea-level up to mountainous regions (e.g. 2,000-2,500 m in altitude)[263, 264, 265].

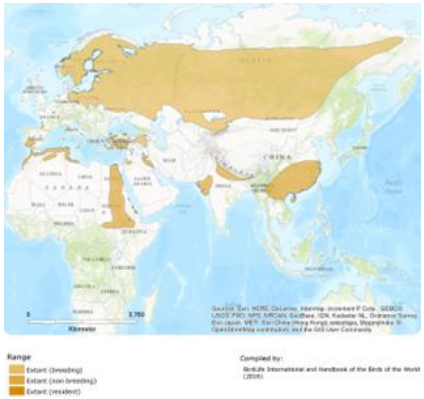
[252] Snow, D.W. and Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[253] Galushin, V.; Clarke, R.; Davygora, A. 2003. International Action Plan for the Pallid Harrier (Circus macrourus).
[254] Terraube, J.; Arroyo, B. E.; Mougeot, F.; Madders, M.; Watson, J.; Bragin, E. A. 2009. Breeding biology of the Pallid Harrier Circus macrourus in north-central Kazakhstan: implications for the conservation of a near threatened species. Oryx 43(1): 104-112.
[255] Kuznetsov, A. V. 1994. Birds of prey of the Kostroma lowland. In: Kurochkin, E.N. (ed.), Modern ornithology, pp. 86-93. Nauka, Moscow.
[256] Galushin, V.; Clarke, R.; Davygora, A. 2003. International Action Plan for the Pallid Harrier (Circus macrourus).
[257] Limiñana, R., Arroyo, B., Terraube, J., McGrady, M., & Mougeot, F. 2015. Using satellite telemetry and environmental niche modelling to inform conservation targets for a long-distance migratory raptor in its wintering grounds. Oryx 49(2): 329-337.
[258] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=
[259] https://ebird.org/map/palhar1?neg=true&env.minX=66.35196825376184&env.minY=19.707023743438377&env.maxX=77.60196825376183&env.maxY=24.23923880081607&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[260] https://ebird.org/checklist/S35149640
[261] BirdLife International. 2017. Ciconia nigra. The IUCN Red List of Threatened Species 2017: e.T22697669A111747857
[262] BirdLife International. 2017. Ciconia nigra. The IUCN Red List of Threatened Species 2017: e.T22697669A111747857
[263] Hancock, J. A.; Kushlan, J. A.; Kahl, M. P. 1992. Storks, ibises and spoonbills of the world. Academic Press, London.
[264] del Hoyo, J., Elliot, A. and Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[265] Snow, D.W. and Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.

	 https://www.iucnredlist.org/species/22697669/111747857			It forages in shallow streams, pools, marshes, occasionally grasslands[266], swampy patches[267], damp meadows[268], flood-plains, pools in dry riverbeds[269], especially where there are stands of reeds or long grass[270]. Undoubtedly the species has a presence in the surroundings of Vadodara[271], however based on available secondary information extracted from eBird Database[272] (which reports maximum 3 individuals near Vadhavana Lake[273]), it is less likely to meet the threshold i.e. 240-440 (≥1 percent of the global population) for the EAAA.
31	Booted Eagle (*Hieraaetus pennatus*)	**IUCN:** Least Concern **IWP:** Schedule I **Restricted range:** No **Migratory:** Yes	3a	Booted eagle has breeding populations in many different regions in both the northern and southern hemisphere. These include southern Europe, North Africa and across Asia, and also in western South Africa and Namibia. The northern populations are migratory spending November to February in Sub-Saharan Africa and South Asia[274]. Its European population is estimated at 23,300-30,300 pairs (equates to 46,600-60,500 mature individuals). Europe forms ca. 31% of the global range, so a very preliminary estimate of the global population size is 150,000-195,000 mature individuals[275].	Screened Out

[266] del Hoyo, J., Elliot, A. and Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[267] Snow, D.W. and Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[268] Hancock, J. A.; Kushlan, J. A.; Kahl, M. P. 1992. Storks, ibises and spoonbills of the world. Academic Press, London.
[269] Hockey, P.A.R., Dean, W.R.J. and Ryan, P.G. 2005. Roberts birds of southern Africa. Trustees of the John Voelcker Bird Book Fund, Cape Town, South Africa.
[270] Brown, L.H., Urban, E.K. and Newman, K. 1982. The Birds of Africa, Volume I. Academic Press, London.
[271] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=
[272] https://ebird.org/map/blasto1?neg=true&env.minX=72.44034085089949&env.minY=21.97997965490528&env.maxX=73.84659085089949&env.maxY=22.545536274490424&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[273] https://ebird.org/checklist/S40460677
[274] https://web.archive.org/web/20160327005804/http://www.biodiversityexplorer.org/birds/accipitridae/aquila_pennatus.htm
[275] https://www.iucnredlist.org/species/22696092/206456835#population

	 https://www.iucnredlist.org/species/22696092/206456835			It is a species of open woodland, preferring patches of forest interspersed with open areas; it is recorded up to 3,000 m[276]. Definitely, the species has a presence in the surroundings of Vadodara[277], however based on available secondary information extracted from eBird Database[278] (which reports maximum 2 individuals from Ankodiya road[279], 2 individuals from Navrachana University Campus[280], and 2 individuals from Vadhavana Lake, Dabhoi [281]), it is less likely to meet the threshold i.e. 1,500-1,950 (≥1 percent of the global population) for the EAAA.	
32	Common Crane (*Grus grus*)	**IUCN:** Least Concern **IWP:** Schedule IV **Restricted range:** No **Migratory:** Yes	3a	During the breeding season this species utilises a wide variety of shallow wetlands, including high altitude, treeless moors or bogs (where the main vegetation is Sphagnum moss or Ericaceae) usually with some standing water, swampy forest clearings, reedy marshes and rice paddies. The species requires inaccessible ground nesting-sites, so is commonly associated with quaking bogs and other impassible mires, especially in the vicinity of Alnus carr woodland or seasonally flooded riverine forest. The global population is estimated to number c. 491,000-503,000 individuals[282]. The non-breeding wintering and migration habitats of the species include floodland, swampy meadows, shallow sheltered bays, rice paddies, pastures and savannah-like areas (such as open holm oak woodlands in the Iberian Peninsula). The species may also be found roosting on mudflats or sandbanks along rivers, lakes and reservoirs[283].	Screened Out

[276] del Hoyo, J.; Elliott, A.; Sargatal, J. 1994. Handbook of the Birds of the World, vol. 2: New World Vultures to Guineafowl. Lynx Edicions, Barcelona, Spain.
[277] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=
[278] https://ebird.org/map/booeag1?neg=true&env.minX=72.43669010384694&env.minY=22.003715501989312&env.maxX=73.84294010384694&env.maxY=22.569176353500012&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[279] https://ebird.org/checklist/S68850290
[280] https://ebird.org/checklist/S62946053
[281] https://ebird.org/checklist/S79306264
[282] https://www.iucnredlist.org/species/22692146/86219168#population
[283] BirdLife International. 2016. Grus grus. The IUCN Red List of Threatened Species 2016: e.T22692146A86219168

	 https://www.iucnredlist.org/species/22692146/86219168			Definitely, the species has a presence in the surroundings of Vadodara[284], however based on available secondary information extracted from eBird Database[285] (which reports maximum 222 individuals from Vadhavana Lake, Dabhoi [286]), it is less likely to meet the threshold i.e. 4,910-5,030 (≥1 percent of the global population) for the EAAA.	
33	Common Kestrel (*Falco tinnunculus*)	**IUCN:** Least Concern **IWP:** Schedule IV **Restricted range:** No **Migratory:** Yes	3a	Common Kestrel occurs over a large range. It is widespread in Europe, Asia, and Africa, as well as occasionally reaching the east coast of North America[287]. These birds are sedentary but in the cold parts of their range, they migrate south in winter. The European population is estimated at 411,000-631,000 pairs (equates to 823,000-1,270,000 mature individuals). As Europe forms ca. 19% of the global range, a very preliminary estimate of the global population size is 4,330,000-6,680,000 mature individuals, therefore placed in the band 4,300,000-6,700,000 mature individuals[288]. The species can tolerate a wide range of open and partially forested habitats and has been recorded up to 4,500 m[289]. Undoubtedly the species has a presence in the surroundings of Vadodara[290], however based on available secondary information extracted from eBird Database[291] (which	Screened Out

[284] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=

[285] https://ebird.org/map/comcra?neg=true&env.minX=71.70274092336321&env.minY=21.529087065847065&env.maxX=74.51524092336321&env.maxY=22.66153036847644&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

[286] https://ebird.org/checklist/S35630643

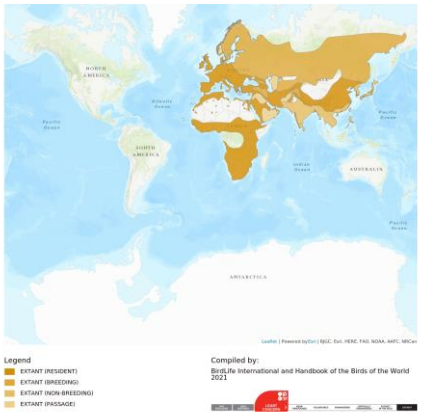
[287] https://www.beautyofbirds.com/commonkestrels.html

[288] https://www.iucnredlist.org/species/22696362/206316110#population

[289] del Hoyo, J.; Elliott, A.; Sargatal, J. 1994. Handbook of the Birds of the World, vol. 2: New World Vultures to Guineafowl. Lynx Edicions, Barcelona, Spain.

[290] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=

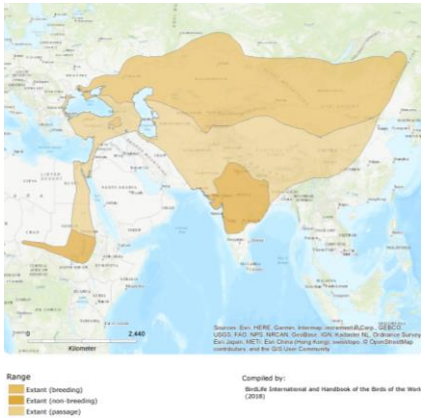
[291] https://ebird.org/map/eurkes?neg=true&env.minX=72.45079109017118&env.minY=21.994375784493l9&env.maxX=73.85704109017118&env.maxY=22.55987433088705&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

	 https://www.iucnredlist.org/species/22696362/206316110			reports maximum 2 individuals from Timbi Lake[292]), it is less likely to meet the threshold i.e. 240-440 (≥1 percent of the global population) for the EAAA.	
34	Common Teal (*Anas crecca*)	**IUCN:** Least Concern **IWP:** Schedule IV **Restricted range:** No **Migratory:** Yes	3a	Common Teal migrates from Europe & formal USSR and winter in coasts of Northern Africa, East Africa, Central Asia, Indian Subcontinent, & Eastern Asia[293]. The global population is estimated at c. 2,800,000 mature individuals[294, 295]. The European population is estimated at 557,000-915,000 pairs, which equates to 1,110,000-1,830,000 mature individuals[296]. Its habitats include Forest, Shrubland, Wetlands (inland), Marine Intertidal, Marine Coastal/Supratidal, Artificial/Terrestrial, Artificial/Aquatic & Marine[297]. Definitely, the species has a presence in the surroundings of Vadodara[298, 299], however based on available secondary information extracted from eBird Database[300] (which reports maximum 1000 individuals from Timbi Lake[301]), it is less likely to meet the threshold i.e. 28,000 (≥1 percent of the global population) for the EAAA.	Screened Out

[292] https://ebird.org/checklist/S96964427
[293] BirdLife International. 2020. Anas crecca. The IUCN Red List of Threatened Species 2020: e.T22680321A181692388
[294] Partners in Flight. 2019. Avian Conservation Assessment Database, version 2019. Available at: http://pif.birdconservancy.org/ACAD.
[295] Wetlands International. 2020. Waterbird Population Estimates. Available at: wpe.wetlands.org.
[296] BirdLife International. 2015. European Red List of Birds. Office for Official Publications of the European Communities, Luxembourg.
[297] BirdLife International. 2020. Anas crecca. The IUCN Red List of Threatened Species 2020: e.T22680321A181692388
[298] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=
[299] https://www.inaturalist.org/observations?iconic_taxa=Aves&place_id=32168&subview=map&view=species
[300] https://ebird.org/map/gnwtea?neg=true&env.minX=72.4066970939343&env.minY=22.03650817117787&env.maxX=73.8129470939343&env.maxY=22.601836553969157&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[301] https://ebird.org/checklist/S99275042

	 https://www.iucnredlist.org/species/22680321/181692388				
35	Demoiselle Crane (*Anthropoides virgo*)	**IUCN:** Least Concern **IWP:** Schedule IV **Restricted range:** No **Migratory:** Yes	3a	Demoiselle Crane breeds eastwards from Central Asia to Mongolia and winters almost entirely in western India (Gujarat and Rajasthan specifically)[302]. The global population is estimated to number c. 230,000-261,000 individuals[303]. In both its breeding and wintering ranges this species shows a preference for grassland habitats in close proximity to streams, shallow lakes and other wetlands, mudflats surrounded by water, cultivated areas, also frequenting desert areas where water is available[304, 305, 306, 307]. In India a wider range of habitat types are used, including marshes, freshwater lakes, rivers[308], cultivated fields and rice stubble[309], sandy riverbeds, the flat and open margins of seasonal pans and farm ponds[310], and hot desert (if water is readily available) [311, 312].	Screened Out

[302] https://birdcount.in/migration-map/demcra1/
[303] Wetlands International. 2015. Waterbird Population Estimates. Available at: wpe.wetlands.org.
[304] Johnsgard, P. A. 1983. Cranes of the world. Croom Helm, London.
[305] Ellis, D.H., Gee, G.F. and Mirande, C.M. 1996. Cranes: their biology, husbandary, and conservation. Gazelle Books, Lancaster, U.K.
[306] del Hoyo, J.; Elliott, A.; Sargatal, J. 1996. Handbook of the Birds of the World, vol. 3: Hoatzin to Auks. Lynx Edicions, Barcelona, Spain.
[307] Meine, C. D. and Archibald, G. W. 1996. The cranes - status survey and conservation action plan. International Union for Conservation of Nature and Natural Resources, Gland, Switzerland, and Cambridge, U.K.
[308] Urban, E.K.; Fry, C.H.; Keith, S. 1986. The Birds of Africa, Volume II. Academic Press, London.
[309] del Hoyo, J.; Elliott, A.; Sargatal, J. 1996. Handbook of the Birds of the World, vol. 3: Hoatzin to Auks. Lynx Edicions, Barcelona, Spain.
[310] Johnsgard, P. A. 1983. Cranes of the world. Croom Helm, London.
[311] Ellis, D.H., Gee, G.F. and Mirande, C.M. 1996. Cranes: their biology, husbandary, and conservation. Gazelle Books, Lancaster, U.K.
[312] Meine, C. D. and Archibald, G. W. 1996. The cranes - status survey and conservation action plan. International Union for Conservation of Nature and Natural Resources, Gland, Switzerland, and Cambridge, U.K.

	 https://www.iucnredlist.org/species/22692081/131927771			Kaj Lake (Pipalava Bandharo), Salt Pans of Bhavnagar, Wild Ass Wildlife Sanctuary & Nanda Island, and Gosabara (Mokarsar) Wetlands Complex area are the possible habitats for this migratory species in Gujarat[313]. Indeed, the species has a presence in the surroundings of Vadodara[314], however based on available secondary information extracted from eBird Database[315] (which reports maximum 1000 individuals from Vadhavana Lake, Dabhoi[316] in 2022), it is less likely to meet the threshold i.e. 2300-2610 (≥1 percent of the global population) for the EAAA.	
36	Eurasian Wigeon (*Mareca penelope*)	**IUCN:** Least Concern **IWP:** Schedule IV **Restricted range:** No **Migratory:** Yes	3a	Eurasian wigeons breed in the northernmost areas of Europe and the Palearctic. They are strongly migratory and winters further south than their breeding range. They spend winter in southern Asia and Africa. The global population is estimated to number c.2,800,000-3,300,000 individuals[317]. This species breeds in lowland freshwater marshes, slow-flowing large rivers[318] and shallow lakes and lagoons with ample submerged, floating and emerging vegetation[319]. Ideal wetland habitats for this species are those surrounded by sparse open forest, woodland and especially agricultural land. In the non-breeding season this species shows a preference for coastal salt-marshes, freshwater, brackish and saline lagoons, flooded grasslands, estuaries, intertidal mudflats, and other sheltered marine habitats[320, 321].	Screened Out

[313] 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.). Pp. 1992 + xii

[314] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=

[315] https://ebird.org/map/demcra1?neg=true&env.minX=73.44155753302533&env.minY=22.163878457523488&env.maxX=73.52944815802533&env.maxY=22.199246407778386&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

[316] https://ebird.org/india/checklist/S135169100

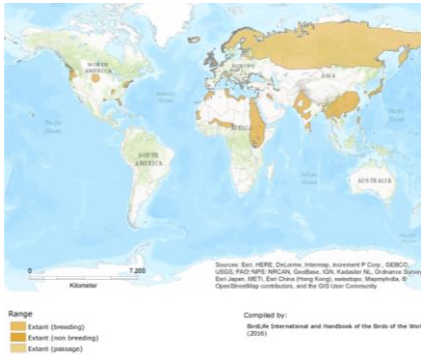
[317] Wetlands International. 2015. Waterbird Population Estimates. Available at: wpe.wetlands.org.

[318] Kretchmar, A. V. 1994. Eurasian wigeon (Anas penelope) in north-eastern Asia. Zoologichesky Zhurnal 73(5): 68-79.

[319] Kear, J. 2005. Ducks, geese and swans volume 2: species accounts (Cairina to Mergus). Oxford University Press, Oxford, U.K.

[320] Cramp, S.; Simmons, K. E. L. 1977. Handbook of the birds of Europe, the Middle East and Africa. The birds of the western Palearctic, vol. I: ostriches to ducks. Oxford University Press, Oxford.

[321] Kear, J. 2005. Ducks, geese and swans volume 2: species accounts (Cairina to Mergus). Oxford University Press, Oxford, U.K.

	 https://www.iucnredlist.org/species/22680157/111892532			Nalsarovar Wildlife Sanctuary, and Salt Pans of Bhavnagar are the possible habitats for this migratory species in Gujarat[322]. Indeed, the species has a presence in the surroundings of Vadodara[323, 324], however based on available secondary information extracted from eBird Database[325] (which reports maximum 250 individuals from Vadhavana Lake, Dabhoi [326] followed by 200 individuals from Timbi Lake[327]), it is less likely to meet the threshold i.e. 28,000-33,000 (≥1 percent of the global population) for the EAAA.	
37	Gadwall (*Mareca strepera*)	**IUCN:** Least Concern **IWP:** Schedule IV **Restricted range:** No **Migratory:** Yes	3a	Gadwall has an extremely wide distribution across the Palearctic and Nearctic regions. The global population is estimated to number c. 4,300,000-4,900,000 individuals[328]. The species inhabits highly productive & eutrophic freshwater marsha or lakes, open lowland grassland, shallow, standing or slow-flowing waters with abundant emergent vegetation, and grass-covered islands[329]. It may also be found on permanent, shallow, slightly alkaline marshes, as well as on oxbow lakes, channels, reservoirs, and gravel-pits[330]. Although the Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated Edition - 2016)[331] reports the species from Salt Pans	Screened Out

[322] 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.). Pp. 1992 + xii

[323] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=

[324] https://www.inaturalist.org/observations?iconic_taxa=Aves&place_id=32168&subview=map&view=species

[325] https://ebird.org/map/eurwig?neg=true&env.minX=71.81366729736328&env.minY=21.7433125182012&env.maxX=74.62616729736328&env.maxY=22.874035915941572&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

[326] https://ebird.org/india/checklist/S127726013

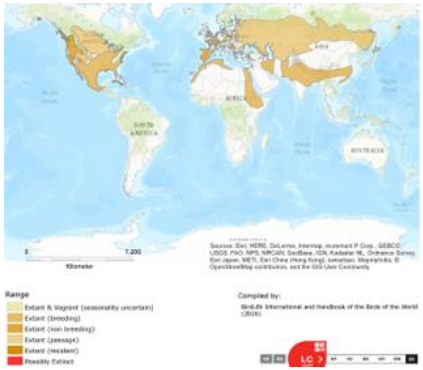
[327] https://ebird.org/checklist/S99091820

[328] Wetlands International. 2015. Waterbird Population Estimates. Available at: wpe.wetlands.org.

[329] Kear, J. 2005. Ducks, geese and swans volume 2: species accounts (Cairina to Mergus). Oxford University Press, Oxford, U.K.

[330] BirdLife International. 2016. Mareca strepera. The IUCN Red List of Threatened Species 2016: e.T22680149A86020572

[331] 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.). Pp. 1992 + xii

	 https://www.iucnredlist.org/species/22680149/86020572			of Bhavnagar. However, the species has been reported throughout the state (Gujarat)[332]. Indeed, the species has a presence in the surroundings of Vadodara[333, 334], however based on available secondary information extracted from eBird Database[335] (which reports maximum 500 individuals from Timbi Lake[336]), it is less likely to meet the threshold i.e. 43,000-49,000 (≥1 percent of the global population) for the EAAA.	
38	Garganey (*Spatula querquedula*)	**IUCN:** Least Concern **IWP:** Schedule IV **Restricted range:** No **Migratory:** Yes	3a	Garganey breed Europe and Northwest Asia. They move to Africa, Indian Subcontinent (particularly South India), Australia, New Zealand, New Guinea and neighbouring islands for wintering[337]. The global population is estimated to number c. 2,600,000-2,800,000 individuals[338]. In the breeding season this species frequents small, shallow ponds and lakes with abundant floating, emergent and fringing vegetation, grass dominated environments (i.e. swampy meadows, flooded fields), shallow freshwater marshes[339, 340, 341, 342, 343]. During nonbreeding season the species shows a preference for large freshwater or occasionally	Screened Out

[332] https://ebird.org/map/gadwal?neg=true&env.minX=64.1924152412128&env.minY=19.18638948676505&env.maxX=75.4424152412128&env.maxY=23.734789838523643&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

[333] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=

[334] https://www.inaturalist.org/observations?iconic_taxa=Aves&place_id=32168&subview=map&view=species

[335] https://ebird.org/map/gadwal?neg=true&env.minX=73.43156886825099&env.minY=22.153530333602217&env.maxX=73.51945949325099&env.maxY=22.188900887353353&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

[336] https://ebird.org/checklist/S99275042

[337] https://indianbirds.thedynamicnature.com/2015/03/garganey-spatula-querquedula.html#google_vignette

[338] Wetlands International. 2015. Waterbird Population Estimates. Available at: wpe.wetlands.org.

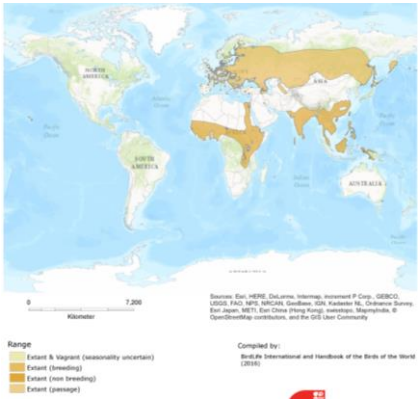
[339] Cramp, S.; Simmons, K. E. L. 1977. Handbook of the birds of Europe, the Middle East and Africa. The birds of the western Palearctic, vol. I: ostriches to ducks. Oxford University Press, Oxford.

[340] Johnsgard, P.A. 1978. Ducks, geese and swans of the World. University of Nebraska Press, Lincoln and London.

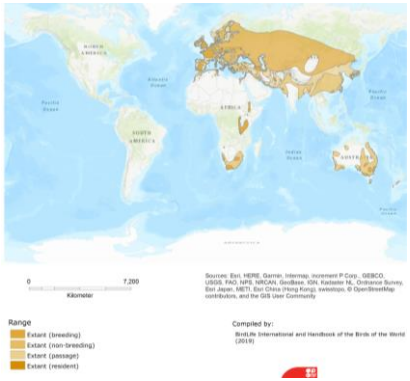
[341] del Hoyo, J., Collar, N.J., Christie, D.A., Elliott, A. and Fishpool, L.D.C. 2014. HBW and BirdLife International Illustrated Checklist of the Birds of the World. Lynx Edicions BirdLife International, Barcelona, Spain and Cambridge, UK.

[342] Green, A. J. 1998. Habitat selection by the Marbled Teal Marmaronetta angustirostris, Ferruginous Duck Aythya nyroca and other ducks in the Göksu Delta, Turkey in late summer. Revue d'Ecologie (La Terre et la Vie) 53: 225-243.

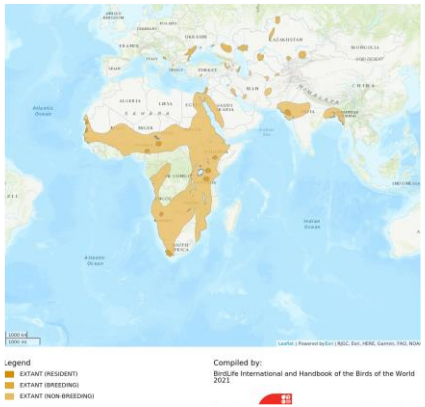
[343] Schricke, V. 2002. Elements for a garganey (Anas querquedula) management plan. Game and Wildlife Science 18(1): 9-41.

	 https://www.iucnredlist.org/species/22680313/86016410			brackish lakes, again with abundant floating, emergent and fringing vegetation[344], also shallow flood plains, shallow dams, pans and sewage ponds (in South Africa)[345]. The species also frequents coastal saltmarshes and lagoons on passage[346] and may spend the day resting on marine inshore waters when migrating[347]. Although the Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated Edition - 2016)[348] reports the species from Salt Pans of Bhavnagar. However, the species has been reported throughout the state (Gujarat)[349]. Indeed, the species has a presence in the surroundings of Vadodara[350, 351], however based on available secondary information extracted from eBird Database[352] (which reports maximum 337 individuals from Vadhavana Lake, Dabhoi[353]), it is less likely to meet the threshold i.e. 26,000-28,000 (≥1 percent of the global population) for the EAAA.	
39	Great Crested Grebe (*Podiceps cristatus*)	**IUCN:** Least Concern **IWP:** Schedule IV **Restricted range:** No **Migratory:** Yes	3a	Great Crested Grebe is found across most of Europe and central Asia, though it also winters in parts of southern Asia (e.g. northern India). Colonies can also be found scattered throughout Africa, from Tunisia and Egypt in the north and a few colonies in central Africa down to South Africa. Nesting colonies are also found in southern Australia and New Zealand, with individuals wintering in eastern and northern Australia[354]. The global population is estimated to number c. 915,000-1,400,000 individuals[355]. The species breeds on fresh or brackish waters with abundant emergent and submerged vegetation, showing a preference for non-acidic eutrophic waterbodies with flat or sloping banks and muddy or sandy substrates, usually 0.5-5 m deep and with large areas	Screened Outs

[344] Kear, J. 2005. Ducks, geese and swans volume 2: species accounts (Cairina to Mergus). Oxford University Press, Oxford, U.K.
[345] Hockey, P.A.R., Dean, W.R.J. and Ryan, P.G. 2005. Roberts birds of southern Africa. Trustees of the John Voelcker Bird Book Fund, Cape Town, South Africa.
[346] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[347] Madge, S.; Burn, H. 1988. Wildfowl. Christopher Helm, London.
[348] 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.). Pp. 1992 + xii
[349] https://ebird.org/map/gargan?neg=true&env.minX=57.44641875687685&env.minY=17.108674891385363&env.maxX=79.94641875687685&env.maxY=26.184438205735823&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[350] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=
[351] https://www.inaturalist.org/observations?iconic_taxa=Aves&place_id=32168&subview=map&view=species
[352] https://ebird.org/map/gargan?neg=true&env.minX=72.85641366698621&env.minY=22.241118117255343&env.maxX=73.55953866698621&env.maxY=22.523655259465745&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[353] https://ebird.org/checklist/S160239487
[354] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[355] Wetlands International. 2015. Waterbird Population Estimates. Available at: wpe.wetlands.org.

	 https://www.iucnredlist.org/species/22696602/154250080			of open water[356, 357]. Suitable habitats include small pools or lakes, backwaters of slow-flowing rivers and artificial waterbodies (e.g. reservoirs, fish-ponds, gravel pits and ornamental lakes)[358]. The species overwinters on large exposed ice-free lakes and reservoirs, moving to sheltered coastal inshore waters less than 10 m deep, such as brackish estuaries, deltas, tidal channels and tidal lagoons during cold spells[359, 360, 361]. The Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated Edition - 2016)[362] reports the species from Charakla Saltworks, Khijadiya Bird Sanctuary, and Gosabara Wetland. Definitely, the species has a presence in the surroundings of Vadodara[363], however based on available secondary information extracted from eBird Database[364] (which reports maximum 2 individuals from Timbi Lake[365] as well as Vadhavana Lake, Dabhoi[366]), it is less likely to meet the threshold i.e. 9,150-14,000 (≥1 percent of the global population) for the EAAA.	
40	Great White Pelican (*Pelecanus onocrotalus*)	**IUCN:** Least Concern **IWP:** Schedule IV **Restricted range:** No **Migratory:** Yes	3a	Great White Pelican is widely distributed in Africa and parts of Eurasia. The species is nomadic, moving vast distances in response to environmental conditions[367]. The global population of the species is estimated at 265,000-295,000 individuals[368]. The species is associated with relatively large, warm, shallow fresh, brackish, alkaline or saline lakes, lagoons, marshes, broad rivers, deltas, estuaries and coasts of landlocked	Screened Out

[356] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[357] Snow, D.W.; Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[358] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[359] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[360] Snow, D.W.; Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[361] Fjeldså, J. 2004. The grebes. Oxford University Press, Oxford, U.K.
[362] 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.). Pp. 1992 + xii
[363] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=
[364] https://ebird.org/map/grcgre1?neg=true&env.minX=73.37078590937263&env.minY=22.1485704179685&env.maxX=73.54656715937263&env.maxY=22.219305118286183&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[365] https://ebird.org/checklist/S40734009
[366] https://ebird.org/checklist/S20371854
[367] http://speciesstatus.sanbi.org/assessment/last-assessment/3118/
[368] Wetlands International. 2015. Waterbird Population Estimates. Available at: wpe.wetlands.org.

	 https://www.iucnredlist.org/species/22697590/177120498			seas[369, 370, 371]. The species requires secure areas of extensive reedbeds, wet swamps, mudflats and sandbanks or gravel and rocky substrates for nesting[372, 373, 374, 375]. The Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated Edition - 2016)[376] reports the species from Kaj Lake, Khijadiya Bird Sanctuary, Marine National Park & Wildlife Sanctuary, Salt Pans of Bhavnagar, Wild Ass Wildlife Sanctuary & Nanda Island. Definitely, the species has a presence in the surroundings of Vadodara[377], however based on available secondary information extracted from eBird Database[378] (which reports maximum 5 individuals from Vadhavana Lake, Dabhoi[379]), it is less likely to meet the threshold i.e. 9,150-14,000 (≥1 percent of the global population) for the EAAA.	
41	Greater Flamingo (*Phoenicopterus roseus*)	**IUCN:** Least Concern **IWP:** Schedule IV **Restricted range:** No **Migratory:** Yes	3a	This species is regularly seen from West Africa eastward throughout the Mediterranean to Southwest and South Asia, and throughout sub-Saharan Africa. In India it is a winter migrant but can be seen throughout the year in Rann of Gujarat. The overall population is estimated at 550,000-680,000 individuals[380]. The species inhabits shallow (c.1 m deep over a large area) eutrophic waterbodies such as saline lagoons, saltpans and large saline or alkaline lakes (up to pH 11). It will also frequent sewage treatment pans, inland dams, estuaries and coastal waters, seldom alighting on freshwater but commonly bathing and drinking from freshwater inlets	Screened Out

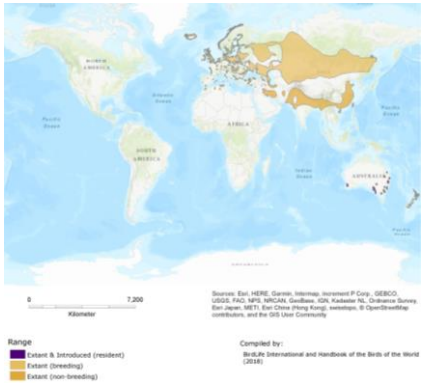
[369] del Hoyo, J., Elliot, A. and Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[370] Johnsgard, P. A. 1993. Cormorants, darters, and pelicans of the world. Smithsonian Institution Press, Washington.
[371] Snow, D.W. and Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[372] del Hoyo, J., Elliot, A. and Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[373] Johnsgard, P. A. 1993. Cormorants, darters, and pelicans of the world. Smithsonian Institution Press, Washington.
[374] Snow, D.W. and Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[375] Nelson, J. B. 2005. Pelicans, cormorants and their relatives. Pelecanidae, Sulidae, Phalacrocoracidae, Anhingidae, Fregatidae, Phaethontidae. Oxford University Press, Oxford, U.K.
[376] 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.). Pp. 1992 + xii
[377] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=
[378] https://ebird.org/map/grwpel1?neg=true&env.minX=71.76547946237261&env.minY=21.590564190862885&env.maxX=74.57797946237261&env.maxY=22.72251552484486&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[379] https://ebird.org/checklist/S78190307
[380] https://www.iucnredlist.org/species/22697360/155527405#population

	 https://www.iucnredlist.org/species/22697360/155527405			entering alkaline or saline lakes[381, 382]. It nests and roosts nests in large dense colonies on sandbanks, mudflats, islands or boggy, open shores[383, 384]. Flamingo City, Nalsarovar Wildlife Sanctuary, Salt Pans of Bhavnagar, Thol Lake Bird Sanctuary, and Wild Ass Wildlife Sanctuary & Nanda Island are the possible habitats for this migratory species in Gujarat[385]. Indeed, the species has a presence in the surroundings of Vadodara[386], however based on available secondary information extracted from eBird Database[387] (which reports maximum 120 individuals from Munjasar Tank[388]), it is less likely to meet the threshold i.e. 5,500-6,800 (≥1 percent of the global population) for the EAAA.	
42	Greater White-fronted Goose (*Anser albifrons*)	**IUCN:** Least Concern **IWP:** Schedule IV **Restricted range:** No **Migratory:** Yes	3a	Greater white-fronted goose is migratory, breeding in northern Canada, Alaska, Greenland and Russia, and winters farther south in North America, Europe and Asia[389]. The European breeding population is estimated at 280,000-331,000 pairs, which equates to 560,000-662,000 mature individuals[390]. In East Asia, the population across South Korea, Japan and China are thought to number 231,000-283,000 individuals[391]. Thus the global population estimate is therefore placed in the band of 5,000,000-5,999,999 mature individuals[392].	Screened Out

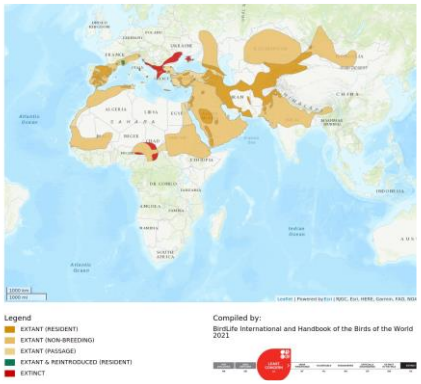
[381] Hockey, P.A.R.; Dean, W.R.J.; Ryan, P.G. 2005. Roberts Birds of Southern Africa. Trustees of the John Voelcker Bird Book Fund, Cape Town, South Africa.
[382] BirdLife International. 2019. Phoenicopterus roseus (amended version of 2018 assessment). The IUCN Red List of Threatened Species 2019: e.T22697360A155527405
[383] Brown, L.H.; Urban, E.K.; Newman, K. 1982. The Birds of Africa, Volume I. Academic Press, London.
[384] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[385] 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.). Pp. 1992 + xii
[386] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=
[387] https://ebird.org/map/grefla3?neg=true&env.minX=71.76547946237261&env.minY=21.590564190862885&env.maxX=74.57797946237261&env.maxY=22.72251552484486&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[388] https://ebird.org/checklist/S87146555
[389] https://doi.org/10.2305%2FIUCN.UK.2016-3.RLTS.T22679881A85980652.en
[390] BirdLife International. 2021. European Red List of Birds. Publications Office of the European Union, Luxembourg.
[391] Jia, Q.; Koyama, K.; Choi, C.-Y.; Kim, H.-J.; Cao, L.; Gao, D.; Liu, G.; Fox, A. D. 2016. Population estimates and geographical distributions of swans and geese in East Asia based on counts during the non-breeding season. Bird Conservation International 26: 397-417.
[392] https://www.iucnredlist.org/species/22679881/213839615#population

	 https://www.iucnredlist.org/species/22679881/213839615			The species breeds in open, low-lying, shrubby tundra on the coast and inland, in close proximity to marshes, lakes, pools, rivers, and willow- and shrub-lined ponds and streams[393, 394, 395]. It requires dry slopes, banks, mounds, hummocks or patches of sand or clay for nesting sites, especially those commanding good views of the surrounding area[396]. The species winters in open country on steppe and agricultural land (e.g. improved grassland, stubble fields and wet meadows), or in brackish and freshwater marshy habitats (such as upland bogs, peatlands and floodlands) [397, 398, 399, 400, 401]. Although, Vadodara is excluded from the global distribution map of the species[402]; however, the available secondary data supports the presence of species in the surroundings of Vadodara[403]. Based on available secondary information extracted from eBird Database[404], maximum 03 individuals were reported from Vadhavana Lake, Dabhoi during Nov. 2020[405]). Thus, it is less likely to meet the threshold i.e. 50,000-59,999 (≥1 percent of the global population) for the EAAA.
43	Greylag Goose (*Anser anser*)	**IUCN:** Least Concern **IWP:** Schedule IV **Restricted range:** No **Migratory:** Yes	3a	Greylag Goose is widespread species, from the north of its range in Europe and Asia often migrating southwards to spend the winter in warmer places, although many populations are resident, even in the north. The global population is estimated to number c. 1,000,000-1,100,000 individuals[406].	Screened Out

[393] Johnsgard, P.A. 1978. Ducks, geese and swans of the World. University of Nebraska Press, Lincoln and London.
[394] del Hoyo, J., Elliot, A. and Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[395] Snow, D.W. and Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[396] Snow, D.W. and Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[397] Johnsgard, P.A. 1978. Ducks, geese and swans of the World. University of Nebraska Press, Lincoln and London.
[398] Madge, S.; Burn, H. 1988. Wildfowl. Christopher Helm, London.
[399] del Hoyo, J., Elliot, A. and Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[400] Scott, D. A.; Rose, P. M. 1996. Atlas of Anatidae populations in Africa and western Eurasia. Wetlands International, Wageningen, Netherlands.
[401] Kear, J. 2005. Ducks, geese and swans volume 1: general chapters; species accounts (Anhima to Salvadorina). Oxford University Press, Oxford, U.K.
[402] https://www.iucnredlist.org/species/22679881/213839615
[403] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=
[404] https://ebird.org/map/gwfgoo?neg=true&env.minX=72.37094952936191&env.minY=22.043779922952528&env.maxX=73.77719952936191&env.maxY=22.60907890596123&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[405] https://ebird.org/checklist/S76833920
[406] Wetlands International. 2015. Waterbird Population Estimates. Available at: wpe.wetlands.org.

	 https://www.iucnredlist.org/species/22679889/131907747			During the breeding season the species inhabits wetlands surrounded by fringing vegetation in open grassland[407], sedge or heather moorland[408], arctic tundra, steppe or semi-desert from sea-level up to 2,300 m[409]. In the winter the species inhabits lowland farmland in open country, swamps, lakes, reservoirs, coastal lagoons, and estuaries[410, 411]. Indeed, the species has a presence in the surroundings of Vadodara[412, 413], however based on available secondary information extracted from eBird Database[414] (which reports maximum 500 individuals from Timbi Lake[415]), it is less likely to meet the threshold i.e. 10,000-11,000 (≥1 percent of the global population) for the EAAA.	
44	Griffon Vulture (*Gyps fulvus*)	**IUCN:** Least Concern **IWP:** Schedule I **Restricted range:** No **Migratory:** Yes	3a	Griffon Vulture has a very large range, across the Middle East, North Africa, and Europe, from India to Portugal and Spain, most commonly found in countries that border the Mediterranean. The biggest population is in Spain, being more than three-quarters of the European population[416]. The European population is estimated at 34,800-44,700 pairs, which equates to 69,600-89,400 mature individuals[417]. Approximately 10% of the global range for this species falls within Europe, so a very preliminary estimate of the global population size is 696,000-894,000 mature individuals. Thus, it is placed in the band 80,000-900,000 mature individuals. It is a species of expansive open areas in a wide array of environments, from mountains to semi-desert, and is recorded regularly from sea level up to c.3,000 m[418].	Screened Out

[407] del Hoyo, J., Elliot, A. and Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[408] Johnsgard, P.A. 1978. Ducks, geese and swans of the World. University of Nebraska Press, Lincoln and London.
[409] Snow, D.W.; Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[410] del Hoyo, J., Elliot, A. and Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[411] Madge, S.; Burn, H. 1988. Wildfowl. Christopher Helm, London.
[412] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=
[413] https://www.inaturalist.org/observations?iconic_taxa=Aves&place_id=32168&subview=map&view=species
[414] https://ebird.org/map/gragoo?neg=true&env.minX=71.49290012802257&env.minY=21.556082790353667&env.maxX=74.30540012802257&env.maxY=22.68831021920002&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[415] https://ebird.org/checklist/S157062250
[416] https://animalia.bio/griffon-vulture?letter=v#distribution
[417] BirdLife International. In prep. European Red List of Birds. Deliverable to the European Commission (DG Environment) in 2021 under Service Contract ENV.D.3/SER/2018/0018.
[418] del Hoyo, J.; Elliott, A.; Sargatal, J. 1994. Handbook of the Birds of the World, vol. 2: New World Vultures to Guineafowl. Lynx Edicions, Barcelona, Spain.

	 https://www.iucnredlist.org/species/22695219/157719127			Although the Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated Edition - 2016)[419] reports the species from Nikol-Samadhiyala-Malan Wetlands Complex. However, the species has been reported from throughout the state (Gujarat)[420]. Definitely, the species has a presence in the surroundings of Vadodara[421], however based on available secondary information extracted from eBird Database[422], the species has only two reports (with single individual) from i. Vadodara city[423] in Dec. 2014 and ii. Vadhavana Lake, Dabhoi[424] in Jan. 2016. Thus, it is less likely to meet the threshold i.e. 800-9,000 (≥1 percent of the global population) for the EAAA.
45	Lesser Kestrel (*Falco naumanni*)	**IUCN:** Least Concern 3a **IWP:** Schedule II **Restricted range:** No **Migratory:** Yes		Lesser Kestrel breeds in Spain, Portugal, Gibraltar (to UK), France, Italy, Bosnia-Herzegovina, FYRO Macedonia, Albania, Greece, Turkey, Morocco, Algeria, Tunisia, Libya, Israel, Palestinian Authority Territories, Jordan, Iran, Iraq, Armenia, Azerbaijan, Georgia, Russia, Ukraine, Afghanistan, Turkmenistan, Uzbekistan, Kazakhstan, China and Mongolia. Birds winter in southern Spain, southern Turkey, Malta and across much of Africa, particularly South Africa[425]. The European population is estimated at 32,900-42,600 pairs, which equates to 65,800-85,200 mature individuals[426]. The population in China has been estimated at c.100-10,000 breeding pairs and c.50-1,000 individuals on migration[427]. The population in Kazakhstan has been estimated at 5,000-10,000 pairs[428]. The population in North Africa is estimated	Screened Out

[419] 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.). Pp. 1992 + xii

[420] https://ebird.org/map/eurgri1?neg=true&env.minX=72.35875139565407&env.minY=22.01334821835036&env.maxX=73.76500139565407&env.maxY=22.578770176796517&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

[421] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=

[422] https://ebird.org/map/eurgri1?neg=true&env.minX=72.35875139565407&env.minY=22.01334821835036&env.maxX=73.76500139565407&env.maxY=22.578770176796517&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

[423] https://ebird.org/checklist/S26736555

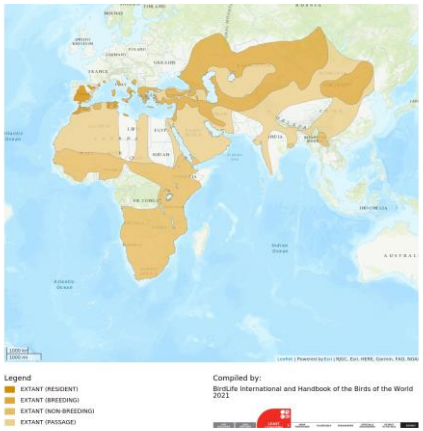
[424] https://ebird.org/checklist/S27011814

[425] https://www.iucnredlist.org/species/22696357/205768513#geographic-range

[426] BirdLife International. In prep. European Red List of Birds. Deliverable to the European Commission (DG Environment) in 2021 under Service Contract ENV.D.3/SER/2018/0018.

[427] Brazil, M. 2009. Birds of East Asia: eastern China, Taiwan, Korea, Japan, eastern Russia. Christopher Helm, London.

[428] Orta, J. & Kirwan, G. M. 2020. Lesser Kestrel (Falco naumanni), version 1.0. In: J. del Hoyo, A. Elliott, J. Sargatal, D. A. Christie, and E. de Juana (eds), Birds of the World, Cornell Lab of Ornithology, Ithaca, NY.

	 https://www.iucnredlist.org/species/22696357/205768513			to be at least 2,500-3,000 breeding pairs[429]. The global population is therefore roughly estimated at 80,000-134,000 mature individuals[430]. It is usually a colonial breeder, often in the vicinity of human settlements. It forages in steppe-like habitats, natural and managed grasslands, and non-intensive cultivation. It is mainly migratory, with most breeders overwintering in sub-Saharan Africa, although some travel to parts of north-west Africa, southern Europe and southern Asia[431]. Although the global distribution map of the species includes Vadodara area[432] however based on available secondary information[433, 434], the species has not been reported from the Vadodara and surrounding areas.	
46	Long-legged Buzzard (*Buteo rufinus*)	**IUCN:** Least Concern **IWP:** Schedule IV **Restricted range:** No **Migratory:** Yes	3a	Long-legged Buzzard inhabits dry open plains of northern Africa, southeastern Europe, west and central Asia east to China, and across central India[435]. The European population is estimated at 13,800-22,900 pairs, which equates to 27,600-45,800 mature individuals (BirdLife International in prep.). Europe forms approximately 17% of the global range, so a very preliminary estimate of the global population size is 162,000-269,000 mature individuals, although further validation of this estimate is needed. It is placed in the band 100,000 to 499,999 mature individuals. It is a species of open areas, particularly steppe and semi-desert, and has been recorded up to 3,500 m[436].	Screened Out

[429] Garrido, J. R., Numa, C., Barrios, V. et al. In prep. The conservation status and distribution of the breeding birds of prey in Northern Africa. The IUCN Red List of Threatened Species - Regional Assessment .

[430] https://www.iucnredlist.org/species/22696357/205768513#population

[431] https://www.iucnredlist.org/species/22696357/205768513#habitat-ecology

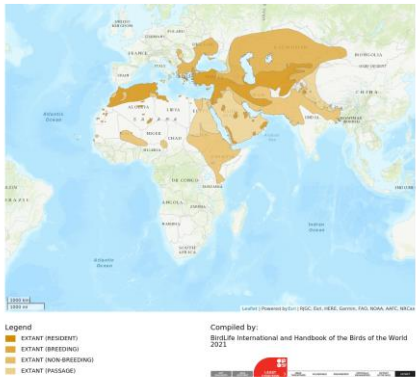
[432] https://www.iucnredlist.org/species/22696357/205768513

[433] https://ebird.org/map/leskes1?neg=true&env.minX=73.21378684032818&env.minY=22.264152671461943&env.maxX=73.22477316845318&env.maxY=22.2685709927211&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

[434] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=59845

[435] https://www.thainationalparks.com/species/long-legged-buzzard

[436] del Hoyo, J.; Elliott, A.; Sargatal, J. 1994. Handbook of the Birds of the World, vol. 2: New World Vultures to Guineafowl. Lynx Edicions, Barcelona, Spain.

				Indeed, the species has a presence in the surroundings of Vadodara[437], however based on available secondary information extracted from eBird Database[438] (which reports two solitary observations, i. near Sindhrot[439] in Dec. 2012, and ii. near Sakarda[440] in Nov. 2020), it is less likely to meet the threshold i.e. 1,000 to 4,999 (≥1 percent of the global population) for the EAAA.	
47	Mallard (*Anas platyrhynchos*)	**IUCN:** Least Concern **IWP:** Schedule IV **Restricted range:** No **Migratory:** Yes	3a	Mallard is widely distributed across the Northern (in northern Europe, North America and Asia) and Southern Hemispheres (Australia). It migrates southwards to Africa, Southeast Asia, Indian Subcontinent, China, Mexico and Cuba[441]. The global population is estimated to number > c. 19,000,000 individuals[442], while the European population is estimated at 2,850,000-4,610,000 pairs[443]. Habitats commonly frequented include flooded swampy woodlands, seasonal flood lands[444], wet grassy swamps and meadows, oxbow lakes[445], open waters with mudflats, banks or spits, irrigation networks, reservoirs, ornamental waters[446, 447], canals and sewage farms[448].	Screened Out

[437] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=

[438] https://ebird.org/map/lolbuz1?neg=true&env.minX=66.51868339468788&env.minY=19.837684459470744&env.maxX=77.76868339468788&env.maxY=24.365781485488851&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

[439] https://ebird.org/checklist/S32874082

[440] https://ebird.org/checklist/S76895687

[441] https://indianbirds.thedynamicnature.com/2015/03/mallard-anas-platyrhynchos.html

[442] Wetlands International. 2015. Waterbird Population Estimates. Available at: wpe.wetlands.org.

[443] BirdLife International. 2015. European Red List of Birds. Office for Official Publications of the European Communities, Luxembourg.

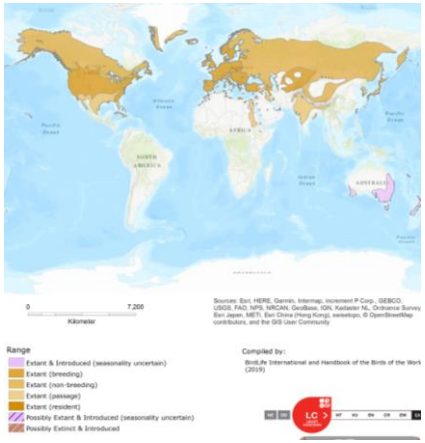
[444] Snow, D.W.; Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.

[445] Flint, V.E.; Boehme, R.L.; Kostin, Y.V.; Kuznetsov, A.A. 1984. A field guide to birds of the USSR. Princeton University Press, Princeton, New Jersey.

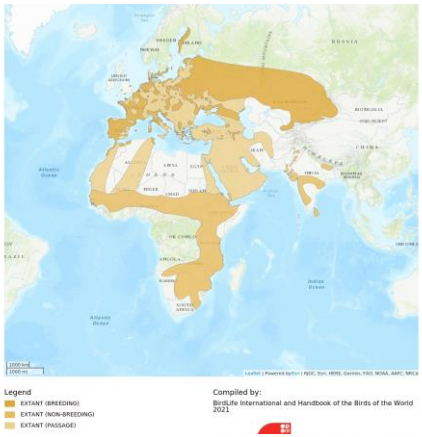
[446] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.

[447] Scott, D. A.; Rose, P. M. 1996. Atlas of Anatidae populations in Africa and western Eurasia. Wetlands International, Wageningen, Netherlands.

[448] Snow, D.W.; Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.

	 https://www.iucnredlist.org/species/22680186/155457360			During the winter the species may also be found in saline habitats along the coast[449] where water is shallow, fairly sheltered and within site of land i.e. brackish lagoons, brackish estuaries and bays[450, 451]. Undoubtedly the species has a presence in the surroundings of Vadodara[452], however based on available secondary information extracted from eBird Database[453] (which reports maximum 12 individuals from Timbi Lake[454]), it is less likely to meet the threshold i.e. 1,90,000 (≥1 percent of the global population) for the EAAA.	
48	Montagu's Harrier (*Circus pygargus*)	**IUCN:** Least Concern **IWP:** Schedule IV **Restricted range:** No **Migratory:** Yes	3a	Montagu's Harrier is distributed from Europe to central Asia and southward to Armenia, Iran and Kazakhstan. In the western Palaearctic, it nests from southern England, southern Sweden and Denmark to the northern coast of the Mediterranean, with a limited presence in Tunisia and Morocco. Migrant, it winters south of the Sahara to South Africa. The largest migratory movements are through Gibraltar, but also occur in the Straits of Messina and at Eilat, Israel[455]. The European population is estimated at 69,700-110,000 breeding females, which equates to 139,000- 219,000 mature individuals[456]. Europe forms approximately 41% of the global range, so a very preliminary estimate of the global population size is 339,000-534,000 mature individuals, although further validation of this estimate is needed. It is placed in the band 300,000 to 550,000 mature individuals[457].	Screened Out

[449] Madge, S.; Burn, H. 1988. Wildfowl. Christopher Helm, London.
[450] Snow, D.W.; Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[451] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[452] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=
[453] https://ebird.org/map/mallar3?neg=true&env.minX=72.45954032828163&env.minY=22.16432599810835&env.maxX=73.86579032828163&env.maxY=22.729136293612477&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[454] https://ebird.org/checklist/S26130129
[455] https://www.iucn.it/documenti/flora.fauna.italia/3-uccelli-2/files/Falconiformes/albanella_minore/albanella_minore_gb.htm
[456] BirdLife International. In prep. European Red List of Birds. Deliverable to the European Commission (DG Environment) in 2021 under Service Contract ENV.D.3/SER/2018/0018.
[457] https://www.iucnredlist.org/species/22695405/201058261#population

	 https://www.iucnredlist.org/species/22695405/201058261			It is a bird of open country, usually in lowlands but occurring up to 1,500 m in central Asia, and on its African wintering grounds up to 4,000 m[458]. The Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated Edition - 2016)[459] reports the species from Velavadar National Park only; though, the species has been reported from throughout the state (Gujarat)[460]. Indeed, the species has a presence in the surroundings of Vadodara[461], however based on available secondary information extracted from eBird Database[462] (which reports maximum 3 individuals from Timbi Lake[463] in Dec. 2019), it is less likely to meet the threshold i.e. 3,000 – 5,500 (≥1 percent of the global population) for the EAAA.	
49	Northern Pintail (*Anas acuta*)	**IUCN:** Least Concern **IWP:** Schedule IV **Restricted range:** No **Migratory:** Yes	3a	Northern Pintail is a duck species with wide geographic distribution that breeds in the northern areas of Europe and across the Palearctic and North America. It is migratory and winters south of its breeding range to the equator. The population is estimated to number 7,100,000-7,200,000 individuals[464]; while the European population is estimated at 210,000-269,000 pairs[465]. The species shows a preference for open lowland grassland, prairie or tundra habitats containing freshwater marshes, brackish & saline wetlands with shallow water (10-30 cm deep), marshy lakes, wet meadows, floodplains, sewage ponds, dense marginal	Screened Out

[458] del Hoyo, J.; Elliott, A.; Sargatal, J. 1994. Handbook of the Birds of the World, vol. 2: New World Vultures to Guineafowl. Lynx Edicions, Barcelona, Spain.

[459] 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.). Pp. 1992 + xii

[460] https://ebird.org/map/monhar1?neg=true&env.minX=71.52023352987499&env.minY=21.721360693376052&env.maxX=74.33273352987499&env.maxY=22.852261049495716&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

[461] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=

[462] https://ebird.org/map/lolbuz1?neg=true&env.minX=66.51868339468788&env.minY=19.837684459470744&env.maxX=77.76868339468788&env.maxY=24.365781485488851&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

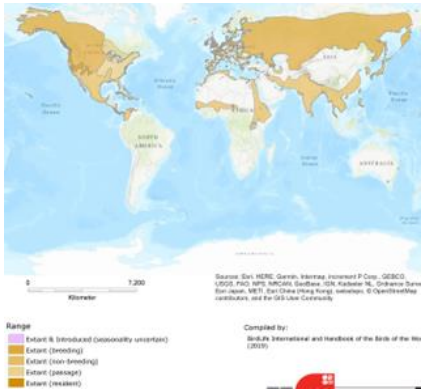
[463] https://ebird.org/checklist/S62520515

[464] Wetlands International. 2006. Waterbird Population Estimates – Fourth Edition. Wageningen, The Netherlands.

[465] BirdLife International. 2015. European Red List of Birds. Office for Official Publications of the European Communities, Luxembourg.

	 https://www.iucnredlist.org/species/22680301/153882797			vegetation and wetlands interspersed with brushy thickets or copses[466, 467, 468, 469, 470, 471]. During the winter, it frequents large inland lakes, brackish coastal lagoons, brackish & saline marshes, shallow fresh or brackish estuaries, tidal flats and river deltas with adjacent agricultural land (e.g. stubble fields) and scattered impoundments[472, 473, 474, 475, 476, 477, 478]. Nalsarovar Wildlife Sanctuary, and Salt Pans of Bhavnagar are the possible habitats for this migratory species in Gujarat as per the Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated Edition - 2016)[479]. Undoubtedly the species has a presence in the surroundings of Vadodara[480, 481], however based on available secondary information extracted from eBird Database[482] (which reports maximum 800 individuals from Timbi Lake[483]), it is less likely to meet the threshold i.e. 71,000-72,000 (≥1 percent of the global population) for the EAAA.	
50	Northern Shoveler (*Spatula clypeata*)	**IUCN:** Least Concern 3a **IWP:** Schedule IV **Restricted range:** No **Migratory:** Yes		Northern Shoveler generally occur in North America, North Europe and North Asia during the breeding season. In winter, they migrate to Central and South America, Southern Europe, Africa, Indian Subcontinent, China and Southeast Asia.	Screened Out

[466] Johnsgard, P.A. 1978. Ducks, geese and swans of the World. University of Nebraska Press, Lincoln and London.
[467] Madge, S.; Burn, H. 1988. Wildfowl. Christopher Helm, London.
[468] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[469] Snow, D.W.; Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[470] Hockey, P.A.R.; Dean, W.R.J.; Ryan, P.G. 2005. Roberts Birds of Southern Africa. Trustees of the John Voelcker Bird Book Fund, Cape Town, South Africa.
[471] Kear, J. 2005. Ducks, geese and swans volume 2: species accounts (Cairina to Mergus). Oxford University Press, Oxford, U.K.
[472] Johnsgard, P.A. 1978. Ducks, geese and swans of the World. University of Nebraska Press, Lincoln and London.
[473] Brown, L.H.; Urban, E.K.; Newman, K. 1982. The Birds of Africa, Volume I. Academic Press, London.
[474] Madge, S.; Burn, H. 1988. Wildfowl. Christopher Helm, London.
[475] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[476] Scott, D. A.; Rose, P. M. 1996. Atlas of Anatidae populations in Africa and western Eurasia. Wetlands International, Wageningen, Netherlands.
[477] Steele, B.B., Reitsma, L.R., Racine, C.H., Burson, S.L. III., Stuart, R. and Theberge, R. 1997. Different susceptibilities to white phosphorous poisoning among five species of ducks. Environmental Toxicology and Chemistry 16(11): 2275-2282.
[478] Snow, D.W.; Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[479] 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.). Pp. 1992 + xii
[480] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=
[481] https://www.inaturalist.org/observations?iconic_taxa=Aves&place_id=32168&subview=map&view=species
[482] https://ebird.org/map/norpin?neg=true&env.minX=71.510221242407&env.minY=21.623187842823185&env.maxX=74.322721242407&env.maxY=22.75487758413399&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[483] https://ebird.org/checklist/S99275042



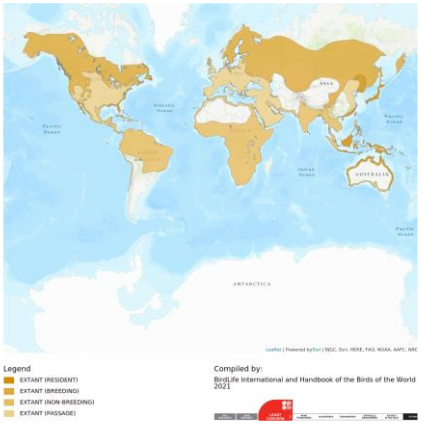
https://www.iucnredlist.org/species/22680247/153875944

The global population is estimated to number 6,500,000-7,000,000 individuals[484]; while the European population is estimated at 170,000-233,000 pairs[485].

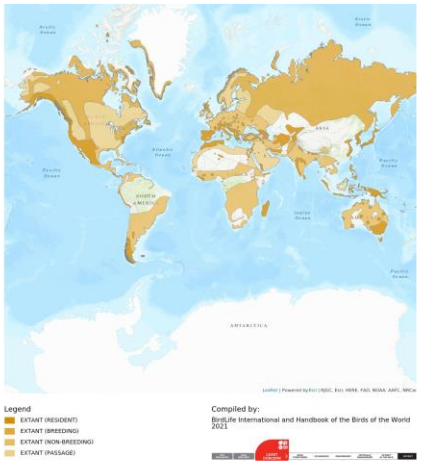
It inhabits from sea level up to 2,900 m (Ethiopia) in permanent shallow well-vegetated (surrounded by dense stands of reeds or other emergent vegetation) freshwater lakes & marshes/wetlands with muddy shores and substrates in open country (e.g. grasslands)[486, 487, 488, 489], oxbow lakes, channels and swamps[490, 491, 492, 493, 494, 495], artificial waters bordered by lush grassland such as sewage farms, rice-fields and fish ponds[496, 497, 498]. In the winter it can be found on coastal brackish lagoons, tidal muflats, estuaries, coastal shorelines, fresh and brackish estuarine marshes, inland seas and brackish or saline inland waters, occasionally occurring (briefly) on marine waters during migration (although it generally avoids very saline habitats)[499, 500, 501, 502, 503].

Undoubtedly the species has a presence in the surroundings of Vadodara[504, 505], however based on available secondary information extracted from eBird Database[506] (which reports maximum 200 individuals from Timbi Lake[507]), it is less likely to meet the threshold i.e. 65,000-70,000 (≥1 percent of the global population) for the EAAA.

[484] Wetlands International. 2015. Waterbird Population Estimates. Available at: wpe.wetlands.org.
[485] BirdLife International. 2015. European Red List of Birds. Office for Official Publications of the European Communities, Luxembourg.
[486] Johnsgard, P.A. 1978. Ducks, geese and swans of the World. University of Nebraska Press, Lincoln and London.
[487] Brown, L.H.; Urban, E.K.; Newman, K. 1982. The Birds of Africa, Volume I. Academic Press, London.
[488] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[489] Snow, D.W.; Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[490] Johnsgard, P.A. 1978. Ducks, geese and swans of the World. University of Nebraska Press, Lincoln and London.
[491] Brown, L.H.; Urban, E.K.; Newman, K. 1982. The Birds of Africa, Volume I. Academic Press, London.
[492] Flint, V.E.; Boehme, R.L.; Kostin, Y.V.; Kuznetsov, A.A. 1984. A field guide to birds of the USSR. Princeton University Press, Princeton, New Jersey.
[493] Madge, S.; Burn, H. 1988. Wildfowl. Christopher Helm, London.
[494] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[495] Kear, J. 2005. Ducks, geese and swans volume 2: species accounts (Cairina to Mergus). Oxford University Press, Oxford, U.K.
[496] Snow, D.W.; Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[497] Kear, J. 2005. Ducks, geese and swans volume 2: species accounts (Cairina to Mergus). Oxford University Press, Oxford, U.K.
[498] Musil, P. 2006. A review of the effects of intensive fish production on waterbird breeding populations. In: G. Boere, C. Galbraith and D. Stroud (eds), Waterbirds around the world, pp. 520-521. The Stationary Office, Edinburgh, U.K.
[499] Johnsgard, P.A. 1978. Ducks, geese and swans of the World. University of Nebraska Press, Lincoln and London.
[500] Madge, S.; Burn, H. 1988. Wildfowl. Christopher Helm, London.
[501] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[502] Snow, D.W.; Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[503] Kear, J. 2005. Ducks, geese and swans volume 2: species accounts (Cairina to Mergus). Oxford University Press, Oxford, U.K.
[504] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=
[505] https://www.inaturalist.org/observations?iconic_taxa=Aves&place_id=32168&subview=map&view=species
[506] https://ebird.org/map/norsho?neg=true&env.minX=73.2424275730431&env.minY=22.30217975915185&env.maxX=73.3303181980431&env.maxY=22.337512803352677&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[507] https://ebird.org/checklist/S99091820

51	Osprey (*Pandion haliaetus*)  https://www.iucnredlist.org/species/22694938/206628879	**IUCN:** Least Concern **IWP:** Schedule I **Restricted range:** No **Migratory:** Yes	3a	Osprey is the second most widely distributed raptor species, after the peregrine falcon, and is one of only six land-birds with a worldwide distribution[508]. It is found in temperate and tropical regions of all continents, except Antarctica. In North America it breeds from Alaska and Newfoundland south to the Gulf Coast and Florida, wintering further south from the southern United States through to Argentina[509]. The European population is estimated at 9,600-13,600 pairs, which equates to 19,200-27,200 mature individuals. As Europe forms ca. 14% of the global range, so a very preliminary estimate of the global population size is 137,000-200,000 mature individuals[510]. It inhabits the areas around shallow waters, being sufficiently tolerant of human settlement to persist in suburban and sometimes urban environments[511]. Undoubtedly the species has a presence in the surroundings of Vadodara[512], however based on available secondary information extracted from eBird Database[513] (which reports maximum 3 individuals from the Timbi Lake[514]), it is less likely to meet the threshold i.e. 96-136 (≥1 percent of the global population) for the EAAA.	Screened Out
52	Peregrine Falcon (*Falco peregrinus*)	**IUCN:** Least Concern **IWP:** Schedule IV **Restricted range:** No **Migratory:** Yes	3a	Peregrine Falcon is one of the most widespread birds in the world. It is found on all continents except Antarctica, and on many oceanic islands[515]. The European population is estimated at 16,100-31,100 pairs, which equates to 32,200-62,100 mature individuals[516]. Europe forms approximately 13% of the global range, so a very preliminary estimate of the global population size is 248,000-478,000 mature individuals, although further validation of this estimate is needed. Thus, the population is therefore placed in the band 100,000-499,999 mature individuals[517].	Screened Out

[508] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4650845
[509] https://archive.org/details/audubonsocietyfi0000bull/page/469
[510] BirdLife International. 2021. Pandion haliaetus. The IUCN Red List of Threatened Species 2021: e.T22694938A206628879
[511] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[512] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=
[513] https://ebird.org/map/osprey?neg=true&env.minX=73.36002088751769&env.minY=22.15863211609402&env.maxX=73.53580213751769&env.maxY=22.229361751454146&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[514] https://ebird.org/checklist/S80635900
[515] https://www.allaboutbirds.org/guide/Peregrine_Falcon/overview
[516] BirdLife International. In prep. European Red List of Birds. Deliverable to the European Commission (DG Environment) in 2021 under Service Contract ENV.D.3/SER/2018/0018.
[517] https://www.iucnredlist.org/species/45354964/206217909#population

	 https://www.iucnredlist.org/species/45354964/206217909		It inhabits an extreme variety of habitats, tolerating wet and dry, hot and cool climates, from sea level up to c.4,000 m[518]. Undoubtedly the species has a presence in the surroundings of Vadodara[519], however based on available secondary information extracted from eBird Database[520] (which reports maximum 3 individuals from the Chanakyapuri Society[521] in 2020 and from Makarpura area[522] in 2016), it is less likely to meet the threshold i.e. 1,000-4,999 (≥1 percent of the global population) for the EAAA.	
53	Red-crested Pochard (*Netta rufina*)	**IUCN:** Least Concern 3a **IWP:** Schedule IV **Restricted range:** No **Migratory:** Yes		Red-crested Pochard is distributed in Southern Europe and extends from Black Sea to Central Asia and Mongolia. Indian Subcontinent and Africa are the wintering areas. The global population is estimated at 420,000-600,000 individuals[523, 524]. The species inhabits inland deep fresh or brackish[525] reed-fringed lakes, rivers, or saline and alkaline lagoons[526] in open country[527], also occurring (less often) on estuaries, river deltas and other sheltered coastal habitats[528] on passage[529] or during the winter[530].	Screened Out

[518] del Hoyo, J.; Elliott, A.; Sargatal, J. 1994. Handbook of the Birds of the World, vol. 2: New World Vultures to Guineafowl. Lynx Edicions, Barcelona, Spain.
[519] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=
[520] https://ebird.org/map/perfal?neg=true&env.minX=73.27526807785034&env.minY=22.3029724554732&env.maxX=73.29724073410034&env.maxY=22.311806504904816&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[521] https://ebird.org/india/checklist/S74872241
[522] https://ebird.org/india/checklist/S30934615
[523] Wetlands International. 2015. Waterbird Population Estimates. Available at: wpe.wetlands.org.
[524] https://www.iucnredlist.org/species/22680348/86012189
[525] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[526] Kear, J. 2005. Ducks, geese and swans volume 2: species accounts (Cairina to Mergus). Oxford University Press, Oxford, U.K.
[527] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[528] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[529] Madge, S.; Burn, H. 1988. Wildfowl. Christopher Helm, London.
[530] Scott, D. A.; Rose, P. M. 1996. Atlas of Anatidae populations in Africa and western Eurasia. Wetlands International, Wageningen, Netherlands.

	 https://www.iucnredlist.org/species/22680348/86012189			Undoubtedly the species has a presence in the surroundings of Vadodara[531], however based on available secondary information extracted from eBird Database[532] (which reports maximum 28 individuals from the Vadhavana Lake[533]), it is less likely to meet the threshold i.e. 4200-6000 (≥1 percent of the global population) for the EAAA.	
54	Ruff (*Calidris pugnax*)	**IUCN:** Least Concern **IWP:** Schedule IV **Restricted range:** No **Migratory:** Yes	3a	Ruff is a medium-sized wading bird that breeds in marshes and wet meadows across northern Eurasia. Its winter grounds, include southern and western Europe, Africa, southern Asia and Australia[534]. The European population is estimated at 265,000-1,650,000 calling or lekking males, which equates to 797,000-4,970,000 individuals. As Europe forms approximately 50% of the global range so a very preliminary estimate of the global population size is 1,594,000-9,940,000[535, 536]. The species inhabits tundra habitats from the coast to the Arctic treeline[537, 538] during the breeding season, requiring adjacent foraging, lekking and nesting areas[539]. Suitable foraging habitats include littoral belts, deltas, coastal saltmarshes, extensive lowland freshwater wetlands such as small shallow lakes with marginal vegetation, grassy hummocky marshes, damp swampy grasslands and with shallow pools or ditches[540, 541,	Screened Out

[531] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=

[532] https://ebird.org/map/recpoc?neg=true&env.minX=72.39678988758108&env.minY=22.010724135204242&env.maxX=73.80303988758108&env.maxY=22.576156690225265&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

[533] https://ebird.org/india/checklist/S127726013

[534] https://www.thainationalparks.com/species/ruff

[535] BirdLife International. 2015. European Red List of Birds. Office for Official Publications of the European Communities, Luxembourg.

[536] https://www.iucnredlist.org/species/22693468/86591264

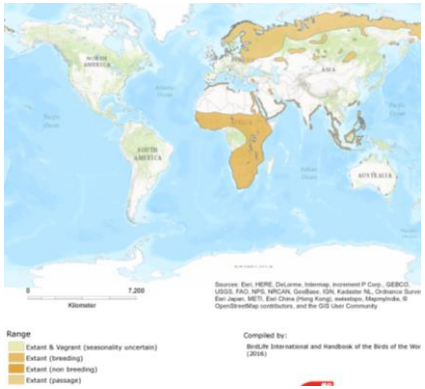
[537] Johnsgard, P. A. 1981. The plovers, sandpipers and snipes of the world. University of Nebraska Press, Lincoln, U.S.A. and London.

[538] del Hoyo, J., Elliott, A., and Sargatal, J. 1996. Handbook of the Birds of the World, vol. 3: Hoatzin to Auks. Lynx Edicions, Barcelona, Spain.

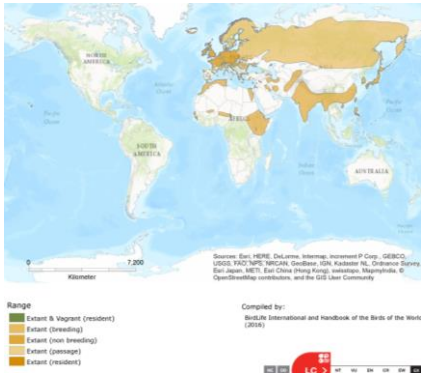
[539] del Hoyo, J., Elliott, A., and Sargatal, J. 1996. Handbook of the Birds of the World, vol. 3: Hoatzin to Auks. Lynx Edicions, Barcelona, Spain.

[540] Johnsgard, P. A. 1981. The plovers, sandpipers and snipes of the world. University of Nebraska Press, Lincoln, U.S.A. and London.

[541] Hayman, P.; Marchant, J.; Prater, A. J. 1986. Shorebirds. Croom Helm, London.

	 https://www.iucnredlist.org/species/22693468/86591264			[542, 543]. During the non-breeding season the species occupies the muddy margins of brackish, saline and alkaline lakes, ponds, pools, rivers, marshes, food-plains, freshly mown or grazed short-sward grasslands, wheat- or rice-fields, usually roosting at night in the shallow waters of lake shores[544, 545]. The species rarely utilises intertidal habitats[546] but may frequent tidal mudflats and lagoons in India[547]. Indeed, the species has a presence in the surroundings of Vadodara[548, 549], however based on available secondary information extracted from eBird Database[550] (which reports maximum 200 individuals from the Timbi Lake[551] during Jan. 2020), it is less likely to meet the threshold i.e. 15,940-99,400 (≥1 percent of the global population) for the EAAA.	
55	Tufted Duck (*Aythya fuligula*)	**IUCN:** Least Concern **IWP:** Schedule IV **Restricted range:** No **Migratory:** Yes	3a	Tufted Duck has a wide distribution throughout northern Canada and Eurasia, localised in parts of America, Africa, southern Europe, the middle east, India through to southern China and Japan[552]. The global population is estimated to number c. 2,600,000-2,900,000 individuals[553]. The species breeds in lowland regions and shows a preference for eutrophic waters 3-5 m deep (avoiding lakes deeper than 15 m) with open water, islands for breeding and abundant marginal and emergent vegetation[554, 555]. It is common on large, freshwater	Screened Out

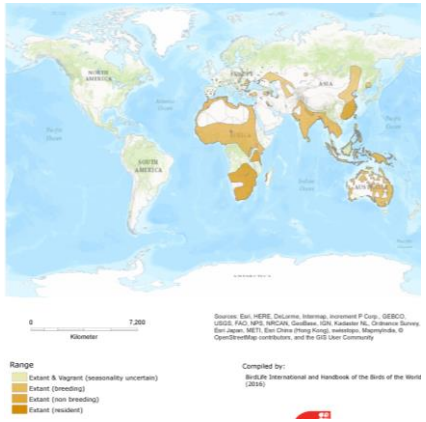
[542] del Hoyo, J., Elliott, A., and Sargatal, J. 1996. Handbook of the Birds of the World, vol. 3: Hoatzin to Auks. Lynx Edicions, Barcelona, Spain.
[543] Snow, D.W.; Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[544] Hayman, P.; Marchant, J.; Prater, A. J. 1986. Shorebirds. Croom Helm, London.
[545] del Hoyo, J., Elliott, A., and Sargatal, J. 1996. Handbook of the Birds of the World, vol. 3: Hoatzin to Auks. Lynx Edicions, Barcelona, Spain.
[546] Hayman, P.; Marchant, J.; Prater, A. J. 1986. Shorebirds. Croom Helm, London.
[547] del Hoyo, J., Elliott, A., and Sargatal, J. 1996. Handbook of the Birds of the World, vol. 3: Hoatzin to Auks. Lynx Edicions, Barcelona, Spain.
[548] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=
[549] https://www.inaturalist.org/observations?iconic_taxa=Aves&place_id=32168&subview=map&view=species
[550] https://ebird.org/map/ruff?neg=true&env.minX=73.4389459066339&env.minY=22.163878457523488&env.maxX=73.5268365316339&env.maxY=22.199246407778386&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[551] https://ebird.org/checklist/S63692165
[552] https://www.brickfieldspark.org/data/ducktufted.htm
[553] Wetlands International. 2015. Waterbird Population Estimates. Available at: wpe.wetlands.org.
[554] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[555] Kear, J. 2005. Ducks, geese and swans volume 2: species accounts (Cairina to Mergus). Oxford University Press, Oxford, U.K.

	 https://www.iucnredlist.org/species/22680391/86013549			lakes, ponds, reservoirs, gravel-pits and quiet stretches of wide slow-flowing rivers during this season[556, 557]. During the winter the species frequents large freshwater lakes, reservoirs and sheltered coastal locations such as brackish lagoons, brackish inland seas (e.g. Caspian Sea), tidal bays and estuaries although it avoids strong wave action and very exposed maritime conditions unless all inland freshwaters become frozen[558, 559, 560, 561, 562]. Indeed, the species has a presence in the surroundings of Vadodara[563, 564], however based on available secondary information extracted from eBird Database[565] (which reports maximum 5 individuals from the Timbi Lake[566] during Feb. 2019), it is less likely to meet the threshold i.e. 26,000-29,000 (≥1 percent of the global population) for the EAAA.	
56	Western Marsh-harrier (*Circus aeruginosus*)	**IUCN:** Least Concern **IWP:** Schedule I **Restricted range:** No **Migratory:** Yes	3a	Western Marsh-harrier has a wide breeding range from Europe and northwestern Africa to Central Asia and the northern parts of the Middle East. It breeds in almost every country of Europe but is absent from mountainous regions and subarctic Scandinavia[567]. In Europe, the breeding population is estimated to number 151,000-243,000 breeding females, which equates to 303,000-485,000 mature individuals[568]. Europe forms ca. 48% of the global range, so a very preliminary estimate of the global population size is 631,000-1,010,000 mature individuals, although further validation of this estimate is needed, thus, it is placed in the band 600,000 to 1,100,000 mature individuals.	Screened Out

[556] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[557] Kear, J. 2005. Ducks, geese and swans volume 2: species accounts (Cairina to Mergus). Oxford University Press, Oxford, U.K.
[558] Madge, S.; Burn, H. 1988. Wildfowl. Christopher Helm, London.
[559] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[560] Scott, D. A.; Rose, P. M. 1996. Atlas of Anatidae populations in Africa and western Eurasia. Wetlands International, Wageningen, Netherlands.
[561] Snow, D.W.; Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[562] Kear, J. 2005. Ducks, geese and swans volume 2: species accounts (Cairina to Mergus). Oxford University Press, Oxford, U.K.
[563] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=
[564] https://www.inaturalist.org/observations?iconic_taxa=Aves&place_id=32168&subview=map&view=species
[565] https://ebird.org/map/tufduc?neg=true&env.minX=73.26536226272586&env.minY=22.30096203524505&env.maxX=73.30930757522586&env.maxY=22.318629829565946&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[566] https://ebird.org/gbbc/checklist/S52804938
[567] https://animalia.bio/western-marsh-harrier#distribution
[568] BirdLife International. In prep. European Red List of Birds. Deliverable to the European Commission (DG Environment) in 2021 under Service Contract ENV.D.3/SER/2018/0018.

	 https://www.iucnredlist.org/species/22695344/203357709			The species inhabits extensive areas of dense marsh vegetation, in fresh or brackish water, generally in lowlands but up to 2,000 m in Asia and 3,000 m on its wintering grounds in Cameroon[569]. Definitely, the species has a presence in the surroundings of Vadodara[570, 571], however based on available secondary information extracted from eBird Database[572] (which reports maximum 6 individuals from the Timbi Lake[573] during Dec. 2022), it is less likely to meet the threshold i.e. 6,000 – 11,000 (≥1 percent of the global population) for the EAAA.	
57	Whiskered Tern (*Chlidonias hybrida*)	**IUCN:** Least Concern 3a **IWP:** Schedule IV **Restricted range:** No **Migratory:** Yes		Whiskered Tern has a wide distribution range covering four continents: Africa, Asia, Europe, and Australia. In South Asia, it is known as a breeding resident in the Gangetic Plains and is likely to breed in Afghanistan. It is a winter visitor and passage migrant in most of parts of the Indian Subcontinent[574]. The global population is estimated to number c. 300,000-1,500,000 individuals[575, 576]. The species utilises a variety of wetland habitats but shows a preference for freshwater marshlands with scattered pools, particularly where the surrounding vegetation is grazed by cattle or horses[577]. It frequents inland lakes, rivers, marshes, temporary pans, artificial fish-ponds and drainage-ponds covered with water-lilies, swamps, river pools, reservoirs, large dams, sewage-ponds, flooded saltmarshes, arable fields and rice-	Screened Out

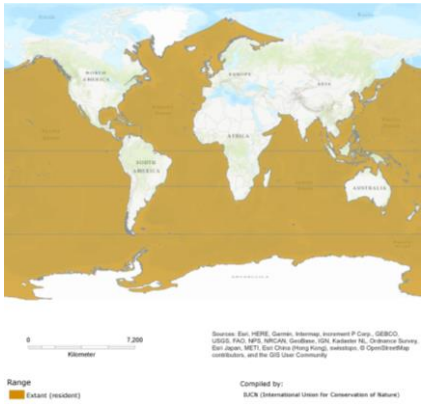
[569] del Hoyo, J.; Elliott, A.; Sargatal, J. 1994. Handbook of the Birds of the World, vol. 2: New World Vultures to Guineafowl. Lynx Edicions, Barcelona, Spain.
[570] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=
[571] https://www.inaturalist.org/observations?iconic_taxa=Aves&place_id=32168&subview=map&view=species
[572] https://ebird.org/map/wemhar1?neg=true&env.minX=73.2552853653299&env.minY=22.112360652362582&env.maxX=73.6068478653299&env.maxY=22.253830864817065&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[573] https://ebird.org/checklist/S123986472
[574] https://indianbirds.in/pdfs/IB_17_1_Ranade_WhiskeredTern.pdf
[575] Wetlands International. 2015. Waterbird Population Estimates. Available at: wpe.wetlands.org.
[576] https://www.iucnredlist.org/species/22694764/111750380
[577] Richards, A. 1990. Seabirds of the northern hemisphere. Dragon's World Ltd, Limpsfield, U.K.

	 https://www.iucnredlist.org/species/22694764/111750380			fields[578, 579]. It also occurs along the coast on estuaries, coastal lagoons, creeks in mangrove swamps[580] and tidal mudflats[581]. Definitely, the species has a presence in the surroundings of Vadodara[582, 583], however based on available secondary information extracted from eBird Database[584] (which reports maximum 30 individuals from the Dabhoi area in 2018[585]), it is less likely to meet the threshold i.e. 3,000-15,000 (≥1 percent of the global population) for the EAAA.	
58	White Stork (*Ciconia ciconia*)	**IUCN:** Least Concern **IWP:** Schedule IV **Restricted range:** No **Migratory:** Yes	3a	White storks are found across Europe, Asia Minor, the northern part of Africa, and the Middle East. By the winter months, they migrate into tropical regions of Africa, some parts of the Middle East, and the Indian subcontinent[586]. The global population size is estimated at 700,000-704,000 individuals[587, 588]. The species inhabits open areas, generally avoiding regions with persistent cold, wet weather or large tracts of tall, dense vegetation such as reedbeds or forests, shallow marshes, lakesides, lagoons, flood-plains, rice-fields and arable land especially where there are scattered trees for roosting[589, 590, 591]. During the winter the species shows a	Screened Out

[578] Higgins, P. J.; Davies, S. J. J. F. 1996. Handbook of Australian, New Zealand and Antarctic birds vol 3: snipe to pigeons. Oxford University Press, Oxford.
[579] del Hoyo, J., Elliott, A., and Sargatal, J. 1996. Handbook of the Birds of the World, vol. 3: Hoatzin to Auks. Lynx Edicions, Barcelona, Spain.
[580] Snow, D.W.; Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[581] del Hoyo, J., Elliott, A., and Sargatal, J. 1996. Handbook of the Birds of the World, vol. 3: Hoatzin to Auks. Lynx Edicions, Barcelona, Spain.
[582] https://ebird.org/barchart?r=IN-GJ-VD&yr=all&m=
[583] https://www.inaturalist.org/observations?iconic_taxa=Aves&place_id=32168&subview=map&view=species
[584] https://ebird.org/map/whiter2?neg=true&env.minX=72.39195688359627&env.minY=21.989534704785022&env.maxX=73.79820688359627&env.maxY=22.55505278378717&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[585] https://ebird.org/checklist/S49285316
[586] https://animalia.bio/white-stork
[587] Wetlands International. 2015. Waterbird Population Estimates. Available at: wpe.wetlands.org.
[588] https://www.iucnredlist.org/species/22697691/86248677
[589] Hancock, J. A.; Kushlan, J. A.; Kahl, M. P. 1992. Storks, ibises and spoonbills of the world. Academic Press, London.
[590] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[591] Snow, D.W.; Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.

	 https://www.iucnredlist.org/species/22697691/86248677			preference for drier habitats such as grasslands, steppe, savanna and cultivated fields, often gathering near lakes, ponds, pools, slow-flowing streams, ditches or rivers[592, 593]. Bhal Area and Velavadar National Park are the possible habitats for this migratory species in Gujarat[594]. The available secondary information[595, 596, 597] also supports the less likelihood of the species in the Vadodara city and more specifically in the project's EAAA.	
Mammals						
59	Blue Whale (*Balaenoptera musculus*)	**IUCN:** Endangered **IWP:** Schedule I **Restricted range:** No **Migratory:** No	1 a	The Blue Whale is a cosmopolitan species, found in all oceans but absent from some regional seas such as the Mediterranean, Okhotsk, and Bering seas. In the Northern Indian Ocean, Blue Whales are found year-round in the northern Indian Ocean, especially around Sri Lanka, and seasonally around the Maldive Islands and in the Gulf of Aden[598, 599, 600, 601].	Screened Out

[592] Hancock, J. A.; Kushlan, J. A.; Kahl, M. P. 1992. Storks, ibises and spoonbills of the world. Academic Press, London.
[593] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[594] 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.). Pp. 1992 + xii
[595] https://ebird.org/map/whisto1?neg=true&env.minX=72.4303731032164&env.minY=22.03138830734687&env.maxX=73.8366231032164&env.maxY=22.596737384381402&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[596] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=4733
[597] https://www.gbif.org/occurrence/map?taxon_key=2481912
[598] Alling, A., Dorsey, E.M. and Gordon, J.C.D. 1991. Blue whales (Balaenoptera musculus) off the northeast coast of Sri Lanka: distribution, feeding and individual identification. UNEP Marine Mammal Technical Report 3: 247-258.
[599] Mikhalev, Yu. A. 2000. Whaling in the Arabian Sea by the whaling fleets Slava and Sovetskaya Ukraina. Soviet Whaling Data (1949-1979), pp. 141-180. Center for Russian Environmental Policy, Moscow, Russia.
[600] Stafford, K.M., Chapp, E., Bohnenstiel, D.R. and Tolstoy, M. 2011. Seasonal detection of three types of "pygmy" blue whale calls in the Indian Ocean. Marine Mammal Science 27(4): 828–840.
[601] Anderson C., Branch T.A., Alagiyawadu A., Baldwin R. and Marsac F. 2012. Seasonal distribution, movements and taxonomic status of blue whales (Balaenoptera musculus) in the northern Indian

	 https://www.iucnredlist.org/species/2477/156923585				The global population of the species ranges from 5000 to 15000; however, no abundance estimation for the Northern Indian Ocean are available[602]. In the Indian Ocean, blue whales are only documented from the highly productive northern part[603]. No recognized information about the presence of the species in Gujarat cost was available[604]. In Sep. 2017, an individual of the species was rescued and pushed into the sea in the coast of Nava Bandar, taluka Una, district Junagadh[605]. In Apr. 2018, an observation was also made about 112 km away from the Dwarka cost[606]. All the above-mentioned records are away from the EAAA and no record of the species is available from the EAAA[607, 608].	
60	Indian Pangolin (*Manis crassicaudata*)	**IUCN:** Endangered **IWP:** Schedule I **Restricted range:** No **Migratory:** No	1 a		Indian Pangolin is distributed in South Asia from northern and southeastern Pakistan through much of India south of the Himalayas (excluding far northeastern portions of the country), southern Nepal, and Sri Lanka[609]. The species is understood to occur in various types of tropical forests as well as open land, grasslands and degraded habitats, including in close proximity to villages. The species can adapt well to modified habitats, provided its ant and termite prey remains abundant. Indian Pangolin is widely distributed in India, except the arid region, high Himalayas and the North-East[610]. Although, the distribution map of Indian Pangolin includes the entire Gujarat state, however no information about the presence of the species has been reported from Vadodara area, specifically from the project's EAAA[611, 612].	Screened Out

Ocean. Journal of Cetacean Research and Management 12(2): 203-218.

[602] https://www.iucnredlist.org/species/2477/156923585#population

[603] https://www.currentscience.ac.in/Volumes/120/03/0470.pdf

[604] https://arabianseawhalenetwork.org/wp-content/uploads/2017/09/sc_66b_sh_34_baleen-whale-records-from-arabian-sea-coast-of-india.pdf

[605] https://timesofindia.indiatimes.com/city/ahmedabad/30-feet-blue-whale-rescued-off-una-coast/articleshow/60785894.cms

[606] https://www.currentscience.ac.in/Volumes/120/03/0470.pdf

[607] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=41553

[608] https://www.gbif.org/species/2440735

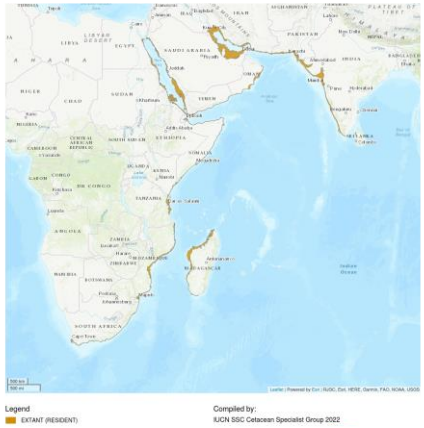
[609] Mahmood, T., Challender, D., Khatiwada, A., Andleeb, S., Perera, P., Trageser, S., Ghose, A. & Mohapatra, R. 2019. Manis crassicaudata. The IUCN Red List of Threatened Species 2019: e.T12761A123583998

[610] https://www.wwfindia.org/about_wwf/priority_species/threatened_species/indian_pangolin/

[611] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=43362

[612] https://www.gbif.org/species/5219633

https://www.iucnredlist.org/species/12761/123583998

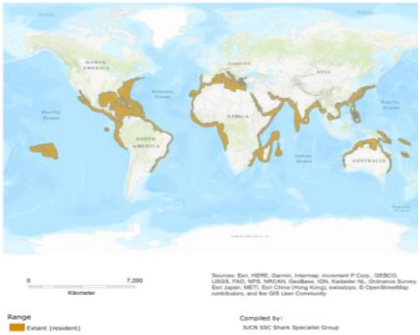
61	Indian Ocean Humpback Dolphin (*Sousa plumbea*) 	**IUCN:** Endangered **IWP:** Schedule I **Restricted range:** No **Migratory:** No	1 a	Indian Ocean Humpback Dolphins are found in a narrow strip of shallow coastal waters from False Bay, South Africa, in the west, through the coastal waters of east Africa, the Horn of Africa, and the Middle East to approximately the southern tip of India and Sri Lanka[613]. Indices of abundance for Indian Ocean Humpback Dolphins were recorded for the Gulf of Kachchh and the Goa coast of India, and the sighting rate was over six times higher in Goa[614]. In Sindhudurg, Maharashtra, the local population size is thought to be fewer than 1,000 individuals, probably closer to 500 based on an analysis of the photo-identification catalogue[615]. Throughout their range, Indian Ocean Humpback Dolphins occur in coastal habitats that include mangroves, rocky reefs, coral reefs, lagoons, and shallow protected bays. The over-riding habitat preference appears to be for water shallower than 25 m in depth[616].	Screened Out

[613] Braulik, G. T., K. Findlay, S. Cerchio and R. Baldwin. 2015. Chapter Five - Assessment of the Conservation Status of the Indian Ocean Humpback Dolphin (Sousa plumbea) Using the IUCN Red List Criteria. Advances in Marine Biology 72: 119-141.

[614] Sutaria, D. and Jefferson, T. A. 2004. Records of Indo-Pacific humpback dolphins (Sousa chinensis, Osbeck, 1765) along the coasts of India and Sri Lanka: An overview. Aquatic Mammals 30(1): 125-136.

[615] Sule, M., Jog, K., Bopardikar, I., Patankar, V. and Sutaria, D. 2017. Cetaceans of the Sindhudurg coast. Report submitted to the Government of India: GOI-GEF-UNDP.

[616] Braulik, G.T., Natoli, A., Sutaria, D. & Vermeulen, E. 2023. Sousa plumbea. The IUCN Red List of Threatened Species 2023: e.T82031633A230253271.

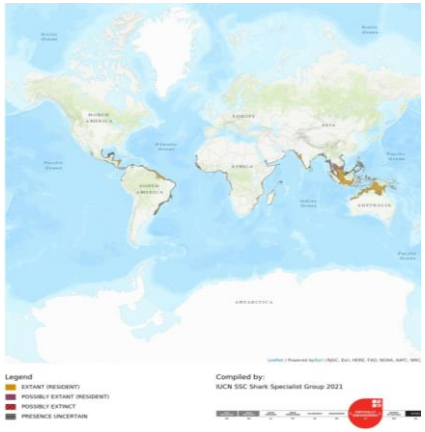
	https://www.iucnredlist.org/species/82031633/230253271			During 2001-02, the Indian Ocean Humpback Dolphins were reported from the Gulf of Katchh[617]. Recently the species was reported only from Dwarka in 2014, 2019, & 2023[618]. The species has not been reported from the surroundings of Vadodara[619, 620].	
Other Aquatic Fauna					
62	Great Hammerhead (*Sphyrna mokarran*)  https://www.iucnredlist.org/species/39386/2920499	**IUCN:** Critically Endangered **IWP:** Schedule-II **Restricted range:** No **Migratory:** No	1 a	The great hammerhead shark is the largest of all nine hammerhead species, reaching an average length of 13.1 feet (4 m) and weight of 500 pounds (230 kg)[621]. The Great Hammerhead ranges worldwide throughout tropical and warm temperate seas[622]. The Great Hammerhead is a generally solitary, coastal and semi-oceanic pelagic shark, that occurs close inshore and well offshore at depths ranging from near-surface to 300 m deep[623]. They are seen in tropical and subtropical coastal waters, near continental shelves, coral reefs and in deep waters[624]. Great hammerheads are, however, vulnerable to overfishing[625]. Although the global distribution map of the species includes the entire coast of India, however as per the available secondary information[626, 627], the species has not been reported from the coast of Gujarat State, specifically from the surroundings of Vadodara area. Thus, its presence in the project's EAAA is less likely.	Screened Out
63	Green Sawfish (*Pristis zijsron*)	**IUCN:** Critically Endangered	1 a	Green Sawfish was formerly widespread throughout the northwest Indian Ocean and continuously distributed from Somalia to India, occurring throughout the Red Sea, Gulf	Screened Out

[617] Sutaria, D. and Jefferson, T. A. 2004. Records of Indo-Pacific humpback dolphins (Sousa chinensis, Osbeck, 1765) along the coasts of India and Sri Lanka: An overview. Aquatic Mammals 30(1): 125-136.
[618] https://www.marinemammals.in/database/sightings-and-strandings/
[619] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=469961
[620] https://www.gbif.org/species/2440506
[621] https://oceana.org/marine-life/great-hammerhead-shark/
[622] Last, P.R. and Stevens, J.D. 2009. Sharks and Rays of Australia. CSIRO Publishing, Collingwood
[623] Ebert, D.A., Fowler, S. and Compagno, L. 2013. Sharks of the World. A Fully Illustrated Guide. Wild Nature Press, Plymouth, United Kingdom.
[624]
[625] https://oceana.org/marine-life/great-hammerhead-shark/
[626] https://www.gbif.org/species/2418792
[627] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=56766

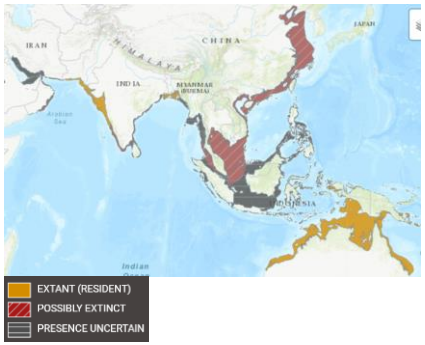
	 https://www.iucnredlist.org/species/39393/58304631	**IWP:** Schedule I **Restricted range:** No **Migratory:** No		of Aden, the Persian/Arabian Gulf, Gulf of Oman, and Arabian Sea[628]. Its current occurrence in much of this range is uncertain, partly due to a lack of reliable data, but it is now rare and restricted to a few areas. It is currently known to be extant in Eritrea, Sudan, Saudi Arabia (Red Sea), Oman, United Arab Emirates (UAE), Bahrain, and Iran [629, 630]. For larger individuals, the movement between the river mouth or creeks and nearshore coastal habitats was largely tidally driven, with nearshore coastal habitats used during low tide and protected tidal waters (mangrove creeks) used during high tide. Emigration from the river estuary appeared to be influenced by increases in freshwater discharge and high turbidity brought on by cyclonic rainfall events[631]. As the species has been displayed as "possibly extant" in IUCN portal for throughout the Indian coast[632] and has also not been reported from the coasts of Gujarat (specifically surroundings of Vadodara)[633, 634, 635]; its presence in the project's EAAA is unlikely.	
64	Largetooth Sawfish (*Pristis pristis*)	**IUCN:** Critically Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1a,c & 2a	The Largetooth Sawfish has a widespread circumtropical distribution across the Western Atlantic, Eastern Pacific, Eastern Atlantic, and the Indo-West Pacific. The Largetooth Sawfish are seen at depths of 0–60 m with juveniles occupying freshwater and estuarine habitats, and adults occurring in both estuarine and coastal waters. All subpopulations of this specie have undergone severe historic and ongoing steep population reductions due to overexploitation and habitat loss and degradation with significant range contractions across their distribution. Although the species distribution map includes the Indian coasts, however as per the available secondary information[636, 637, 638], the species has not been reported from the surroundings of Vadodara area. Thus, its presence in the project's EAAA is less likely.	Screened Out

[628] Harrison, L.R. and Dulvy, N.K. 2014. Sawfish: A Global Strategy for Conservation. IUCN Species Survival Commission's Shark Specialist Group, Vancouver, Canada.
[629] McClenachan, L., Cooper, A.B. and Dulvy, N.K. 2016. Rethinking Trade-Driven Extinction Risk in Marine and Terrestrial Megafauna. Current Biology 26: 1640–1646.
[630] Yan, H.F., Kyne, P.M., Jabado, R.W., Leeney, R.H., Davidson, L.N.K., Derrick, D.H., Finucci, B., Freckleton, R.P., Fordham, S.V. and Dulvy, N.K. 2021. Overfishing and habitat loss drive range contraction of iconic marine fishes to near extinction. Science Advances 7(7): eabb6026.
[631] Morgan, D. L., Ebner, B. C., Allen, M. G., Gleiss, A. C., Beatty, S. J., & Whitty, J. M. (2017). Habitat use and site fidelity of neonate and juvenile green sawfish Pristis zijsron in a nursery area in Western Australia. Endangered Species Research, 34, 235-249.

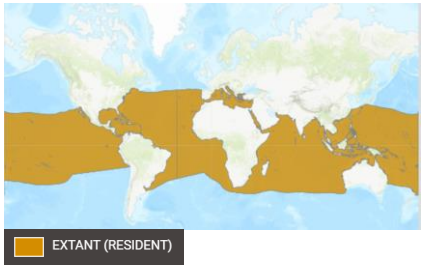
[632] https://www.iucnredlist.org/species/39393/58304631
[633] https://www.gbif.org/species/5216288
[634] https://indiabiodiversity.org/species/show/233208
[635] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=110382
[636] https://www.gbif.org/species/5216276
[637] https://indiabiodiversity.org/species/show/233205
[638] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=110381



https://www.iucnredlist.org/species/18584848/58336780

65	Narrow Sawfish (*Anoxypristis cuspidate*)  https://www.iucnredlist.org/species/39389/58304073	**IUCN:** Critically Endangered **IWP:** Not Available **Restricted range:** No **Migratory:** No	1 a	Historically, the Narrow Sawfish was distributed across the tropical Indo-West Pacific, including the Arabian Sea and adjacent waters, Southeast Asia, Papua New Guinea, and northern Australia. The extant range of this species appears to now be restricted to the eastern Arabian Sea, parts of South Asia, Papua New Guinea, and Australia[639, 640, 641]. It inhabits nearshore estuarine (juveniles and pupping females) and offshore marine (adults) waters. Observed in depths of >100 m[642]. Across its global range, it is suspected that the Narrow Sawfish has undergone a population reduction of >80% over the past three generation lengths (18 years) due to actual levels of exploitation, habitat degradation, and a decline in the extent of occurrence[643]. The Narrow Sawfish typically resides in shallow coastal waters, including estuaries, mangrove swamps, and river mouths, preferring depths of less than 30 meters. They favor soft-bottomed habitats like sandy or muddy substrates, ideal for feeding. Typically found in tropical and subtropical regions with warm water temperatures, these areas serve as prime environments for the Narrow Sawfish[644, 645].	Screened Out

[639] D'Anastasi, B.R., Simpfendorfer, C.A. and van Herwerden, L. 2013. Anoxypristis cuspidata (errata version published in 2019.
[640] Harrison, L.R. and Dulvy, N.K. 2014. Sawfish: A Global Strategy for Conservation. IUCN Species Survival Commission's Shark Specialist Group, Vancouver, Canada.
[641] Last, P., White, W., de Carvalho, M., Séret, B., Stehmann, M. and Naylor, G. 2016. Rays of the World. CSIRO Publishing, Clayton.
[642] https://www.sawfishconservationsociety.org/narrow-sawfish
[643] https://www.iucnredlist.org/species/39389/58304073#population
[644] Feutry, P., Laird, A., Davies, C. L., Devloo-Delva, F., Fry, G., Johnson, G., ... & Kyne, P. M. (2021). Population structure of Narrow Sawfish Anoxypristis cuspidata across northern Australia.
[645] Green, M. E., Anastasi, B. R., Hobbs, J. P. A., Feldheim, K., McAuley, R., Peverell, S., ... & van Herwerden, L. (2018). Mixed-marker approach suggests maternal philopatry and sex-biased behaviours of narrow sawfish Anoxypristis cuspidata. Endangered Species Research, 37, 45-54.

			Observer data on Indian landings of Narrow Sawfish between 1989–2011 reported considerable catch from Okha, Gujarat on the Arabian Sea coast[646]. Currently the species distribution is restricted to the coasts of Orissa, Tamil Nadu, Travancore and Mumbai[647] and no record has been reported from the surroundings of Vadodara.	
66	Oceanic Whitetip Shark (*Carcharhinus longimanus*)  https://www.iucnredlist.org/species/39374/2911619	**IUCN:** Critically Endangered **IWP:** Schedule II **Restricted range:** No **Migratory:** No	The Oceanic Whitetip Shark is found worldwide in tropical and temperate waters, occurring in both the Atlantic and Pacific Oceans. It is one of the most widespread shark species, ranging across entire oceans in tropical and subtropical waters. It is an oceanic-epipelagic shark usually found far offshore in the open sea with a preference for surface waters, but it has been reported to depths of up to 1,082 meters[648, 649]. The species has experienced significant declines in abundance across its range, with estimates indicating a median reduction of 98–100% over three generation lengths (approximately 61.2 years). This declining trend is primarily attributed to various threats including fishing and harvesting activities, leading to slow and significant declines in the population. Due to these factors, the Oceanic Whitetip Shark is facing a critical situation globally, with its population severely fragmented and continuing to decline[650, 651]. The Oceanic Whitetip Shark primarily inhabits marine neritic and oceanic environments. As an oceanic-epipelagic species, it is commonly found far offshore in open seas, showing a preference for surface waters. Despite its typical habitat, it has been documented at depths of up to 1,082 meters. This shark species occupies both tropical and subtropical waters, spanning entire oceanic regions within these zones. Its habitat preferences underscore a strong affinity for open ocean environments, particularly in tropical and subtropical regions[652, 653, 654]. The species has not been reported from the coasts of Gujarat specifically around the Vadodara area[655, 656], thus its presence in the project's EAAA is less likely.	Screened Out

[646] Harrison, L.R. and Dulvy, N.K. 2014. Sawfish: A Global Strategy for Conservation. IUCN Species Survival Commission's Shark Specialist Group, Vancouver, Canada.
[647] https://indiabiodiversity.org/species/show/231641
[648] Last, P.R. and Stevens, J.D. 2009. Sharks and Rays of Australia. Second Edition. CSIRO Publishing, Collingwood.
[649] Ebert, D.A., Fowler, S. and Compagno, L. 2013. Sharks of the World. Wild Nature Press, Plymouth.
[650] Rice, J. and Harley, S. 2012. Stock assessment of oceanic whitetip sharks in the western and central Pacific Ocean. WCPFC-SC8-2012/SA_WP-06 Rev 1. Scientific Committee Eight Regular Session 7 15 August Busan, Republic of Korea. Western and Central Pacific Fisheries Commission.
[651] Rice, J., Tremblay-Boyer, L., Scott, R., Hare, S. and Tidd, A. 2015. Analysis of stock status and related indicators for key shark species of the Western Central Pacific Fisheries Commission. In: Western Central Pacific Fisheries Commission (ed.), Scientific Committee Eleventh Regular Session, 5-13 August 2015, Pohnpei, Federated States of Micronesia.
[652] Bonfil, R., Clarke, S. and Nakano, H. 2008. The biology and ecology of the oceanic whitetip shark, Carcharhinus longimanus. In: Camhi, M., Pikitch, E.K. and Babcock, E. (eds), Sharks of the open ocean: biology, fisheries and conservation, pp. 128-139. Blackwell Publishing, Oxford.
[653] Tolotti, M.T., Bach, P., Hazin, F., Travassos, P. and Dagorn, L. 2015. Vulnerability of the Oceanic Whitetip Shark to pelagic longline fisheries. PLOS ONE 10(10): e0141396.
[654] Weigmann, S. 2016. Annotated checklist of the living sharks, batoids and chimaeras (Chondrichthyes) of the world, with a focus on biogeographical diversity. Journal of Fish Biology 88(3): 837 1037.
[655] https://indiabiodiversity.org/species/show/231901
[656] https://www.gbif.org/species/2418052

67	Pakistan Whipray (*Maculabatis arabica*)  https://www.iucnredlist.org/species/107604987/109922508	**IUCN:** Critically Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	The Pakistan Whipray is endemic to the Arabian Seas region, occurring in the Arabian Sea of Pakistan (Sonmiani Bay, Baluchistan and west of Turshian Creek, Sind) and eastward to at least nearby Gujarat, India[657]. This species is taken as incidental catch in inshore trawl fisheries and targeted using bottom-set gillnets, and is consumed locally for fresh and dried flesh. Juveniles are found in estuaries and much of the fishing effort, particularly with stake nets, occurs in this habitat. This species occurs in shallow inshore and shelf waters on muddy bottoms up to 37 m depths[658]. Although the species distribution map includes the western coast of India, however as per the available secondary information[659, 660], the species has been reported near the coast of Pingleshwar, Bhuj, Gujarat, but not from the surroundings of Vadodara area. Thus, its presence in the project's EAAA is less likely.	Screened Out
68	Scalloped Hammerhead (*Sphyrna lewini*)	**IUCN:** Critically Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	Scalloped Hammerhead is a coastal pelagic species; it occurs over continental and insular shelves and in nearby deeper water. It is found in warm temperate and tropical waters[661], worldwide from 46°N to 36°S. It can be found down to depths over 500 m (1,600 ft), but is most often found above 25 m (82 ft)[662]. There are no data available on the population size of the Scalloped Hammerhead. The trend analysis of the modelled population abundance for 1981–2005 (25 years) yielded annual rates of reduction of 7.5% consistent with an estimated median reduction of 99.6% over three generation lengths (72.3 years), with the highest probability of >80% reduction over three generation lengths[663]. It is a coastal and semi-oceanic pelagic shark, found over continental and insular shelves and nearby deep water, ranging from the intertidal and surface usually to 275 m depth, though has been recorded to 1,043 m[664].	Screened Out

[657] Manjaji-Matsumoto, B.M. and Last, P.R. 2016. Two new whiprays, Maculabatis arabica sp. nov. and M. bineeshi sp. nov. (Myliobatiformes: Dasyatidae), from the northern Indian Ocean. Zootaxa 4144(3): 335- 353.

[658] Pierce, S.J. and Bennett, M.B. 2009. Validated annual band-pair periodicity and growth parameters of blue-spotted maskray Neotrygon kuhlii from south-east Queensland, Australlia. Journal of Fish Biology 75: 2490 - 2508.

[659] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=623859

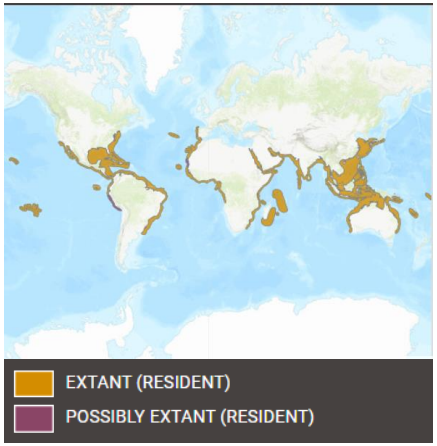
[660] https://www.gbif.org/species/9125247

[661] https://marinesanctuary.org/blog/scalloped-hammerhead-shark/

[662] http://www.fishbase.org/Summary/SpeciesSummary.php?id=912

[663] https://www.iucnredlist.org/species/39385/2918526#population

[664] Moore, A.B.M. and Gates, A.R. 2015. Deep-water observation of scalloped hammerhead Sphyrna lewini in the western Indian Ocean off Tanzania. Marine Biodiversity Records 8: 10.1017/S1755267215000627.

	 https://www.iucnredlist.org/species/39385/2918526			The species distribution map includes the entire coast of India. As per the available secondary information[665, 666], the species has been reported near the coast of Somnath; and Porbandar in Gujarat, but not from the surroundings of Vadodara area. Thus, its presence in the project's EAAA is less likely.	
69	Sharpnose Guitarfish (*Glaucostegus granulatus*)  https://www.iucnredlist.org/species/60166/215829219	**IUCN:** Critically Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	Sharpnose Guitarfish is moderately widespread in the northern Indian Ocean, spanning from the Arabian/Persian Gulf to Myanmar[667]. However, it is absent from Bahrain and Qatar, and in the United Arab Emirates, it may only occur in the Gulf of Oman[668]. Despite being previously mapped in the Andaman and Nicobar Islands, recent surveys indicate its absence there[669]. The global population status of the Sharpnose Guitarfish indicates a severe decline over the last three generations, spanning approximately 45 years. This decline is attributed to high levels of exploitation across its range in the Indo-West Pacific. Historical accounts and contemporary datasets from various countries demonstrate significant reductions in landings and catch rates, suggesting a population reduction exceeding 80%. It occurs from close inshore (including the intertidal zone) to depths of 120 m on the continental shelf [667]. Maximum size is 229 cm total length (TL). Reproduction is	Screened Out

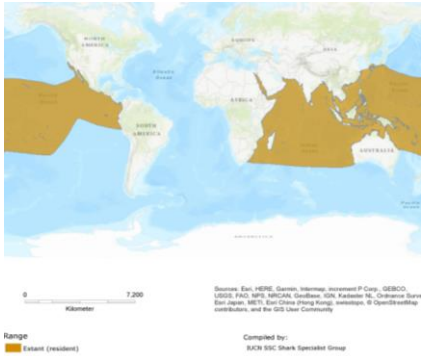
[665] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=111777
[666] https://www.gbif.org/species/2418939
[667]Last, P., White, W., de Carvalho, M., Séret, B., Stehmann, M. and Naylor, G. 2016b. Rays of the World. CSIRO Publishing, Clayton.
[668] Jabado, R.W., Kyne, P.M., Pollom, R.A., Ebert, D.A., Simpfendorfer, C.A., Ralph, G.M. and Dulvy, N.K. (eds.). 2017. The conservation status of sharks, rays, and chimaeras in the Arabian Sea and adjacent waters. Environment Agency – Abu Dhabi, UAE and IUCN Species Survival Commission Shark Specialist Group, Vancouver, Canada.
[669] Tyabji, Z., Wagh, T., Patankar, V., Jabado, R.W. and Sutaria, D. 2020. Catch composition and life history characteristics of sharks and rays (Elasmobranchii) landed in the Andaman and Nicobar Islands, India. PLOS ONE 15(10): e0231069.

				lecithotrophic viviparous with litter sizes of 6–18 pups[670], size at birth is ~39 cm TL. Generation length is estimated as 15 years[671]. In Gujarat has been reported from Veraval, and Dwarka[672, 673, 674]. However, no observation has been recorded around the Vadodara area, thus its presence in the project's EAAA is less likely.	
70	Stripenose Guitarfish (*Acroteriobatus variegatus*)  https://www.iucnredlist.org/species/161476/109905030	**IUCN:** Critically Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	Stripenose Guitarfish is endemic to the Arabian Seas region where it is known from southern India and Sri Lanka[675]. This species is regularly caught in shrimp trawl fisheries in southern India, mostly in 30-40 m where it is often caught with the Bengal Guitarfish (*Rhinobatos annandalei*). Wedgefish and guitarfish landings decreased by 86% over the five years of monitoring (2002-2006)[676]. The Central Marine Fisheries Research Institute (CMFRI 2010) reports that 5,767 trawlers operate in Tamil Nadu waters, and so fishing pressure is intense with severe declines in fish stocks, including elasmobranchs (Mohanraj et al. 2009, Karnad et al. 2014). Trawling is also intense in Kerala where CMFRI (2010) reported 3,678 trawlers[677]. Stripenose Guitarfish is a small species reported from the continental shelf to 366 m (Weigmann 2016), but they typically prefer shallow waters of 10-40 m depth, including coral habitats[678]. As per the IUCN assessment of the species, the species has been reported from the coasts of Tamil Nadu, Kerala and Maharashtra (in India) and Sri Lanka. The available secondary data[679, 680] also suggest the absence of any record of the species from the coasts of Gujarat. Thus, its presence in the project's EAAA is less likely.	Screened Out

[670] Prasad, R.R. 1951. Observations on the egg-cases of some ovoviviparous and viviparous elasmobranchs, with a note on the formation of the elasmobranch egg-case. Journal of the Bombay Natural History Society 49:755–762.
[671] Moore, A.B.M., McCarthy, I.D., Carvalho, G.R. and Peirce, R. 2012. Species, sex, size and male maturity composition of previously unreported elasmobranch landings in Kuwait, Qatar and Abu Dhabi Emirate. Journal of Fish Biology 80: 1619-1642.
[672] Johri, S., Fellows, S. R., Solanki, J., Busch, A., Livingston, I., Mora, M. F., ... & Dinsdale, E. A. (2020). Mitochondrial genome to aid species delimitation and effective conservation of the Sharpnose Guitarfish (Glaucostegus granulatus). Meta Gene, 24, 100648.
[673] https://www.gbif.org/species/2418915
[674] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=101483
[675] Last, P., White, W., de Carvalho, M., Séret, B., Stehmann, M. and Naylor, G. 2016. Rays of the World. CSIRO Publishing, Clayton.
[676] Kyne, P.M., Simpfendorfer, C., Bineesh, K.K., Moore, A., Jabado, R. & Valinassab, T. 2017. Acroteriobatus variegatus. The IUCN Red List of Threatened Species 2017: e.T161476A109905030.
[677] CMFRI. 2010. Marine Fisheries Census (2010), Part 1. India, Govt. of India, Ministry of Agriculture, Dept. of Animal Husbandry, Dairying & Fisheries and Central Marine Fisheries Research Institute, Indian Council of Agricultural Research. New Dehli.
[678] Last, P., White, W., de Carvalho, M., Séret, B., Stehmann, M. and Naylor, G. 2016. Rays of the World. CSIRO Publishing, Clayton.
[679] https://www.gbif.org/species/9344331
[680] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=624036

71	Widenose Guitarfish (*Glaucostegus obtusus*)  https://www.iucnredlist.org/species/60170/207283191	**IUCN:** Critically Endangered **IWP:** Schedule I **Restricted range:** No **Migratory:** No		Widenose Guitarfish is moderately widespread in the northern Indian Ocean from Pakistan to the Gulf of Thailand[681]. The global population status of the Widenose Guitarfish is critically endangered, as inferred from severe declines observed over the last three generations, spanning approximately 30 years. Various historical accounts and contemporary datasets from regions such as Iran, Pakistan, India, and Indonesia demonstrate significant reductions in landings and catch rates, indicative of population depletion. Fishing pressure across its range, particularly in the Indo-West Pacific, has contributed to this decline, leading to an estimated reduction exceeding 80%[682]. It occurs from close inshore to depths of at least 60 m on the continental shelf. Maximum size is 93 cm total length (TL); males mature at ~48 cm TL[683]. Although it is common landing in fishing nets in western coasts of India[684]; however, their records are restricted from the coasts of Kerala to Goa[685, 686] and no record of the species is available from the coasts of Gujarat[687]. Thus, its presence in the project's EAAA is less likely.	Screened Out
72	Ocellate Eagle Ray (*Aetomylaeus milvus*)	**IUCN:** Endangered **IWP:** Schedule II **Restricted range:** No **Migratory:** No	1 a	Ocellate Eagle Ray is distributed from Indo-Pacific: East Africa, including the Red Sea to Hawaiian Islands and French Polynesia[688]. Most of the distribution of the species is under extremely intense and increasing demersal fishing pressure. The loss and modification of coastal habitats in the Arabian Gulf/Persian Gulf (hereafter referred to as the 'Gulf') is a significant concern for inshore species such as this. The relative rarity, large size, low productivity, and relatively small range of the Ocellate Eagle Ray makes it particularly susceptible to an overall population decline as a result of fishing pressure and habitat loss. It is suspected that this species has undergone declines of 50% or more over the last three generations (~45 years), and with ongoing fishing pressure and habitat degradation and loss[689]. Although the global distribution map of the species includes the entire coast of India, however as per the available secondary information[690, 691], the species has not been	Screened Out

[681] Last, P., White, W., de Carvalho, M., Séret, B., Stehmann, M. and Naylor, G. 2016b. Rays of the World. CSIRO Publishing, Clayton.
[682] Kyne, P.M. & Jabado, R.W. 2021. Glaucostegus obtusus (amended version of 2019 assessment). The IUCN Red List of Threatened Species 2021: e.T60170A207283191.
[683] Last, P., White, W., de Carvalho, M., Séret, B., Stehmann, M. and Naylor, G. 2016b. Rays of the World. CSIRO Publishing, Clayton.
[684] Gupa, T., Warde, K., Rao, C., Manoharakrishnan, M., and Shanker, K. (2020) Potential nursery grounds of endangered elasmobranchs around Sindhudurg. Technical Report submitted to the Mangrove Foundation, Forest Department of Maharashtra, India.
[685] https://www.gbif.org/species/9341842
[686] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=623881
[687] https://www.gbif.org/species/9341842
[688] https://www.fishbase.se/summary/12600
[689] https://www.iucnredlist.org/species/104023514/109922492
[690] https://www.gbif.org/species/2419264
[691] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=607462

	 https://www.iucnredlist.org/species/104023514/109922492			reported from the coast of Gujarat State, specifically from the surroundings of Vadodara area. Thus, its presence in the project's EAAA is less likely.	
73	Pelagic Thresher (*Alopias pelagicus*)  https://www.iucnredlist.org/species/161597/68607857	**IUCN:** Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	Pelagic Thresher occurs in warm and temperate offshore waters of the Pacific and Indian oceans, including the Mediterranean Sea. This species is abundant off the northeastern coast of Taiwan. The pelagic thresher inhabits surface waters of the open ocean, from the surface to at least 150 m (492 ft) deep. It also sometimes occurs in cool inshore waters[692]. Pelagic Thresher is especially susceptible to fisheries exploitation because its epipelagic habitat occurs within the range of many largely unregulated and under-reported, small-scale and artisanal gillnet and longline fisheries, in which it is readily caught. The species is estimated to be declining in both the Pacific and Indian Oceans[693]. The species distribution map includes the entire coast of India. As per the available secondary information[694, 695], the species has been reported near the coast of Dwarka in Gujarat, but not from the surroundings of Vadodara area. Thus, its presence in the project's EAAA is less likely.	Screened Out

[692] https://www.floridamuseum.ufl.edu/discover-fish/species-profiles/alopias-pelagicus/#:~:text=Geographical%20Distribution&text=The%20pelagic%20thresher%20occurs%20in,found%20off%20California%20and%20Mexico.
[693] https://www.iucnredlist.org/species/161597/68607857

[694] https://www.gbif.org/species/2420809
[695] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=68050

74	Dusky Meagre (*Argyrosomus japonicus*)  https://www.iucnredlist.org/species/169243577/124440562	**IUCN:** Endangered **IWP:** Not available **Restricted range:** No **Migratory:** Yes	1 a	Dusky Meagre is a pantropical species occurring throughout the Indo-West Pacific from South Africa to Beira, Mozambique, the coast of Oman and the Gulf of Aden to Pakistan and the western and eastern coasts of India and Sri Lanka[696, 697, 698]. This species occurs in nearshore, turbid coastal habitats and is found in estuaries, in the surf zone, and in the nearshore zone to depths of about 100 m. In the nearshore environment, the species rarely ventures onto the soft, flat substrates exploited by trawlers and prefers reefs, especially wrecks or highprofile rocky reefs that are associated with sand[699]. This species has not recently been reported from India and fisheries data are not available[700]. The species distribution map includes the entire coast of India. As per the available secondary information[701, 702], the species has not been reported from the coasts of India, as well as from the surroundings of Vadodara area. Thus, its presence in the project's EAAA is unlikely.	Screened Out
75	Whitecheek Shark (*Carcharhinus dussumieri*)	**IUCN:** Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	Whitecheek Shark is widespread along the north coast of the Arabian Sea and the Arabian/Persian Gulf in the Western and Eastern Indian Ocean[703]. It is more patchily distributed along the southwest coast of India but has been recorded from the northern coast of Sri Lanka (Gulf of Mannar) and the east coast of India (Tamil Nadu State to Pondicherry)[704]. There have been no dedicated surveys or population estimates for this species. The Whitecheek Shark is a small species of carcharhinid shark that is common in inshore waters over soft substrates at depths of 0-100 m[705].	Screened Out

[696] Sasaki, K. 2001. Sciaenidae. Croakers (drums). In: K.E. Carpenter and V.H. Niem (eds), The Living Marine Resources of the Western Central Pacific, pp. p.3117-3174.. FAO, Rome.
[697] Silberschneider, V. and Gray, C.A. 2008. Synopsis of biological, fisheries and aquaculture related information on mulloway Argyrosomus japonicus (Pisces: Sciaenidae), with particular reference to Australia. journal of Applied Ichthyology 24: 7–17.
[698] Psomadakis, P.N., Osmany, H.B. and Moazzam, M. 2015. Field identification guide to the living marine resources of Pakistan. Food and Agriculture Organization of the United Nations, Marine Fisheries Department, Ministry of Ports & Shipping, Government of Pakistan, Rome, Italy.
[699] Fennessy, S. 2020. Argyrosomus japonicus. The IUCN Red List of Threatened Species 2020: e.T49145403A49234015
[700] Fennessy, S. 2020. Argyrosomus japonicus. The IUCN Red List of Threatened Species 2020: e.T49145403A49234015
[701] https://www.gbif.org/species/5212440
[702] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=203918
[703] White, W.T. 2012. A redescription of Carcharhinus dussumieri and C. seali, with resurrection of C.coatesi and C. tjutjot as valid species (Chondrichthyes: Carcharhinidae). Zootaxa 3241(1-34).
[704] Appukuttan, K.K. and Nair, K.P. 1988. Shark resources of India, with notes on biology of few species. In: Joseph, M.M. (ed.), The first Indian Fisheries Forum, pp. 173-183. Mangalore.
[705] Weigmann, S. 2016. Annotated checklist of the living sharks, batoids and chimaeras (Chondrichthyes) of the world, with a focus on biogeographical diversity. Journal of Fish Biology 88(3): 837–1037.

	 https://www.iucnredlist.org/species/70680197/68612632			The species distribution map includes the entire coast of India. As per the available secondary information[706, 707], the species has been reported near the Gulf of Kutch[708], but not from the surroundings of Vadodara area. Thus, its presence in the project's EAAA is less likely.	
76	Winghead Shark (*Eusphyra blochii*)	**IUCN:** Endangered **IWP:** Schedule II **Restricted range:** No **Migratory:** No	1 a	The Winghead Shark occurs on and near continental shelf waters of the Indo-West Pacific from the Arabian/Persian Gulf through south Asia to northern Australia and Papua New Guinea[709]. There are no species-specific data available on population numbers, and how they have changed over time, for any part of the range. Globally, however, shark and ray landings have declined by at least 20% since 2003, but the Indo-Pacific is amongst the regions where this decline has been more severe[710]. The Winghead Shark occurs on the continental shelves and is mainly found in coastal nearshore waters. In eastern Australia, this species is mainly encountered in concentrated areas of less than 50 km². This species is familiar to local fishers within these concentrated areas and is seldom encountered by fishers further away, thereby suggesting a patchy localised distribution[711].	Screened Out

[706] https://www.gbif.org/species/2418172
[707] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=96753
[708] https://www.gbif.org/occurrence/90122440
[709] Last, P.R. and Stevens, J.D. 2009. Sharks and Rays of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia.
[710] Dulvy, N.K., Fowler, S.L., Musick, J.A., Cavanagh, R.D., Kyne, P.M., Harrison, L.R., Carlson, J.K., Davidson, L.N.K., Fordham, S.V., Francis, M.P., Pollock, C.M., Simpfendorfer, C.A., Burgess, G.H., Carpenter, K.E., Compagno, L.J.V., Ebert, D.A., Gibson, C., Heupel, M.R., Livingstone, S.R., Sanciangco, J.C., Stevens, J.D., Valenti, S. and White, W.T. 2014. Extinction risk and conservation of the world's sharks and rays. eLife 3: e00590.
[711] Smart, J.J. & Simpfendorfer, C. 2016. Eusphyra blochii. The IUCN Red List of Threatened Species 2016: e.T41810A68623209

	 https://www.iucnredlist.org/species/41810/68623209			The species distribution map includes the entire coast of India. As per the available secondary information[712, 713], the species has not been reported in the coasts of Gujarat, as well as from the surroundings of Vadodara area. Thus, its presence in the project's EAAA is unlikely.	
77	Black Teatfish (*Holothuria nobilis*)	**IUCN:** Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	Black Teatfish only occurs in the Indian Ocean[714] and does not occur in the Western Central Pacific[715] or in Asia[716]. It is present in the Africa and Indian Ocean region[717], and is found in Madagascar, East Africa, Seychelles, India, Sri Lanka, the Maldives, Comoros, and the Red Sea. This species is largely restricted to coral reef habitat. It occurs on reef flats and outer slopes and it is generally solitary[718]. This species is common in shallow waters of reef bottom where there is no terrigenous action, at depths from 0 to 40 m. However, they are distributed mainly in shallow coral reef areas, on reef flats, slopes and shallow seagrass beds. They prefer sandy hard substrate[719]. The species distribution map includes the entire coast of India. As per the available secondary information[720, 721], the species has not been reported in the coasts of Gujarat,	Screened Out

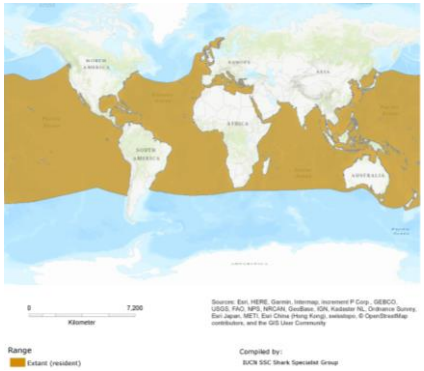
[712] https://www.gbif.org/species/2418825
[713] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=48066
[714] Uthicke, S. 2004. Overfishing of holothurians: lessons from the Great Barrier Reef. Advances in sea cucumber aquaculture and management. FAO Fisheries Technical Paper. No. 463. FAO.
[715] Kinch, J., Purcell, S., Uthicke, S. and Friedman, K. 2008. Population status, fisheries and trade of sea cucumbers in the Western Central Pacific. In: V. Toral-Granda and A. Lovatelli and M. Vasconcellos. (eds), Sea cucumbers. A global review of fisheries and trade. Fisheries and Aquaculture Technical Paper. No. 516, pp. 7-55. FAO, Rome.
[716] Choo, P.S. 2008. Population status, fisheries and trade of sea cucumbers in Asia. In: M.V. Toral-Granda, A. Lovatelli, M. Vasconcellos. (ed.), Sea cucumbers. A global review on fisheries and trade.. FAO, Rome.
[717] Conand, C. 2008. Population status, fisheries and trade of sea cucumbers in Africa and the Indian Ocean. In: M.V. Toral-Granada, A. Lovatelli, M. Vasconcellos. (ed.), Sea cucumbers. A global review on fisheries and trade.. FAO, Rome.
[718] Conand, C. and Mangion, P. 2002. Sea cucumbers on La Reunion Island fringing reefs: Diversity, distribution, abundance and structure of the populations. SPC Beche-de-mer Information Bulletin 17(17): 27-33.
[719] Conand, C., Purcell, S., Gamboa, R. & Toral-Granda, T.-G. 2013. Holothuria nobilis. The IUCN Red List of Threatened Species 2013: e.T180326A1615368
[720] https://www.gbif.org/species/2279194
[721] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=353252

	 https://www.iucnredlist.org/species/180326/1615368			as well as from the surroundings of Vadodara area. Thus, its presence in the project's EAAA is less likely.	
78	Golden Sandfish (*Holothuria scabra*)	**IUCN:** Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	This species is widespread throughout the Indo-Pacific between latitudes 30°N and 30°S[722], from South Africa to the Red Sea, India, China and Japan to Australia, and to Micronesia in the northeast and Tonga in the southeast. In Madagascar, this species is observed in the west coast from the south of Toliara to Nosy-be[723]. Depletion refers to commercially unviable, and estimated to represent an approximately 90% loss or greater over the past 25-50 years[724]. This species is distributed mainly in low energy environments behind fringing reefs or within protected bays and shores. Individuals prefer ordinary coastal areas to coral reefs, particularly intertidal seagrass beds close to mangroves, however they are also found along inner reef flats and lagoons. This species is attracted to muddy sand or mud habitats[725]. Juveniles of this species settle in shallow seagrass beds and some may make it to deeper waters[726]. This species has been found to preferentially settle on seagrass such as *Thallassia hemprichi*[727].	Screened Out

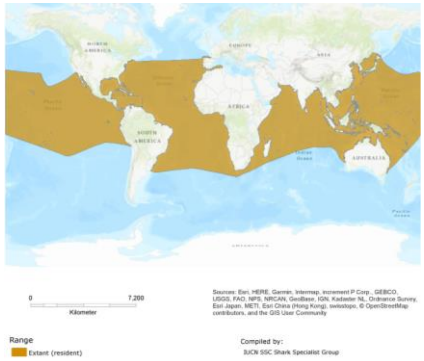
[722] Hamel, J.-F., Conand, C., Pawson, D.L. and Mercier, A. 2001. The sea cucumber Holothuria scabra (Holothuroidea: Echinodermata): Its biology and exploitation as Beche-de-mer. Advances in Marine Biology 41: 129-223.
[723] Hamel, J.-F., Mercier, A., Conand, C., Purcell, S., Toral-Granda, T.-G. & Gamboa, R. 2013. Holothuria scabra. The IUCN Red List of Threatened Species 2013: e.T180257A1606648.
[724] Hamel, J.-F., Mercier, A., Conand, C., Purcell, S., Toral-Granda, T.-G. & Gamboa, R. 2013. Holothuria scabra. The IUCN Red List of Threatened Species 2013: e.T180257A1606648.
[725] Skewes, T., Haywood, M., Pitchern, R. and Willan, R . 2004. Holothurians. National Oceans Office, Hobart, Australia.
[726] Hamel, J.-F., Mercier, A., Conand, C., Purcell, S., Toral-Granda, T.-G. & Gamboa, R. 2013. Holothuria scabra. The IUCN Red List of Threatened Species 2013: e.T180257A1606648.
[727] Hamel, J.-F., Conand, C., Pawson, D.L. and Mercier, A. 2001. The sea cucumber Holothuria scabra (Holothuroidea: Echinodermata): Its biology and exploitation as Beche-de-mer. Advances in Marine Biology 41: 129-223.

	 https://www.iucnredlist.org/species/180257/1606648			The species distribution map includes the entire coast of India. As per the available secondary information[728, 729], the species has been solitary reported from the coast of Devbhumi Dwarka, but not from the Vadodara area. Thus, its presence in the project's EAAA is less likely.	
79	Shortfin Mako (*Isurus oxyrinchus*)	**IUCN:** Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	Shortfin Mako is widespread in temperate and tropical waters of all oceans[730]. There are no data available on the absolute global population size of the Shortfin Mako. In Indian Ocean the trend analysis of the biomass for 1971–2015 (45 years) revealed annual rates of decline of 0.9%, consistent with a median decline of 47.9% over three generation lengths (72 years), with the highest probability of 30–49% reduction over three generation lengths[731]. The Shortfin Mako is a neritic and oceanic, epipelagic and mesopelagic species, found worldwide in tropical and warm-temperate seas to depths of 888 m[732, 733, 734]. The species distribution map includes the entire coast of India. As per the available secondary information[735, 736], the species has not been reported from the surroundings of Vadodara area. Thus, its presence in the project's EAAA is less likely.	Screened Out

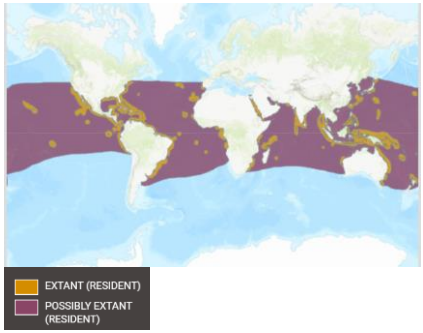
[728] https://www.gbif.org/species/2279170
[729] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=348150
[730] Ebert, D.A., Fowler, S. and Compagno, L. 2013. Sharks of the World. A Fully Illustrated Guide. Wild Nature Press, Plymouth, United Kingdom.
[731] Rigby, C.L., Barreto, R., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Jabado, R.W., Liu, K.M., Marshall, A., Pacoureau, N., Romanov, E., Sherley, R.B. & Winker, H. 2019. Isurus oxyrinchus. The IUCN Red List of Threatened Species 2019: e.T39341A2903170
[732] Ebert, D.A., Fowler, S. and Compagno, L. 2013. Sharks of the World. A Fully Illustrated Guide. Wild Nature Press, Plymouth, United Kingdom.
[733] Abascal, F.J., Quintans, M., Ramos-Cartelle, A. and Mejuto, J. 2011. Movements and environmental preferences of the shortfin mako,Isurus oxyrinchus, in the southeastern Pacific Ocean. Marine Biology 158(5): 1175-1184.
[734] Weigmann, S. 2016. Annotated checklist of the living sharks, batoids and chimaeras (Chondrichthyes) of the world, with a focus on biogeographical diversity. Journal of Fish Biology 88(3): 837–1037.
[735] https://www.gbif.org/species/5216248
[736] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=69677



https://www.iucnredlist.org/species/39341/29 03170

80	Longfin Mako (*Isurus paucus*)  https://www.iucnredlist.org/species/60225/30 95898	**IUCN:** Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	Longfin Mako is widespread in tropical and warm temperate waters, and likely occurs in all oceans, although its distribution is poorly recorded[737]. There are no data available on the population size or structure of the Longfin Mako. The trend analysis of these data revealed annual rates of decline of 3.7%, consistent with an estimated median decline of 93.4% over three generation lengths (75 years), with the highest probability of >80% reduction over three generation lengths[738]. The Longfin Mako is a poorly-known epi-, meso- and bathypelagic species found in tropical and warmtemperate seas. It usually occurs to depths of 760 m, but has been reported to 1,752 m[739, 740, 741]. The species distribution map includes the entire coast of India. As per the available secondary information[742, 743], the species has not been reported from the costs of Gujarat as well as surroundings of Vadodara area. Thus, its presence in the project's EAAA is unlikely.	Screened Out

[737] Ebert, D.A., Fowler, S. and Compagno, L. 2013. Sharks of the World. A Fully Illustrated Guide. Wild Nature Press, Plymouth, United Kingdom.
[738] Rigby, C.L., Barreto, R., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Jabado, R.W., Liu, K.M., Marshall, A., Pacoureau, N., Romanov, E., Sherley, R.B. & Winker, H. 2019. Isurus paucus. The IUCN Red List of Threatened Species 2019: e.T60225A3095898
[739] Ebert, D.A., Fowler, S. and Compagno, L. 2013. Sharks of the World. A Fully Illustrated Guide. Wild Nature Press, Plymouth, United Kingdom.
[740] Hueter, R.E., Tyminski, J.P., Morris, J.J., Abierno, A.R. and Valdes, J.A. 2016. Horizontal and vertical movements of longfin mako (Isurus paucus) tracked with satellite-linked tags in the northwestern Atlantic Ocean. Fishery Bulletin 115(1): 101–116.
[741] Weigmann, S. 2016. Annotated checklist of the living sharks, batoids and chimaeras (Chondrichthyes) of the world, with a focus on biogeographical diversity. Journal of Fish Biology 88(3): 837–1037.
[742] https://www.gbif.org/species/5216258
[743] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=103571

81	Oceanic Manta Ray (*Mobula birostris*)  https://www.iucnredlist.org/species/198921/214397182	**IUCN:** Endangered **IWP:** Schedule I **Restricted range:** No **Migratory:** No	1 a	Oceanic Manta Ray is circumglobal in tropical and temperate waters from the surface to 1,000 m depth[744]. The global population size of the Oceanic Manta Ray is difficult to assess, but abundance trajectories have been estimated based on long time series of sightings at diving sites. In most regions, Oceanic Manta Ray population sizes appear to be small (less than 1,000 individuals). Photo-identification studies at specific aggregation sites have yielded minimum estimates of 42 to 500 individuals over almost a decade of monitoring in most locations, including: Mozambique, Thailand, Myanmar, Indonesia[745], Japan[746], Brazil[747], and Mexico[748]. A 6-year study has catalogued more than 2,000 individuals in a single site, off mainland Ecuador[749]. Oceanic Manta Ray is a neritic and oceanic pelagic ray that occurs in places with regular upwelling along coastlines, oceanic islands, and offshore pinnacles and seamounts[750]. The Oceanic Manta Ray can exhibit diel patterns in habitat use, moving inshore during the day to clean and socialize in shallow waters, and then moving offshore at night to feed to depths of 1,000 meters[751, 752]. It can spend long periods of time offshore without visiting shallow coastal waters[753]. The species distribution map includes the entire coast of India. As per the available secondary information[754, 755], the species has not been reported from the coasts of Gujarat as well as surroundings of the Vadodara area. Thus, its presence in the project's EAAA is unlikely.	Screened Out

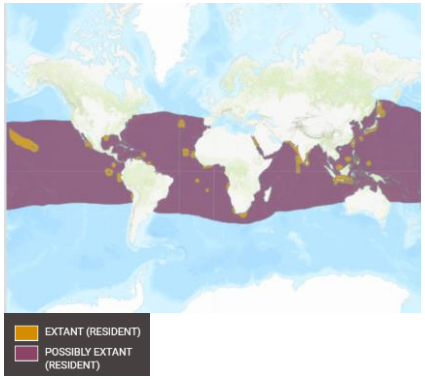
[744] Last, P., White, W., de Carvalho, M., Séret, B., Stehmann, M. and Naylor, G. 2016. Rays of the World. CSIRO Publishing, Clayton.
[745] Holmberg J. and Marshall A.D. 2018. Manta Matcher Photo-identification Library. Available at: http://www. mantamatcher.org.
[746] Kashiwagi, T., Ito, T. and Sato, F. 2010. Occurrences of reef manta ray, Manta alfredi, and giant manta ray, M. birostris, in Japan, examined by photographic records. Report of Japanese Society for Elasmobranch Studies 46: 20-27.
[747] Luiz, O.J., Balboni, A.P., Kodja, G., Andrade, M. and Marum, H. 2008. Seasonal occurrences of Manta birostris (Chondrichthyes: Mobulidae) in southeastern Brazil. Ichthyological Research 56(1): 96–99.
[748] Rubin, R. 2002. Manta rays: not all black and white. Shark Focus 15: 4-5.
[749] Holmberg J. and Marshall A.D. 2018. Manta Matcher Photo-identification Library. Available at: http://www. mantamatcher.org.
[750] Marshall, A.D., Compagno, L.J.V. and Bennett, M.B. 2009. Redescription of the genus Manta with resurrection of Manta alfredi (Krefft, 1868) (Chondrichthyes; Myliobatoidei; Mobulidae). Zootaxa 2301: 1-28.
[751] Hearn, A.R., Acuna, D., Ketchum, J.T., Penaherrera, C., Green, J., Marshall, A., Guerrero, M. and Shillinger, G. 2014. Elasmobranchs of the Galapagos Marine Reserve. In: Denkinger, J. and Vinueza, L. (eds), The Galapagos Marine Reserve, Social and Ecological Interactions in the Galapagos Islands, pp. 23–59.
[752] Burgess, K. 2017. Feeding ecology and habitat use of the giant manta ray Manta birostris at a key aggregation site off mainland Ecuador. PhD Thesis. University of Queensland.
[753] Stewart, J.D., Beale, C.S., Fernando, D., Sianipar, A.B., Burton, R.S., Semmens, B.X. and Aburto-Oropeza, O. 2016. Spatial ecology and conservation of Manta birostris in the Indo-Pacific. Biological Conservation 200: 178–183.
[754] https://www.gbif.org/species/9548142
[755] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=623966

82	Shorthorned Pygmy Devil Ray (*Mobula kuhlii*)  https://www.iucnredlist.org/species/161439/214405747	**IUCN:** Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	Shorthorned Pygmy Devil Ray has an Indo-West Pacific distribution from South Africa to the Solomon Islands[756, 757, 758]. As presently known, the distribution is patchy, but it is most likely more wide-ranging than current confirmed records suggest. In Indian waters, population reductions are inferred based on general declines in devil ray catches. Despite increasing effort in several regions, including Kerala[759], along the Chennai and Tuticorin coasts[760], and Mumbai[761], catches indicate depletion of stocks. Several studies represent a 51% decline in landings over approximately 10 years when fishing effort almost doubled, from which local population declines can be inferred[762]. The Shorthorned Pygmy Devil Ray is an inshore, mainly shelf species found in continental coastal areas to 50 m deep[763, 764]. The species' distribution does not extend into the epipelagic zone. The species distribution map includes the entire coast of India. As per the available secondary information[765, 766], the species has not been reported from the coasts of Gujarat as well as surroundings of the Vadodara area. Thus, its presence in the project's EAAA is unlikely.	Screened Out
83	Spinetail Devil Ray (*Mobula mobular*)	**IUCN:** Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	Spinetail Devil Ray is circumglobal in temperate and tropical waters throughout all oceans. Notably, it is present in the Mediterranean Sea but absent in the Red Sea[767] and its occurrence is patchy throughout its distribution[768]. There are no current or historical estimates of the global abundance of the Spinetail Devil Ray. In India, population reductions are suspected based on declines in devil ray catches, while effort has increased in several regions, including Kerala, along the	Screened Out

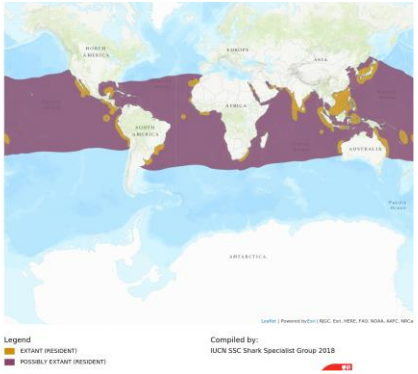
[756] Lawson, J.M., Fordham, S. V, O'Malley, M.P., Davidson, L. N. K., Walls, R. H. L., Heupel, M. R., Stevens, G., Fernando, D., Budziak, A., Simpfendorfer, C. A., Ender, I., Francis, M. P., Notarbartolo di Sciara, G., and Dulvy, N. K. 2017. Sympathy for the devil: a conservation strategy for devil and manta rays. PeerJ 5:e3027 : doi: 10.7717/peerj.3027.
[757] Notarbartolo di Sciara, G., Fernando, D., Adnet, S., Cappetta, H. and Jabado, R.W. 2017. Devil rays (Chondrichthyes: Mobula) of the Arabian Seas, with a redescription of Mobula kuhlii (Valenciennes in Müller and Henle, 1841). Aquatic Conservation: Marine and Freshwater Ecosystems 27: 197–218.
[758] Chin, C., Rigby, C., Short, A. and White, W.T. 2019. Verified record of Kuhl's devil ray (Mobula kuhlii) in the Solomon Islands from citizen scientists. Pacific Conservation Biology: doi.org/10.1071/PC18088.
[759] Nair, R.J., Zacharia, P.U., Kishor, T.G., Dinesh, K.S., Dhaneesh, K.V., Suraj, K.S., Siva, G.K. and Seetha, P.K. 2013. Heavy landings of mobulids reported at Cochin Fisheries Harbour, Kerala. Marine Fisheries Information Services, T&E Series 21: 19-20.
[760] Kizhakudan, S.J., Zacharia, P.U., Thomas, S, Vivekanandan, E, and Muktha, M. 2015. Guidance on National Plan of Action for Sharks in India. CMFRI Marine Fisheries Policy Series.
[761] Mohanraj, G., Rajapackiam, S., Mohan, S., Batcha, H. and Gomathy, S. 2009. Status of elasmobranchs fishery in Chennai, India. Asian Fisheries Science, 22(2): 607-615.
[762] https://www.iucnredlist.org/species/161439/214405747#population
[763] Last, P., White, W., de Carvalho, M., Séret, B., Stehmann, M. and Naylor, G. 2016. Rays of the World. CSIRO Publishing, Clayton.
[764] Weigmann, S. 2016. Annotated checklist of the living sharks, batoids and chimaeras (Chondrichthyes) of the world, with a focus on biogeographical diversity. Journal of Fish Biology 88(3): 837-1037.
[765] https://www.gbif.org/species/2419221
[766] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=105922
[767] Notarbartolo di Sciara, G., Fernando, D., Adnet, S., Capetta, H. and Jabado, R. 2017. Devil rays (Chondrichthyes: Mobula) of the Arabian Seas, with a redescription of Mobula kuhlii (Valenciennes in Muller and Henle, 1841). Aquatic Conservation Marine and Freshwater Ecosystems 27: 197-218.
[768] Lawson, J.M., Fordham, S. V, O'Malley, M.P., Davidson, L. N. K., Walls, R. H. L., Heupel, M. R., Stevens, G., Fernando, D., Budziak, A., Simpfendorfer, C. A., Ender, I., Francis, M. P., Notarbartolo di Sciara, G., and Dulvy, N. K. 2017. Sympathy for the devil: a conservation strategy for devil and manta rays. PeerJ 5:e3027 : doi: 10.7717/peerj.3027.

	 https://www.iucnredlist.org/species/110847130/214381504			Tuticorin coast, and Mumbai[769, 770]. The studies represent a 51% decline in landings over approximately 10 years during which time fishing effort almost doubled[771]. Spinetail Devil Ray is a pelagic species that resides in coastal and continental shelf waters. It spends the majority of its time in less than 50 m of water but occasionally dives to depths of 1,112 m[772, 773, 774, 775]. The species distribution map includes the entire coast of India. As per the available secondary information[776, 777], the species has been solitary reported from the coast of Dwarka, but not from the Vadodara area. Thus, its presence in the project's EAAA is less likely.	
84	Sicklefin Devil Ray (*Mobula tarapacana*)	**IUCN:** Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	Sicklefin Devil Ray has a patchy circumglobal distribution and is found in tropical, subtropical, and temperate waters of the Pacific, Atlantic, and Indian Oceans[778, 779, 780]. There are no historical baseline population data and global population numbers are unknown for any devil ray species. In India, population reductions are suspected based on general declines in devil ray catches while effort has increased in several regions, including Kerala, where this species represented 11% of devil rays landed in 2012[781],	Screened Out

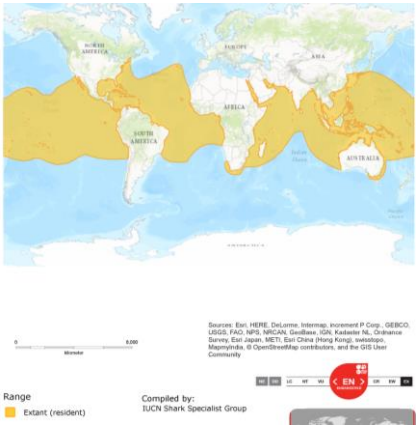
[769] Mohanraj, G., Rajapackiam, S., Mohan, S., Batcha, H. and Gomathy, S. 2009. Status of elasmobranchs fishery in Chennai, India. Asian Fisheries Science, 22(2): 607-615.
[770] Couturier, L.I.E., Marshall, A.D., Jaine, F.R.A., Kashiwagi, T., Pierce, S.J., Townsend, K.A., Weeks, S.J., Bennet, M.B. and Richardson, A.J. 2012. Biology, ecology and conservation of the Mobulidae. Journal of Fish Biology 80: 1075-1119.
[771] Marshall, A., Barreto, R., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Herman, K., Jabado, R.W., Liu, K.M., Rigby, C.L. & Romanov, E. 2022. Mobula mobular (amended version of 2020 assessment). The IUCN Red List of Threatened Species 2022: e.T110847130A214381504.
[772] Canese, S., Cardinali, A., Romeo, T., Giusti, M., Salvati, E., Angiolillo, M. and Greco, S. 2011. Diving behaviour of Giant Devil ray in the Mediterranean Sea. Endangered Species Research 14: 171-176.
[773] Croll, D.A., Newton, K.M., Weng, K., Galvan-Magana, F., O'Sullivan, J., and Dewar, H. 2012. Movement and habitat use by the spine-tail devil ray in the Eastern Pacific Ocean. Marine Ecology Progress Series 465: 193-200. doi:10.3354/meps09900.
[774] Holcer, D., Lazar, B., Mackelworth, P. and Fortuna, C.M. 2012. Rare or just unknown? The occurrence of the Giant Devil ray (Mobula mobular) in the Adriatic Sea . Journal of Applied Ichthyology 29(1): 139-144.
[775] Francis, M.P. and Jones, E.G. 2017. Movement, depth distribution and survival of spinetail devilrays (Mobula japanica) tagged and released from purse-seine catches in New Zealand. Aquatic Conservation: Marine and Freshwater Ecosystems 27(1): 219-236.
[776] https://www.gbif.org/species/2419188
[777] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=105923
[778] Mendonça, S.A. 2011. Abundância Relativa, Sazonalidade e Comportamento de Mobula tarapacana (Philippi 1892) (Condrichthyes: Mobulidae) No Arquipélago de São Pedro e São Paulo-Brasil. Dissertação apresentada ao Programa de Pós-Graduação em Oceanografía, Universidade Federal de Pernambuco.
[779] Couturier, L.I.E., Marshall, A.D., Jaine, F.R.A., Kashiwagi, T., Pierce, S.J., Townsend, K.A., Weeks, S.J., Bennet, M.B. and Richardson, A.J. 2012. Biology, ecology and conservation of the Mobulidae. Journal of Fish Biology 80: 1075-1119.
[780] Lawson, J.M., Fordham, S. V, O'Malley, M.P., Davidson, L. N. K., Walls, R. H. L., Heupel, M. R., Stevens, G., Fernando, D., Budziak, A., Simpfendorfer, C. A., Ender, I., Francis, M. P., Notarbartolo di Sciara, G., and Dulvy, N. K. 2017. Sympathy for the devil: a conservation strategy for devil and manta rays. PeerJ 5:e3027 : doi: 10.7717/peerj.3027.
[781] Nair, R.J., Zacharia, P.U., Dinesh Kumar, S., Kishor, T.G., Divya, N.D., Seetha, P.K. and Sobhana, K.S. 2015. Recent trends in the mobulid fishery in Indian waters. Indian Journal of Geo-Marine Sciences 44(9): 1265-1283.

	 https://www.iucnredlist.org/species/60199/214371388			along the Chennai and Tuticorin coasts[782], and Mumbai[783]. Several studies represent a 51% decline in landings over approximately 10 years during which fishing effort almost doubled, from which local population declines can be inferred[784]. The Sicklefin Devil Ray is primarily oceanic, but is also found in coastal waters, and appears to be a seasonal visitor along productive coastlines with regular upwelling in oceanic island groups, and near offshore pinnacles and seamounts. The species is highly mobile and capable of significant migrations. Tagged individuals have travelled over 3,800 km over seven months and dived to depths of 1,896 m[785]. The species distribution map includes the entire coast of India. As per the available secondary information[786, 787], the species has been solitary reported from the coast of Dwarka, but not from the Vadodara area. Thus, its presence in the project's EAAA is less likely.	
85	Bentfin Devil Ray (*Mobula thurstoni*)	**IUCN:** Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	Bentfin Devil Ray has a circumglobal distribution and is found in tropical, subtropical, and temperate waters of the Pacific, Atlantic, and Indian Oceans[788], [789]. There are no historical baseline population data and global population numbers are unknown for any devil ray species. In India, population reductions are inferred based on general declines in devil ray catches. Despite increasing effort in several regions, including Kerala[790], along the Chennai and Tuticorin coasts[791], and Mumbai[792], catches indicate depletion of stocks. The Bentfin Devil Ray occurs in neritic and oceanic waters from the surface to depths of 100 m[793]. The Bentfin Devil Ray is a seasonal visitor along productive coastlines with	Screened Out

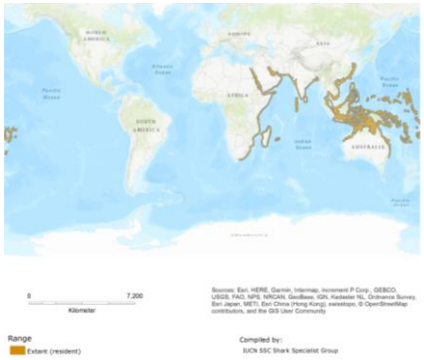
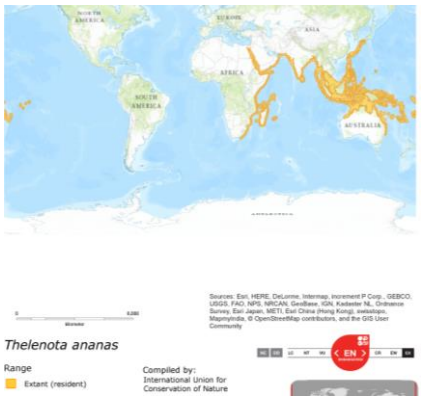
[782] Kizhakudan, S.J., Zacharia, P.U., Thomas, S, Vivekanandan, E, and Muktha, M. 2015. Guidance on National Plan of Action for Sharks in India. . CMFRI Marine Fisheries Policy Series.
[783] Mohanraj, G., Rajapackiam, S., Mohan, S., Batcha, H. and Gomathy, S. 2009. Status of elasmobranchs fishery in Chennai, India. Asian Fisheries Science, 22(2): 607-615.
[784] Marshall, A., Barreto, R., Bigman, J.S., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Herman, K., Jabado, R.W., Liu, K.M., Pardo, S.A., Rigby, C.L., Romanov, E. & Walls, R.H.L. 2022. Mobula tarapacana (amended version of 2019 assessment). The IUCN Red List of Threatened Species 2022: e.T60199A214371388.
[785] Thorrold, S.R., Afonso, P., Fontes, J, Braun, C.D., Santos, R.S, Skomal, G.B. and Berumen, M.L. 2014. Extreme diving behavior in devil rays links surface water and the deep ocean. Nature Communications 5: 4274.
[786] https://www.gbif.org/species/2419179
[787] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=105926
[788] Couturier, L.I.E., Marshall, A.D., Jaine, F.R.A., Kashiwagi, T., Pierce, S.J., Townsend, K.A., Weeks, S.J., Bennet, M.B. and Richardson, A.J. 2012. Biology, ecology and conservation of the Mobulidae. Journal of Fish Biology 80: 1075-1119.
[789] Lawson, J.M., Fordham, S. V, O'Malley, M.P., Davidson, L. N. K., Walls, R. H. L., Heupel, M. R., Stevens, G., Fernando, D., Budziak, A., Simpfendorfer, C. A., Ender, I., Francis, M. P., Notarbartolo di Sciara, G., and Dulvy, N. K. 2017. Sympathy for the devil: a conservation strategy for devil and manta rays. PeerJ 5:e3027 : doi: 10.7717/peerj.3027.
[790] Nair, R.J., Zacharia, P.U., Dinesh Kumar, S., Kishor, T.G., Divya, N.D., Seetha, P.K. and Sobhana, K.S. 2015. Recent trends in the mobulid fishery in Indian waters. Indian Journal of Geo-Marine Sciences 44(9): 1265-1283.
[791] Kizhakudan, S.J., Zacharia, P.U., Thomas, S, Vivekanandan, E, and Muktha, M. 2015. Guidance on National Plan of Action for Sharks in India. . CMFRI Marine Fisheries Policy Series.
[792] Mohanraj, G., Rajapackiam, S., Mohan, S., Batcha, H. and Gomathy, S. 2009. Status of elasmobranchs fishery in Chennai, India. Asian Fisheries Science, 22(2): 607-615.
[793] Weigmann, S. 2016. Annotated checklist of the living sharks, batoids and chimaeras (Chondrichthyes) of the world, with a focus on biogeographical diversity. Journal of Fish Biology 88(3): 837-1037.

	 https://www.iucnredlist.org/species/60200/214368409			regular upwelling, off oceanic island groups, and near offshore pinnacles and seamounts[794, 795, 796, 797]. The Bentfin Devilray is sighted in both upwelling pelagic environments[798] and in shallow, productive, neritic waters[799, 800]. The species distribution map includes the entire coast of India. As per the available secondary information[801, 802], the species has not been reported from the coasts of Gujarat as well as surroundings of the Vadodara area. Thus, its presence in the project's EAAA is unlikely.	
86	Whale Shark (*Rhincodon typus*)	**IUCN:** Endangered **IWP:** Schedule I **Restricted range:** No **Migratory:** Yes	1 a	Whale Shark has a circumtropical distribution through all tropical and warm temperate seas, apart from the Mediterranean[803]. Their core distribution is between approximately 30°N and 35°S, with occasional seasonal penetration to the north and south[804, 805]. Based on counts, modelled population estimates and habitat availability, it is inferred that approximately 75% of the global Whale Shark population occurs in the Indo-Pacific, and 25% in the Atlantic. In the Indo-Pacific, a population reduction of 63% is inferred over the last three generations (75 years), and in the Atlantic a population reduction of more than 30% is inferred (see the discussion for each subpopulation below).	Screened Out

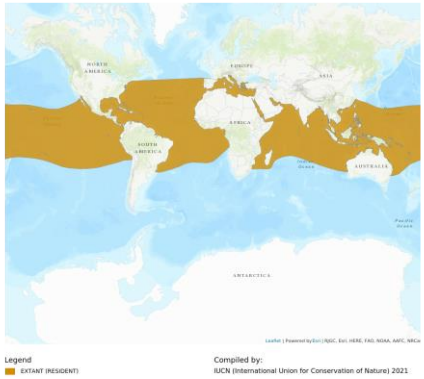
[794] Gadig, O.B.F., Namora, R.C. and Motta, F.D.S. 2003. Occurrence of the bentfin devil ray, Mobula thurstoni (Chondrichthyes: Mobulidae), in the western Atlantic. Journal of the Marine Biological Association of the United Kingdom 83:869–870.
[795] White, W.T., Giles, J., Dharmadi and Potter, I.C. 2006b. Data on the bycatch fishery and reproductive biology of mobulid rays (Myliobatiformes) in Indonesia. Fisheries Research 82: 65-73.
[796] Mendonça, S.A., Macena, B.C.L., Creio, E., Viana, D.L., Viana, D.F., and Hazin, F.H.V. 2012. Record of a pregnant Mobula thurstoni and occurrence of Manta birostris (Myliobatiformes: Mobulidae) in the vicinity of Saint Peter and Saint Paul Archipelago (Equatorial Atlantic). Pan-American Journal of Aquatic Sciences 7(1): 21-26.
[797] Poortvliet, M., Olsen, J., Croll, D.A., Bernardi, G., Newton, K., Kollias, S., O'Sullivan, J., Fernando, D., Stevens, G., Galván Magaña, F., Seret, B., Wintner, S. and Hoarau, G. 2015. A dated molecular phylogeny of manta and devil rays (Mobulidae) based on mitogenome and nuclear sequences. Molecular Phylogenetics and Evolution 83: 72-85.
[798] Mas, F., Forselledo and R., Domingo, A. 2015 . Mobulid ray by-catch in longline fisheries over the southwestern Atlantic Ocean. Marine & Freshwater Research. http://dx.doi.org/10.1071/MF14180.
[799] Gadig, O.B.F., Namora, R.C. and Motta, F.D.S. 2003. Occurrence of the bentfin devil ray, Mobula thurstoni (Chondrichthyes: Mobulidae), in the western Atlantic. Journal of the Marine Biological Association of the United Kingdom 83:869–870.
[800] Croll, D., Dewar, H., Dulvy, N.K., Fernando, D., Malcolm, F., Galvan-Magana, F., Martin, H., Heinrichs, S., Marshall, A., McCauley, D., Newton, K., Notarbartolo di Sciara, G., O'Malley, M., O'Sullivan, J., Poortvliet, M., Roman, M., Stevens, G., Tershy, B., and White, W. 2016. Slow life histories and fisheries impacts: the uncertain future of Manta and Devil Rays. Aquatic Conservation: Marine and Freshwater Ecosystems: Online Early View.
[801] https://www.gbif.org/species/2419218
[802] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=105927
[803] Rowat, D. and Brooks, K.S. 2012. A review of the biology, fisheries and conservation of the whale shark Rhincodon typus. Journal of Fish Biology 80: 1019-1056.
[804] Colman, J. 1997. A review of the biology and ecology of the whale shark. Journal of Fish Biology 51: 1219-1234.
[805] Sequeira, A.M.M., Mellin, C. and Floch, L. 2014. Inter-ocean asynchrony in whale shark occurrence patterns. Journal of Experimental Marine Biology and Ecology 450: 21-29.

	 https://www.iucnredlist.org/species/19488/2365291			Combining data from both regions, it is likely that the global Whale Shark population has declined by >50% over the last 75 years[806]. Whale Sharks are found in both coastal and oceanic habitats[807]. Oceanic sightings are strongly correlated with temperature in the Indian and Atlantic oceans[808], with most occurring between 26.5° and 30°C in the Indian Ocean[809]. Depth was an important predictor in the Atlantic and Pacific Oceans; but was not significant in the Indian Ocean[810]. Whale Sharks are highly mobile, with mean daily movement rates of 24–28 km based on tethered geopositioning tags[811]. The species distribution map includes the entire coast of India. As per the available secondary information[812, 813], the species has not been reported from the coasts of Gujarat as well as surroundings of the Vadodara area. Thus, its presence in the project's EAAA is unlikely.	
87	Indo-Pacific Leopard Shark (*Stegostoma tigrinum*)	**IUCN:** Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	Indo-Pacific Leopard Shark is found in inshore waters of the continental and insular shelves of the Western Pacific and Indian Oceans[814]. Population size information for the Indian Ocean-Southeast Asian subpopulation is limited. Indo-Pacific Leopard Shark are reported from fish markets across the region[815]. The Zebra Shark occurs in tropical and subtropical, shallow inshore and offshore waters, often found on and around coral and rocky reefs and on sandy plateaus near coral, at depths down to at least 62 m. They are often observed resting on the bottom as well as swimming near the surface as both juveniles and adults[816].	Screened Out

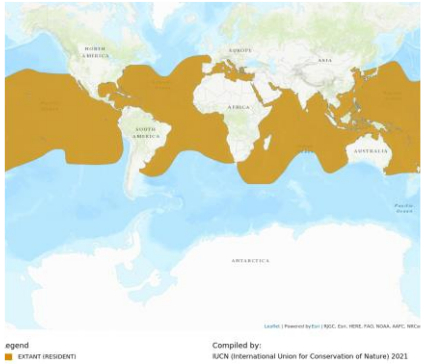
[806] https://www.iucnredlist.org/species/19488/2365291#population
[807] Rowat, D. and Brooks, K.S. 2012. A review of the biology, fisheries and conservation of the whale shark Rhincodon typus. Journal of Fish Biology 80: 1019-1056.
[808] Sequeira, A.M.M., Mellin, C. and Floch, L. 2014. Inter-ocean asynchrony in whale shark occurrence patterns. Journal of Experimental Marine Biology and Ecology 450: 21-29.
[809] Sequeira, A., Mellin, C., Rowat, D., Meekan, M.G. and Bradshaw, C.J.A. 2012. Ocean-scale prediction of whale shark distribution. Diversity and Distributions 18: 504-518.
[810] Sequeira, A.M.M., Mellin, C. and Floch, L. 2014. Inter-ocean asynchrony in whale shark occurrence patterns. Journal of Experimental Marine Biology and Ecology 450: 21-29.
[811] Hueter, R.E., Tyminski, J.P. and de la Parra, R. 2013. Horizontal movements, migration patterns, and population structure of whale sharks in the Gulf of Mexico and northwestern Caribbean Sea. PloS ONE 8: e71883.
[812] https://www.gbif.org/species/2417522
[813] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=52188
[814] Compagno, L.J.V. 2001. Sharks of the world. An annotated and illustrated catalogue of shark species known to date. Vol. 2. Bullhead, mackeral and carpet sharks (Heterodontiformes, Lamniformes and Orectolobiformes). FAO species catalogue for fisheries purposes. No. 1. Vol. 2. FAO, Rome.
[815] Pillans, R. and Simpfendorfer, C. 2003. Stegostoma fasciatum. The IUCN Red List of Threatened Species 2003. Available at: http://dx.doi.org/10.2305/IUCN.UK.2003.RLTS.T41878A10564988.en.
[816] https://www.iucnredlist.org/species/41878/161303882#habitat-ecology

	 https://www.iucnredlist.org/species/41878/161303882			The species distribution map includes the entire coast of India. As per the available secondary information[817, 818], the species has not been reported from the coasts of Gujarat as well as surroundings of the Vadodara area. Thus, its presence in the project's EAAA is unlikely.	
88	Pineapple Sea Cucumber (*Thelenota ananas*)  https://www.iucnredlist.org/species/180481/1636021	**IUCN:** Endangered **IWP:** Not Available **Restricted range:** No **Migratory:** No	1 a	Pineapple Sea Cucumber is widely distributed throughout the Indo-Pacific, excluding Hawaii. It occurs in Australia, Bangladesh, Brunei Darussalam, Cambodia, China, Cocos (Keeling) Islands, Comoros, Cook Islands, Djibouti, Egypt, Eritrea, Fiji, French Polynesia, Guam, India, Indonesia, Islamic Republic of Iran, Israel, Japan, Jordan, Kenya, Kiribati, Madagascar, Malaysia, Maldives, Marshall Islands, Mauritius, Mayotte, Mozambique, Myanmar, New Caledonia, Niue, Oman, Pakistan, Palau, Papua New Guinea, Philippines, Réunion, Samoa, Saudi Arabia, Seychelles, Singapore, Solomon Islands, Somalia, South Africa, Sri Lanka, Sudan, Taiwan (Province of China), United Republic of Tanzania, Thailand, Tonga, Tuvalu, United States of America (N. Marianas Islands),Vanuatu, Viet Nam and Yemen[819, 820]. No species-specific population information available for this species. This species is found along slopes and passes within reef zones[821] and along outer reef flats[822] to depths of 35 m, but is more common in waters from 10-20 m.	Screened Out

[817] https://www.gbif.org/species/8493577
[818] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=1303450
[819] Conand, C., Gamboa, R. & Purcell, S. (2013). Thelenota ananas. The IUCN Red List of Threatened Species 2013: e.T180481A1636021.
[820] Kinch, J., Purcell, S., Uthicke, S., & Friedman, K. (2008). Population status, fisheries and trade of sea cucumbers in the Western Central Pacific. Sea cucumbers. A global review of fisheries and trade. FAO Fisheries and Aquaculture Technical Paper, 516, 7-55.
[821] Skewes, T., Haywood, M., Pitchern, R. and Willan, R . 2004. Holothurians. National Oceans Office, Hobart, Australia.
[822] Conand, C. and Mangion, P. 2002. Sea cucumbers on La Reunion Island fringing reefs: Diversity, distribution, abundance and structure of the populations. SPC Beche-de-mer Information Bulletin 17(17): 27-33.

				Although the global distribution of the species includes the entire coast of India, however it has been reported around the Andaman and Nicobar Islands and Lakshadweep only[823, 824, 825]. Thus, the presence of this species in the EAAA is unlikely.	
89	Silky Shark (*Carcharhinus falciformis*)  https://www.iucnredlist.org/species/39370/205782570	**IUCN:** Vulnerable **IWP:** Not Available **Restricted range:** No **Migratory:** Yes	3a	Silky Shark has a circumglobal distribution in tropical waters[826]. In the Indian Ocean, the species occurs off Madagascar, Mozambique, Tanzania, Comoros and Aldabra Island, also from Somalia to the Maldives, Oman, Red Sea, and Sri Lanka. The Silky Shark population structure is poorly understood. Population changes have been noted in all ocean regions but no population estimates are available[827]. In the Indian Ocean, there is no stock assessment or any reliable fishery indicators of status, therefore the stock status is highly uncertain[828, 829]. The Silky Shark is a circumtropical oceanic and coastal-pelagic species. It is most often found near the edge of continental and insular shelves at depths of 200 m or more in the epipelagic zone although it occurs from the surface to a depth of at least 500 m offshore[830]. It is often associated with islands, near insular slopes and over deepwater reefs preferring warmer waters (about 23°C). The species distribution map includes the entire coast of India. As per the available secondary information[831, 832, 833], the species has been reported from the coasts of Somnath[834] in 2017 and Dwarka[835] in 2018 from Gujarat, but not from the surroundings of Vadodara area. Thus, its presence in the project's EAAA is less likely.	Screened Out
90	Sailfish (*Istiophorus platypterus*)	**IUCN:** Vulnerable **IWP:** Not Available **Restricted range:** No **Migratory:** Yes	3a	In the Indian and Pacific oceans, Sailfish occur between approximately 45.5°N and 40.35°S in the western Pacific, 35°N and 35°S in the eastern Pacific, 45°S in the western Indian Ocean and 35°S in the eastern Indian Ocean[836].	Screened Out

[823] Raghunathan, C. and Venkataraman, K., 2014. Status Survey of Holothurians (Sea Cucumber) in the Territorial waters of Andaman and Nicobar Islands : 1–96, (Publishedby the Director, Zool. Surv. India, Kolkata) [https://faunaofindia.nic.in/PDFVolumes/sse/011/index.pdf]
[824] https://www.gbif.org/species/4343232
[825] https://core.ac.uk/download/pdf/33013177.pdf
[826] Last, P.R. and Stevens, J.D. 2009. Sharks and Rays of Australia. CSIRO Division of Fisheries, Hobart.
[827] https://www.iucnredlist.org/species/39370/205782570#population
[828] IOTC. 2013. Report of the sixteenth session of the IOTC Scientific Committee. IOTC-2013-SC16-R[E].
[829] Lack, M, Sant, G., Burgener, M., Okes, N. 2014. Development of a rapid management-risk assessment method for fish species through its application to sharks: framework and results. Report to the Department of Environment, Food and Rural Affairs.Defra Contract No. MB0123.
[830] Last, P.R. and Stevens, J.D. 2009. Sharks and Rays of Australia. CSIRO Division of Fisheries, Hobart.
[831] https://www.gbif.org/species/2418095
[832] https://indiabiodiversity.org/species/show/231900
[833] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=96754
[834] https://www.inaturalist.org/observations/29996807
[835] https://www.inaturalist.org/observations/30087862
[836] https://www.iucnredlist.org/species/170338/46649664#geographic-range



https://www.iucnredlist.org/species/170338/46649664

Sailfish are managed in five stocks: Western Atlantic, Eastern Atlantic, Eastern Pacific, Western Central Pacific and Indian oceans. In the Indian Ocean catches of all billfishes have greatly increased from around 5,000 t in the early 1990s to almost 29,000 t in 2011 due largely to development of a gillnet/longline fishery[837, 838, 839]. With MSY estimated as 23,900 t, the Indian Ocean stock may represent about 87% of this species' global population[840].

Sailfish are oceanic and epipelagic, spending most of their time in the upper 10 m in a temperature range between 21 and 28 °C. However, on occasion they descend into deeper waters, greater than 100 m[841, 842].

The species distribution map includes the entire coast of India. As per the available secondary information[843, 844, 845], the species has been reported from the Arabian sea, but not from the surroundings of Vadodara area. Thus, its presence in the project's EAAA is less likely.

[837] IOTC. 2013. Status of the Indian Ocean Indo-Pacific Sailfish (SFA: Istiophorus platypterus) resource. IOTC–2013–SC16–ES15[E].
[838] IOTC. 2018a. Report of the 21st Session of the IOTC Scientific Committee.
[839] Collette, B.B. and Graves, J. 2019. Tunas and Billfishes of the World. Johns Hopkins University Press, Baltimore, Maryland.
[840] IOTC. 2019. Assessment of Indian Ocean Indo-Pacific Sailfish (Istiophorus platypterus) using catch-only methods. IOTC–2019–WPB–24.
[841] Hoolihan, J.P. 2006. Estimating survival and recovery probabilities for Arabian Gulf Sailfish (Istiophorus platypterus) from tag recovery studies. Bulletin of Marine Science 79(3): 577-587.
[842] Mourato, B.L., Carvalho, F., Musyl, M., Amorin, A., Pacheco, J.D., Hazin, H. and Hazin, F. 2014. Short-term movements and habitat preferences of Sailfish, Istiophorus platypterus (Istiophoridae), along the southeast coast of Brazil. Neotropical Ichthyology 12(4): 861-870.
[843] https://www.gbif.org/species/5211984
[844] https://indiabiodiversity.org/species/show/232616
[845] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=119719