Environmental and Social Impact Assessment (ESIA) for 7.5 MW Operational Waste to Energy Plant at Jamnagar, Gujarat

Project SPV: Goodwatts WTE Jamnagar Private Limited

Project Location: Navagam, Jamnagar, Gujarat

Final Report

May 2024

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Abbreviations

Name	Description
ACEL	Abellon Clean Energy Limited
WTE	Waste to Energy
AMSL	Above mean sea level
GETCO	Gujarat Energy Transmission Corporation Limited
GWJPL	Goodwatts WTE Jamnagar Private Limited
JMC	Jamnagar 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	Electrostatic 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

Name	Description
MoEFCC	Ministry of Environment, Forest and Climate Change
MW	Mega Watt
NAAQ	National Ambient Air Quality
NOC	No Objection Certificate
O&M	Operation and Maintenance
OBC	Other Backward Caste
PPE	Personal Protective Equipment
PPM	Parts per million
PM	Particulate Matter
PPM	Project-affected People's Mechanism
PS	Performance Standards
PUC	Pollution under Control
PPA	Power Purchase Agreement
STP	Sewage Treatment Plant
RDF	Refuse Derived Fuel
SC/ST	Schedule Caste/Schedule Tribe
SPV	Special Purpose Vehicle
TPH	Tons Per Hours
TPD	Tons 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 (ESIA) of its 7.5 MW operational waste to energy plant located in Navagam Ghed in Jamnagar tehsil and district in the state of 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 plants 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[1]. 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 advisor to undertake ESIA for the Project.

This ESIA report identifies and analyses environmental and social risks and impacts associated with 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
- WBGEHS 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:

[1] https://abelloncleanenergy.com/ (Accessed on June 07, 2023)

- 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 operational waste to energy plant to understand site settings, environmental and social baseline and identify 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 to map sensitive receptors within the study area including land-use pattern of the allocated land to the Waste to Energy plant and along the route of transmission line and water pipeline based on 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 waste to energy 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 operational 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 operation phase of the 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 Advisors 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 Advisors reviewed 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 review of the documents, E&S Advisors prepared the legal, and administrative framework within which the site visits were carried out, including state and central regulations, obligations of implementing relevant international social and environmental treaties, agreements, and conventions and IFC PS. E&S Advisors has compiled desk-based information on the environmental and social baseline of the Project area which are supported by primary data collection thereafter.

1.4.3 Detailed Site Visit & Baseline Data Collection

Team comprising of EHS, social and ecological expert conducted site visit to the Project location and associated facilities between 13th- 15th May (for Ecology and Biodiversity), followed by 21st June & 27th June to understand key ecological, environmental and social sensitivities within the Project footprint, associated facilities 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 operations and consultation with key stakeholder groups was also undertaken during site visit. Details of activities undertaken during site visit is as presented in ***Table 1-1*** below.

Table 1-1 Site Assessment Activities

Date(s)	Location	Activities
13th May 2023	5 km buffer of Project Site	• Ecology and Biodiversity Survey. • Consultations with the locals. • Consultation with Ragpickers at Happa transfer station. • Discussion with client representative to understand the project infrastructures and project activities. • Ecology and Biodiversity Survey of the surrounding area.
14-15th May 2023	10 km buffer of Project Site	• Ecology and Biodiversity Survey. • Consultations with the locals on ecology and biodiversity aspects.
21st June 2023	• Project Site • Along the route for transmission line and pipeline • Existing dumping ground for Jamnagar Municipal Corporation	• Discussion with project team on Plant operations, process and layout. • Site reconnaissance of the WTE plant. • 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, storage of segregated waste, material recovery and conveyance to treatment facilities (internal transfer of waste) (to WTE/ to landfill). • Visit to the existing landfill and transfer station.
27th June 2023	• Project Site • Along the route for transmission line and pipeline • Existing dumping ground for Jamnagar Municipal Corporation • Stakeholder consultation	• Discussion with the project teams regarding HR policy, labor welfare • Plant inspection to understand the EHS implementation and labor issues. • Consultation with labor to understand the labor welfare practices followed at project level. • Transit walk /route survey along the TL and water pipeline route. • Consultations with affected family (Head of the Household).

1.4.3.1 Primary Environmental Baseline

The primary baseline data collection has been undertaken for a period of four (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 (AAQ) including Dioxins and Furan
- Ground water quality (drinking purpose). A separate study has been undertaken for the site contamination/historical pollution assessment.
- Traffic monitoring for the access road
- Soil quality sampling and analysis
- Surface water quality sampling and analysis
- 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 13th – 15th 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. were 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 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 project was qualitative in nature. 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 1-2*** below:

Table 1-2 Sources of Secondary Data Collection

Sr. 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 Jamnagar Municipal Corporation

1.4.5 Analysis of Alternatives

E&S Advisors 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, 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, staff, security guards, and affected family 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.

There are no new projects proposed in immediate proximity of the operational WTE plant. Nor any other developmental projects are proposed in immediate future. Therefore, no cumulative impacts are anticipated from the operations of the WTE plant.

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 GWJPL 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 GWJPL site representative and local community.
- 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.
- Considering the nature and phase of the project and its potential impact, the assessment of marine habitat and marine species was not conducted during the survey.
- As informed, currently no formal stakeholder engagement activities have been carried out at the project level. And due to limited interactions and unfavourable weather conditions as it was raining heavily therefore most of the community was unavailable for consultations.

1.6 Structure of the Report

Chapter 1	Introduction (This Section)
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Chapter 3	Analysis of Alternatives
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Chapter 5	Environment & Social Baseline Conditions
Chapter 6	Stakeholder Identification & Engagement
Chapter 7	Impact Assessment & Mitigation Measures
Chapter 8	Environment & Social Management and Monitoring Plan
Chapter 9	Impact Summary & Conclusion
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Appendix 2	Photolog
Appendix 3	Design Specification for Flue Gas Cleaning
Appendix 4	Emergency Preparedness and Response Plan
Appendix 5	Contractor Management Plan
Appendix 6	Pollution Prevention and Management Plan
Appendix 7	Traffic Management Plan
Appendix 8	Resource Efficiency and Conservation Management
Appendix 9	Biodiversity Management Plan
Appendix 10	Security Risk and management plan
Appendix 11	Stakeholder Engagement Plan & Grievance Redressal mechanism
Appendix 12	Labour Management and Working Condition including Labour Camps
Appendix 13	Environment and Social Monitoring Plan
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Appendix 15	Detailed AEROMOD Results with Source Pathways
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Appendix 18	Birds reported from the area
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Appendix 20	CEMS data
Appendix 21	Critical Habitat Screening

2 Project Description

This section provides an overview of the 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 notified Gujarat Waste to Energy Policy, 2016 to facilitate and promote utilization of Municipal Solid Waste for generation of electricity in a sustainable manner and also contribute to Swachh Bharat Abhiyan. In line with the Gujarat Waste to Energy (WTE) Policy, 2016, Jamnagar Municipal Corporation (JMC) issued an expression of interest (EOI) on 20.03.2016 inviting bidders for setting up waste processing and disposal plant including waste to energy plant in Jamnagar. The competitive bidders submitted their respective Expression of Interest (EOIs) for development of the 7.5 MW waste to energy plant at a tariff of INR 7.07 per unit of electricity. Post evaluation of the EOIs, JMC declared Abellon Clean Energy Limited (ACEL) as the successful bidder for setting up the WTE plant as per provision of the WTE policy, 2016 and issued letter of award (LoA) dated 03.06.2016. ACEL established a special purpose vehicle (SPV) i.e., Goodwatts WTE Jamnagar Private Limited[2] and incorporated the SPV under Companies Act 2013 and further requested JMC to accept the SPV as the concessionaire for the project which shall perform the obligations under the LoA and Concession Agreement (CA).

The concession agreement was executed between JMC and Goodwatts WTE Jamnagar Private Limited (GWJPL) on 25.04.2017 for 250 TPD municipal solid waste to energy project at Navan Gam in Jamnagar tehsil and district in the state of Gujarat, India. The 7.5 MW WTE plant is operational since November 2021 and has been established on a land measuring 16.70 acres. The project has been developed with a waste processing capacity of 650-750 TPD, out of which 250-300 TPD municipal solid waste is generated and transported from Jamnagar city in line with the concession agreement and remaining 400-500 TPD is utilised through biomining activity being carried out at Rajkot Municipal Solid Waste (MSW) landfill.

The salient features of the operational 7.5 MW waste to energy project have been presented in ***Table 2-1*** and project process flow has been presented as ***Figure 2-1***

Table 2-1 Salient Features of the Operational Project

Sr. No.	Components	Description
1	SPV Name	Goodwatts WTE Jamnagar Private Limited (GWJPL)
2	Project Capacity	7.5 MW
3	Project Coordinates	22°29'44.68"N 70° 3'58.99"E
4	Project Location	Nava Gam Ghed in Jamnagar tehsil and district in the state of Gujarat, India
5	Project Current Status	Operational
6	Commercial Operation Date	November 2021
7	Total Municipal Waste used per day	650-750 TPD (250 TPD MSW directly sourced from door-to-door collection in the Jamnagar Municipal Corporation authority area and 400-500 TPD is being sourced from biomining activity at Rajkot MSW landfill. However, as per discussions with the Goodwatts WTE Jamnagar Private Limited (GWJPL) project team, there are plans to source MSW directly from collection centers in other nearby cities of Jamnagar in the future. This is intended to replace the use of bio-mined/legacy waste currently being transported from the Rajkot MSW landfill. By sourcing additional waste directly from nearby areas, the reliance on waste from the Rajkot landfill can be reduced. Refer ***Section 2.4*** for details
8	Biomining activities	Biomining operations at the Rajkot Municipal Solid Waste (MSW) landfill site are conducted by a third-party contractor, duly appointed by the Rajkot Municipal Corporation (RMC). As per information provided by the project representative, the project currently procures biomining waste from this contractor. The volume of bio mined waste sourced from the contractor amounts to 200 MT per Contractor. The biomining activities for 3 lakh MT/year of legacy waste at the Rajkot MSW landfill is being undertaken by an independent third-party contractor named M/s Jay Vachharaj Roadways & Earth Movers (JVREM), JVREM, appointed directly by Rajkot Municipal Corporation (RMC). GWJPL has entered

[2] Goodwatts WTE Jamnagar Private Limited is a 100% owned SPV of ACEL.

<table>
<tr><th>Sr. No.</th><th>Components</th><th>Description</th></tr>
<tr><td></td><td></td><td>into a provisional contract with JVREM to provide the Refuse-derived fuel (RDF) at the plant The company is not bound to procure RDF from the above-mentioned contractor further as mentioned above the company may also receiving RDF at the plant from other bio-mining contractor as well. Currently, only bio mined waste is only being received from JVREM. Refer Section 2.4.2 for further details.
It is important to note that the contractor involved in biomining operates autonomously and is responsible for the excavation and extraction of legacy waste from the Rajkot MSW landfill site. The biomining activities encompass various processes, including the extraction of legacy waste, segregation and recovery of recyclable materials, organic waste separation, and handling of other waste components, all of which are further subjected to specific processing and disposal procedures.</td></tr>
<tr><td>9</td><td>Boiler no. and capacity</td><td>1 Boiler of 40 ton per hour (TPH) capacity</td></tr>
<tr><td>10</td><td>Boiler Stack Height</td><td>40 meters
As per the WBG EHS guidelines the stack height should be as per following formula:
Hg[3]= H+1.5L, Hg is calculated to be ~35 m (considering H= 14m, L= 14m). Since the stack height is 40 m which is higher than the minimum stack height requirement for the project i.e., 35 m, therefore the stack height of the boiler is compliant to WBG EHS guidelines.
For details on refer section 2.7.1.</td></tr>
<tr><td>11</td><td>Ash generated from the Waste to Energy Plant</td><td>100 TPD
The quantity of types of generated have been provided below:
<table>
<tr><th>Particular</th><th>Quantity**</th><th>%</th></tr>
<tr><td>Bottom Ash</td><td>66.6 TPD</td><td>66.67</td></tr>
<tr><td>Bank Zone Ash</td><td>13.50 TPD</td><td>13.50</td></tr>
<tr><td>ESP Fly Ash</td><td>13.50 TPD</td><td>13.50</td></tr>
<tr><td>Bag Filter Cake Ash</td><td>6.40 TPD</td><td>6.40</td></tr>
<tr><td colspan="3">** The ash is calculated on 750 TPD feed to boiler on a conservative basis.</td></tr>
</table></td></tr>
<tr><td>12</td><td>Transmission Line</td><td>66 kV underground transmission line of 56.4 m length connecting the Plant to Gujarat Energy Transmission Corporation Limited (GETCO) Substation</td></tr>
<tr><td>13</td><td>Land Requirement for the Project</td><td>The land requirement for the Project is provided below:
<table>
<tr><th>Project Proponent</th><th>Land (Acres)</th></tr>
<tr><td>Waste to Energy Plant</td><td>16.70</td></tr>
<tr><td>Underground Transmission Line</td><td>0.01398</td></tr>
<tr><td>Underground Water Pipeline</td><td>0.0800</td></tr>
<tr><td>Total</td><td>16.8</td></tr>
</table></td></tr>
<tr><td>14</td><td>Water Requirement and Source</td><td>The project requires 770 m^3/day[4] water for industrial purpose and 7.5 m^3/day water for domestic purpose.
Project has been allocated 1000 m^3/day (1 MLD[5]) of secondary treated water from 70,000 m^3/day sewage treatment plant (STP) operated by JMC for industrial requirement. For domestic purposes, Project has received permission to abstract 7.5 m^3/day groundwater from Central Ground Water Authority (CGWA). Bottled water for drinking purposes is being procured from third party. Groundwater can only be used for flushing purpose as it is contaminated as per Phase II groundwater quality results (refer 5.3.7.2). Recommendation on use of groundwater for domestic purpose are given in Section 7.4.4.</td></tr>
</table>

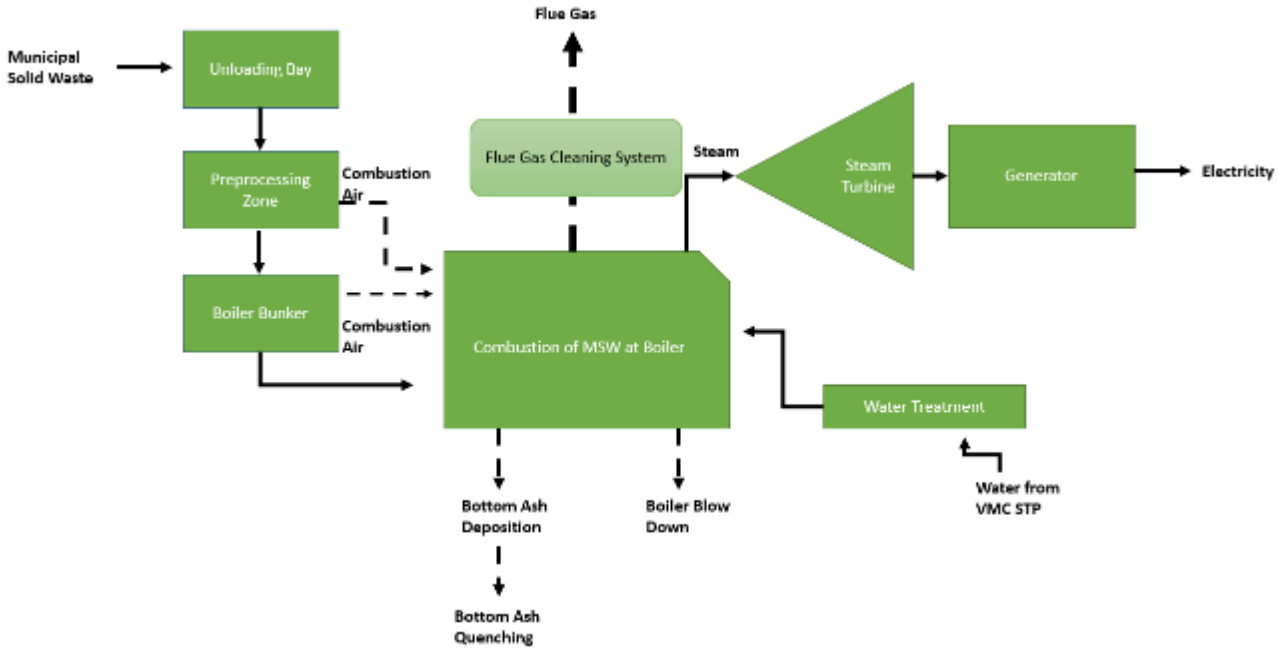
[3] GEP stack height measured from the ground level elevation at the base of the stack.
[4] 1KLD= 1 m^3/day
[5] 1MLD=1000 m^3/day

Sr. No.	Components	Description
15	Underground Water Pipeline	The total length of the underground water pipeline is 324 meters underground water pipeline (1 no.) connecting plant to 70 MLD JMC STP.
16	Presence of Indigenous People (ownership of procured land or usage on procured land)	The land for the waste-to-energy plant has been provided by the Jamnagar Municipal Corporation (JMC) under a lease agreement for a period of 25 years. Prior to the project, a majority of the land, approximately 82% (13.7 acres out of the total 16.7 acres), was categorized as barren or unused. The remaining 18% (3 acres out of the total 16.7 acres) was being cultivated by a single household. The household that was cultivating the land belongs to the Rathod Caste, which is classified as an "other backward caste (OBC)[3]" in the state of Gujarat[4]. Further, the waste-to-energy project does not have any impact on communities or groups of Indigenous Peoples[5]. Since there are no indications or mentions of Indigenous Peoples in the project area or their rights being affected, it can be concluded that the project does not have any direct impact on Indigenous Peoples.
17	National Park, Protected Area, or ecologically sensitive sites	Marine Sanctuary is the nearest protected area, situated about 1.8 km from the project location in north direction, while Marine National Park is situated about 9.5 km away from the project area in northwest direction. Another protected area as well as Important Bird and Biodiversity Areas (IBA) and Samsar site, Khejadiya Wildlife Sanctuary is situated about 5 km away from the project location in East-Northeast direction.
18	River / water bodies	A seasonal water stream which is also used to escape overcapacity water of Ranjit Sagar Dam is flowing adjacent to the project boundary. Other seasonal water streams are also present within the 5 km buffer. Lakhota lake, Dhinchada lake, Reservoir near Gordhanpur, Khijadia dam and reservoir are the important waterbodies present within the 10 km buffer. Several other medium to small sized waterbodies are also present within the buffer area.
19	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[6] have been presented below. • **Earthquake:** The Project is located in an area categorized as Zone IV i.e., high damage risk zone (MSK VIII) • **Wind:** The Project is located in an area categorized as Very High Damage Risk Zone with wind speed of 50 m/s • **Flood:** The Project is located in an area not vulnerable to floods. However, as per information available on public domain, there had been instance of flood in Jamnagar in 2021 due to heavy rainfall. Additionally, as per District Disaster Management Plan for Jamnagar, 2022, Jamnagar has faced flood in 2013 of magnitude 4 due to heavy rainfall which caused 12 human deaths and 70 cattle loss. • **Drought:** According to District Disaster Management Plan for Jamnagar, 2022, probability of drought for Jamnagar is low, but may occur in the month of July to October due to low rainfall. **The project is operational since 2021, and the Design basis reports were developed for civil/structural design where geotechnical investigation was undertaken along with structural analysis. Earthquake load and high wind load was factored in while construction. Recommendations in the study were implemented during construction stage.**
20	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, o ***Core Area:*** Boundary of the project, and o ***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 (Kutcha) besides considering the actual land area which is used for the facilities. This road is also currently being by JMC sewage treatment plant (STP) and GETCO substation located near to the plant. For the purpose of environmental baseline assessment, o *core (0 – 2km from project site) and* o *buffer zones (beyond 2km – 10km of project site).*

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-categorization 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 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 5 km 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 (grazing and agricultural land) and increased vehicular activity in remote areas. **Study area:** Project footprint = Core zone (5 km) + buffer zone (10 km). **Note:** As the transmission line (TL) and the STP line route is present within the core and buffer area, no separate buffer area was demarcated for TL and the STP pipeline.

Source: GWJPL & Site visit

Figure 2-1 Process Flow



Source: GWJPL, Project Parameter booklet

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

S.No	Type of Industry	Waste Name
3	Automobiles	Oily Rags, Cotton rags
4	Pharmaceuticals	Date expired goods
5		Off specifications goods
6		Spent Carbon
7		Process Wastes and residues
8	Heavy Engineering	Used Oil
9		Waste residues containing Oil

Source: GWJPL

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 7.5 MW operational waste to energy plant is located at Nava Gam village in Jamnagar tehsil and district in the state of Gujarat. The Project is located in the outskirts of Jamnagar city, surrounded by agriculture and fallow land in all the directions within 200 m radius of the Project boundary. Based on historical images available on google earth, a majority of the land, approximately 82% (13.7 acres out of the total 16.7 acres), was categorized as barren or unused and the remaining 18% (3 acres out of the total 16.7 acres) was being cultivated by a single household. However during the handover of allocated project land parcel to the SPV by JMC, the land use was barren land. Salt pans are located ~1.5 km (aerial distance) from the project towards northwest direction. Gulf of Kutch is located approximately 5 km (aerial distance) from Project boundary towards north direction.

Rangamati River stream flows adjacent to the Project boundary towards west direction[6]. A railway track is located ~ 380 m (aerial distance) from the Plant towards north direction. INS Valsura road is located ~ 1.6 km from the Plant and is used for the access to the Plant. INS Valsura road is connected to the village road which is the main access road to reach the WTE plant.

A temple[7] (Mamadev Temple) is located ~ 30 m (aerial distance) from the entrance of the WTE Plant towards northeast direction. The 70 MLD JMC is located ~ 60 m (aerial distance) from the WTE plant towards north direction. Additionally, GETCO 66kV substation is located adjacent to the WTE plant towards north direction. Navagam Ghed city is located ~ 130 m (aerial distance) towards south direction and ~ 300 m (aerial distance) towards west direction. Set back distance of MSW processing site from habitation should be 500 m as per guidelines issued by Central Public Health and Environmental Engineering Organisation (CPHEEO) and CPCB guidelines 2019. However land for the Project was allocated by JMC and Abellon had no role in site consideration. Further, as per CPCB Guidelines, responsibility for identification, demarcation and implementation of the buffer zones lies with the urban local bodies, Town Planning Department and the SPCB and the Operator has no role to play in the same. In addition consent to operate granted by SPCB does not specify any provision regarding the same. As per the CA, JMC is responsible to procure project site authorization from the concerned authorities.

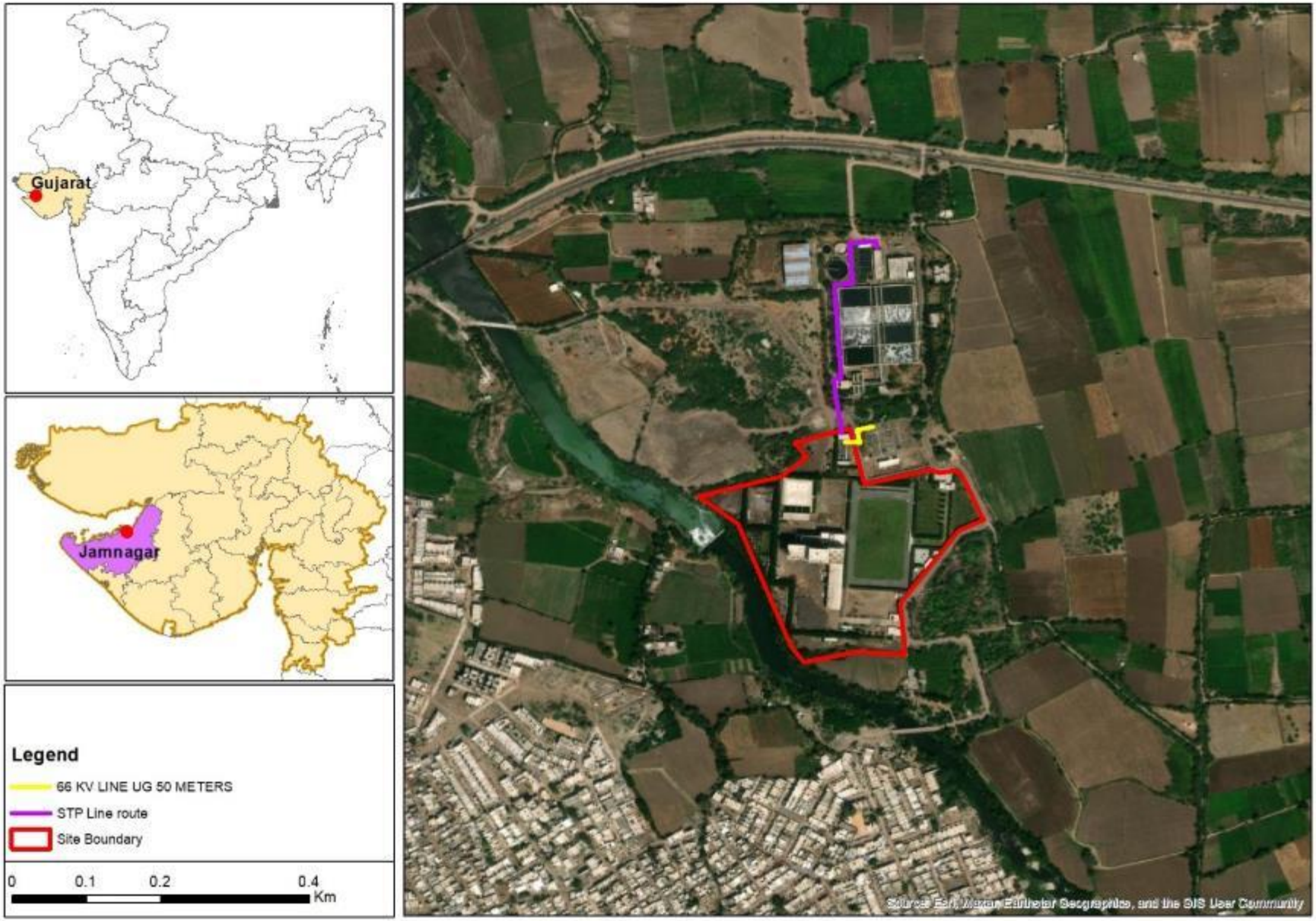
Nearest airport to the WTE plant is Jamnagar airport located ~ 6 km (aerial distance) towards southwest direction and nearest commercial railway station is Jamnagar railway station located ~ 1.3 km (aerial distance) towards west direction. As per

[6] The river was observed to be contaminated, possibly due to release of untreated wastewater from nearby residential areas
[7] Reportedly, the temple is visited by local community from nearby areas on daily basis

guidelines MSW processing site should be 20 km away from the airport. However in special cases, landfill may be set up after obtaining NOC from the civil aviation authority or air force as the case may. Project had approached Airport Authority of India (AAI) for the NOC, however, was advised to approach Ministry of Defense as the airport is owned by Indian Airforce. Project has received NOC from Ministry of Defense dated 11.03.2020.

A tentative Project location map showing route of water pipeline and transmission line has been presented in ***Figure 2-2***

Figure 2-2 Project Location Map



Source: ARC GIS Mapping, E&S Advisor

2.3 Project Planning & Strategy

2.3.1 Waste Quantity

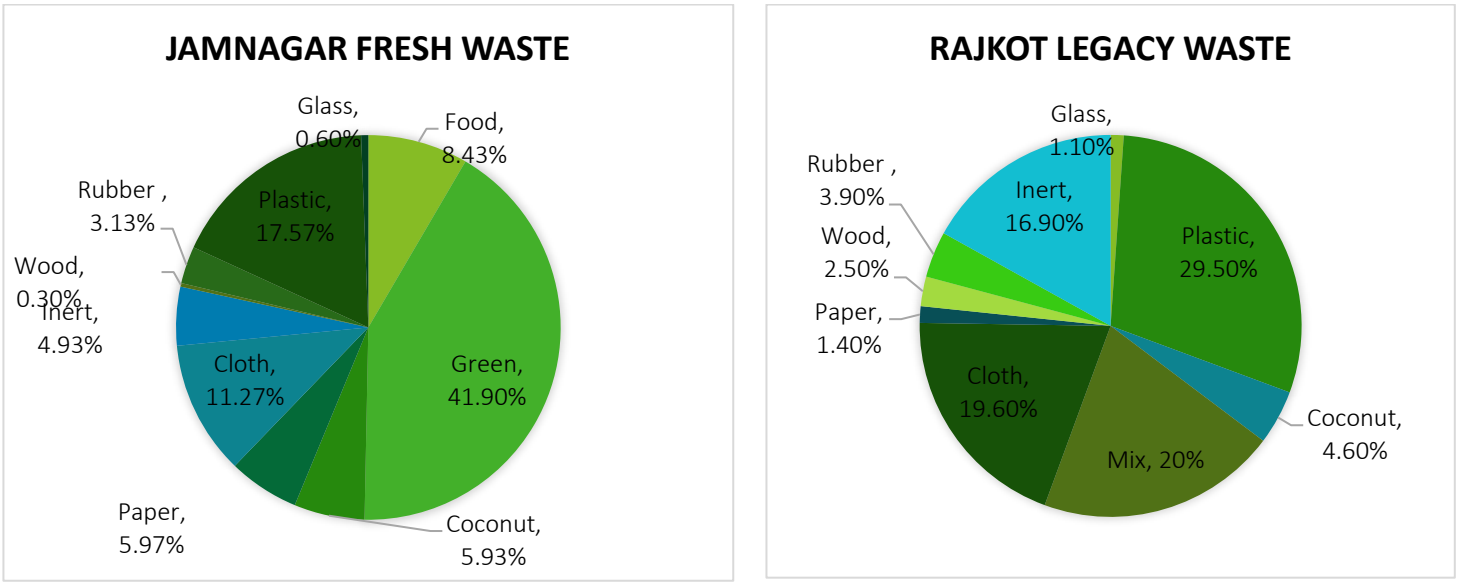
At present, the plant receives 250 TPD of MSW directly from Jamnagar households, which is transported by trucks and tippers owned by the Jamnagar Municipal Corporation (JMC) on a daily basis. The entire waste generated from the Jamnagar city is brought to the plant. The remaining 500 TPD of waste is sourced from the Rajkot MSW landfill (refer ***section 2.4.2*** for sourcing of legacy waste).

Additionally, the project may consider cluster formation from nearby districts in future for collection of waste from nearby cities to eliminate the need for transportation of bio mined waste from Rajkot MSW landfill (Refer ***section 2.4.1*** for clusters details for waste sourcing).

2.3.2 Waste Characteristics

To understand the waste categorization proximate analysis was done for the area by Abellon wherein samples of waste were collected from Door-to-Door Waste being dumped in MSW Dumping Yard, Theba Bypass Jamnagar, Waste directly sampled from Open Points, Bins, and container and from the legacy waste present at the Jamnagar waste dumping area. Total 2241 tests were performed on the samples collected on 27th April 2022. This included qualitative tests like bulk density, moisture, ash, Gross Calorific Value (GCV) along with quantitative sieve analysis for above 8-inch, 4–8-inch, 2-4 inch and below 2-inch size and boiler feed waste. Waste characterization for the fresh waste and legacy waste[8] (sampled from Jamnagar Waste dumping area) has been presented in ***Figure 2-3.*** The Fresh Municipal Solid waste collected majorly comprised of green waste (landscape & gardening waste) (41.90%), Plastic (17.57%) and Cloth (11.27%). Other materials like Food (8.43%), Coconut (5.93%), Paper (5.97%), Rubber (3.13%) and Inert (4.93%) also contributes to the collection.

Figure 2-3 Waste characterization for Fresh waste as well as legacy waste for Jamnagar Waste to Energy Facility



Source: GWJPL

Waste categorization was also undertaken separately by Abellon for the waste streams to assess the moisture content, ash %, Gross Calorific Value (GCV), Heating value etc, details have been presented in ***Table 2-2***. The waste streams were recorded to have moisture % between 22-33%, percentage of dry ash was recorded to be maximum from legacy waste and the least from fresh waste. This resulted in higher GCV value of dry waste from Rajkot Legacy waste.

[8] Legacy waste refers to accumulated waste that has not been properly managed or treated over a long period of time

Table 2-2 Transfer Station specific waste characterization

	Weighted Average values				
Waste Source	Moisture (%)	Ash_{dry} (%)	GCV_{dry} (kcal/kg)	GCV_{wet} (kcal/kg)	LHV_{wet} (kcal/kg)
OM Swatchhata (DTD MSW)	33%	20%	4405	3052	2694
Powerline (DTD MSW)	30%	21%	3853	2417	2043
Rajkot RDF	22%	36%	3982	3075	2787
Open Bin (MSW + Street)	30%	23%	4110	2903	2559
Average	29%	25%	4087.5	2861.75	2520.75

Source: GWJPL

2.4 Waste Collection and Transportation

2.4.1 Door to Door Waste Collection

33% to 40% of the total waste (250-300 TPD of the total 650-750 TPD) for the project is being used from the door-to-door collected waste or the fresh waste. The process adopted by Jamnagar Municipal Corporation (JMC), generally involves following steps:

1. **Segregation:** Waste generated by households is generally 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:** JMC sets a collection schedule for each area or locality of the Jamnagar city. The schedule specifies the time when waste will be collected from each household or area.
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.
4. **Collection Process:** Waste collectors go to each household or area during the designated collection hours and collect the segregated waste. They may 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.

As observed during site visit, JMC has allocated a 16.7 acres of land for transfer station at Happa in Jamnagar, where limited quantity of MSW (which directly does not go to the WTE plant) is disposed by JMC tippers from households where rag pickers carry out waste segregation. MSW disposed at the Happa transfer station is then loaded in the JMC trucks which is further transported at the WTE plant for preprocessing.

However, as per discussions with the Goodwatts WTE Jamnagar Private Limited (GWJPL) project team, there are plans to source MSW directly from collection centers in other nearby cities of Jamnagar in the future. This is intended to replace the use of bio-mined/legacy waste currently being transported from the Rajkot MSW landfill. By sourcing additional waste directly from nearby areas, the reliance on waste from the Rajkot landfill can be reduced. GWJPL has already undertaken the detailed assessment with identification of nearby cities with potential of solid waste generation to setup these collection centers. Details of the assessment is provided below:

Cluster- ULB	Sub-ULB	Quantity of MSW (In TPD)
Jamnagar	Dhrol	11
	Sikka	7
	Kalavad	5
	Jamjodhpur	5
Porbandar	Porbandar-Chhaya	40
	Ranavav	4.5

Cluster- ULB	Sub-ULB	Quantity of MSW (In TPD)
	Kuthiyana	4
Dwarka	Dwarka	20
	Raval	4.75
	Salaya	9
	Bhanvad	4
	Jamkhambhalia	20
	Okha	36
Morbi	Morbi	90
	Wakaner	10
	Miyana-Maliya	0.5
	Halvad	7
	Total	**277.75**

2.4.2 Legacy Waste[9] Bio-Mining and Transportation

The project is sourcing 66.66% of the total waste required (400-500 TPD out of the 650-750 TPD) from legacy waste. This legacy waste is collected, processed, and transported from the Rajkot MSW Landfill to the Project. The general process adopted by the Project for collection, processing and transportation is delineated below:

1. **Identification and Assessment:** Abellon (at the group level) in collaboration with Rajkot Municipal Corporation (RMC) has identified Rajkot MSW landfill where legacy waste is already been accumulated and is used as a site to mine the legacy waste.
2. **Collection and Segregation[10]:** Abellon is using a third-party subcontractor appointed by RMC to undertake the legacy waste bio-mining at the Rajkot MSW landfill site. The bio mined waste is segregated into different categories, such as organic waste, recyclables, and non-recyclables. This segregation helps in optimizing the waste-to-energy conversion process and maximizing resource recovery.
3. **Temporary storage:** Segregated legacy waste is temporarily stored at designated area inside the legacy waste site.
4. **Transportation:** The segregated waste is transported from the legacy waste site at Rajkot to the Project. This transportation is typically done using specialized waste transport vehicles, such as trucks or dumpers. The transportation of biomining waste from the Rajkot MSW landfill to the Jamnagar WTE plant falls under the purview of the contractor (M/s Jay Vachharaj Roadways & Earth Movers). Refer section below on legacy waste biomining for details.

2.4.2.1 Legacy Waste Biomining

The legacy waste biomining activity is not considered as an associated facility for the project. As the biomining operations at the Rajkot Municipal Solid Waste (MSW) landfill site are conducted by a contractor (named M/s Jay Vachharaj Roadways & Earth Movers) who operates autonomously (without any involvement of Abellon Group), duly appointed by the Rajkot Municipal Corporation (RMC). M/s Jay Vachharaj Roadways & Earth Movers (JVREM) has direct contract with Rajkot Municipal Corporation to undertake the bio-mining of 3.0 Lacs MT/year of Legacy Waste. The contractor is responsible for the excavation and extraction of the legacy waste from the landfill site.

[9] Legacy waste refers to accumulated waste that has not been properly managed or treated over a long period of time.
[10] Currently, the biomining activities at the Rajkot Municipal Solid Waste (MSW) landfill are being undertaken by a third-party contractor appointed by RMC.

As per information provided by the project representative, the project currently procures biomining waste from this contractor, who forms an integral part of the Project's supply chain but not as an associated facility. Further, the following information is considered while stating that the biomining activity is not associated facility for the Project.

- The initiation and continuation of bio-mining operations are not contingent upon the existence of implementation of the Project. Bio-mining is an independent activity undertaken by a third-party contractor and is not initiated or driven by the Project. It is an ongoing process aimed at addressing the legacy waste at Rajkot MSW landfill site irrespective of the Project's presence.
- The bio-mining contract between the appointed contractor and RMC, does not obligate the contractor to supply of bio-mine waste exclusively to the Project. The contractor retains the independence to sell the waste or other derived materials to entities other than the Project. There is no contractual binding that mandates the exclusive supply of the bio-mine waste to the Project.
- The bio-mining contract is distinct from the Project concession and contract. Bio-mining operations, including the contractual agreements with the biomining contractor, may have commenced prior to, concurrently with, or subsequent to the project concession and contract. These are separate and independent contractual relationships.
- The project concession agreement does not obligate the Project to take a specific portion of waste from the bio-mining activity. The Project operates independently and has the discretion to determine its waste sourcing strategy, including whether or not to procure waste from the bio-mining activity. There is no contractual binding that mandates the project to take a specific amount of waste from bio-mining.
- The Project is free to exercise its discretion in deciding whether to procure bio-mined waste. There is no contractual obligation that compels the Project to accept or utilize waste derived from the bio-mining process. The Project retains the flexibility to make waste procurement decisions based on its operational requirements and objectives.

Current arrangement of the Project for sourcing bio mined waste.

- As of the present operational phase, Goodwatts WTE Jamnagar Private Limited (GWJPL) has formally engaged in a provisional contractual arrangement with M/s Jay Vachharaj Roadways & Earth Movers (JVREM). The primary objective of this contractual association is the provision of Refuse-derived Fuel (RDF), specifically derived from legacy waste originating from the Rajkot MSW landfill, to meet the comprehensive fuel requirements of the Project situated in Jamnagar.
- Under the terms of this arrangement, JVREM is committed to supplying 200 metric tons per day (MT/Day) of RDF to the WTE Plant from the total bio mined waste. JVREM produces 31116.05 MT of RDF per 1 lakh ton of legacy biomining. Any surplus RDF beyond the Project's needs is permissible to be supplied to other entities. This flexibility is exercised in accordance with prevailing regulations and in fulfilment of JVREM's agreement with the Rajkot Municipal Corporation (RMC).
- Furthermore, JVREM independently holds a direct contract with the Rajkot Municipal Corporation to conduct bio-mining activities involving 3.0 Lacs MT/year of Legacy Waste producing 92194 MT of RDF. Importantly, the operations conducted by JVREM in the bio-mining process are undertaken autonomously, with no direct involvement or oversight from the Abellon Group or GWJPL. JVREM's responsibilities span the excavation and extraction of legacy waste from Rajkot MSW landfill site.

Future plan of the Project for sourcing bio mined waste and MSW

- In addition to the ongoing collaboration with M/s Jay Vachharaj Roadways & Earth Movers (JVREM), Goodwatts WTE Jamnagar Private Limited (GWJPL) has actively initiated discussions with other biomining contractors, notably Gunarth Infra Pvt Ltd based in Vadodara. This strategic exploration is aimed at establishing alternative avenues for the supply of Refuse-derived Fuel (RDF) to the Jamnagar plant, contingent on the project's requirements.
- Furthermore, Abellon, the overseeing entity, has proactively engaged with government authorities to facilitate the formation of a cluster comprising small nearby Urban Local Bodies (ULBs). This collaborative effort is designed to streamline the supply of Municipal Solid Waste (MSW) to the Jamnagar Waste-to-Energy (WTE) Plant. The ongoing conversations with government authorities have progressed to an advanced stage, indicating a collective intent to source RDF (152 MT) from these additional locations in the future for their respective facilities.

Supply from the Dumping Area/Landfill	Quantity Supplied	Name of Contractor & Quantity biomined by them
Rajkot MSW Landfill	200TPD	Jay Vachharaj Roadways & Earth Movers Total Quantity Biomined: 3,00,000 MT
Junagarh Dumping Area	200TPD	Gunarth Infra Pvt Ltd, Vadodara Total Quantity Biomined: 2,50,000 MT
Future sources of Legacy Waste in the state of Gujarat:		
Ahmedabad	70.00 MT	--
Baroda	10.00 MT	--
Surat	25.00 MT	-
Jamnagar	15.00 MT	-
Jamnagar	1.00 MT	-
Bhavnagar	5.00 MT	-
Junagadh	0.6 MT	-
Gandhinagar	1.00 MT	-
100 ULB (1)	25.00 MT	-
Total Legacy Waste	**152.60 MT**	

Further, the state of Gujarat is also in the process to enter into agreements with third party contractors for legacy waste Bio Mining at the below mentioned sites with the Quantity mentioned which will further add to the supply chain of RDF within the close vicinity of GWJPL:

- Vadodara: 5,00,000 MT
- Surendra Nagar: 2,00,000 MT
- Jamnagar: 1,30,000 MT

2.5 Waste Handling and Treatment Process

GWJPL receives 250 TPD MSW directly from Jamnagar households which are transported through trucks and tippers owned by JMC at the WTE plant on daily basis. Nearly 120-125 trucks and tippers arrive at the plant with MSW. The remaining 400-500 TPD waste is sourced from Rajkot MSW landfill where biomining activity is carried out by third party sub-contractor[11] for which approximately 18-20 trucks arrive at the plant. The Project also has plans to source MSW directly from households of other nearby areas/cities of Jamnagar in future to source the balance 400-500 TPD waste to prevent use of bio mined/legacy waste currently being transported from Rajkot MSW landfill.

Also, JMC has allocated a 16.7 acre of land for transfer station at Happa in Jamnagar, where limited quantity of MSW (which directly does not go to the WTE plant) is disposed by JMC tippers from households where rag pickers carry out waste segregation. MSW disposed at the Happa transfer station is then loaded in the JMC trucks which is further transported at the WTE plant for preprocessing.

Each truck carrying the municipal solid waste (MSW) is visually inspected before it goes to a weighbridge. If the MSW vehicle contains a high percentage of unwanted materials, then it is not accepted in the plant[12]. After this, the municipal solid waste, is unloaded at the unloading bay from where it is fed into the pre-processing zone. At the pre-processing zone, splitters, shredders, star screen and metal removing equipment are installed.

- Removal of unwanted particle size from MSW and size reduction of RDF

[11] JVREM has direct contract with Rajkot Municipal Corporation to undertake the legacy waste bio-mining without any involvement of the Abellon Group or the GWJPL in contracting and biomining activity. GWJPL has entered into provisional contract with JVREM to provide the Refuse-derived fuel (RDF) to fulfil the requirement of total fuel for the Project.

[12] The waste truck is returned back, and the waste is dumped at the dumping area. However, as reported no waste trucks have been returned since past 5-6 months.

- 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

During the preprocessing stage, there is a generation of rejected waste or inert waste, which refers to materials that cannot be effectively processed or converted into energy. This rejected waste/ inert waste generated at the preprocessing unit is transferred back into JMC trucks which dispose the inert waste (including glass and metal) at Theba MSW landfill, Jamnagar. Approximately, 25-30 dumper trucks go out from the project with the rejected waste.

Post preprocessing of waste, the processed waste is then transferred at the boiler bunker where prepared fuel for boiler is stored. Capacity of boiler bunker is adequate to store sufficient quantity of RDF to ensure availability of fuel for the boiler for at least 3 days.

RDF is fed into the boiler with the help of fuel feeding system. The WTE plant at GWJPL is equipped with a single boiler that has a capacity of 40 TPH (Tons per Hour) with steam pressure and temperature of 42 kg/cm^2(g) and 410+-10^{0}C and a stack height of 40 meters and stack diameter of 2.1 m. Fuel enters the boiler at elevated height of 5.5 m above travelling grate (total height of 12.887m) which helps in partial combustion of about 40% in suspension and remaining combustion takes place on grate. The primary air required for combustion is drawn from boiler bunker area and preprocessing zone to manage odor generated from the waste. This system also ensures a continuous and controlled supply of fuel to maintain the desired combustion process within the boiler.

Auxiliary fuel (biomass) is fed to ignite boiler and to achieve the targeted furnace temperature within 4-6 hours. Only after achieving the desired temperature profile of RDF fuel can be fed. Also while shutting down boiler, the boiler is changed over from RDF fuel to auxiliary fuel.

The plant has installed a comprehensive flue gas cleaning system with dust extraction, to control emission of dioxin, furan and heavy metals, emission of acidic gases and particulate matter emission. The fuel fed into the boiler gets combusted at a temperature of more than 900 ^{o}C. A special design zone is present in the boiler after the last injection point of secondary air into furnace. As it goes higher, the temperature of the boiler decreases, however it remains 850 ^{o}C at least for about two seconds. This helps in achieving complete combustion and ensure destruction of harmful emissions before flue gas enters heat recovery area. A rapid cooling zone is provided for the flue gas post combustion.

Boilers generate superheated steam which expands in steam turbine. A cooling water circulation in condenser is located below steam turbine. Water in the condenser is obtained through treated water from JMC STP. Steam Turbine rotates alternator and generated electricity is evacuated through 66KV transmission line at GETCO substation. Bottom ash and fly ash generated from the boiler is disposed through JMC owned truck at designated landfill[13].

2.6 Project Components

Layout plan and area details of the Project are presented below in ***Table 2-3*** and ***Figure 2-4***

Table 2-3 Area Statement

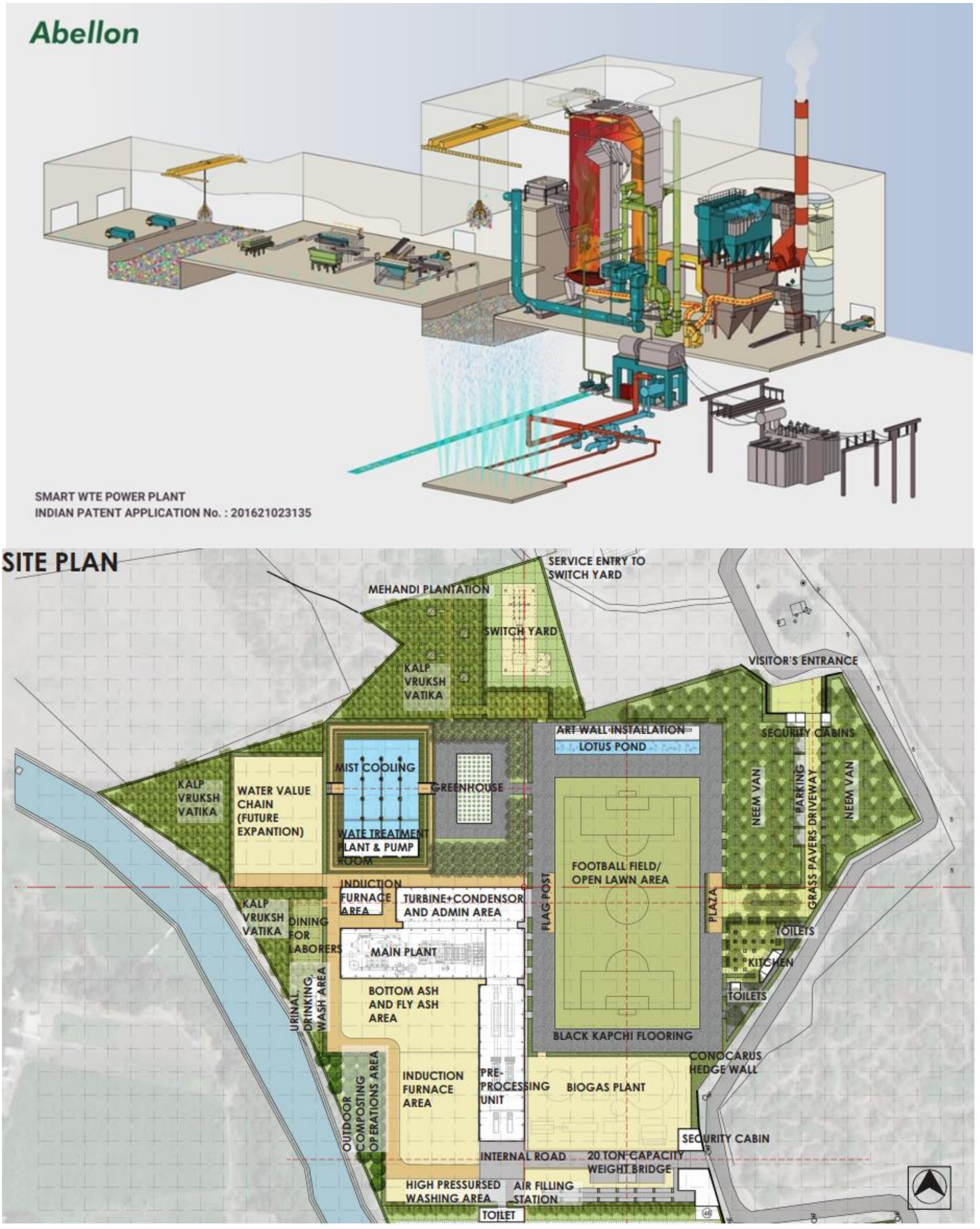
Sr. No.	Particular	Area (Sq. m.)
1.	Security cabin at visitor entry	72
2.	Four-wheeler parking	243
3.	Male female toilet at VIP seating	52
4.	Kitchen, wash area, drinking water at VIP seating	58
5.	VIP outdoor seating	577
6.	Toilet, drinking water, Change rooms, Lockers	197
7.	Two-wheeler parking	341

[13] As reported by GWJPL, the inert waste and ash disposal does not fall within the purview of GWJPL and the same is disposed by JMC at designated landfill through JMC owned trucks

Sr. No.	Particular	Area (Sq. m.)
8.	Urinal, Drinking water, wash area block for labours	234
9.	Bottom ash area	1912
10.	Water value chain	2190
11.	Switch yard	860
12.	High tech farming tower (Greenhouse)	450
13.	Mist cooling and pump house and water treatment plant	1682
14.	Admin + Turbine + condenser	2288
15.	Main Plant	1709
16.	Pre-processing unit	1374

Source: GWJPL, Abellon

Figure 2-4 Project Site Overview & Layout



Source: GWJPL, Abellon

2.6.1 Weighbridge

One weighbridge has been setup at the truck/vehicle entrance of the project and is used to weigh trucks loaded with waste and 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. Pre-processing unit of the plant operates 20 hours/day with a processing capacity of 30-40 TPH. The material storage capacity of pre-processing bunker is 750 Tons. Hence, the unloading area has been designed with the provision to store 750 tons of waste to operate the plant consistently throughout the day. European technology has been adopted for the Pre-processing section in order to achieve boilers optimum performance. The whole pre-processing line is designed with full automation so as to decrease human intervention during processing waste. The entire system has auto start/stop for all the equipment and can be operated by the operator sitting in the operation station. Only 4-5 personnel are required to be present within the area to overlook the overall processing.

Pre-processing includes three steps.

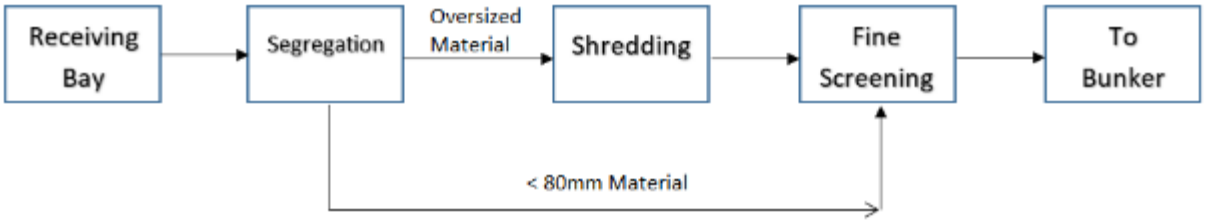
Waste segregation: Waste from the receiving area is fed into splitter machine through grabbers/ Hitachi Machine. The splitter segregates the in-feed material in 3 streams:

- 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 is passed through a single shaft shredder. 90% of the output material is the size of <80 mm.

Waste screening: The fine material of size < 80 mm from both splitter and shredder then pass through star screen unit for the segregation of the material. The screened material is mostly inert and of the size of <20 mm. This material is sent back with the JMC trucks for disposal. Process flow diagram for pre-processing is as presented below.

Figure 2-5 Process Flow Diagram for Pre-Processing



2.6.3 Fuel Feeding System

The fuel feeding system consists of Boiler Bunker, Orange Peel Grab Crane, Fuel Pushing Mechanism, Auxiliary Fuel Feeding System, Boiler Fuel Feeding Chute System.

- Boiler bunker along with storage of auxiliary fuel: The boiler bunker supplies prepared fuel (RDF) to boiler with desire quantity without interruptions to ensure higher Plant Load Factor (PLF) and to create buffer stock of Boiler fuel at least for three days to achieve better homogeneity, to allow excess moisture presence in boiler fuel in the form of leachate, to accommodate maximum capacity and address emergency.
- Orange Peel Grab Crane: Orange peel grab lifts the required quantity of boiler fuel from bunker and deliver the same on fuel pushing mechanism and mix stored Boiler Fuel (RDF) in bunker to achieve better homogeneity.
- Fuel Pushing Mechanism (FPM) & Fuel feeding chute system: 1 fuel pushing mechanism is available to supply fuel to the boiler. It consists of a hydraulic pusher followed by a vibro-feeder. Vibro-feeders increase forward flow ability. It improves

fluffiness of boiler fuel which helps in achieving higher degree of suspended fire. It ensures unidirectional flow of fuel through vibro-feeders to prevent chances of fire in bunker area, in case of back flow of excessive fuel.

- Auxiliary Fuel Feeding System: The auxiliary fuel feeding system is provided to ignite boiler with good quality auxiliary fuel to achieve targeted furnace temperature as per regulatory need. It also helps to supply adequate quantity of fuel to boiler round the year.
- Boiler Fuel Feeding Chute System: There are four Fuel feeding Chutes for boiler. Each fuel chute is equipped with a puff arrestor to isolate fuel supply to boiler in case of uncontrolled positive draft inside furnace. Portion directly connected with furnace of boiler of feeding chute are made of stainless steel (SS) material and are safeguarded with water jacketed arrangement with water level sensors.

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		One
Boiler output – Maximum Continuous Rating	TPH	40
Boiler type		Single-drum, Water tube natural circulation, Top supported
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 up to 20)
Fuel GCV	Kcal/kg	2300
Fuel Required quantity	Kg/Hr	18.75
Water wall construction		Membrane type/Flat fin welded panels
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: GJRPL Project Parameter Booklet, Abellon

2.6.5 Power Generation & Evacuation

Boiler is generating superheated steam which expands in steam turbine which in turns rotates alternator and generated electricity is being evacuated through 66KV transmission line at GETCO substation (Nava Gam Ghed). Steam turbine is equipped with condenser with cooling water circulation. Process of generation of electricity from turbogenerator is as described below.

2.6.5.1 Steam Turbine

Turbogenerators 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 is directly coupled with the turbine or mechanically connected through a gear box in between. This coupling is connected through reduction gearbox and is of pin bush/shear pinbush type.

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 is 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 & Steam Coil Air Pre-Heater (SCAPH). This steam is extracted from the turbine under different modes.

Table 2-5 Turbine Technical Specification

Description	Value
Type	Multistage, impulse/reaction, nozzle governed bleed cum condensing
Casing split	Horizontal
Rotor type	Solidly forged & machined rotor with integral disks
No of Stage	13
Shaft seal	Labyrinth
No. of governing valves	Three(Inlet)
Bearing support	Double pedestal
Rated power	7500 KW
Power Generation Capacity (MW)	7.5
Generation Voltage (kV)	11
Frequency (Hz)	50±5%

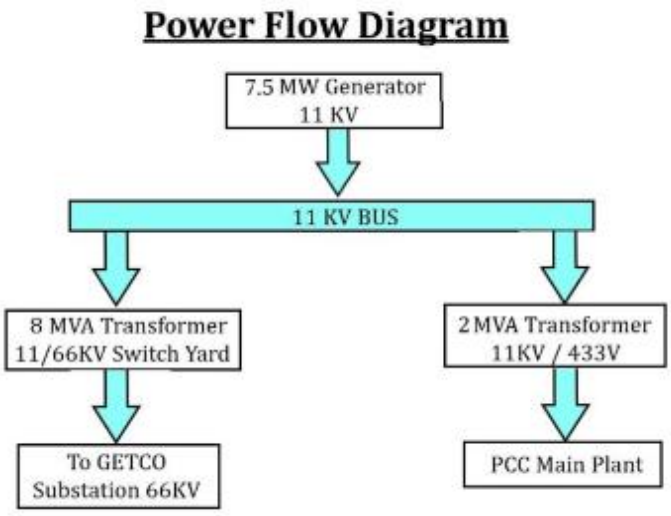
Source: GWJPL Project Parameter Booklet, Abellon

2.6.5.2 Power Evacuation

GWJPL has setup a switchyard within the project premises, where the Power Transformer (8 MVA, 66/11 KV) is used to step up voltage from 11 KV to 66 KV. 66 KV power from the switchyard is further evacuated to Navagam Ghed 66 KV Substation through transmission line.

At GWJPL end 66Kv switchyard has been constructed which includes Deadline PT, Lightning Arrestor, Isolator with Earth switch, Metering Pts & CTs, circuit breaker, 8 MVA-66/11 KV Transformer. Refer ***Section 2.6.5.3*** for details on transmission line.

Figure 2-6 Power Flow Diagram



Source: GWJPL Project Parameter Booklet, Abellon

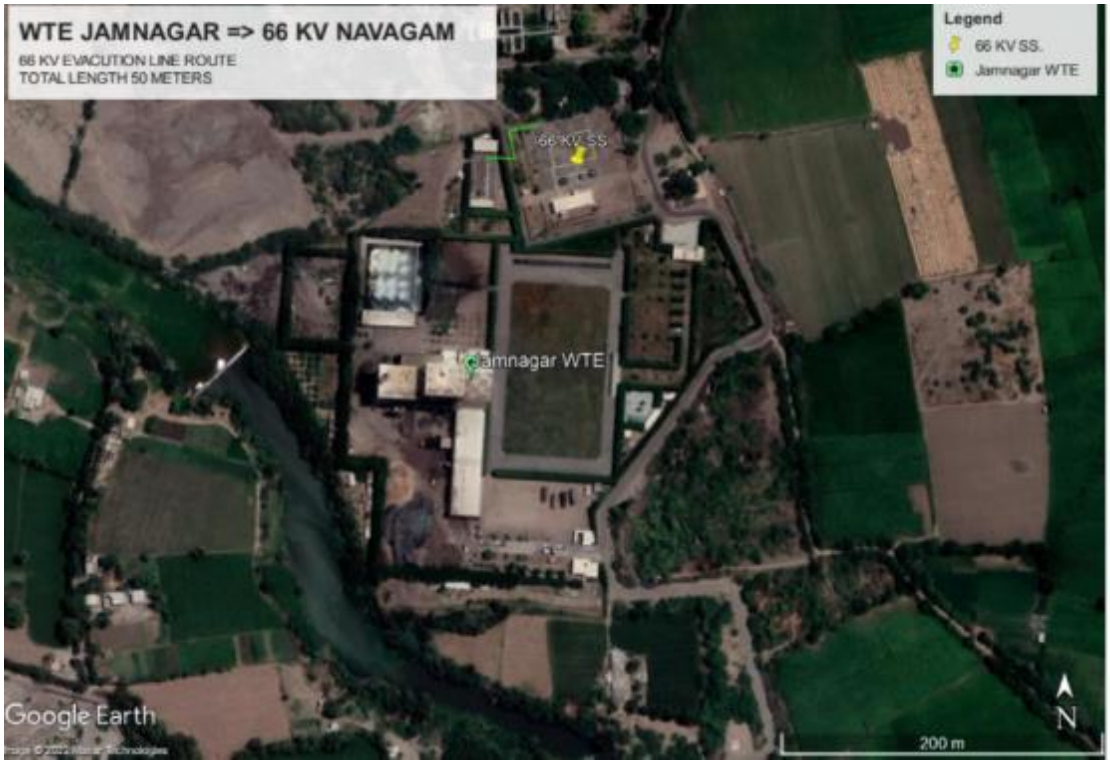
Project is generating power within the premises for various project components. The Auxiliary power transformer steps down the voltage from 11KV to 433 Volt and further distributes power through the panels and is being used at various locations within the WtE Plant.

2.6.5.3 Transmission Line

The total length of the 66 kV transmission line (underground) from the project location to nearby Gujarat Energy Transmission Corporation Limited (GETCO) Substation is 56.4 m.

The transmission line is not associated facilities[14] 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.

[14] 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.



Source: Project Parameter Booklet, GWJPL

2.6.6 Mist 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 2000 m^3 of water being done in condenser unit. Mist cooling system (MCS) 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.

Mist Cooling System, Jamnagar WTE Plant

The design parameters of Mist cooling system are as presented below:

Table 2-6 Design Parameters of Mist Cooling System

Sr. No.	Description	Parameter
1	Model	Mist Cooling System for 7.5 MW WTE Plant
2	Type	Open Type Mist Cooling System
3	Circulating Water Flow	2000 m3/hr
4	Inlet Water Temperature	40°C
5	Outlet Water Temperature	32°C
6	Design ambient Wet Bulb Temperature	29°C
7	Approach to Design WBT	3°C
8	Drift Loss, % of Circulating Flow	0.2%
9	Evaporation Loss	1.17% for Temperature of 8°C
10	Design Wind Velocity for Performance created by Mist Creation Assembly	5 KMPH
11	Mist Creation Assembly	12 Nos
12	Nozzle in 1 Mist Creation Assembly	10 Nos
13	Total Nos of Nozzle	120 Nos
14	Inside Diameter of Nozzle	26 mm

2.7 Air Pollution Control Devices

2.7.1 Stack Height

GWJPL has setup one boiler with 40TPH steam generation capacity and is using waste as primary fuel for the boiler. GWJPL has installed a stack with height of 40m for the boiler. The Jamnagar WTE Project is located near the Airport of Indian Air Force (IAF), therefore only 40 meters of the Stack height is permitted by Ministry of Defense vide NOC letter dated 11 March 2020.

Stack Design for the boiler is as follows:

- Top Part of Stack the Height of the Top Part of the Chimney is 14.50 meters
- Bottom Part of Chimney: The Height of the Bottom Part of the Chimney is 12.70 meters.

The Bottom part of chimney starts at elevation of 12.80 meters. So, total height of the chimney is 40 meters from the Ground Level at the plant.

As per the Environment (Protection) Amendment Rules, 2023, published on 16th May 2023[15], for boilers, minimum stack height (in meter) shall be as per the formula,

- $H=14Q^{0.3}$ (where Q is SO2 emission rate in kg/hr.); or
- $H=74Q^{0.27}$ (where Q is PM emission rate in tonne/hr.), whichever is more.

[15] https://cpcb.nic.in/displaypdf.php?id=SW5kdXN0cnktU3BlY2lmaWMtU3RhbmRhcmRzL0VmZmx1ZW50LzQ1OS0xLnBkZg==

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. As per the Environment Protection rules, the minimum chimney height is to be 30 m or as per above formula. Stack height for the Project as calculated based on the above-mentioned formula should be 48.75m.

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)

Values considered are as provided in the Project Booklet for GWJPL project

According to the condition of the CCA under Air Act 1981, the stack height of the boiler should be 45 m. However, the stack height of the boiler has been developed as 40m, which is non-compliance to the condition of the Combined Consent for Authorization. Though, the project has received NOC from Ministry of Defense dated 11.03.2020 for stack height of 40 m. GWJPL has made a request to GPCB to amend the height of stack from 45 m to 40m.

As per the WBG EHS guidelines the stack height should be as per following formula:

Hg[16]= H+1.5L,

- H is the height of the nearby structures above the base of the stack (stack is set on ground level)
- 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, nearest structure present is the admin building present adjacent to the stack with a height of 14 m and width of 23 m approx.)

H is calculated to be ~35 m (considering H= 14m, L= 14m). Since the stack height is 40 m which is higher than the minimum stack height requirement for the project i.e., 35 m, therefore the stack height of the boiler is compliant to WBG EHS guidelines.

2.7.2 Flue Gas Cleaning Mechanism

GWJPL's flue gas cleaning system is 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).

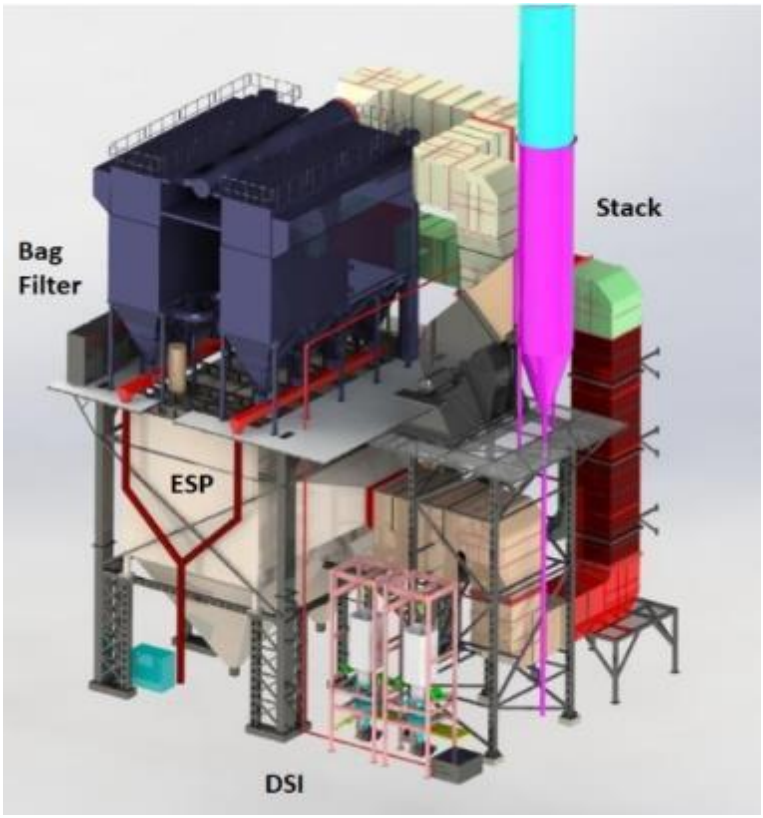
The dust extraction system is equipped with bag filters and Electrostatic Precipitator (ESP). The bag filters enhance the acid removal process by forming cake and also minimize SPM emission. Air is purged on the Deferential Pressure (DP) basis within the bag house system. The bag house system is designed in a way that whenever there is increase in differential pressure to certain limit, the air is 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 (DJSI)[17]. As per documents shared by GWJPL, there are two no.s of flue gas cleaning trains within the dust extraction system where one train of flue gas cleaning system comprise of ESP, reaction tower, DJSI and bag filter. Technical details and design parameters for ESP, Acid Control Reactor Tower, Dry Sorbent Injection (DSI) system, Filter bag house have been added as ***Appendix 3***

The layout of the flue gas cleaning system has been presented in ***Figure 2-7.***

[16] GEP stack height measured from the ground level elevation at the base of the stack

[17] 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.

Figure 2-7 Flue Gas Cleaning System Layout



Source: GWJPL

2.7.3 Dioxin and Furan Control Mechanism

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

GWJPL ensures 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

Since the 40 TPH boiler has Suspended Firing Combustion System, therefore, about 20% of total ash generated during incineration process is “Fly Ash”. The fly ash quantity generated at the WTE plant is about 100 TPD which is collected at different points i.e., Bank Zone[18], ESP and bag filter, quantities of ash generated has been presented below. The fly ash is separated in different fly ash silos which improve its salability prior to its disposal. 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.

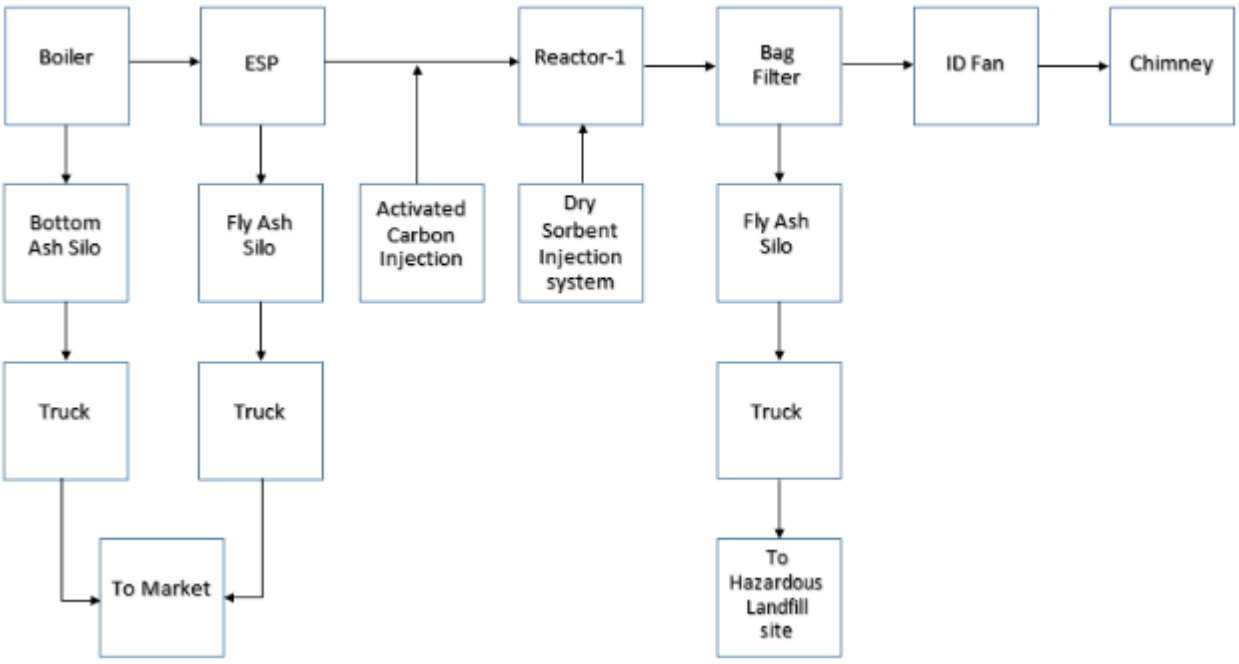
[18] Bank zone is an area between boiler super heater and economizer area. It is horizontally laid immediately after end of furnace. There are three fly ash collector pipeline which are connected in bank zone area at three different location. This provision is required to drain any fly ash deposition in this area. With help of common RAV (rotary airlock valve) they are connected to fly ash silo located adjoining boiler house.

Type of Ash	Quantity Generated	% of the total quantity	Potential Ash Use[19]
Bottom Ash	66.6 TPD	66.67	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	13.5 TPD	13.50	It can be utilized in place of river sand in construction due to its larger course size.
ESP Fly Ash	13.5 TPD	13.50	it can be utilized to produce concrete pavers, aerated concrete blocks, etc.
Bag Filter Cake Ash	6.4 TPD	6.40	Most of It can be used as void material for construction purpose subject to proper screening and drying process

The bottom ash received from the boiler is disposed in the water submerged belt conveyor to reduce high temperature of bottom ash and also avoid unwanted air ingression in the boiler. The bottom ash temperature at the boiler is about 350 ^{0}C which is reduced to 100 ^{0}C at the submerged water belt conveyor. The bottom ash is transported to the sludge dying area for natural drying prior to its disposal through JMC trucks. As per discussion with project team, disposal of fly ash and bottom ash from the WTE plant to cement plants and designated landfill respectively falls under the purview of JMC. However, it was further reported that currently, fly ash generated from the Project is not being disposed at the cement plants by JMC and all the types of ash (fly ash and bottom ash) generated from the boiler are disposed from the project to the landfill through Jamnagar Municipal Corporation (JMC) owned trucks.

The layout for ash handling system has been presented in ***Figure 2-8***

Figure 2-8 Flue Gas and Ash Handling Layout



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

2.7.5 Continuous Emission Monitoring System (CEMS)

CEMS includes 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 is directly communicated with the GPCB. Flue gas emission monitoring is being done via CEMS which monitors SO_2, NO_2, CO, PM_{10}, and $PM_{2.5}$. Stack emission monitoring is also being conducted for SO2, NOx, CO, PM, NH3, Dioxin and Furan and HCL.

2.7.6 Odor Control Mechanism

Dust generation inside the bunker & pre-processing area is taken care by keeping negative pressure. The suction of forced draft fan is taken from top of the bunker which then suck all the dust and odor from bunker and pre-processing area, which is connected with bunker bracket, with the help of such designed system dust particles can be controlled in aforesaid area and the air from the draft fan is released in the boiler. In addition Project has installed fragrance sprinkler as well as fogging system in the pre-processing area for odor management.

There is long duration storage area at the facility, fresh waste is stored for a maximum of 8-10 hours which leaves limited time for disintegration and odour. Also a significant quantity of waste is from biomining which has largely stabilized and has low disintegration/ decay and hence odour is low. Buffer stock will be maintained at the Plant which will be a couple of days stock, hence odour modelling will be conducted and management measures, as required will be implemented.

The actual observation around the fence line indicated no smell. Also, discussions with nearby residents suggested that they have not experienced any instance of odour from the operations.

2.7.7 Water Requirement

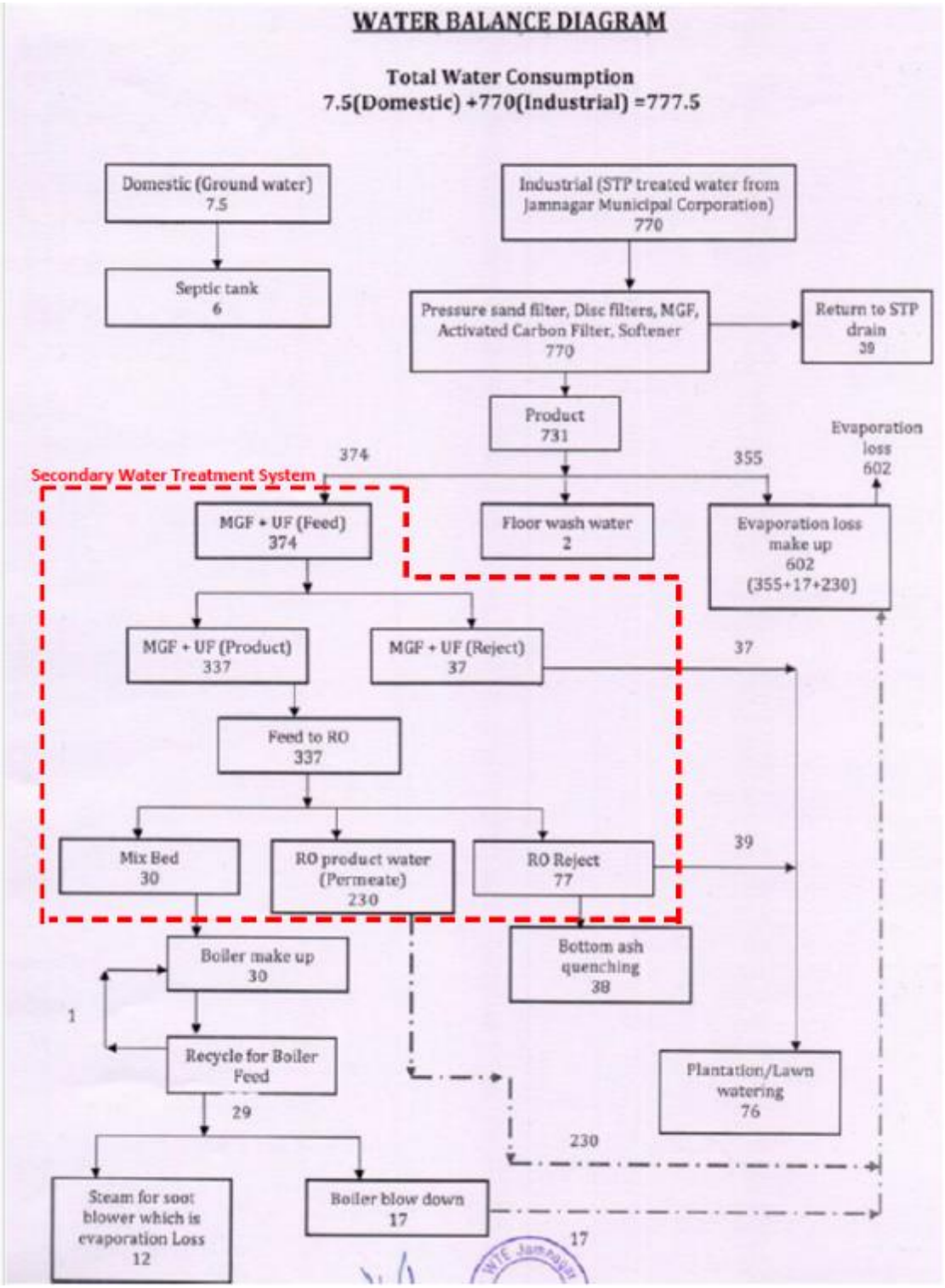
To meet the water requirement for WTE plant operations, GWJPL has obtained permission from Solid Waste Management Department of Jamnagar Municipal Corporation to procure 1 MLD of the treated water from the 70 MLD Sewage Treatment Plant (STP) located ~ 60 m (aerial distance) from site towards north direction. GWJPL has laid underground pipeline[20] of 324 m (1.5 m below natural ground level) connecting the STP to the project's pump house. The pipeline is traverses the JMC-owned road and links the WTE Plant to the JMC owned Sewage Treatment Plant (STP)

The project undertakes secondary treatment of the water received from STP prior to its use within the WTE plant. The daily water use for industrial purpose within the WTE plant is ~770 m3/day. Approximately, 30 m3/day of water is used for boiler feed and 602 m3/day is used as cooling water and the remaining quantity of water is rejected water from secondary treatment, RO reject and boiler blowdown. As reported, rejected water is from secondary treatment is utilized for bottom ash quenching. Any excess water will be diluted within the campus with the help of makeup water (treated wastewater from the nearby STP) to bring down TDS level to less than or equal to 2100 PPM, which will further be used for gardening on premise[21]
For domestic purpose, approximately 7.5 m3/day water is abstracted from the existing borewell within the plant and permission for abstraction and use of 7.5 m3/day groundwater has been obtained from Central Groundwater Authority (CGWA). Groundwater can only be used for flushing purpose as it is contaminated as per Phase II groundwater quality results (refer 5.3.7.2).

Water balance plan for the Project has been presented in ***Figure 2-9*** .

[20] The underground water pipeline is not considered as associated facilities 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, underground water pipeline do not fall under the scope of the definition of associated facilities.
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.
[21] Water for gardening will meet the GPCB requirement and the TDS of the water is less than or equal to 2100 PPM

Figure 2-9 Detailed Water Balance Plan



Source: Project Layout, GWJPL

2.7.8 Water Treatment Process

2.7.8.1 Pre-Treatment Process (Water Treatment of Treated Water at STP)

JMC has set up a sewage treatment plant of capacity 70MLD and GWJPL further treats the treated water from STP within its premises to be used for industrial purpose.

To meet the water requirement for WTE plant operations, GWJPL has obtained permission vide letter dated 15th September 2022 from the Jamnagar Municipal Corporation, Solid Waste Management Branch, and is sourcing 1 MLD treated water from the 70 MLD Sewage Treatment Plant (STP) located at ~ 60 m (aerial distance) from site towards north direction.

The Pre-treatment comprise of three stage process:

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

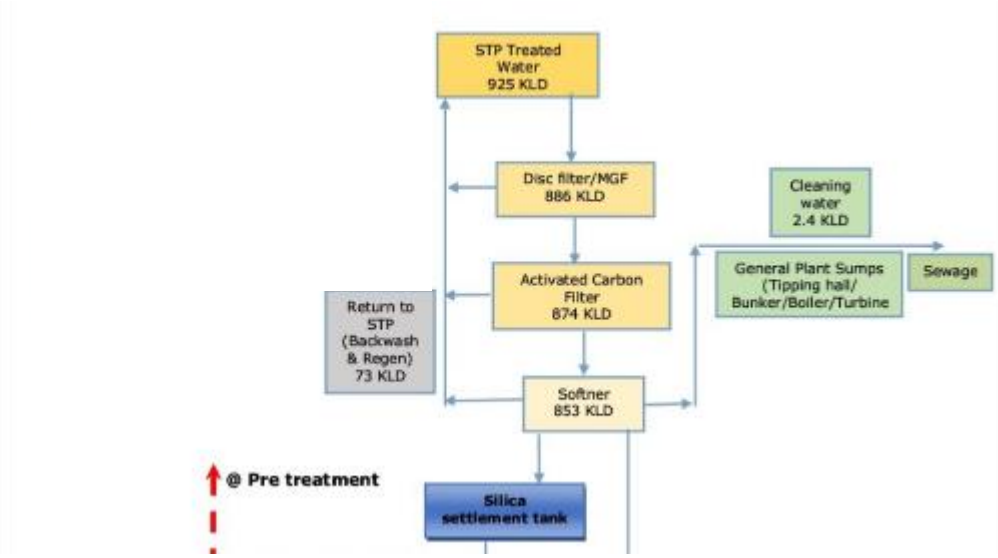
Flow diagram of the Pre-treatment process has been presented as **Figure 2-8.** The project is treating 925 m3/day of treated STP water and all reject water (73 m3/day) in the form of backwash/regeneration/reject from MGF, ACF, Softener & RO etc. is sent back to STP Inlet for further treatment at the STP plant itself. This treated water i.e. 853 m3/day is transported via underground water pipeline to the WTE plant. GWJPL undertakes the Pre-Treatment process at the STP as the treated water from the Jamnagar STP does not meet the quality requirement. Details of the inlet and Outlet parameters of the water for the per-treatment process has been presented in ***Table 2-8*** below.

Table 2-8 Inlet and Outlet water quality for the Pre-Treatment Process

Parameters	Inlet water quality	Outlet water quality
Appearance	Light Turbid	Clear
pH	≤ 7.2	8.8-10.2
Total dissolved solid (ppm)	≤ 800	100
Total suspended solid (ppm)	≤ 70	<5
Alkalinity (mg/L)	≤ 301	Nil
Sulphate as SO4 (ppm)	≤ 15.43	Nil
Chloride as Cl (ppm)	≤ 136	<8
Sodium (ppm)	≤ 105	Nil
Potassium (ppm)	≤ 9	Nil
Calcium (ppm)	≤ 105	Nil
Total Hardness (ppm)	≤ 240	<5
Silica (ppm)	≤ 6.2	Nil
Biological Oxygen Demand (mg/l)	≤ 60	Nil
Chemical Oxygen Demand (mg/l)	≤ 150	Nil
Dissolved Oxygen Demand (mg/l)	≤ 3.8	Nil
Oil & Grease (mg/l)	≤ 0.8	Nil
Conductivity (µS/cm)	≤ 834	<30 – 40

Source: Project Parameter Booklet, GWJPL

Figure 2-10 Pre-Treatment Process at STP



Source: Project Parameter Booklet, GWJPL

2.7.8.2 Secondary Water Treatment

The Pre-treated water is being further treated prior to use in the boiler.

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

Most of the reject water from secondary treatment will be utilized for bottom ash quenching. Any excess water will be used to diluted along with campus with the help of makeup water (treated wastewater from nearby STP) to bring down TDS level to less than or equal to 2100 PPM (as per GPCB guideline). Also, any water for gardening can be used within premise if TDS of the water is less than or equal to 2100 PPM.

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

2.7.9 Leachate Management

GWJPL has an underground leachate collection system, leachate is collected in a designated leachate collection tank at the waste collection bunker area of capacity 1.5m x 1.5m x 2.5m using a series of underground pipes connecting the leachate collection area to the tank. The leachate collection pit is interconnected and made of solid concrete material with waterproof plaster. Impervious surface area is developed for leachate collection and a screen is provided at the leachate collection area so as to screen waste particles going to the leachate collection tank.

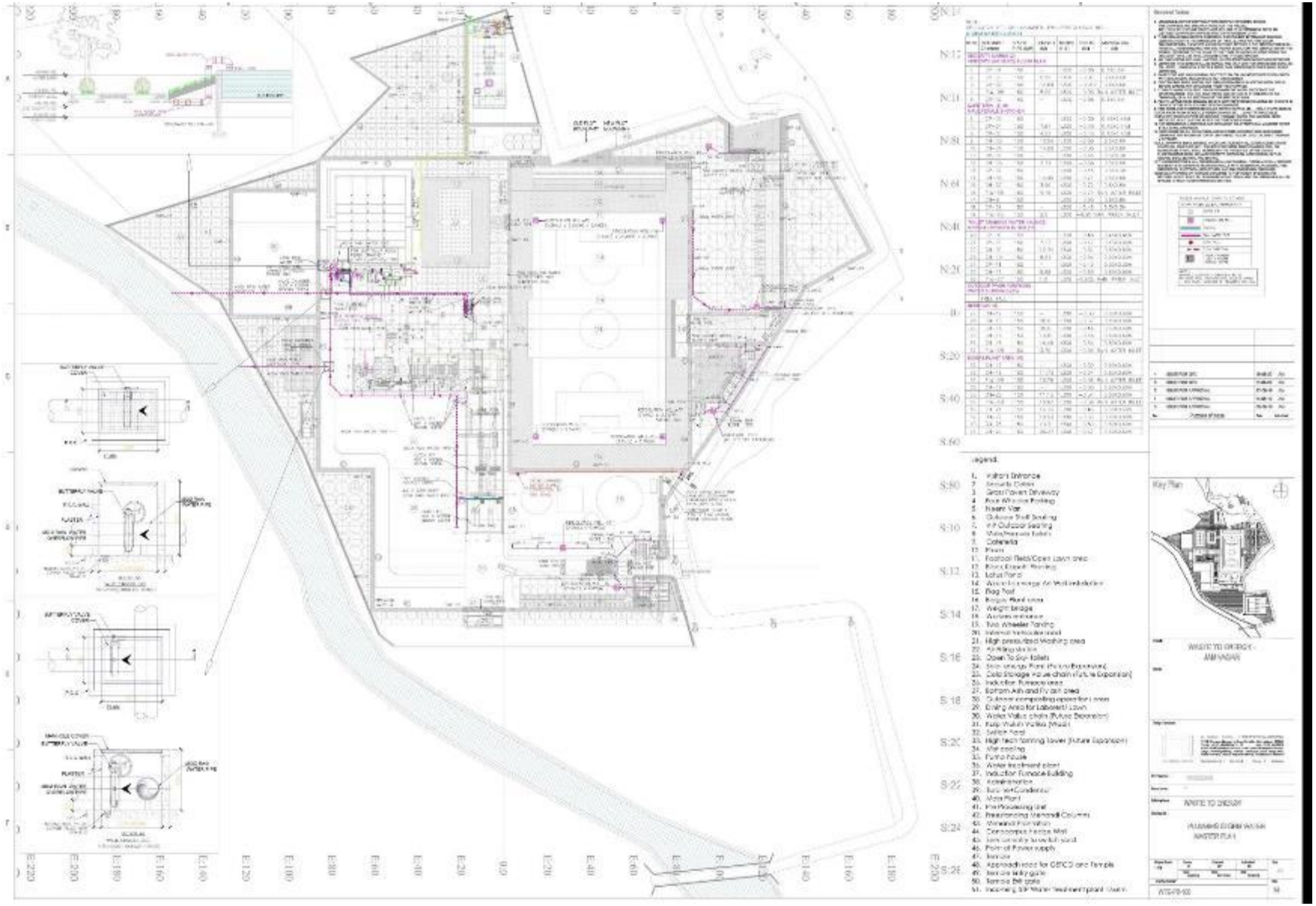
As reported, due to low moisture content in the air and low precipitation in Jamnagar in past 2 years, there has been no significant formation of leachate due to waste decay at the project. The leachate collection system has not been used till date. As observed during site visit, currently no dedicated areas for leachate drying beds have been identified by the project due to limited to negligible amount of leachate generated till date at the WTE plant. Furthermore, as reported by GWJPL team, currently multiple options for leachate disposal is being explored by the project team such as disposal of the dried leachate sludge at the Theba landfill, use of leachate water for bottom ash quenching or alternatively injection of the leachate within the boiler and collection in the tankers to be sent to the nearest STP for disposal.

2.7.10 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. Slope of the site is predominantly towards west. All the recharging pits have been installed in north and east part of the plant which has no processing zone at all.

Water collected in the catch pits installed within the Project site is collected through rainwater pipe and is discharged into the percolation wells. Total 8 no. of percolation wells are present within the project for recharging 17800 m^3/annum of ground water. Layout plan showing location of the catch pits and percolation wells is presented in ***Figure 2-11***.

Figure 2-11 Storm Water Management Plan



Source: Project Layout, GWJPL

2.8 Flood Management

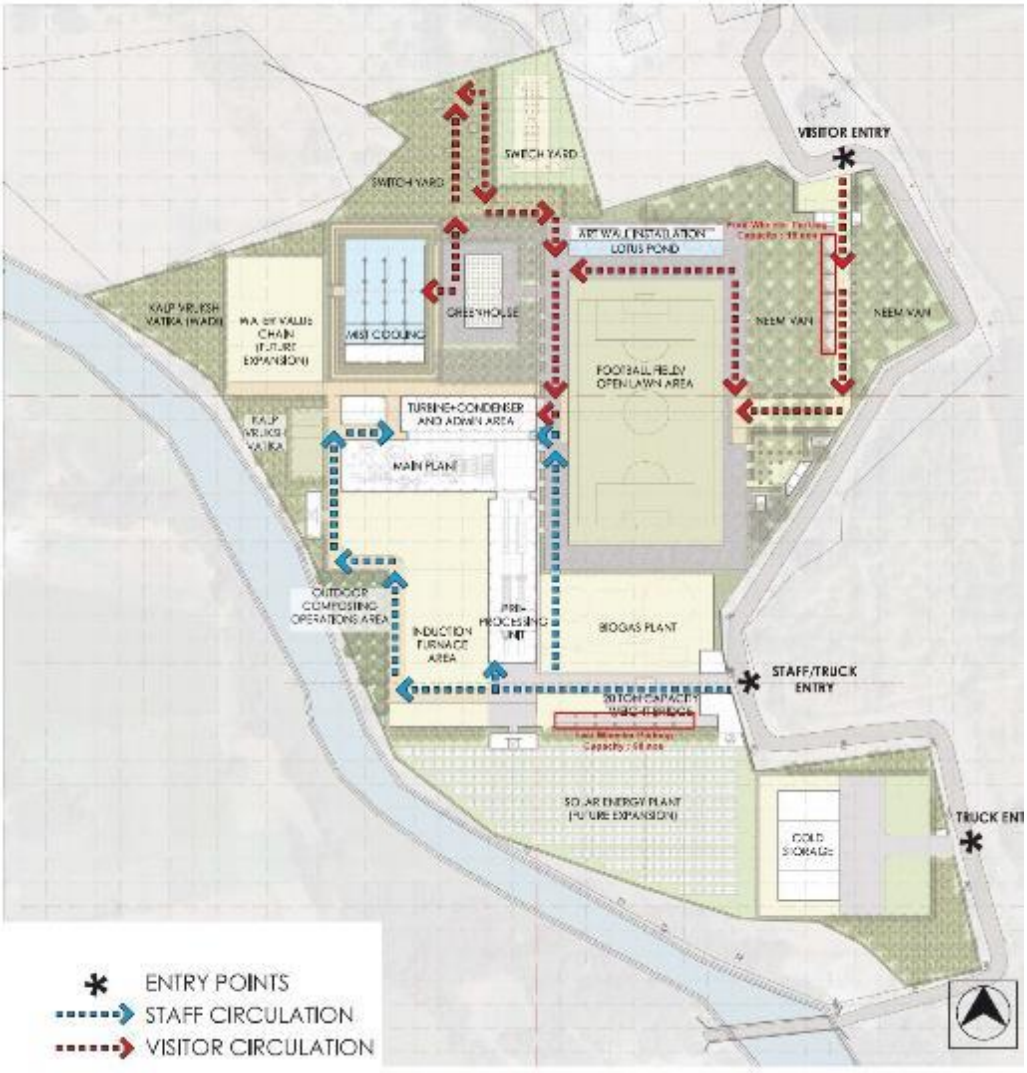
Following measures has been implemented to minimize impact of flooding /waterlogging:

- Provision of water barrier wall at all strategic plant locations
- Location of equipment that can be affected by flood/ water logging at elevated levels within plant building
- Water channel on south end of the plant (lowest part) for fast evacuation of water
- Installation of dewatering pumps to facilitate faster recovery from water logging, if any

2.9 Parking and Traffic Management

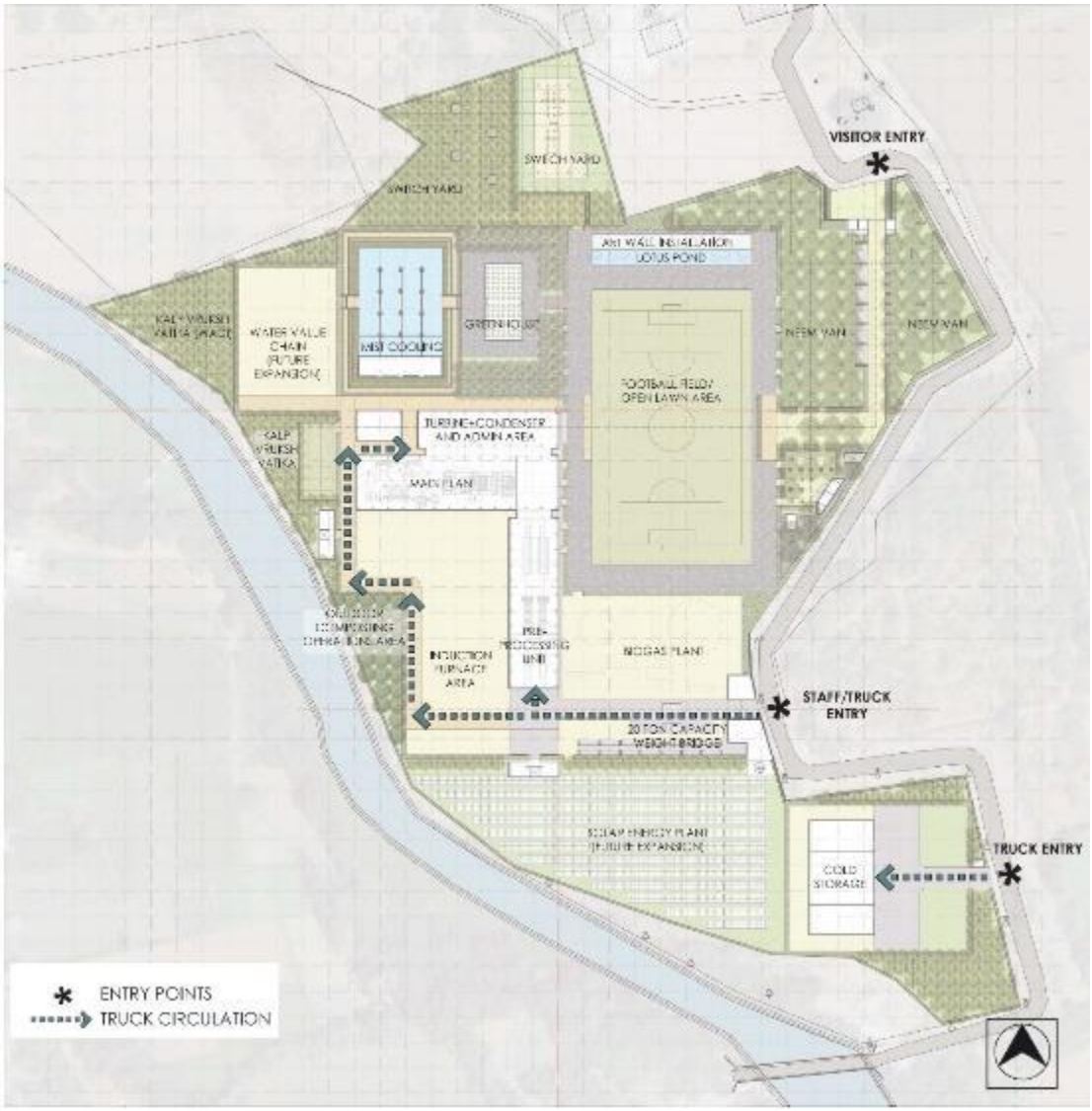
Project has provided separate entry/ exit gates for visitors and staff / trucks. Two wheelers and four-wheeler parking capacity of the Project is 98 and 18 respectively. Layout plan showing visitor, staff and truck circulation is as presented in ***Figure 2-12*** and ***Figure 2-13***.

Figure 2-12 Layout showing circulation of staff and visitors.



Source: Project Layout, GWJPL

Figure 2-13 Layout showing circulation of trucks within the premises.



Source: Project Layout, GWJPL

2.10 Fire Fighting Requirement

Fire safety at the Plant comprises of fire extinguishers (of ABC and CO2 type) and fire hydrant system. Fire hydrant system consists of the main pump which is installed in MCS (mist cooling sump) to utilize full capacity of water storage (360KL) in the Plant. Fire hydrant system is also connected with mist water cooling pumps which ensures pressurised line while the Plant is operational. Fire safety arrangement at the Plant is as presented in ***Figure 2-14***.

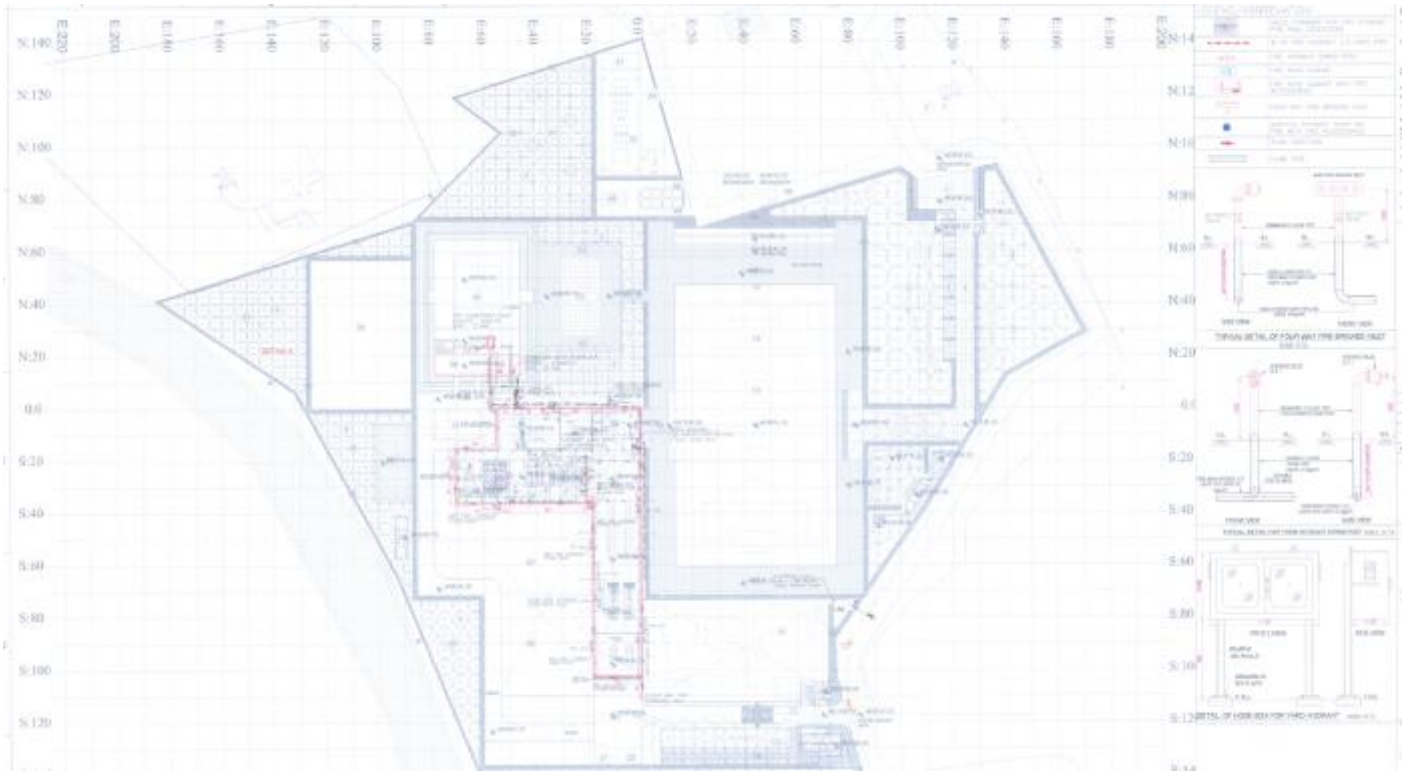
Plant has installed total 40 fire extinguishers comprising of 19 of ABC type and 21 of CO2 type across the premises. The project has installed fire extinguishers of capacity 4 kg to 6kg at labour entrance gate (1 no.), weighbridge (1 no.), MCC room (3 no.s), each floor of admin room (2 no.s at each floor), turbine hall (1 no.), battery room (1 no.), flash tank (1 no.), boiler area (2 no.s), grabber operator cabin (1 no.), quality check lab (1 no.), entrance of pre-processing unit (1 no.), right and left side of the bunker area within pre-processing unit (2 no.s), pre-processing control room panel (2 no.s), switch yard panel room (2no.s) and cafeteria (1 no.). The project has also installed one CO_2 fire extinguisher of 22.5 kg at the switch yard panel room. Also, one fire extinguisher has been installed at the entrance of staircase at each floor of the admin block. Inspection of the fire extinguisher is undertaken by the Security head on monthly basis and the same is tested and refilled on yearly basis by external agency named Vijaya Fire Engineering Works Private Limited. Plant also has 14 spare fire extinguishers of DCP Ball type. In addition, nitrogen injection fire protection system for 8MVA auxiliary transformer (66/11 KV) has been installed.

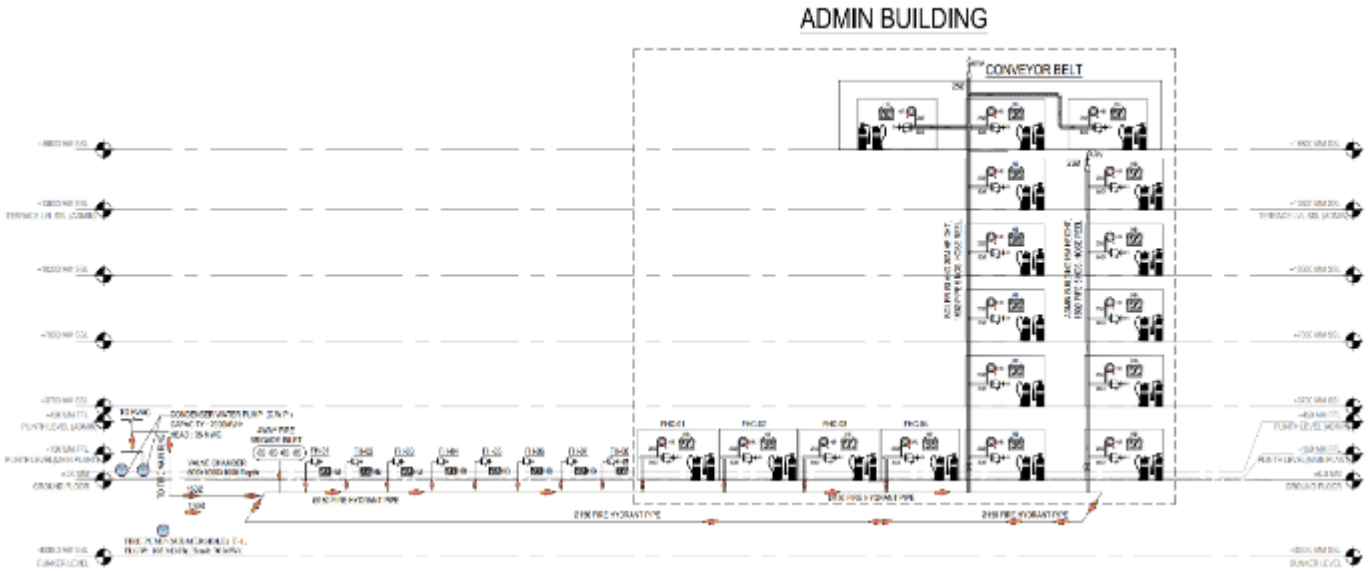
In addition to the above, the project has installed 17 hose boxes with 34 hose pipes and 13 hose reels with nozzle at different locations within the plant.

Smoke detection system is available on 1st and 3rd floor. Bunker and operational has continuous availability of manpower. Fire watcher training has been provided to the entire team to ensure quick prevention of fire, if any.

GWJPL has developed a site-specific Emergency Response Plan identifying both onsite and offsite emergencies along with management measures and Emergency response team to respond to such emergencies on time. Emergency contact numbers are displayed at designated locations within the project premises. Additionally, a dedicated assembly area has been identified within premises. As per consultation with workers, it was confirmed that workers are aware of the location of the assembly area along with the ERP communication matrix to be followed in case of emergency.

Figure 2-14 Fire Hydrant Master Plan and Fire Hydrant Plan for Admin Building





Source: Project Layout, GWJPL

2.11 Greenbelt & Landscape

~ 33% of the total area has been allocated for green and landscape area. Trees planted within the premises includes Neem, Champa, Mango, etc. Details of the green area is as presented in ***Figure 2-15*** and ***Table 2-9***.

Table 2-9 Details of Green Area

Sr. No.	Name of Area / Trees	Area (Sq .m)	Number of trees planted
1.	Kalp Vruksh Vatika	5770	300
2.	Neem Van	4860	102
3.	Champa Trees	1249	70
4.	Mango Trees	870	28
5.	Lawn-Football Ground	5050	
6.	Total Mehnadi Plant (Planted within the facility for boundary purposes)	1470	8625
7.	Total Conocarpus (Planted along the boundary)	3400	9360
8.	**Total Area**	**22669**	**18485**

Figure 2-15 Layout showing Green and Landscape Area

Source: GWJPL

2.12 Land Requirement and Procurement

Based on the information provided, the project has obtained a lease for 16.70 acres of land from the Jamnagar Municipal Corporation (JMC) for a period of 25 years. Prior to the project, a majority of the land, approximately 82% (13.7 acres out of the total 16.7 acres), was categorized as barren or unused and the remaining 18% (3 acres out of the total 16.7 acres) was being cultivated by a single household.

The possession on the land has been allotted on the name of Goodwatts WTE Jamnagar Private Limited vide possession receipt number JMC/Estate/30/WToE/620/2016-17 dated 24.11.2021.

Note: There is no considerable requirement of land for the 66 kV underground external transmission line and the underground water pipeline. The total length of the underground external transmission line is 56.4 meters connecting the WTE plant to the GETCO substation. Further, the total length of the underground water pipeline is 324 meters underground water pipeline (1 no.) connecting plant to 70 MLD JMC STP.

Table 2-10 Total Land Requirement for the Project

Project Component	Total Leased out Land Size (in acres)	Easement Rights (in acres)	Total land requirement (acres)	Land Category	Remarks
Waste to energy plant	16.70	0	16.70	Government leased out land	The project has obtained the land on a lease for a period of 25 years from Jamnagar Municipal Corporation
Underground transmission line	0	0.01398	0.01398	Government owned land	The underground transmission line does not pass through any private land and the entire section of the underground transmission line passes through government land. In a comprehensive evaluation encompassing both the extensive length of the underground transmission line spanning 56.4 meters and consultations with the local community, it has been conclusively ascertained that the installation, as well as the ongoing Operations and Maintenance (O&M) activities associated with the transmission line, have not precipitated any instances of economic or physical displacement. **Land use categorisation of impacted land** Land Use Category / Area (acres) Project Land (10.38 meters) / 0.002568 Road Land (28.93 meters) / 0.007158 Substation Land (17.18 meters) / 0.01398 Total (56.4 meters) / 0.01398
Underground water pipeline	0	0.0800	0.0800	Government owned land	Based on the site visit, the pipeline passes through government land. In a comprehensive evaluation encompassing both the extensive length of the underground water pipeline spanning 324 meters and extensive consultations with the local community, it has been conclusively ascertained that the installation, as well as the ongoing Operations and Maintenance (O&M) activities associated with the

Project Component	Total Leased out Land Size (in acres)	Easement Rights (in acres)	Total land requirement (acres)	Land Category	Remarks
					pipeline, have not precipitated any instances of economic or physical displacement. Land Use Categorisation Land Use Category — Area (acres) Project Land (5 meters) — 0.001235 Road Land (36.42 meters) — 0.008993 Substation Land (17.19 meters) — 0.069773 Total (324 meters) — 0.0800
Total	16.7	0.9398	16.8		

2.12.1 External Transmission Line

The total length of the underground external transmission line is 56.4 meters laid 1.5 meter below natural ground level. It serves as a connection between the Waste-to-Energy (WTE) plant and the GETCO substation. Specifically, the transmission line traverses the JMC-owned road and links WTE project switchyard to the GETCO 66 kV Substation in Navagam Ghed.

2.12.2 Water Pipeline

The total length of the underground water pipeline is 324 meters underground water pipeline (1 no.) connecting plant to 70 MLD JMC STP. Similar, to the external transmission line, the pipeline is traverses the JMC-owned road and links the WTE Plant to the JMC owned Sewage Treatment Plant (STP).

2.13 Manpower Requirement

The project has appointed four (4) different contractors to undertake different operational activities at the plant level. Details of number of employed contract workers along with project on-roll employees is provided below:

Table 2-11 Manpower Details

Sr. No.	Employer name	Nature of work	Total number of employees/contract workers
		On-roll employees	
1.	Abellon Staff	Overall operation of the project	63
		Contractual workers	
2.	Subcontracted workers	(HK, Material Trns., & Maintenance)	98
3.		Site Security	13

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 ensures 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 Jamnagar.

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, contributes 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 Jamnagar, it is evident that the waste management practices need urgent attention. As per Census 2011, Jamnagar City has population base of 21,60,119. The municipal solid waste management in Jamnagar city limits is the responsibility of Jamnagar Municipal Corporation (JMC). There is no existing landfill site, however, JMC has allocated a 16.7 acre of land for transfer station at Happa in Jamnagar, where limited quantity of MSW (which directly does not go to the WTE plant) is disposed by JMC tippers from households where rag pickers carry out waste segregation and the waste is sent to the Jamnagar Waste to Energy Plant. At present, Jamnagar city generates approx. 250 TPD of fresh waste and if it is left untreated then it is anticipated that the waste would accumulate in the landfill and could be in the range of 20-25 Lakhs.

Since, the project is also using the legacy waste from Rajkot MSW Landfill which is an existing landfill site of about 100+ acres near village Nakarwadi in Rajkot where entire waste collected from the Rajkot city is currently being dumped in unscientific manner since last 20 or more years. Jamnagar 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 • Cost effective. • Recyclables can be utilized	• 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	• Diversion of waste from the landfill • Limited 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 operated by Abellon in Jamnagar is helping process approximately 250 TPD of MSW thereby consuming the entire waste generated from Jamnagar City and also additionally using 500TPD of legacy waste from Rajkot MSW Landfill that would otherwise have collected at the landfill in Rajkot. It also helps 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 are eligible for setting up Power Plants utilizing Municipal Solid Waste either for the purpose of captive use or for sale to Obligated Entities. The Jamnagar WTE project is 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 3-3*** 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]

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. Thus, lesser capital investment is required for flue gas

[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

cleaning. Therefore, 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:

- Moving grate furnace system: waste enters from one end while ash is discharged at other.
- Fixed grates: series of steps with drying stage and initial combustion phase, complete combustion and final carbon burn-out

Advantages of grate incinerators	• Prior sorting or shredding (pre-processing) is not required. • This technology is most widely tested and meets the standards of technical performance. • It accommodates large variations in waste composition and calorific value. • Overall thermal efficiency is typically up to 85%.
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

The Project set is setup in the Nava Gam Village, Jamnagar. The location of the Project site was finalized by JMC, on land already owned by JMC and is provided on lease to Abellon for development of WTE plant. The waste is collected on daily basis by JMC from door to door and is supplied to the WTE plant. The Jamnagar project is currently receiving fresh waste from Jamnagar Municipal Corporation (JMC) through small dumper/ compactor/tripper. About 100 no.s of JMC vehicles carry the waste to plant. Apart from this, about 20 trucks bring bio-mined waste from Rajkot MSW landfill site on daily basis. All the waste vehicles currently use the road that is leading towards Nava Gam Ghed city. The road currently being used is an alternate road proposed by JMC on temporary basis, till the time the project is connected to main access road which is planned to be constructed in 1- 2 years' time. This road is also currently being by JMC sewage treatment plant (STP) and GETCO substation located near to the plant. This will ensure that no new route plan has to be prepared or implemented by JMC, thus minimizing any additional community disturbance issues.

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

- Minimum economic displacement due to existing land use
- No reported legacy issues related to waste dumping and contamination.
- No physical structure or house on the land
- Limited to no encroachment
- Good connectivity to village roads and state highways.
- Vicinity to the substation and the STP thereby reducing the length of TL as well as underground water pipeline.

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

The project has laid 66 kV underground transmission line of length 56.4 m connecting to GETCO Substation which is present almost adjacent to the WtE plant. The project has also laid 324m of underground water pipeline from the project location to the Sewage Treatment Plant (STP) Jamnagar.

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.
- Undergrounding of TL has done for the entire stretch.
- Underground water pipeline has been developed.

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
- 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 25.06.2014, the thermal Power plant up to 15MW, based on non-hazardous municipal waste and using auxiliary fuel such as biomass 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 7.5 MW and MSW is 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, “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 Consolidated Consent and Authorization (CCA) under Air Act, 1981, Water Act 1974 and Hazardous and other waste (Management & Transboundary Movement Rules) 2016 dated 23.06.2022 valid till 03.04.2027. GWJPL has entered into an agreement with Aztec Recycling Hub Private Limited to dispose waste such as Used oil, and Discarded containers/Barrels/Liners/ Contaminated with Hazardous Chemicals. Other Hazardous waste such as Spent Ion Exchange Resins from DM Plant, Neutralization Tank Sludge is being disposed of TDSF Facility of Saurashtra Environ Projects Pvt Ltd.

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*** below.

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.

Sr. No	Agency	Function
		• 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 in order to prevent the depletion of groundwater levels and deterioration of its quality.
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: a. The Explosive Act 1884 and Rules, 1983. b. The Petroleum Act 1934 and the Rules 2002. c. The Static and Mobile pressure vessels {Unfired} Rules, 1981 and amendment 2000, 2004. d. Gas Cylinder Rules, 2004; and e. Manufacture, Storage and Import of Hazardous Chemical Rules, 1989 and amendment, 2000
State Level		

Sr. No	Agency	Function
6	Gujarat Energy Development Agency	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 are: • 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. 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.

Sr. No	Agency	Function
		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 so as to obtain the maximum yield consistent with their permanent maintenance and the supply of the needs of the people, agriculture, industry and defence. • 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 Policy – 2022

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.

1. Registration of projects
2. Respond to queries and problems of Project Developers
3. Accreditation and recommending WTE Projects for registering with Central Agency under REC Mechanism
4. 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 operational phase. 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 Permits have been presented as **Appendix 19**.

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

Sr. No.	Applicable Regulation/Permit	Operation	Responsible Authority	Applicability to the Project/ Status
	Environmental 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 7.5 MW and MSW is 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)/2015-2016[24] and GPCB[25] "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 Consolidated Consent and Authorization (CCA) under Air Act, 1981, Water Act 1974 and Hazardous and other waste (Management & Transboundary Movement Rules) 2016 dated 23.06.2022 valid till 03.04.2027.
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 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 IFC 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 ○ Non-recyclable waste having calorific value of 1500 Kcal/kg or more shall not be disposed of 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. ○ High calorific wastes shall be used for coprocessing in cement or thermal power plants. Duties of the industrial units located within one hundred km from the RDF and Waste to Energy plants based on solid waste: • All industrial units using fuel and located within 100 km from a solid waste-based RDF plant shall make arrangements within six months from the date of notification of these rules to replace at least 5% of their fuel requirement by RDF so produced.
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,

[24] https://cpcb.nic.in/openpdffile.php?id=TGF0ZXN0RmlsZS9MYXRlc3RfMTE4X0ZpbmFsX0RpcmVjdGlvbnMucGRm
[25] https://gpcb.gujarat.gov.in/uploads/Final_Categorization.pdf

Sr. No.	Applicable Regulation/Permit	Operation	Responsible Authority	Applicability to the Project/ Status
				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*** • 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 is being pre-processed and processed and is managed by GWJPL 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 uses 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. GWJPL complies with the above requirements during operation phase of the project, Also, GWJPL has obtained boiler certificate as per Form IV under Boilers Act, 1923 from Gujarat Boiler Inspection Department dated 04.10.2022 valid up to 03.10.2023 to be worked at a Maximum Pressure of 51.00 kg/cm²(g).
7	Fly Ash Utilization Notification, 2022	✓	GPCB CPCB	The WtE plant is generating 70TPD fly ash from the waste combustion and the fly ash to be managed as per the Fly ash utilization notification 2022
8	The Batteries (Management and Handling) Rules 2022	✓	GPCB	Batteries waste, if any generated in operation phase to be disposed of as per Batteries (Management and Handling) Rules 2022.
9	E-waste (Management) Rules, 2016	✓	GPCB	E waste generated on site to be collected, stored, and disposed of as per E waste Management Rules.
10	Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 as amended till date	✓	GPCB CPCB	Hazardous waste 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.

Sr. No.	Applicable Regulation/Permit	Operation	Responsible Authority	Applicability to the Project/ Status
				The project has received Consolidated Consent and Authorization (CCA) under Air Act, 1981, Water Act 1974 and Hazardous and other waste (Management & Transboundary Movement Rules) 2016 dated 23.06.2022 valid till 03.04.2027.
11	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.
12	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.
13	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 Management Of Ground Water Resources, Jamnagar District, 2020, the Jamnagar block where the Project fall is categorised as ***Safe*** 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. GWJPL has obtained No Objection Certificate (NOC) from CGWA on 14.09.2022 valid up to 13.09.2053. 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. 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
Social				
14	The Indian Telegraph Act, 1885	X	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. • 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.
15	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”.

Sr. No.	Applicable Regulation/Permit	Operation	Responsible Authority	Applicability to the Project/ Status
				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
	Labour			
16	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 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 for J.G. Services** J.G. services have obtained the contract labour license with the license number CLRA/License/CLRA/JMN/2022/CLL/35 dated 09.01.2023 **Not Applicable for M/s Aditya Security Services, M/s Vijay Singh, and M/s Aditya Enterprises** The number of personnel employed by each above-mentioned contractors are below 20. Therefore, as per the section 4 of the Act, the contractor labour license is not applicable on above mentioned contractors.

[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	Operation	Responsible Authority	Applicability to the Project/ Status
17	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** **Applicable** GWJPL has obtained the factories license vide the license number – 43805 dated 22.03.2021. As per the license, the maximum number of workers to be employed on any days during the year is 250. The Project is in the compliance with the requirement of maximum number of workers
18	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 **Applicability** **Applicable** It has been confirmed through consultation and a review of the wage register that all workers at the project are receiving wages equivalent to the minimum wages prescribed by the Gujarat state notification[28]. 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	Earthmover's driver	18,000/month and 692.3/day	Skilled	474
Workers	Worker involved in waste handling	10,000/month and 384.6/day	Unskilled	363

[28] https://col.gujarat.gov.in/circular.htm (Accessed on July 28, 2023)

Sr. No.	Applicable Regulation/Permit	Operation	Responsible Authority	Applicability to the Project/ Status
19	Equal Remuneration Act 1976	✓	Labour Department	Puts in place rules and regulations governing the remuneration payable to workers and employees **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.
20	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** Based on the consultation with workers and review of wage register, it is understood that all workers receive their wages within seven (7) days of the end of the wage period. In the case of the project, wage period is the last day of a month, and the workers receive their wages on or before the seventh day of the next month
21	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.

22	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.

23	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,

<table>
<tr><th>Sr. No.</th><th>Applicable Regulation/Permit</th><th>Operation</th><th>Responsible Authority</th><th>Applicability to the Project/ Status</th></tr>
<tr><td></td><td></td><td></td><td></td><td>Applicability
Applicable
The project has appointed four (4) contractors, the details of applicability and status of registration of each contractor is provided below:
<table><tr><th>Contractor/Project SPV</th><th>Applicability</th><th>Status</th></tr><tr><td>JG Services</td><td>The Act is applicable on the contractor</td><td>Obtained the registration and the establishment code of the contractor is GJAHD0052506000</td></tr><tr><td>Aditya Security Services</td><td>The Act is applicable on the contractor</td><td>Obtained the registration and the establishment code of the contractor is GJRAJ1044637000</td></tr><tr><td>Vijay Singh</td><td>The contractor has employed seven (7) workers, thus, per the section 1(3) of the Act, the registration is not applicable on the contractor</td><td>Not Applicable</td></tr><tr><td>Aditya Enterprises</td><td>The contractor has employed six (6) workers, thus, per the section 1(3) of the Act, the registration is not applicable on the contractor</td><td>Not Applicable</td></tr></table></td></tr>
<tr><td>24</td><td>Payment of Bonus Act, 1965 and rules and subsequent amendment</td><td>✓</td><td>Labour Department</td><td>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</td></tr>
<tr><td>25</td><td>Payment of Gratuity Act, 1972</td><td>✓</td><td>Labour Department</td><td>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</td></tr>
<tr><td>26</td><td>ESI Act, 1948 (Employees State Insurance Act, 1948)</td><td>✓</td><td>Labour Department</td><td>• It applies to all non-seasonal factories.</td></tr>
</table>

Sr. No.	Applicable Regulation/Permit	Operation	Responsible Authority	Applicability to the Project/ Status
				• 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. **Applicability** **Applicable** The project has appointed four (4) contractors, the details of applicability and status of registration of each contractor is provided below:
27	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.
28	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.
29	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.

Contractor	Applicability	Status
JG Services	The Act is applicable on the contractor	Obtained the registration and the employer code of the contractor is 37001048050001099
Aditya Security Services	The Act is applicable on the contractor	Obtained the registration and the employer code of the contractor is 7001301610001099
Aditya Enterprises	The Act is applicable on the Contractor	The contractor has obtained the registration vide registration number 37001496730001099. The registration has been obtained after the site visit of service provider

Sr. No.	Applicable Regulation/Permit	Operation	Responsible Authority	Applicability to the Project/ Status
30	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.
31	Inter-state Migrant Workmen Act 1979.	✓	Labour Department	The Key provisions of the Act, include: • Responsibility of payment of wages: 1) A contractor shall be responsible for payment of wages to each inter-state migrant workman employed by him and such wages shall be paid before expiry of such period as may be prescribed; 2) Every principal employer shall nominate a representative duly authorised by him to be present at the time of disbursement of wages by the contractor and it shall be the duty of such representative to certify the amounts paid as wages in such manner and may be prescribed; 3) It shall be the duty of the contractor to ensure the disbursement of wages in the presence of the authorize representative of the principal employer; 4) In case the contractor fails to make payment within the prescribed period or make short payment, then the principal employer shall be liable to make payment of the wages in full or the unpaid balance due, as the case maybe, to the inter-State migrant workman employed by the contractor and recover the amount so paid from the contractor either by deduction from any amount payable to the contractor under any contract or as a debt payable by the contractor • The wage rate of an interstate migrant worker shall in no case be paid less than the wages fixed under the Minimum Wages Act, 1948, 2. Wages payable to an interstate migrant workman shall be paid in cash. • There shall be paid by the contractor to every interstate migrant worker at the time of recruitment, a displacement allowance equal to fifty per cent of the monthly wages payable to him or seventy-five rupees whichever is higher. • The amount paid to a worker as displacement allowance shall not be refundable and shall be in addition to the wages or other amount payable to him. **Applicability** **Not Applicable** As per the consultation with workers, the appointed contractual workers do not fall under the definition of Inter-state migrant workmen[29] provided by Section 2(e) of the Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1979.
32	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 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. **Applicability** **Applicable** The project has established a grievance redressal mechanism depicting grievance redressal committee, and the process of redressing the grievances.
33	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.

[29] 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

Sr. No.	Applicable Regulation/Permit	Operation	Responsible Authority	Applicability to the Project/ Status
				• 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.
34	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- o Blindness or low vision. o Bearing impairment. o 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** **Applicable** 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.
35	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. **Applicability** **Applicable** The PSARA license (15101811/Jamnagar) obtained by M/s Aditya Security Services for providing security at the plant and the license is valid till 06.10.2025.
	Ecology			
36	Coastal Regulation Zones Notification, 2019	✓	Gujarat Coastal Zone Management Authority	The Coastal Regulation Zone (CRZ) Notification, 2019, came into effect to regulate development of various projects in coastal zones of the country as defined in the Notification. As per the Notification, project proponent is required to submit the following to the State or Union territory Coastal Zone Management Authority for seeking CRZ clearance. The project is about 300 m away from the nearest boundary of Coastal Regulation Zone II (CRZ II) -Developed Land Areas (Municipal Limits / Urban Areas)30 and is not falling within any CZRZ zones. Therefore, the CRZ notification is not applicable. Refer ***Figure 5-36*** for details and location of the project with respect to the distance from the various CRZ zones.

[30] https://czmp.ncscm.res.in/

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

Sr. No.	IFC Performance Standards	Applicability/ Compliance/Details
1	PS 1: Assessment and Management of Environmental and Social Risks and Impacts	**Applicable** This PS aims to assesses the existing social and environmental management systems of GWJPL 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	PS 2: Labor 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 operation phase for the Project includes 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 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	PS 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 operation phase. PS 4 is applicable to the project as the Project use access roads for transportation MSW wastes which may have potential impact on the health and safety of the commuters and communities located along the access road.
5	Performance Standard 5	**Not Applicable** PS-5 requires project proponents to anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use.

Sr. No.	IFC Performance Standards	Applicability/ Compliance/Details
	Land acquisition and involuntary resettlement	As per the available information for the project is taken 16.70 acres land on lease and prior to the project land was classified as barren. Further as informed one family which was having informal rights over 3 acres of land was compensated for the land as well las head of the household was given full time employment in the project. As the project has provided the due compensation for land as well as employment. Hence there are no remaining impacts on the affected family therefore the applicability of the PS 5 is scoped out. Furthermore, the project is currently in the operational phase, and there is no anticipated impact on the economic displacement of any ragpickers due to project operations. Additionally, the Project does not exercise control over the dumpsite and has not imposed any restrictions on access to the landfill site for ragpickers. During the site visit to the landfill, it was observed that no ragpickers were collecting waste at the landfill itself. However, there are ragpickers actively engaged in ragpicking activities at the transfer station. As reported, the operation of the project will not disrupt the functioning of the transfer station, and the ragpickers will continue to collect waste at the transfer station as they have been doing.
6	Performance Standard 6	**Applicable** The project is surrounded by the open scrub (natural habitat) and agricultural land (modified habitat). Thus, IFC 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 (SO2) µg/m^3	Annual Average*	50	20
	24 Hours**	80	80
Oxides of Nitrogen (NOx) µg/m^3	Annual Average*	40	30
	24 Hours**	80	80
Particulate Matter (PM 10) µg/m^3	Annual Average*	60	60
	24 Hours**	100	100
	Annual Average*	40	40

Pollutant	Time Weighted Avg.	Concentration in Ambient Air	
		Industrial, Residential, Rural & Other Areas	Ecologically Sensitive Areas (notified by Central Government)
Particulate Matter (PM 2.5) µg/m3	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 µg/m3	Annual*	01	01
Arsenic (As) ng/m3	Annual*	06	06
Nickel (Ni) ng/m3	Annual*	20	20
Cadmium ng/m3	Annual*	5***	-
Mercury[31] 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 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 General EHS Guidelines, Ambient Air Quality Standards

Pollutant	Averaging Period	Guideline Value in µg/m3
		125 (Interim target 1)

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

Pollutant	Averaging Period	Guideline Value in µg/m^3
Sulphur Dioxide	24-hour	50 (Interim target 2)
		20 (guideline)
	10 minute	500 (guideline)
Nitrogen Oxide	1 year	40 (guideline)
	1 hour	200 (guideline)
Particulate Matter 10	1 year	70 (Interim target 1)
		50 (Interim target 2)
		30 (Interim target 3)
		20 (guideline)
	24 hour	150 (Interim target 1)
		100 (Interim target 2)
		75 (Interim target 3)
		50 (guideline)
Particulate Matter 2.5	1 year	35 (Interim target 1)
		25 (Interim target 2)
		15 (Interim target 3)
		10 (guideline)
	24 hour	75 (Interim target 1)
		50 (Interim target 2)
		37.5 (Interim target 3)
		25 (guideline)
Ozone	8-hour daily 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 Quality 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*	Nighttime
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	Nighttime 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. No.	Parameters	UOM	India SWM Rules 2016	MSW Incinerators, WBG EHS Guidelines[32] (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

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

Sr. No.	Parameters	UOM	India SWM Rules 2016	MSW Incinerators, WBG EHS Guidelines[32] (EU Directive 2000/76/EC)
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) + Chromium (Cr) + Copper (Cu) + Manganese (Mn) + Nickel (Ni) + vanadium (V) + Their compounds	mg/Nm^3	0.5	0.5 – 1 [0.5 – 8 hr average]
11	Dioxins and furans	mg TEQ/Nm^3	0.1	0.1 mg 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; physio-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 of operational project 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, waste transfer station, 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, administrative building, Sewage Treatment Plant (STP), transmission line infrastructure and water pipeline installed for the Project from STP. 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 a number of factors, including:

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

The Project's AoI refers to the Project footprint area as well as to a larger area in its immediate vicinity. This includes the footprint of the project components, 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:

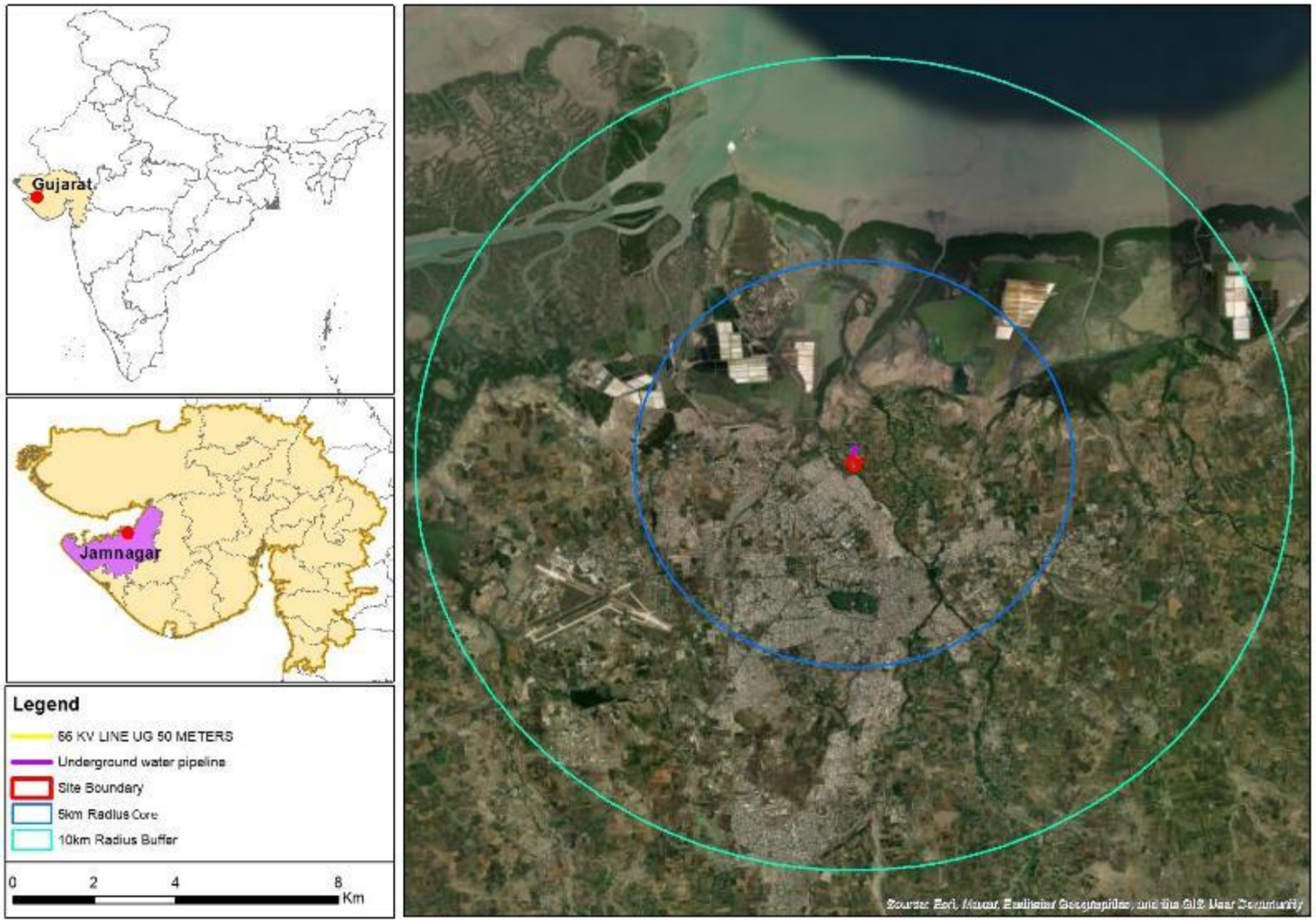
- Ecological Parameters: Based on identified sensitivity during desk-based review and previous experiences, the study area for ecological assessment was demarcated as,
    - Core Area: Boundary of the project, and
    - Buffer Area: 10 km radius from the project boundary.
- Environmental Parameters: 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 – 5km from project site
    - Buffer Area: Beyond 5km – 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 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 5 km 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 (grazing and agricultural land) and increased vehicular activity in remote areas.
- **Study area:** Project footprint = Core zone (5 km) + buffer zone (10 km).

Table 5-1 Core & Buffer zone villages

Sr. No.	Villages	Tehsil	District
Villages falling in Core Zone			
1	Nava Nagna (the village also fall on the access road)	Jamnagar	Jamnagar
2	Juna Nagna	Jamnagar	Jamnagar
3	Navagam (the village also fall on the access road)	Kalavad	Jamnagar
Buffer Area Villages			
1	Gordhanpar	Jamnagar	Jamnagar
2	Dhinchda	Jamnagar	Jamnagar
3	Dhunvav	Jamnagar	Jamnagar
4	Khijadiya	Jamnagar	Jamnagar
5	Naghedi	Jamnagar	Jamnagar
6	Kansumara	Jamnagar	Jamnagar
7	Morkanda	Jamnagar	Jamnagar
8	Theba	Jamnagar	Jamnagar
9	Hapa	Jamnagar	Jamnagar
10	Khimaliya	Jamnagar	Jamnagar
11	Jamnagar (OG) WARD NO.-0019 (Rural MDDS CODE:513673)	Jamnagar	Jamnagar

Figure 5-1 Identified Study area for the Project.



5.2 Primary Environmental Baseline Monitoring

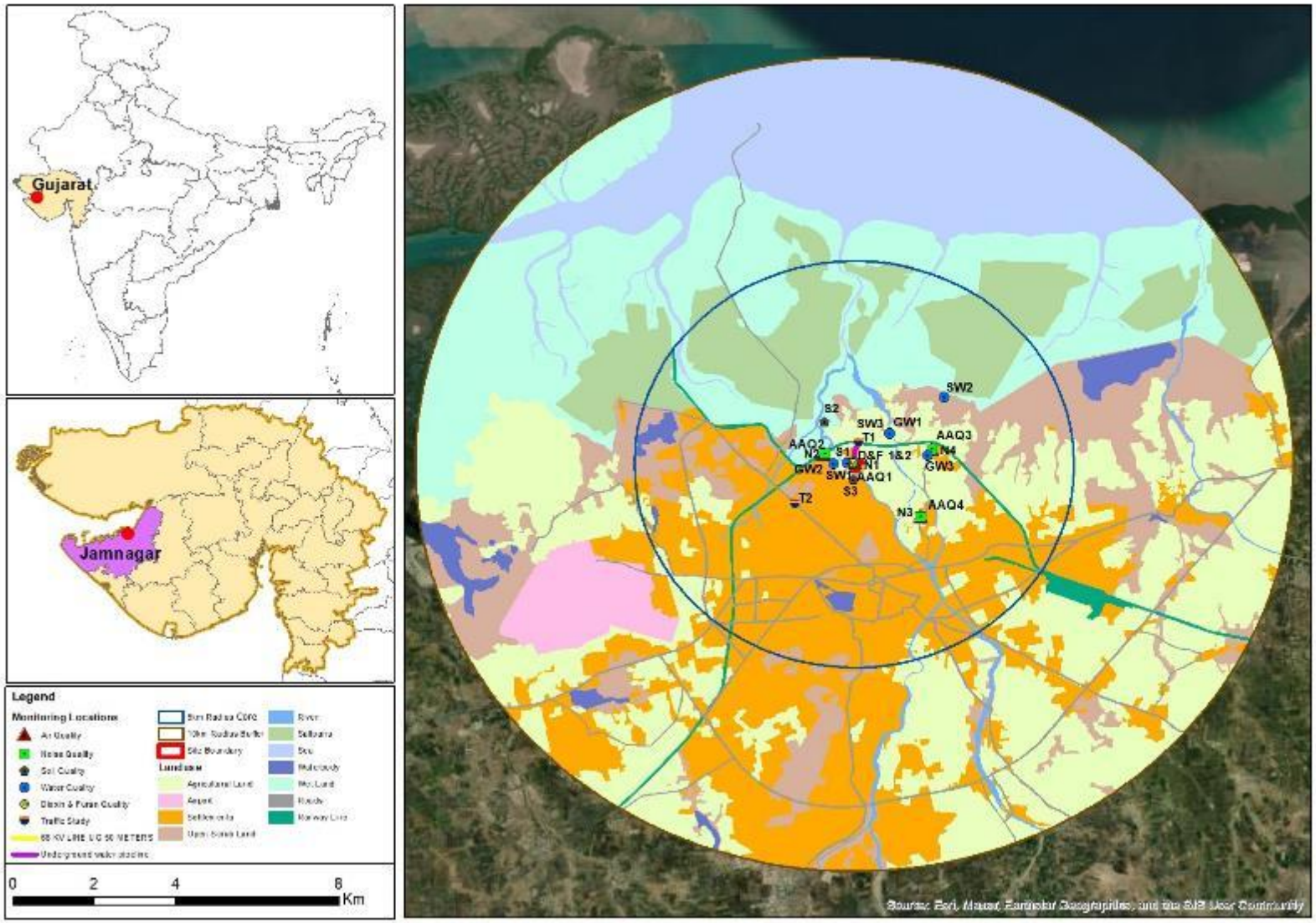
Primary environmental baseline monitoring was conducted within 10 km radius of the study area by a National Accreditation Board for Testing and Calibration Laboratories (NABL) under the supervision of E&S Advisor to understand the baseline conditions of the study area. Monitoring locations considered has been presented in ***Table 5-2***, 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 5-2 Environment Monitoring Locations

Parameter	Location Code	Name of the Location	Coordinates	Distance and Direction from Project Site	Frequency / Remarks
Ground Water	GW 1	Near, JMC STP PLANT (Borewell)	22°30'09.2"N 70°04'28.7"E	0.95 km towards northeast from project site	Physical, chemical and biological parameters as per IS 10500:2012 drinking water standards were assessed for the collected samples. Once during the monitoring period in May 2023
	GW 2	Behind the plant premises, JANARAM TEMPLE (Borewell)	22°29'44.8"N 70°03'44.0"E	0.35 km towards west direction	
	GW 3	Navanagar village. (Borewell)	22°29'51.6"N 70°04'59.1"E	1.5 km towards east	
Surface Water	SW 1	Rangamati River, Behind the plant premises. (downstream to the Plant)	22°29'45.5"N 70°03'55.1"E	20 m towards west	Once during the monitoring period in May 2023
	SW 2	Pond, Metropolitan Area	22°30'38"N 70°05'12"E	2.45 km towards northwest	
	SW 3	Water stream of River Rangamati, Near, Government High school Navanagna	22°30'09.3"N 70°04'28.7"E	0.95 km towards northeast from project site	
Soil	SQ 1	JMC Sewage Treatment Plant	22°29'45.4"N 70°04'00.5"E	Inside the plant	Sample were assessed for parameters such as pH, Conductivity , Moisture Content, Texture, Particle Sizes, Sand Silt, Clay, Bulk Density, Chemical Characteristics, Organic Content, Chlorides as Cl, Sulphates as So4, Total Nitrogen as N, heavy metals, total petroleum hydrocarbons Once during the monitoring period in June 2023
	SQ 2	BSL Ground	22°30'18.0"N 70°03'36.7"E	1.1 km towards northwest	
	SQ 3	Vedmata school	22°29'32.2"N 70°03'59.9"E	230m towards south	
Ambient Air	AQ 1	At Plant premises	22°29'45.3"N 70°04'00.9"E	Plant Premises	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	Jalaram Nagar	22°29'52.6"N 70°03'37.2"E	560m towards north west (Upwind in the month of May and Downwind in the month of June)	
	AQ 3	Navanagna village.	22°29'56.4"N 70°05'02.8"E	1.7km towards east (Cross Wind for the month of May & June)	
	AQ 4	Near Juna Nagna	22°29'02.6"N 70°04'53.5"E	1.9 km towards southeast (downwind in the month of May and upwind in the month of June)	
Ambient Noise	N1	At Plant premises.	22°29'45.4"N 70°03'59.8"E	At Plant	Once for 24 hours from the nearest residential receptors covering all directions in the 3 km radius of the project
	N2	Near Anand Vihar Bag	22°29'52.8"N 70°03'37.3"E	560m towards west	

Parameter	Location Code	Name of the Location	Coordinates	Distance and Direction from Project Site	Frequency / Remarks
	N3	Near Juna Nagna Rd	22°29'02.5"N 70°04'53.2"E	1.9 km towards southeast	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.
	N4	Nava Nagna Gram Panchayat	22°29'56.4"N 70°05'02.8"E	1.7km towards east	
Traffic	T1	JMC Sewage Treatment Plant	22°30'01.9"N 70°04'04.1"E	400m towards north	Access Road used for the project site in June 2023
	T2	Bedi Road	22°29'13.3"N 70°03'13.6"E	1.5 km towards southwest	
Dioxin and Furan	D&F1	At Plant premises	22°29'45.3"N 70°03'59.9"E	At Plant	To assess the presence of D&F in the ambient air in June 2023
	D&F2	At Plant premises.	22°29'45.0"N 70°04'00.1"E	At Plant	

Figure 5-2 Monitoring Location Map



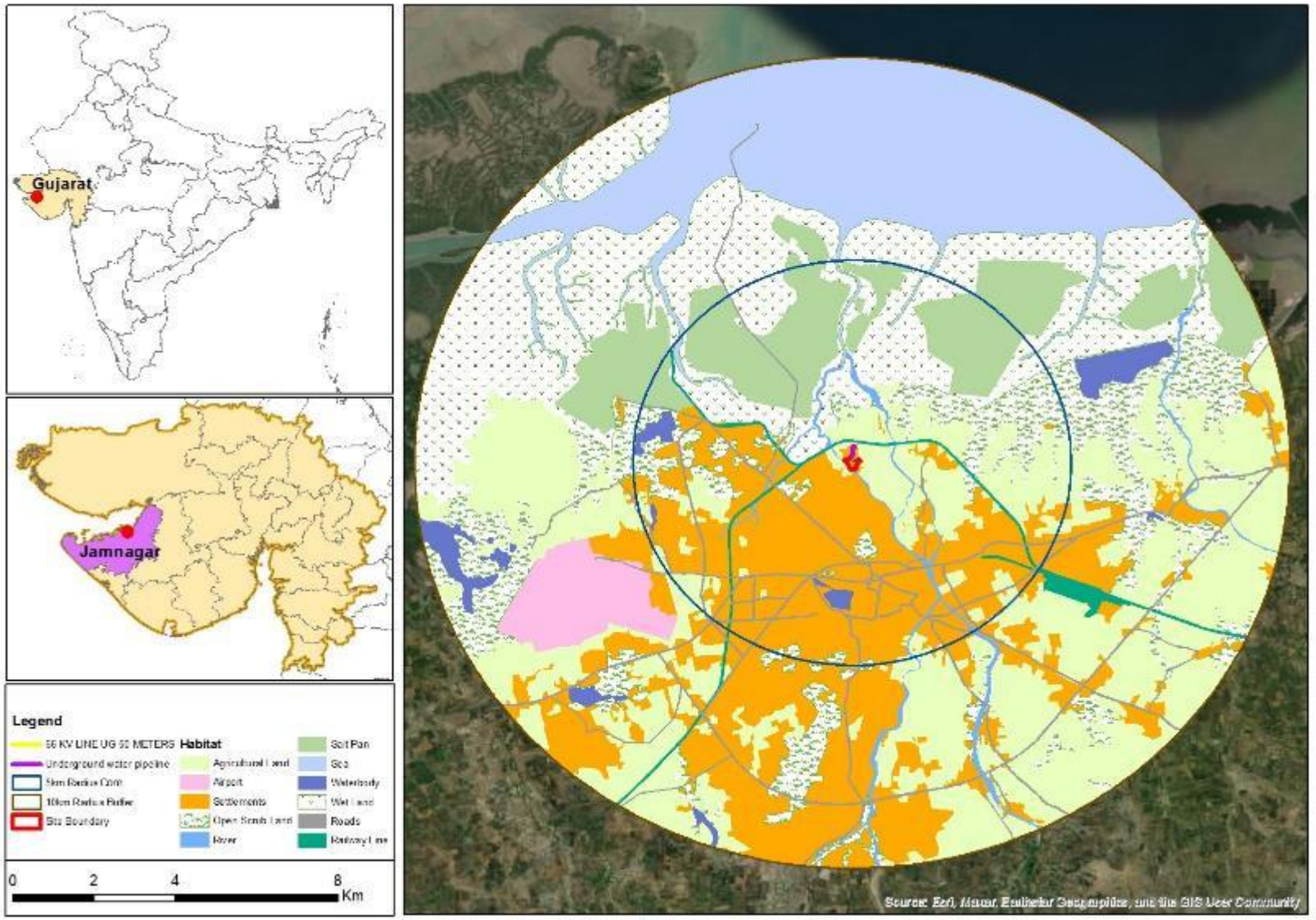
5.3 Physical Environmental Sensitivities

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,
- Water pipeline route from Sewage Treatment Plant
- Settlements within 10 km radius of the Project
- Road and Railway network around the site
- Water bodies (River, Sea, Lakes/ponds) located within 10 km radius.
- Other Features such as Salt Pans, Wetland etc. present within 10 km of the project area.

Figure 5-3 Physical Feature Map of the Study Area



Source: ARC GIS Mapping, Developed by E&S Advisor

5.3.2 Climatology

According to Aquifer Mapping and Ground Water Management Plan for Jamnagar, 2020, the Jamnagar district is a coastal town in Gujarat and is situated in the Gulf of Kutch. Jamnagar is a city located on the western coast of India in the state of Gujarat in the Saurashtra region. Jamnagar has a hot semi-arid climate.

The main seasons prevailing in the district are.

- Monsoon - mid of June to September
- Winter - December to February
- Summer - March to May end.

Table 5-3 Meteorological Data from Jamnagar IMD Station (1991-2020)

Month	Temperature				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		
January	28.6	12.7	36.4	-0.6	61	29	0.7	0.1	7.5	NW
February	31.4	15.3	40.0	1.1	64	25	0.1	0.0	8.6	NW
March	36.0	19.5	43.9	6.1	66	19	0.1	0.0	10.6	NW
April	39.6	23.0	44.8	10.0	70	19	1.3	0.3	14.1	NW
May	41.0	25.7	47.9	16.1	74	28	3.8	0.3	18.6	NW
June	38.1	26.6	45.8	20.0	78	50	130	4.6	18.2	SW
July	33.0	25.4	40.6	19.4	87	71	293.3	10.3	16.7	SW
August	31.7	24.5	38.8	20.1	89	71	195.2	8.5	15.3	SW
September	33.4	23.9	42.8	16.7	87	60	125.1	5.4	12.2	NW
October	36.0	22.6	41.9	12.2	72	35	23.7	1.3	7.7	NW
November	33.6	18.6	38.4	7.2	57	30	2.7	0.2	6.3	NE
December	30.3	14.3	37.6	2.8	60	30	0.2	0.0	6.8	NE

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

Temperature: According to the above ***Table 5-3*** from Meteorological Data for *Jamnagar* District from IMD (1991-2020), the district has semi-arid climate. The mean maximum temperature recorded in the region is 41°C and the highest temperature recorded is 47.9 °C which is recorded in the month of May. The mean minimum temperature recorded is 12.7 °C and the lowest temperature is -0.6 °C which is recorded in the month of January.

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 5-3***, it is established that May month experiences the fastest wind i.e. 18.6m/s from north west direction. The wind speed decreases gradually in the month of November to about 6.3m/s from the Northeast direction. The mean wind speed recorded highest in the month of May and June with 18.6m/s and 18.2m/s.

Rainfall: According to the above table from Meteorological Data for *Jamnagar* District from IMD (1991-2020), the months of June, July, August and September constitute the monsoon season (refer ***Table 5-3***). 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 293.3mm in the last 30 years with at least 11 rain days. During this month the relative maximum and minimum average relative humidity over 3 decades has been recorded as 87% and 71% respectively. Analysis of IMD station data for Jamnagar is presented in ***Table 5-3***

5.3.3 Land Use

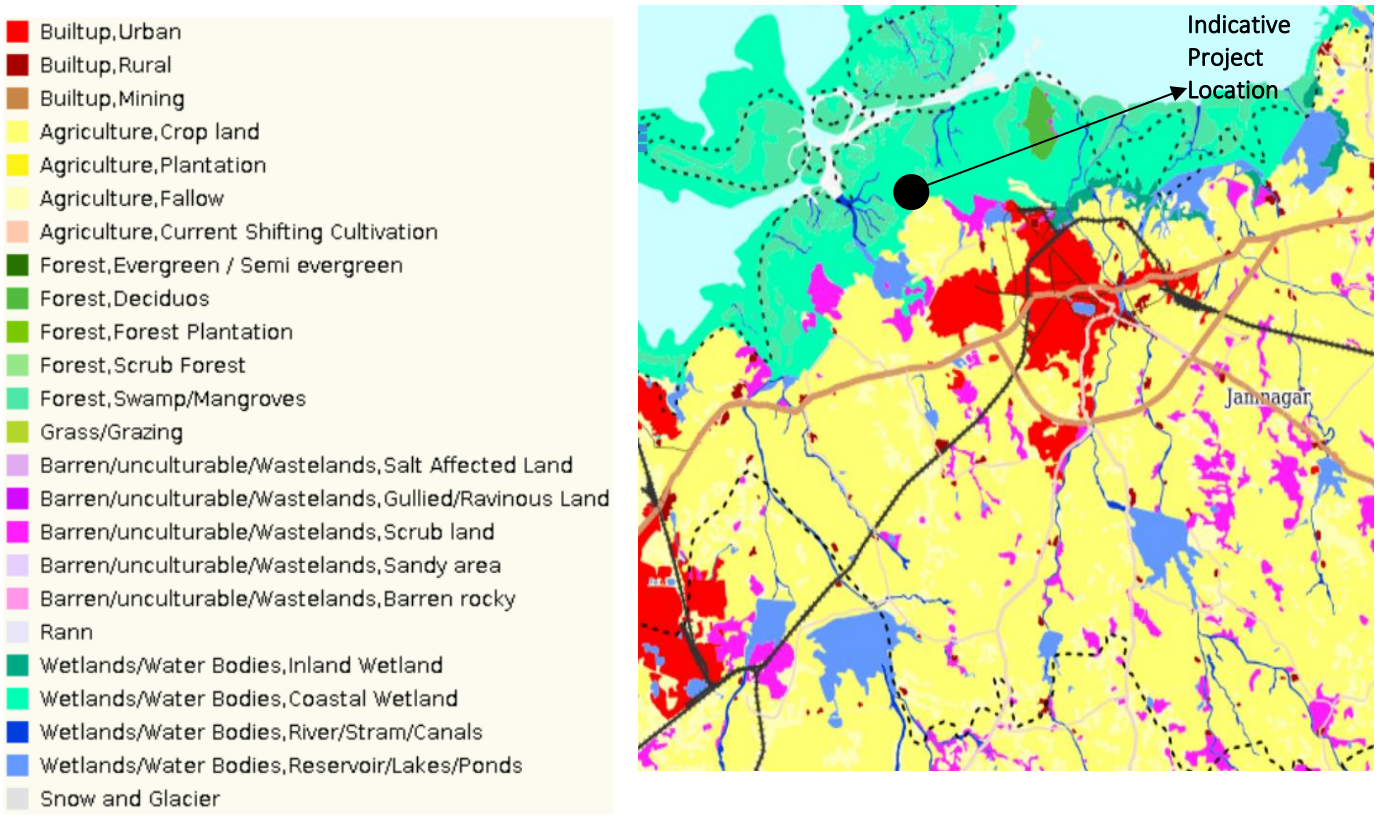
According to Aquifer Mapping and Ground Water Management Plan for Jamnagar, 2020, the majority of the land is net sown area which is 70% followed by Nonagricultural and area under wasteland. The average cropping intensity of the district is 118.09% whereas the cropping intensity of Jamnagar taluka is 126.63%. Majority of district is covered by agriculture and wasteland and spread over all parts of districts. The current land use of the project area majorly falls under Agricultural land category and barren land (project site lies in this region) according to the district land use report 2015-16 as given in below ***Table 5-4***

Table 5-4 Land Utilization Pattern

LU Category (Level 1)	LU Category (Level 2)	Area (in Hectares)
Agriculture	Crop land	8175.22
	Fallow	1776.48
Barren/unculturable/ Wastelands	Plantation	24.06
	Salt Affected Land	172.00
	Sandy Area	12.81
	Scrub Land	1625.75
Built-up	Mining	55.48
	Rural	183.98
	Urban	190.90
Forest	Deciduous	376.08
	Scrub Forest	4.01
	Swamp / Mangroves	327.89
Wet Lands / Water Bodies	Inland Wetland	0.62
	Coastal Wetland	631.88
	River/Stream/Canals	278.49
	Water bodies	284.76

Source: https://bhuvan-app1.nrsc.gov.in/2dresources/thematic/LULC503/MAP/GJ.pdf

Figure 5-4 Land Use Pattern for the district



Source: Bhuvan Indian Geo Platform of ISRO

As observed during site visit, the site area and vicinity is categorized as barren land, unculturable waste land. A snapshot of the land use pattern of the project study area has been presented in ***Table 5-5,*** Map showing the land use pattern of the Project study area has been presented in **Figure 5-5.**

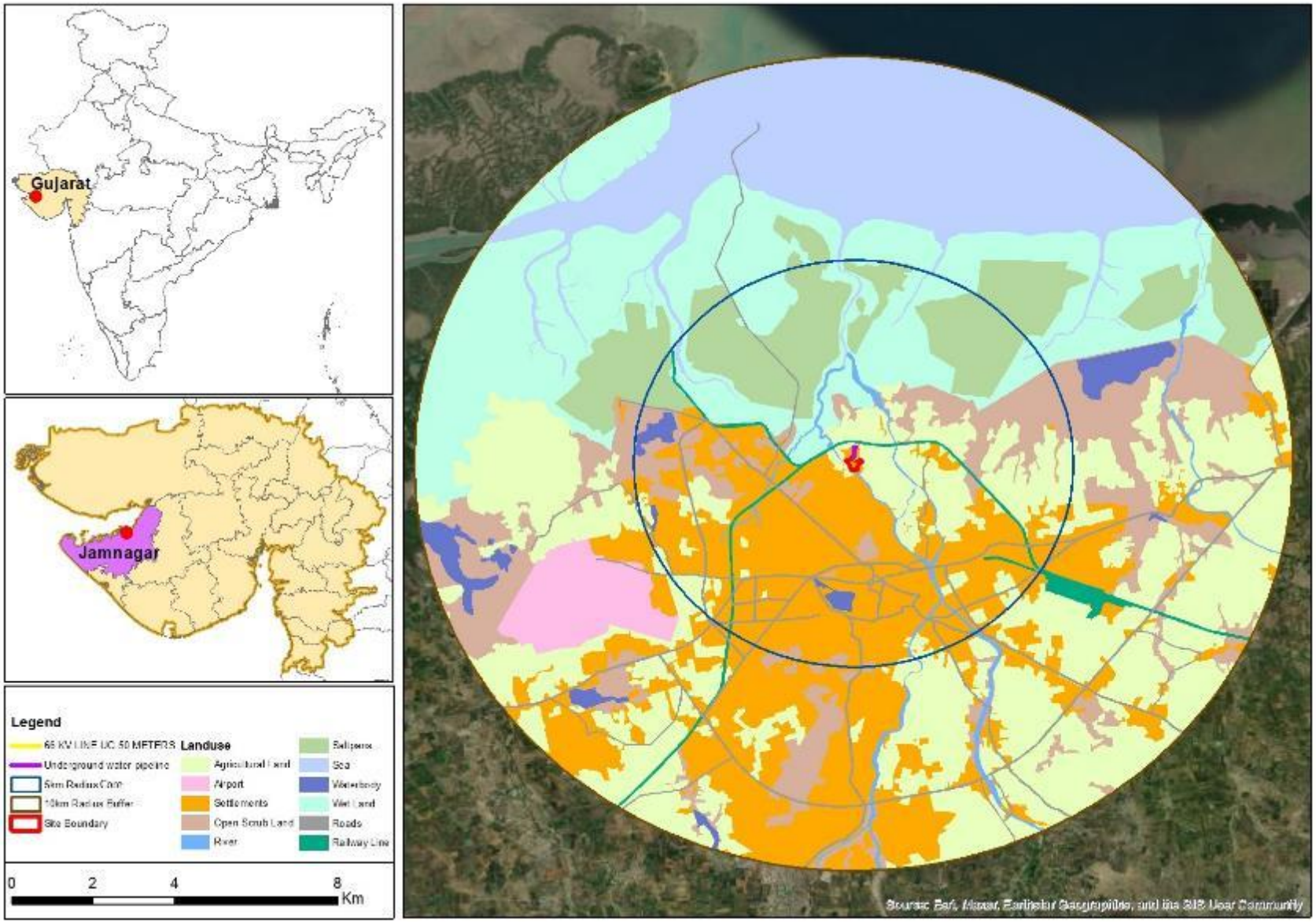
Table 5-5 Land use Pattern of the Project Study Area

Sr. No.	Land use Category	Area (Sq Km)	%
1.	Agricultural Land	73.65	23.59
2.	Settlements	62.76	20.11
3.	River	2.54	0.81
4.	Airport	6.81	2.18
5.	Open Scrub Land	31.14	9.97
6.	Waterboy	4.10	1.31
7.	Saltpans	25.53	8.18
8.	Wet Land	54.03	17.31
9.	Sea	44.81	14.35
10.	Roads	4.75	1.52

Sr. No.	Land use Category	Area (Sq Km)	%
11.	Railway Line	2.05	0.66
Total Area (Sq Km)		**312.18**	**100**

Source: E&S Advisor, ArcGIS Mapping

Figure 5-5 Land Use Pattern of the Study Area



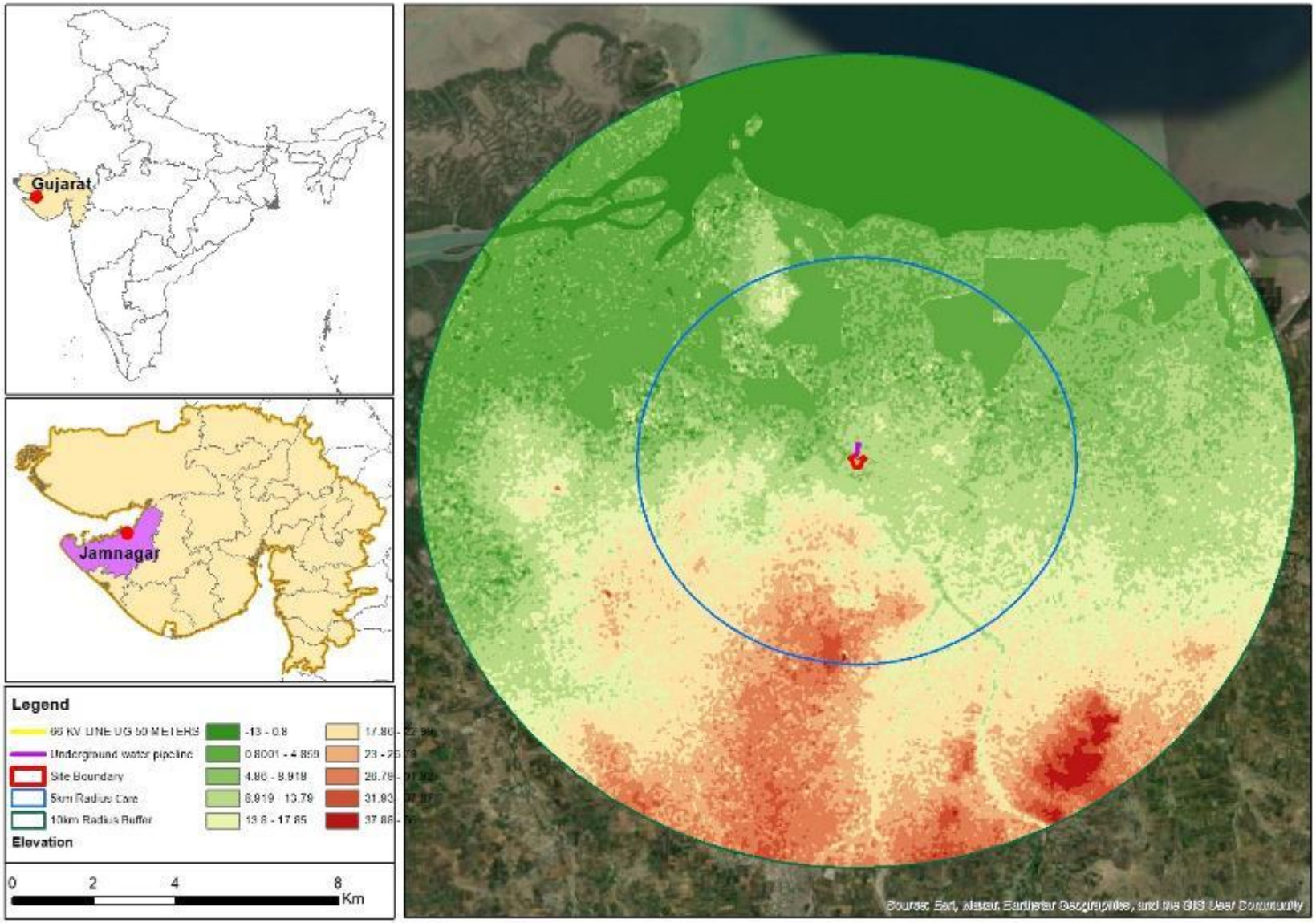
Source: ARC GIS Mapping, Developed by E&S Advisor

5.3.4 Topography

According to Aquifer Mapping and Ground Water Management Plan for Jamnagar, 2020, the district can be divided into the following units: Hilly areas and Coastal & alluvial Plains of Jamnagar. The district has uneven but rich variations in its topography. It consists of hill rages, sand dunes, islands, salt flats, beaches, dense mangrove forests, coral reefs and natural sanctuaries. Average height of the terrain is 250 feet above sea level. The highest region is the Barda Hills which are 2000 feet above sea level with Mount Venu being the highest peak at 2057 feet approx. Major drainage of the district is controlled by Aji, Una, Vartu, Venu, Ghee, Rangmati, Khari Rivers. Drainage in the central part of the area is dendritic and in the western part radial.

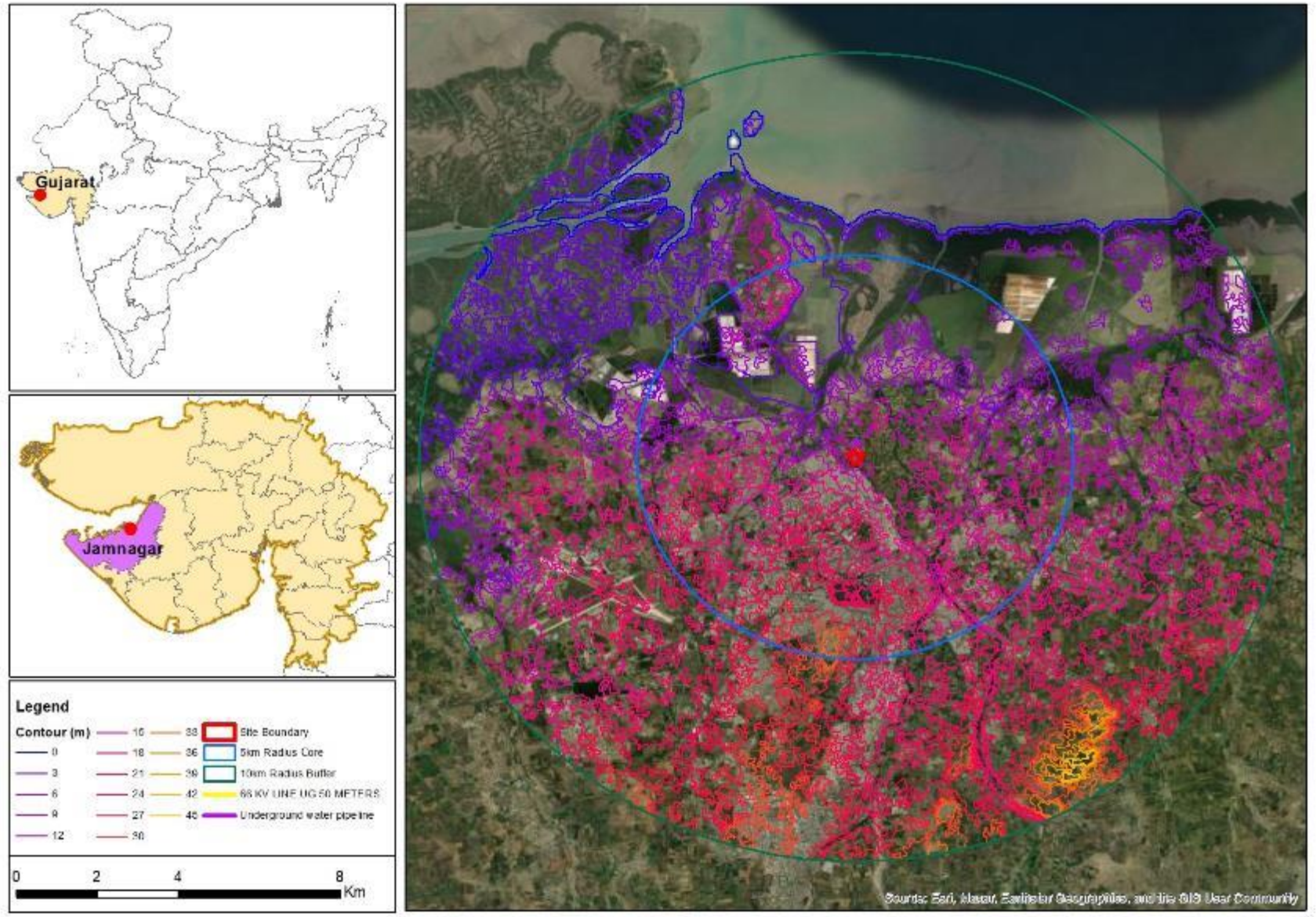
Based on satellite imagery dated 03.05.2022 and site visit, it was observed that the project is located at an elevation of 7 m to 10 m above mean sea level with almost flat surface. Analysis of digital elevation map presented in ***Figure 5-6*** for Project shows a trend in elevations ranging from 4.8 to 13.7 above mean sea level which is indicative of flat to undulating land in Project AoI. The below ***Figure 5-7***, shows the contour map which represents the elevation of the project area lies ~6-9m above mean sea level.

Figure 5-6 Digital Elevation Map of Study Area



Source: ARC GIS Mapping, Developed by E&S Advisor

Figure 5-7 Contour Map of the Study Area



Source: Developed by E&S Advisor

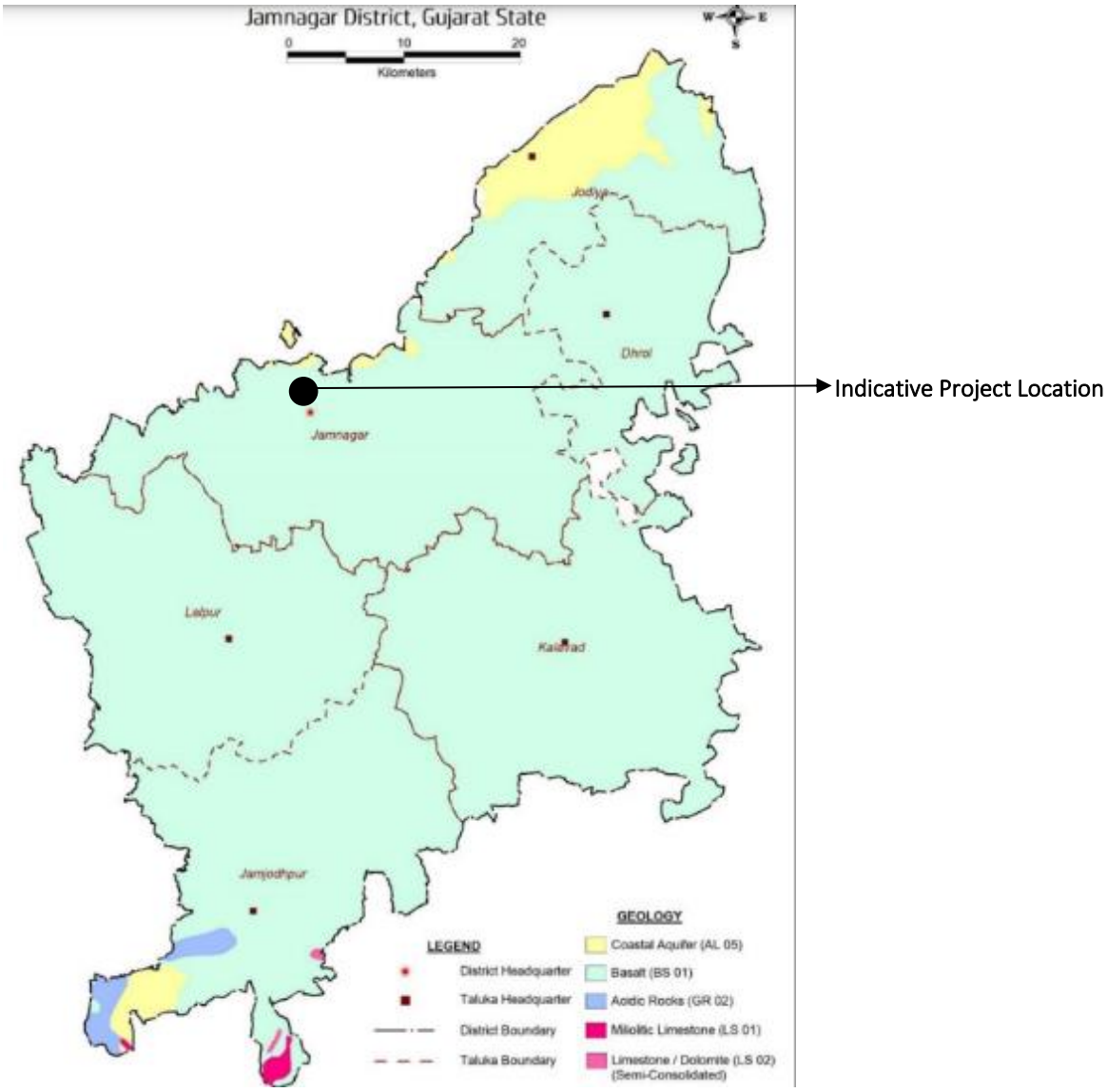
5.3.5 Geology and Geomorphology

Geology

According to Aquifer Mapping and Ground Water Management Plan for Jamnagar, 2020, Geologically the district area can be broadly grouped under hard rock's comprising "Deccan traps" and soft rocks comprising "Tertiaries and Alluvium". Nearly 80% of the area is underlain by Deccan Traps, 19% by the Tertiaries and the rest by Alluvium. Columnar and sheet joints are common in the basalt. Deccan basalt is exposed in major part of the district (project area lies in the Deccan basalt). Deccan basalts of west-central India are hydro geologically inhomogeneous rocks.

As per the below geological map of the district, the project site fall in Basalt area. Two types of basalt, the vesicular amygdaloidal basalt and the compact basalt, occur as alternate layers in the volcanic pile. Although the rocks are generally inhomogeneous, structures in the basalt, such as sheet joints and vertical joints, serve as zones of groundwater flow. In the shallow subsurface, two groundwater systems are operative. Groundwater system A consists of a vesicular amygdaloidal basalt underlain by compact basalt, whereas groundwater system B consists of vesicular amygdaloidal basalt overlain by compact basalt. The geological map of Jamnagar district is shown in below ***Figure 5-8***

Figure 5-8 Geological Map of Jamnagar District



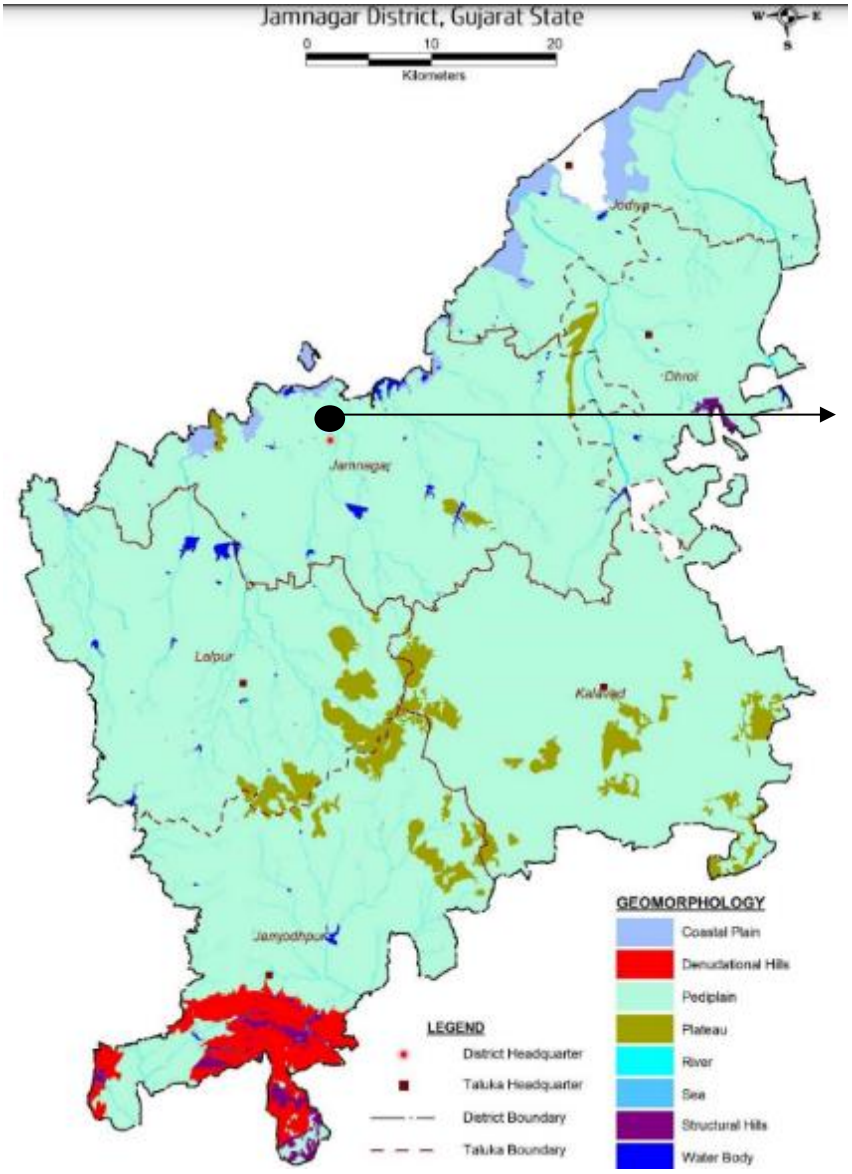
Source: NAQUIM Report -2020

Geomorphology

According to Aquifer Mapping and Ground Water Management Plan for Jamnagar, 2020, the district can be divided into the following units: Hilly areas and Coastal & alluvial Plains of Jamnagar and Jodiya talukas are characterized by plain topography, whereas Jam Jodhpur and Lalpur talukas are characterized by hilly terrains. Low coastal dunes and sand banks run along the north and west coasts. Jamnagar and Jodiya are plain areas. The coastal alluvial soils are found in Jamnagar and Jodiya talukas. These soils are mostly saline and alkaline in nature.

According to the geomorphology map of Jamnagar district, the project site lies in pediplain soil. In the study area clayey loam soil is developed over the pediplain and dissected upland underlain by basaltic rock. Sandy loam soil is developed over the older tidal flat and parts of the pediplain underlain by Tertiary sandstone and limestone. Calcareous sandy loam of 10 to 30 cm thick is developed in the western part of the pediplain occupied by Tertiary limestone. The geomorphology map of the Jamnagar district is given below in ***Figure 5-9***

Figure 5-9 Geomorphology Map of Jamnagar District



Source: NAQUIM Report -2020

5.3.5.1 Water Resources

According to Aquifer Mapping and Ground Water Management Plan for Jamnagar, 2020, Hydro-geologically the district area can be broadly grouped under hard rock's comprising "Deccan traps" and soft rocks comprising "Tertiaries and Alluvium". Nearly 80% of the area is underlain by Deccan Traps, 19% by the Tertiaries and the rest by Alluvium.

The project location lies in the fractured/fissures basalt. The description of the basalts and the aquifers are given below.

Basalts: These are essentially basaltic flows having general horizontal to near horizontal disposition over large area. The basaltic flows do not have any primary porosity in the lower massive portion, but the top vesicular portion has some porosity because of the vesicles formed due to escaping gases.

Limestones: Groundwater occurs under phreatic conditions. These miliolite limestone acts as a reservoir for shallow groundwater in very limited extent. The depth of water level in miliolite limestones is generally about 5m bgl. Open wells are about 10m in depth. The yield of these wells' ranges from 100-200m^3/day.

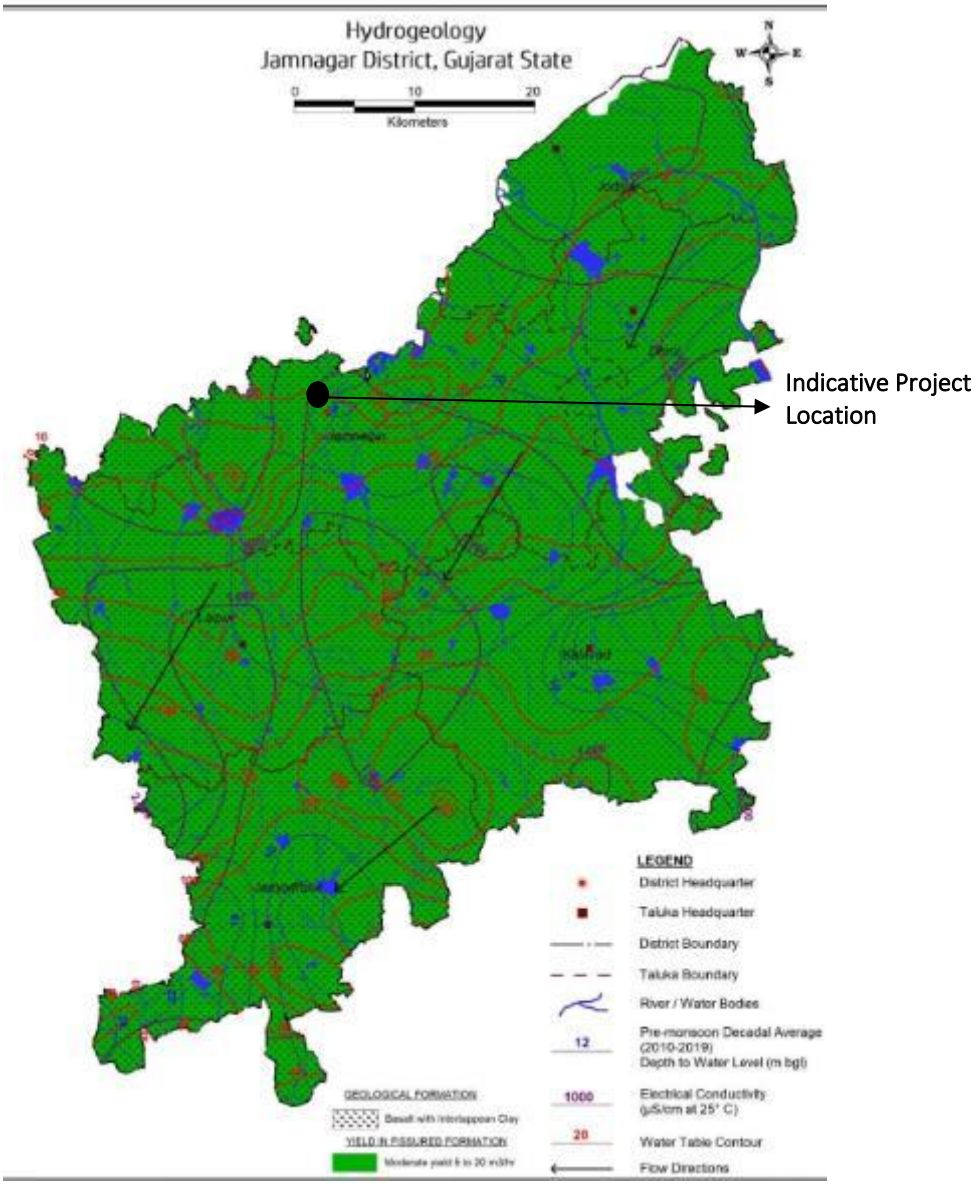
Alluvium: Groundwater occurs under unconfined conditions. The thickness of the alluvium is not more than 20m. Because of its clayey nature, percolation of rainwater is very poor resulting in poor yields.

Aquifer System: Two major aquifer systems exist in Jamnagar district up to 500-meter depth. Major aquifer bearing formation is fractured/fissures basalt.

Shallow Aquifer System: Weathered and fractured basalt are of unconfined nature and ranges from 0 to 87 m bgl. Thickness of this aquifer is 0 to 87 meters. It lies in almost entire district. Quality of water is fresh to Saline. In some areas alluvium aquifer also exit but it is in very limited in extent.

Deeper aquifer System: In the massive Basalt, at some places deep fractures are also encountered maximum to the depth of 438 m in the groundwater exploration of up to the depth of 500 mbgl. The hydrogeological map of Jamnagar is shown in ***Figure 5-10.***

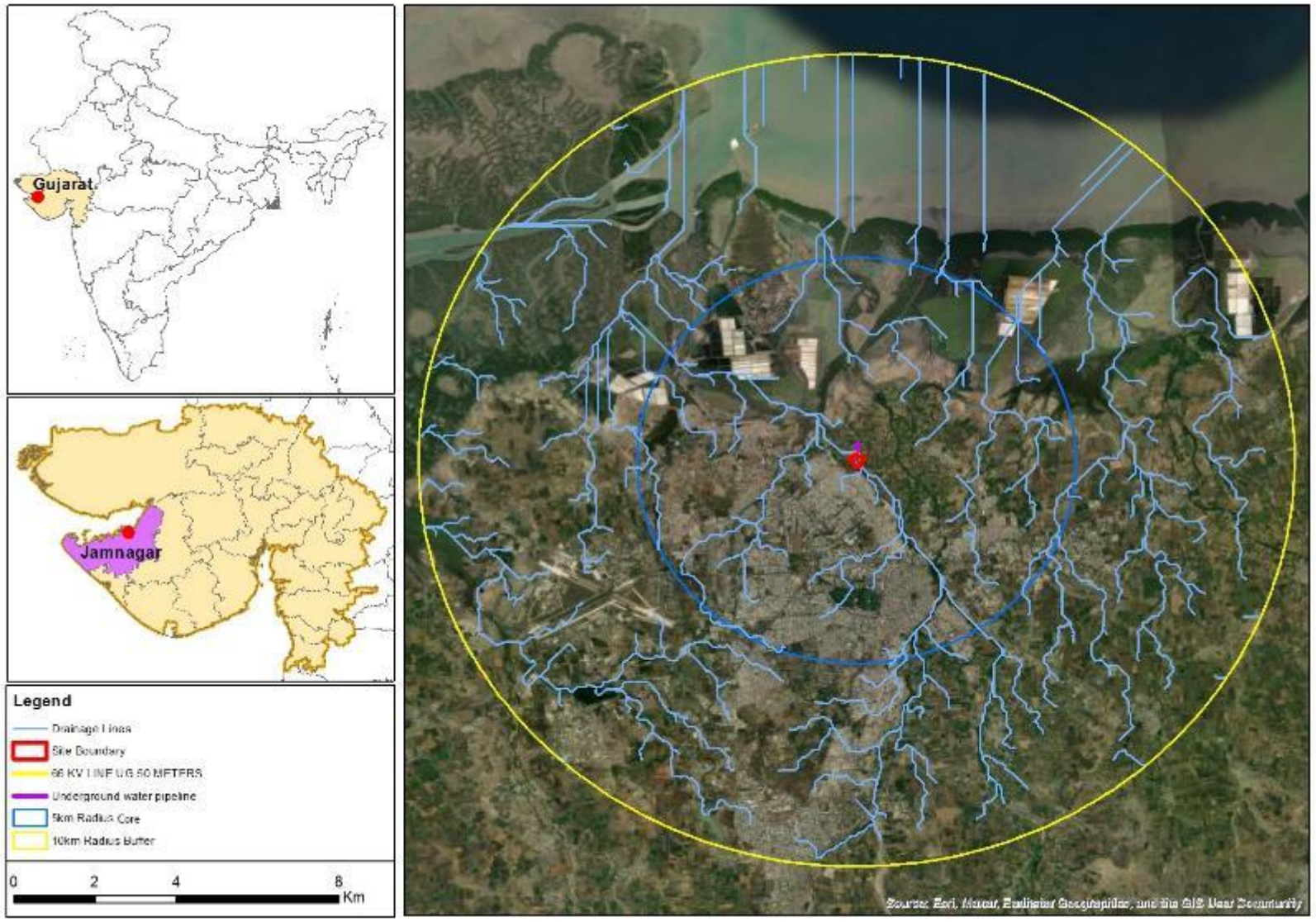
Figure 5-10 Hydrogeological Map of Jamnagar District



Source: NAQUIM Report -2020

The drainage map of project study area is given in ***Figure 5-11.*** The River which flows near the project site is Rangamati river. Tributaries of Rangamati river are flowing in the vicinity of the project site. The water bodies present within 10km radius from the project site are Ranmal lake, Lakhota lake, Rangamati river and reservoir. Also, Salt pans were observed to be located 1.5 km (aerial distance) from the project towards northwest direction and the gulf of kutch is present within 10 km aerial distance from the project site.

Figure 5-11 Drainage Map of Project Study Area



Source: NAQUIM Report -2020

5.3.5.2 Surface Water

The surface water such as stream, river, lake, or reservoir are present within 5km radius of the project location. The surface water bodies including Rangmati river tributary, Ranmal lake, Lakhota lake, deep excavation lake and reservoir are situated within the project study area. The Rangmati river tributary is flowing adjacent to the project boundary, the deep excavation lake is situated at an aerial distance of 1.6km towards west direction and the lakes Lakhota and Ranmal are present at an aerial distance of 3.3km towards south direction from the project boundary. A water reservoir is situated at an aerial distance of 2.5km towards northeast direction.

According to the Gujarat Pollution Control Board, a water quality monitoring programmes has been initiated which monitors the water quality of the surface water bodies. Surface water quality results for Ranmal lake and Lakhota Talav are available and are presented below:

Table 5-6 Surface Water Quality of Lake near the Project Site

Name of Monitoring Location	Distance from the Project Site	Temperature ^{o}C	Dissolved Oxygen (mg/L)	pH	Conductivity (µmhos/cm)	BOD (mg/L)	Nitrate N + Nitrite N(mg/L)	Fecal Coliform (MPN/100ml)	Total Coliform (MPN/100 ml)	TDS	COD
Lakhota Talav Lake	3.35 km	18.0- 29.0	3.0- 4.4	6.8- 8.4	358- 835	1.0- 2.1	0.32- 0.60	3-6	6- 27	Data Not Available	Data Not Available
Ranmal talav, Jamnagar	3.61	Data Not Available	7.3	7.45	Data Not Available	5.6	0.51	Data Not Available	Data Not Available	307	27

Source: https://cpcb.nic.in/wqm/2021/Water_pond_tanks_2021.pdf, & https://gpcb.gujarat.gov.in/webcontroller/viewpage/status-of-water-quality-of-lakestalav-of-gujarat

5.3.6 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 each of surface water was collected from three surface water bodies within 5 km radius of the project and the samples were analyzed against IS 2296 Inland surface Water class C standard. The location of primary surface water sample has been presented in ***Table 5-2*** and the results of the assessment has been presented in ***Table 5-7.*** Map showing monitoring locations has been presented in *Figure 5-2*.

Figure 5-12 Surface water monitoring in study area.

SW 1 Location

SW2 Location

SW3 Location

Table 5-7 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	Test Method
			SW 1	SW 2	SW 3		
Physical Parameters							
1.	Colour	Hazen	<5.0	<5.0	<5.0	300	APHA (23rd Edition) 2120B : 2017
2.	pH at 25 deg C	None	7.51 at 25 deg C	7.59 at 25 deg C	8.49 at 25 deg C	6.5-8.5	APHA (23rd Edition) 4500 -H-B : 2017
3.	Turbidity	NTU	18	30	38	--	APHA (23rd Edition) 2130B : 2017
4.	Total Dissolved Solid (TDS)	mg/l	816	850	7432	1500 max	APHA (23rd Edition) 2540C : 2017
General Parameters							
5.	Calcium (Ca)	mg/l	64	63	23	--	APHA (23rd Edition) 3500 Ca B,2017_(O)
6.	Chloride (Cl)	mg/l	198	224	4050	600	APHA (23rd Edition) 4500 -Cl B: 2017
7.	Copper (Cu)	mg/l	<0.02	<0.02	<0.02	--	APHA (23rd Edition) 4500 -Cl B : 2017
8.	Fluoride (F)	mg/l	0.29	0.31	0.28	1.5	APHA (23rd Edition) 4500 -FC/ D: 2017
9.	Iron (Fe)	mg/l	0.15	0.65	1.5	50	APHA (23rd Edition) 3500 Fe B : 2017
10.	Magnesium (Mg)	mg/l	41	35	179	--	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	48	71	9.6	50	APHA (23rd Edition) 4500 - NO3 - E : 2017

Sr. No.	Parameters	Unit	Surface Water Sample			Permissible Limit as per IS 2296 Inland surface Water class C	Test Method
			SW 1	SW 2	SW 3		
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	38	60	205	400	APHA (23rd Edition) 4500 - SO42- E : 2017
15.	Total Alkalinity	mg/l	355	290	528	--	APHA (23rd Edition) 2320B 2017_(O)
16.	Total Hardness	mg/l	332	300	802	--	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	<0.02	--	APHA (23rd Edition) 3120 B : 2017
21.	Arsenic (As)	mg/l	<0.005	<0.005	<0.005	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	28	38	50	--	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	1320	1340	12170	--	APHA (23rd Edition) 2510B: 2017
27.	Biochemical Oxygen Demand (BOD)	mg/l	3.6	6.9	40	3	APHA (23rd Edition) 5210B : 2017
28.	Chemical Oxygen Demand(COD)	mg/l	16	28	152	---	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	0.79 In respect to KCl equivalent salinity 35	0.80 In respect to KCl equivalent salinity 35.	8.34 In respect to KCl equivalent salinity 35	---	APHA (23rd Edition)2520B, 2017_(O)
31.	Phosphate (PO_4)	mg/l	3.6	2.0	0.31	---	APHA (23rd Edition) 4500- P D, 2017_(O)

Sr. No.	Parameters	Unit	Surface Water Sample			Permissible Limit as per IS 2296 Inland surface Water class C	Test Method
			SW 1	SW 2	SW 3		
32.	DO	mg/l	6.2	6.0	5.8	4 minimum	APHA 23rd Ed. 2017-4500-OC/G_(O)
33.	Chromium (Cr)	mg/l	<0.01	<0.01	<0.01	0.05	APHA (23rd Edition)3120B 2017 (ICP OES)_(O
Bacteriological Parameters							
34.	Faecal coliform	/100ml	33	<1.8	<1.8	--	APHA 23rd Edition 9221 B_(O)
35.	Total coliform bacteria	/100ml	170	<1.8	14	5000	APHA 23rd Edition 9221 B_(O)

Source: NABL Accredited Lab

5.3.6.1 Analysis of Surface Water Quality Monitoring

As per the results from above table, the parameters like Fluoride (1.5), Iron (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 Solid:** The TDS in the samples of SW1 and SW2 were observed to be within the permissible of 1500 max, however the sample SW3 which is 7432 was exceeding the permissible limit. This may be attributed to the fact that the sample was collected from an area which is a mix of urban activities as well as agricultural activities, therefore run off may contaminate the water and mixing of soil contaminants with water through leaching can lead to high TDS.
- **Chloride:** The concentration of Chloride was observed to be 4050 mg/l (SW3) which exceeded the permissible limit of 600mg/l, but the samples SW1 and SW2 was found to be within the permissible limit. Since, TDS in the surface water sample was observed to be high, therefore, high concentration of chloride is bound to occur in the water. Additionally, high chloride content can be attributed to the presence of naturally occurring minerals in the district.
- **Nitrate:** The concentration of Nitrate was observed to be 71 mg/l (SW2) which exceeded the permissible limit of 50mg/l, but the samples SW1 and SW3 was found to be within the permissible limit.
- **Biochemical Oxygen Demand (BOD):** The BOD level of surface water samples SW1, SW2 and SW3 are exceeding the permissible limit of 3 mg/l. The environmental factors contributing to increasing BOD include surface runoff, floating debris, dead animals and plants, soil erosion, etc.

Also, while comparing the surface water quality data via secondary sources (refer Section 5.3.7*)* and surface water Monitoring in Study Area from primary sources (refer ***Table 5-7****)*, most of the parameters like Temperature, Dissolved Oxygen, pH, BOD, Nitrate N +, Nitrite N, Fecal Coliform and Total Coliform are similar except the maximum value of conductivity of the lake is recorded on a higher side.

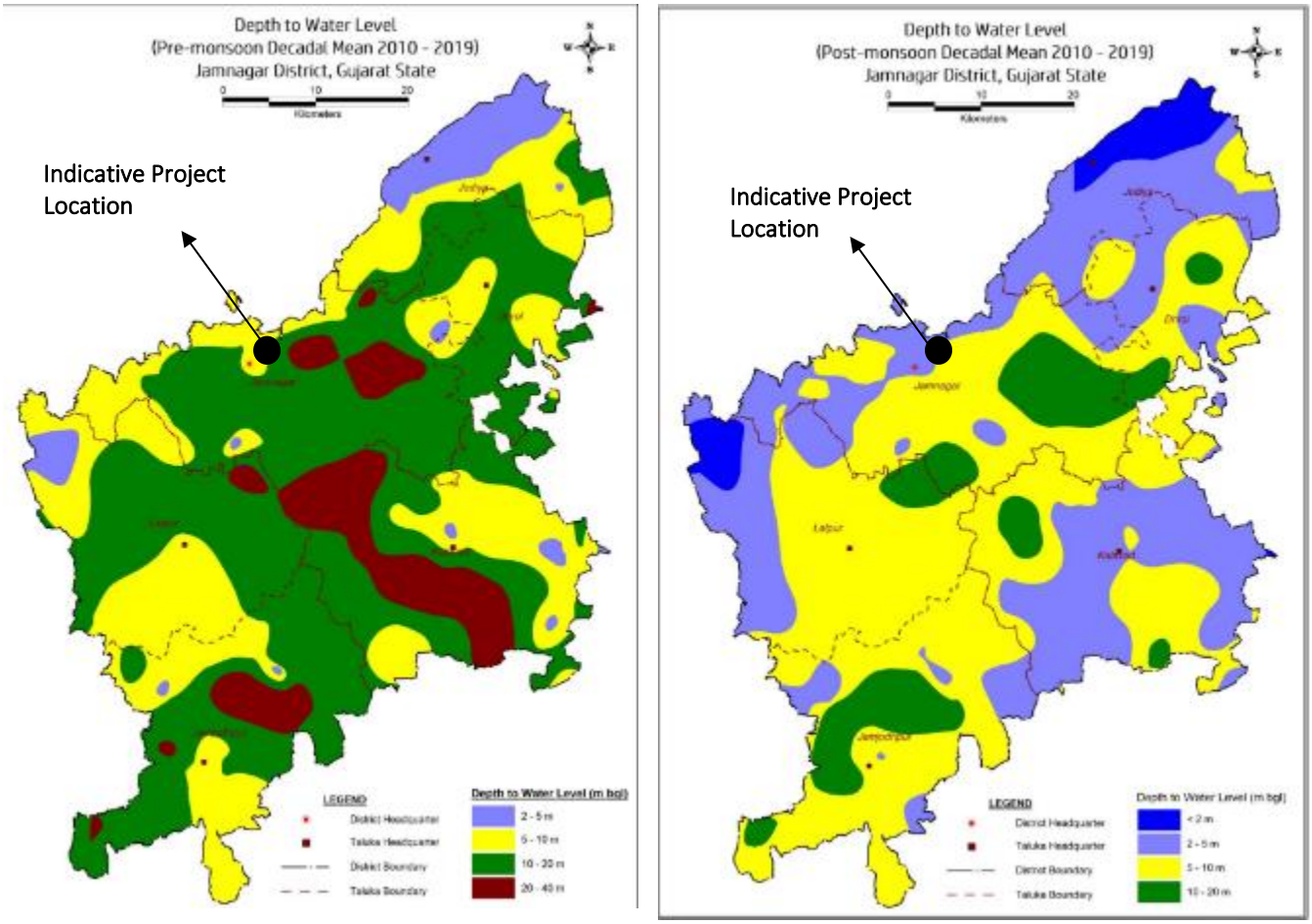
5.3.7 Groundwater Resources

According to Aquifer Mapping and Ground Water Management Plan for Jamnagar, 2020, Groundwater occurs both in hard rock and alluvium. Though ground water occurs in all types of formation, but the most productive aquifer are Fractured/Weathered basalts of Deccan traps and Alluvium formations.

The aquifers are under tremendous pressure and are vulnerable to depletion, particularly in semi-arid and arid regions where the natural recharge is not adequate to balance the withdrawals. This is further aggravated by uncertain and uneven rainfall patterns causing overdependence of agriculture on groundwater resources. The depth to water level in the district ranges from 3.45 to 51.85 mbgl during the pre-monsoon period and some patches shows that water level is deep in Kalavad, Jamjodhpur and Jamnagar talukas of District. Post-monsoon WL in the district ranges from 0.50 mbgl to 15.10 mbgl, about 4% samples shows water level above 10 mbgl. In post monsoon, major part of the district shows decadal average water levels from 2 to 10 mbgl few patches have less than 2 mbgl decadal average water level and in some parts decadal average water level is more than 10 mbgl but neither area represents decadal average water level more than 20 mbgl.

The ***Figure 5-13*** shows that the depth to water level during pre-monsoon, the project lies in are an area where WL is between 5-20 mbgl and during post monsoon, the project lies between 2-10 mbgl.

Figure 5-13 Depth to Water Level during Pre-monsoon and Post Monsoon, 2010-2019



Source: NAQUIM Report -2020

According to the results below of Groundwater Quality Data of borewells from the study area as recorded by CPCB, all the values are within the limit except for the Groundwater at Jamnagar which has been detected with total coliform bacteria indicating disease-causing organisms (water borne pathogens) within the water.

Table 5-8 Groundwater Quality Data of borewells near the Project Site

Location	Temperature °C		pH		Conductivity (µmhos/cm)		BOD (mg/L)		Nitrate N (mg/L)		Faecal Coliform (MPN/100ml)		Total Coliform (MPN/100ml)		Total Dissolved Solids (mg/L)		Fluoride (mg/L)		Arsenic (mg/L)	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Borewell Of GIDC Office, Shankar Tekri, Udhyognagar, Jamnangar	25.0	27.0	7.3	7.6	3309	3415	1.0	1.1	0.30	0.33	2	2	2	2	1166	2580	0.2	0.3	0.001	0.001
Borewell Of Shri Mahavir Metal Craft Pvt. Ltd., Nr. Mahavir Circle, Phase-Iii, GIDC, Dared	26.0	26.0	7.5	7.9	2410	2631	1.0	1.1	0.30	0.33	2	2	2	2	1386	1414	0.2	0.2	0.001	0.001

Source: https://cpcb.nic.in/wqm/2021/NWMP_DATA_2021.pdf

5.3.7.1 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). The location of primary ground water sample has been presented in ***Table 5-2*** and the results of the assessment has been presented in ***Table 5-9***. Map showing monitoring locations has been presented in ***Figure 5-14***.

Figure 5-14 Groundwater monitoring conducted in Study Area

GW 1 Location

GW 2 Location

GW 3 Location

Table 5-9 Results of Primary Groundwater Quality

Sr. No.	Parameters	Unit	Ground Water Sample			Desirable Limit as per 10500:2012	Permissible Limit as per 10500:2012	Standard limits as per WHO guidelines (mg/L)	Test Methods
			GW 1	GW2	GW3				
Physical Parameters									
1.	Colour	Hazen	1.0	1.0	1.0	5	15	No visible colour	3025 (Part 4)-1983;
2.	Odor	None	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	--	3025 (Part 5)-1983; Rffm:2002
3.	pH	None	8.30	7.74	7.58	6.5-8.5	No Relaxation	--	IS 3025 (Part 11)-1984 Rffm:2012
4.	Taste	None	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable		IS 3025 (Part 8)- 1983 Rffm: 2012
5.	Turbidity	NTU	1.5	1.6	1.0	1	5	--	3025 (Part 10)-1984; Rffm:2002
6.	Total Dissolved Solid (TDS)	mg/l	1146	918	630	500	2000	--	IS 3025 (Part 16) : 1984
General Parameters									
7.	Aluminum (Al)	mg/l	0.01	0.01	0.01	0.03	0.2		IS 3025 (Part 2) : 2004
8.	Ammonia (N)	mg/l	0.1	0.1	0.1	0.5	No Relaxation	1.5	IS 3025 (Part 34): 1988
9.	Anionic Detergent	mg/l	0.05	0.05	0.05	0.2	1		IS 13428 (ANNEX _ K): 2005
10.	Barium (Ba)	mg/l	0.1	0.1	0.1	0.7	No Relaxation	0.7	IS 3025 (Part 2) : 2004
11.	Boron (B)	mg/l	0.25	0.25	0.25	0.5	1.0	0.5	IS 3025 (Part 40) : 1991
12.	Calcium (Ca)	mg/l	39.20	39.20	31.36	75	200	--	IS 3025 (Part 26) : 1986

Sr. No.	Parameters	Unit	Ground Water Sample			Desirable Limit as per 10500:2012	Permissible Limit as per 10500:2012	Standard limits as per WHO guidelines (mg/L)	Test Methods
			GW 1	GW2	GW3				
13.	Chloramines (Cl2)	mg/l	0.1	0.1	0.1	4	No Relaxation	0.5-1.5	IS 3025 (Part 32) : 1988
14.	Chloride (Cl)	mg/l	558.43	460.46	313.6	250	1000	200-300	IS 3025 (Part 2) : 2004
15.	Copper (Cu)	mg/l	0.02	0.02	0.02	0.05	1.5	2.0	IS 3025 (Part 60) : 2008
16.	Fluoride (F)	mg/l	0.52	0.48	0.36	1	1.5	1.5	IS 3025 (Part 26) : 1986
17.	Free Residual Chlorine	mg/l	0.1	0.1	0.1	0.2	1	--	IS 3025 (Part 53) : 2003
18.	Iron (Fe)	mg/l	0.05	0.08	0.05	0.3	No Relaxation	--	IS 3025 (Part 46) : 1994
19.	Magnesium (Mg)	mg/l	14.11	9.41	9.41	30	100	--	IS 3025 (Part 2) : 2004
20.	Manganese (Mn)	mg/l	0.02	0.02	0.02	0.1	0.3	0.4	IS 3025 (Part 39) : 1991
21.	Mineral Oil	mg/l	0.5	0.5	0.5	0.5	No Relaxation	--	IS 3025 (Part 34) : 1988
22.	Nitrate (NO_3)	mg/l	1.86	1.05	1.12	45	No Relaxation	50	IS 3025 (Part 43) : 1992
23.	Phenolic Compounds (C_6H_5OH)	mg/l	0.001	0.001	0.001	0.001	0.002	--	IS 3025 (Part 2) : 2004
24.	Selenium (Se)	mg/l	0.005	0.005	0.005	0.01	No Relaxation	0.01	IS 3025 (Part 2) : 2004
25.	Silver (Ag)	mg/l	0.005	0.005	0.005	0.1	No Relaxation	--	IS 3025 (Part 24) : 1986
26.	Sulphate ($SO_{4)}$	mg/l	10.6	8.6	5.66	200	400	--	IS 3025 (Part 29) : 1986
27.	Hydrogen Sulphide (H_2S)	mg/l	0.02	0.02	0.02	0.05	No Relaxation	--	IS 3025 (Part 23) : 1986
28.	Total Alkalinity	mg/l	122.4	102	81.6	200	600	--	IS 3025 (Part 21) : 2009
29.	Total Hardness	mg/l	156.86	137.20	117.60	200	600	--	IS 3025 (Part 2) : 2004
30.	Zinc (Zn)	mg/l	0.02	0.02	0.02	5	15	--	
				Toxic Substances				0.001	
31.	Cadmium (Cd)	mg/l	0.001	0.001	0.001	0.003	No Relaxation	0.003	IS 3025 (Part 2) : 2004
32.	Cyanide (CN)	mg/l	0.01	0.01	0.01	0.05	No Relaxation	0.07	IS 3025 (Part 27) : 1986
33.	Lead (Pb)	mg/l	0.005	0.005	0.005	0.01	No Relaxation	0.01	IS 3025 (Part 2) :2004
34.	Mercury (Hg)	mg/l	0.0002	0.0002	0.0002	0.001	No Relaxation	0.006	IS 3025 (Part 48) : 1994
35.	Molybdenum (Mo)	mg/l	0.05	0.05	0.05	0.07	No Relaxation	0.07	IS 3025 (Part 2) :2004
36.	Nickel (Ni)	mg/l	0.01	0.01	0.01	0.02	No Relaxation	0.07	IS 3025 (Part 2) :2004

Sr. No.	Parameters	Unit	Ground Water Sample			Desirable Limit as per 10500:2012	Permissible Limit as per 10500:2012	Standard limits as per WHO guidelines (mg/L)	Test Methods
			GW 1	GW2	GW3				
37.	Polychlorinated Biphenyl (PCB)	mg/l	0.0005	0.0005	0.0005	0.0005	No Relaxation	--	USEPA 8082: 2007
38.	Polynuclear Aromatic Hydrocarbons (PAH)	mg/l	0.0001	0.0001	0.0001	0.0001	No Relaxation	--	APHA (23rd Edition) 6440C:2017
39.	Arsenic (As)	mg/l	0.005	0.005	0.005	0.01	0.05	0.01	IS 3025 (Part 2) :2004
40.	Total Chromium (Cr)	mg/l	0.01	0.01	0.01	0.05	No Relaxation	0.05	IS 3025 (Part 2) :2004
					Trihalomethanes				
41.	Bromoform	mg/l	0.01	0.01	0.01	0.1	No Relaxation	0.1	APHA (23rd Edition) 6232 B: 2017
42.	Dibromochloro methane	mg/l	0.01	0.01	0.01	0.1	No Relaxation	--	APHA (23rd Edition) 6232 B: 2017
43.	Bromodichloro methane	mg/l	0.01	0.01	0.01	0.06	No Relaxation	0.06	APHA (23rd Edition) 6232 B: 2017
44.	Chloroform	mg/l	0.01	0.01	0.01	0.2	No Relaxation	0.3	APHA (23rd Edition) 6232 B: 2017
					Pesticides Residues				
45.	Alachlor	µg/l	0.02	0.02	0.02	20	20	--	USEPA 525.2
46.	Atrazine	µg/l	0.02	0.02	0.02	2	2	0.002	USEPA 8141A: 2007
47.	Aldrin	µg/l	0.01	0.01	0.01	0.03	0.03	0.00003	AOAC (21st edition), 990.06: 2019
48.	Dieldrin	µg/l	0.01	0.01	0.01	0.03	0.03	0.00003	AOAC (21st edition), 990.06: 2019
49.	Alpha-HCH	µg/l	0.01	0.01	0.01	0.01	0.01	--	AOAC (21st edition), 990.06: 2019
50.	Beta-HCH	µg/l	0.01	0.01	0.01	0.04	0.04	--	AOAC (21st edition), 990.06: 2019
51.	Butachlor	µg/l	0.02	0.02	0.02	125	125	--	USEPA 8141AOAC (21st edition), 990.06: 2019A: 2007
52.	Chlorpyrifos	µg/l	0.02	0.02	0.02	30	30	0.03	USEPA 8141 A
53.	Delta-HCH	µg/l	0.01	0.01	0.01	0.04	0.04	--	AOAC (21st edition), 990.06: 2019
54.	2,4-Dichlorophenoxyacetic acid	µg/l	0.01	0.01	0.01	30	30	0.03	USEPA 515: 1981
55.	o,p-DDT	µg/l	0.01	0.01	0.01	1	1	0.01	AOAC (21st edition), 990.06: 2019
56.	p,p-DDT	µg/l	0.01	0.01	0.01	1	1	0.01	AOAC (21st edition), 990.06: 2019
57.	o,p-DDE	µg/l	0.01	0.01	0.01	1	1	0.01	AOAC (21st edition), 990.06: 2019

Sr. No.	Parameters	Unit	Ground Water Sample			Desirable Limit as per 10500:2012	Permissible Limit as per 10500:2012	Standard limits as per WHO guidelines (mg/L)	Test Methods
			GW 1	GW2	GW3				
58.	p,p-DDE	µg/l	0.01	0.01	0.01	1	1	0.01	AOAC (21st edition), 990.06: 2019
59.	o,p-DDD	µg/l	0.01	0.01	0.01	1	1	0.01	AOAC (21st edition), 990.06: 2019
60.	p,p-DDD	µg/l	0.01	0.01	0.01	1	1	0.01	AOAC (21st edition), 990.06: 2019
61.	Alpha - endosulfan	µg/l	0.01	0.01	0.01	0.4	0.4	--	AOAC (21st edition), 990.06: 2019
62.	Beta-Endosulfan	µg/l	0.01	0.01	0.01	0.4	0.4	--	AOAC (21st edition), 990.06: 2019
63.	Endosulfan sulfate	µg/l	0.01	0.01	0.01	0.4	0.4	--	AOAC (21st edition), 990.06: 2019
64.	Ethion	µg/l	0.02	0.02	0.02	3	3	--	US EPA 8141A: 2007
65.	Gama-HCH(Lindane)	µg/l	0.01	0.01	0.01	2	2	--	AOAC (21st edition), 990.06: 2019
66.	Isoproturon	µg/l	0.02	0.02	0.02	9	9	0.009	USEPA 532: 2000
67.	Malathion	µg/l	0.02	0.02	0.02	190	190	--	USEPA 8141A: 2007
68.	Methyl parathion	µg/l	0.02	0.02	0.02	0.3	0.3	--	USEPA 8141A: 2007
69.	Monostrophes	µg/l	0.02	0.02	0.02	1	1	--	USEPA 8141A: 2007
70.	Phorate	µg/l	0.02	0.02	0.02	2	2	--	USEPA 8141A: 2007
	Bacteriological Parameters								
71.	Total coliform bacteria	/100ml	Not Detectable	Not Detectable	Not Detectable	Not Detectable	Absent	--	IS 15185:2016
72.	E.coli	/100ml	Not Detectable	Not Detectable	Not Detectable	Not Detectable	Absent	--	IS 15185:2016

Source: NABL Accredited Lab

Represents value exceeding the desirable limit

Represents value exceeding the WHO guideline standards

5.3.7.1.1 Analysis of Groundwater Quality Results

Based on the results presented in ***Table 5-9*** it is observed that 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 for drinking water except for the following.

- **Turbidity:** The turbidity of the water samples GW1 and GW2 was observed to be 1.5 NTU and 1.6 NTU which is found to be exceeding the desirable limit of 1 NTU and GW3 was found to be within the desirable limit of 1 NTU. However, the samples S1, S2 and S3 was found to be within the permissible limit of 5 NTU. The reason for high turbidity samples collected can be attributed to the legacy waste dumping site within 3km radius, ground water contamination due to

leachate cannot be ruled out including contamination due to activities like industrial or agricultural run off or natural activities like weather or runoff caused by precipitation.

- Total Dissolved Solid: The TDS in the groundwater samples of GW1, GW2 and GW3 were observed to be exceeding the desirable of 500 mg/l however the samples was within permissible limit of 2000 mg/l. This may be attributed to the fact that the groundwater sample was collected from an area which is a mix of urban activities as well as agricultural activities, therefore run off may contaminate the water and mixing of soil contaminants with groundwater through leaching can lead to high TDS.
- Chloride: The concentration of chloride was observed to be 558.43 mg/l (GW1) and 460.46 (GW2) and 313.6 (GW3) which exceeded the desirable limit of 250 mg/l and the WHO limits, but were well within permissible limit of 1000 mg/l. Since, TDS in the groundwater sample was observed to be high, therefore, high concentration of chloride is bound to occur in the groundwater. Additionally, high chloride content can be attributed to the presence of naturally occurring minerals in the district.
- Atrazine: The Atrazie of the groundwater samples GW1, GW2 and GW3 was found to be exceeding the values of Standard limits as per WHO guidelines (mg/L) which is 0.002
- Aldrin: The Aldrin of the groundwater samples GW1, GW2 and GW3 was found to be exceeding the values of Standard limits as per WHO guidelines (mg/L) which is 0.00003.
- Dieldrin: The Dieldrin of the groundwater samples GW1, GW2 and GW3 was found to be exceeding the values of Standard limits as per WHO guidelines (mg/L) which is 0.00003.

As per Groundwater Quality Data of borewells from secondary sources (refer ***Table Table*** 5-8***)*** and results of groundwater quality form primary sources (refer ***Table 5-9***), the parameters are within the desirable limits for all except TDS level, where the samples are exceeding the desirable limit of 500mg/l. Also, the predominant ions in the region like Calcium, Magnesium, Chloride, Sulphate and Nitrate may affect the ground water quality.

5.3.7.2 ESA Phase II Groundwater Quality Results

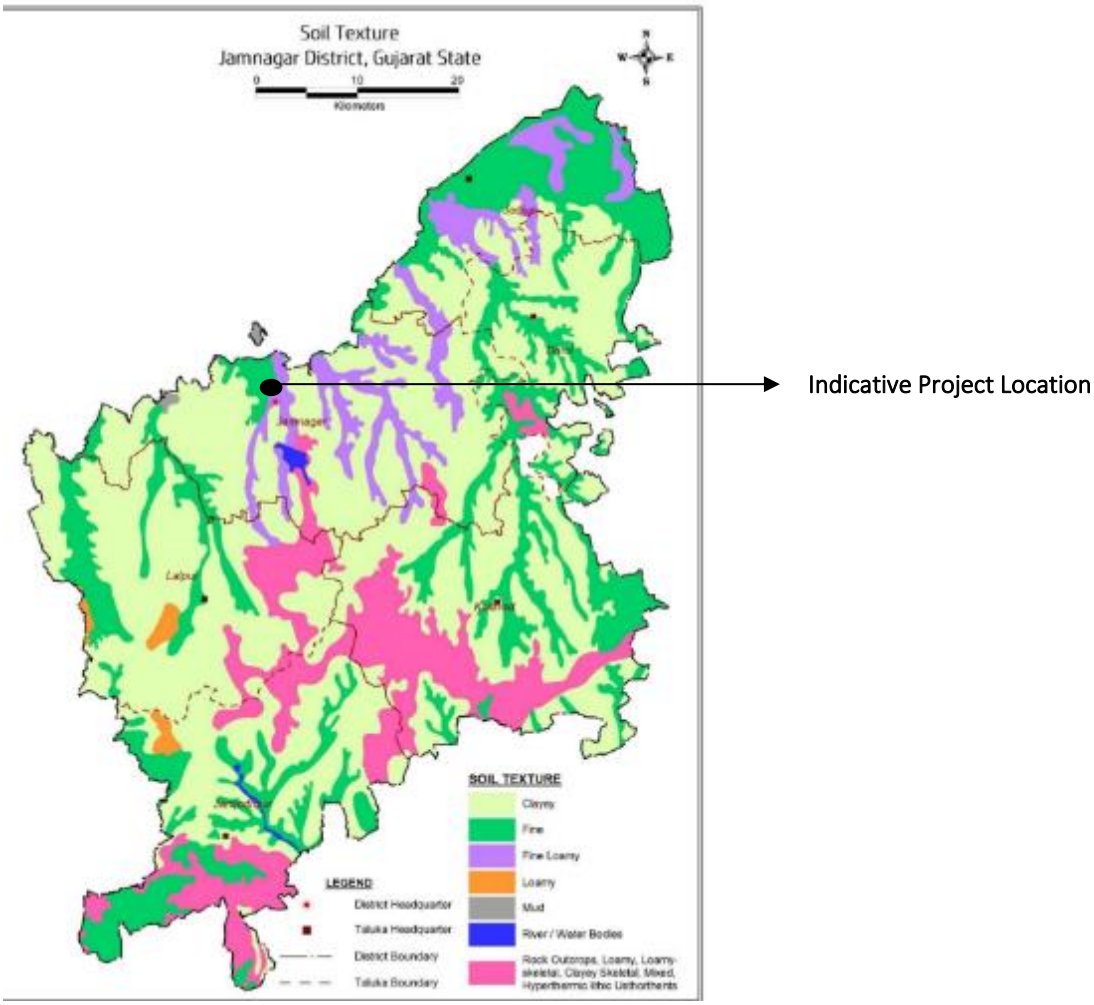
ESA Phase II assessment (undertaken separately) for ground water was undertaken for the facility for which groundwater samples across the Site were undertaken to assess the ground water quality as well as groundwater flow direction.

As per the Phase II report, as per the analytical results of groundwater samples, collected during the current investigation no exceedance of screening criteria was reported apart from marginal MOEF (Indian standards for drinking water screening levels) exceedance of Lead and marginal USEPA RSLs standards exceedance of Arsenic. 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. It may be concluded, based on field visual observation and laboratory analytical results that groundwater at site that currently not infected adversely due to past or current practices at site.

5.3.8 Soil Type

According to Aquifer Mapping and Ground Water Management Plan for Jamnagar, 2020, Soils of the district may be broadly classified as coastal alluvial, medium black, shallow black and hilly. The medium black and shallow black soils are the main soil type of the district, while the coastal and hilly soils are the sub-soils. The medium black soils are found in Dhrol and Jamnagar talukas. These soils are generally 25 to 50 cm deep. The coastal alluvial soils are found in Jamnagar and Jodiya talukas. These soils are mostly saline and alkaline in nature. As per the ***Figure 5-15*** the soil texture of the project site was found to be fine loamy in texture.

Figure 5-15 Soil Texture of the Jamnagar District



Source: NAQUIM Report -2020

5.3.8.1 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 E&S Advisor through a NABL accredited lab in May 2023. The location of soil sample has been presented in ***Table 5-2*** and the results of the assessment has been presented in ***Table 5-10*** Map showing monitoring locations has been presented in ***Figure 5-2***.

Figure 5-16 Soil test and monitoring conducted in Study Area

S1 Location, Near Project Site

S2 Location (Barren Land)

S3 (Agricultural Land)

Table 5-10 Results of Soil Sampling in Study Area

Sr. No.	Parameter	Unit	S1	S2	S3	Test Method
1	Arsenic (as As)	mg/kg	<0.25	<0.25	<0.25	EPA 6010D_(O)
2	Bulk Density	g/cc	1.31	1.29	1.25	IS 2720(Part 29) 1975 RA 2015_(O)
3	Cadmium (as Cd)	mg/kg	<2.0	<2.0	<2.0	EPA 6010D_(O)
4	Chloride (as Cl)	mg/kg	2200	14100	410	TPM/MSK/P&E/1/10_(O)
5	Clay	%	10	26	24	TPM/MSK/P&E/1/36A_(O)

Sr. No.	Parameter	Unit	S1	S2	S3	Test Method
6	Conductivity at 25 deg C	Micro S/cm	4680 (1:2) at 25 deg C	24400 (1:2) at 25 deg C	1998 (1:2) at 25 deg C	IS 14767:2000,RA 2016_(O)
7	Copper (as Cu)	mg/kg	142	68	153	EPA 6010 D (ICP-OES)
8	Heavy metals	mg/kg	19632	20905	21930	TPM/MSK/P&E/3/60_(O)
9	Lead (as Pb)	mg/kg	47	11	44	EPA 6010D_(O)
10	Mercury (as Hg)	mg/kg	<0.1	<0.1	<0.1	USEPA 245.5
11	Moisture	%	27	32	34	TPM/MSK/P&E/1/17_(O)
12	Nickel (as Ni)	mg/kg	36	33	52	EPA 6010 D (ICP-OES)
13	Organic Matter	%	0.36	1.1	1.9	IS 2720 (Part 22): 1972
14	Particle Size Distribution	%	Sand:54%Silt:36 %Clay:10%	Sand:44%Silt:30 %Clay:26%	Sand:37%Silt:39 %Clay:24	TPM/MSK/P&E/1/36A_(O)
15	Sand	%	54	44	37	TPM/MSK/P&E/1/36A_(O)
16	Silt	%	36	30	39	TPM/MSK/P&E/1/36A_(O)
17	Sulphate (as SO_4)	mg/kg	475	769	<15	IS 2720 (Part 27) 1977,RA 2015_(O)
18	Texture	None	Sandy Loam	Loam	Loam	TPM/MSK/P&E/1/36A, Issue date-April 02 Issue no-03: 2018
19	Total Chromium (as Cr)	mg/kg	45	32	43	EPA 6010D_(O)
20	Total Nitrogen (as N)	mg/kg	314	510	1686	IS 14684 : 1999
21	Total Petroleum Hydrocarbon (as TPH)	mg/kg	<1.0	<1.0	<1.0	IS 3025 (Part 39)-1991 Rffm 2014_(O)
22	Zinc (as Zn)	mg/kg	255	64	205	EPA 6010 D (ICP-OES)
23	pH Value at 25 deg C	None	8.03 (1:2.5) at 25 deg C	8.96 (1:2.5) at 25 deg C	8.13 (1:2.5) at 25 deg C	IS 2720 (Part 26) - 1987

Source: Monitoring conducted by NABL accredited lab between May- August 2023

Table 5-11 Soil Classification Standards

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

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

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

5.3.8.1.1 Analysis of Soil Quality Monitoring

- ***pH***: The pH value of the three soil samples were found to be 8.03 (S1) and 8.13 (S3). As per the standard soil classification, S1, and S3 are moderately alkaline whereas the sample S2 is 8.96 which is strongly alkaline.
- ***Texture:*** The texture of the soil samples S2 and S3 were found to be loam and S1 were 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 S3 was found to be 4680 µs/cm[33], 24400 µs/cm and 1998 µs/cm respectively. The values within 640 mhos/cm is an average value as per soil classification standards from Indian Council of Agricultural Research, whereas above 640 mhos/cm, the soil becomes harmful to germination. Hence, the samples S1, S2 and S3 are exceeds the average value which indicates the soil are harmful to crops which is sensitive to salts.
- ***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 142 mg/kg, 68 mg/kg and 153 mg/kg. The level of zinc in the soil samples were found to be 255mg/kg, 64 mg/kg, 205 mg/kg.

[33] 1 mho/centimeter = 1000000 microsiemens/centimeter

5.3.9 Ambient Air Quality

Gujarat Pollution Control Board is monitoring ambient air quality at 62 strategic locations in the state of the Gujarat under the Ambient Air Quality Monitoring programme (AAQM) including Jamnagar. Under National Air Quality Monitoring Programme (NAMP), Ambient Air Quality monitoring is carried out at 38 stations in the state with the financial help of the Central Pollution Control Board, Delhi. Also under State Air Quality Monitoring Programme (SAMP), Air Quality monitoring is carried out at 24 stations in the state of Gujarat**.** The ambient air quality samples were collected as per the standard norms for ambient air quality monitoring prescribed by CPCB. The parameters determined during analysis include SO2, NOx, O-3, NH3, CO, PM10, PM2.5, LEAD, ARSENIC, NICKEL, BENZENE and BENZO-A-PYRENE. Of all the locations, three locations were observed to be present within 15 km radius of the project and the data pertaining to the locations for the year 2014-15 were reviewed and has been presented ***Table 5-12*** below.

Table 5-12 Average Yearly data of Air Quality Monitoring (2014-15)

Location	PM 10	PM 2.5	SO2	Nox	O3	NH3	CO	Pb	As	Ni	Benzene	Benzo-a-pyrene
Nr. FISHERIES OFFICE (NAMP)	90	34	13.7	21.1	11.6	11.1	1.32	0.12	<1.0	1.6	1.6	<0.5
GPCB Office (SAMP)	84	31	13.5	19.8	11.7	10.3	1.26	0.11	< 1.0	1.2	1.3	< 0.5
National Ambient Air Standards	**60**	**40**	**50**	**40**	**100**	**100**	**2**	**0.5**	**6**	**20**	**5**	**1**

Source: https://gpcb.gujarat.gov.in/webcontroller/page/ambient-air-quality-monitoring-programmes

* All parameters are expressed in µg/m^3

As per the above results presented by Gujarat Pollution Control Board, the PM10 is exceeding the permissible standards of 60 µg/m^3 . All other air quality parameters are within the prescribed permissible limits.

5.3.9.1 Ambient Air Quality in Study Area

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. 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 & Furan. All the parameters were monitored on 24 hourly basis, while CO was monitored on 8 hourly basis- twice a week for four weeks in the study area, except dioxin and furan which were monitored twice within the plant premises.

The locations of the ambient air quality monitoring has been presented in ***Table 5-2*** and the results of the assessment has been presented in ***Table 5-13*** Map showing monitoring locations has been presented in ***Figure 5-2***.

Figure 5-17 Ambient Air Quality Monitoring conducted in Study Area

AAQ 1 Location

AAQ 2 Location

AAQ 3 Location

AAQ 4 Location

Table 5-13 Results of Ambient Air Quality Monitoring in Study Area

Monitoring Location	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	98.5	47.9	10.3	19.4	0.43	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.24
	23.05.2023 to 24.05.2023	Sample 2	87.5	49.6	9.7	32.7	0.51	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.22
	25.05.2023 to 26.05.2023	Sample 3	120.2	56.7	9.7	29.6	0.5	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.25
	30.05.2023 to 31.05.2023	Sample 4	151.7	68.8	9.1	33.9	0.49	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.23
	01.06.2023 to 02.06.2023	Sample 5	221.4	107.9	8.5	21.8	0.55	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.32
	06.06.2023 to 07.06.2023	Sample 6	81.3	37.9	10.3	26.6	0.59	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.24
	08.06.2023 to 09.06.2023	Sample 7	101.4	58.8	10.3	30.2	0.58	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.26
	13.06.2023 to14.06.2023	Sample 8	125.5	68.8	8.5	27.8	0.33	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.22
	Values for AAQ-1	**Min**	**81.3**	**37.9**	**8.5**	**19.4**	**0.3**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.2**
		Max	**221.4**	**107.9**	**10.3**	**33.9**	**0.6**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.3**
		Average	**123.4**	**62.0**	**9.5**	**27.7**	**0.5**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.2**
		98 Percentile	**211.64**	**102.46**	**10.28**	**33.70**	**0.59**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.31**
AAQ-2	19.05.2023 to 20.05.2023	Sample 1	53.9	26.3	<6.0	25.4	0.98	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.36
	22.05.2023 to 23.05.2023	Sample 2	45.6	19.2	8.5	29.6	0.42	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.23
	26.05.2023 to 27.05.2023	Sample 3	29.2	11.3	<6.0	26.6	0.45	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.37

Monitoring Location	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)
	29.05.2023 to 30.05.2023	Sample 4	64.4	35.0	<6.0	27.8	0.73	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.28
	02.06.2023 to 03.06.2023	Sample 5	138.0	75.9	10.9	35.1	0.49	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.39
	05.06.2023 to 06.06.2023	Sample 6	87.7	40.4	8.5	30.9	0.34	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.25
	09.06.2023 to 10.06.2023	Sample 7	106.9	55.8	9.7	29.6	0.49	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.4
	12.06.2023 to13.06.2023	Sample 8	58.5	21.3	<6.0	19.4	0.47	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.27
	Values for AAQ-2	**Min**	**29.2**	**11.3**	**8.5**	**19.4**	**0.3**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.2**
		Max	**138.0**	**75.9**	**10.9**	**35.1**	**1.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.4**
		Average	**73.0**	**35.6**	**9.4**	**28.0**	**0.5**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.3**
		98 Percentile	**133.67**	**73.05**	**10.81**	**34.49**	**0.95**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.40**
AAQ-3	18.05.2023 to 19.05.2023	Sample 1	69.6	35.4	<6.0	23.6	0.69	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.35
	23.05.2023 to 24.05.2023	Sample 2	43.2	20.4	<6.0	26.6	0.33	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.21
	25.05.2023 to 26.05.2023	Sample 3	39.7	19.2	<6.0	19.4	0.62	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.35
	30.05.2023 to 31.05.2023	Sample 4	97.5	48.8	8.5	21.2	0.41	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.26
	01.06.2023 to 02.06.2023	Sample 5	58.6	27.1	<6.0	26.6	0.42	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.34
	08.06.2023 to 09.06.2023	Sample 6	34.8	16.7	9.7	28.4	0.52	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.23
	13.06.2023 to 14.06.2023	Sample 7	70.8	37.9	9.1	20.0	0.42	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.31

Monitoring Location	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)
	16.06.2023 to17.06.2023	Sample 8	62.5	30.4	<6.0	18.8	0.3	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.22
	Values for AAQ-3	**Min**	**34.8**	**16.7**	**8.5**	**18.8**	**0.3**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.2**
		Max	**97.5**	**48.8**	**9.7**	**28.4**	**0.7**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.4**
		Average	**59.6**	**29.5**	**9.1**	**23.1**	**0.5**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.3**
		98 Percentile	**93.73**	**47.25**	**9.65**	**28.18**	**0.68**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.35**
AAQ-4	19.05.2023 to 20.05.2023	Sample 1	48.2	28.3	8.5	39.9	0.52	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.28
	22.05.2023 to 23.05.2023	Sample 2	62.2	32.5	10.3	36.3	0.36	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.25
	26.05.2023 to 27.05.2023	Sample 3	38.6	15.8	<6.0	28.4	0.6	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.34
	29.05.2023 to 30.05.2023	Sample 4	34.6	16.3	<6.0	26.6	0.38	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.28
	02.06.2023 to 06.06.2023	Sample 5	50.6	20.4	9.7	31.5	0.61	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.29
	05.06.2023 to 06.06.2023	Sample 6	52.3	24.6	9.1	29.0	0.65	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.24
	09.06.2023 to 10.06.2023	Sample 7	95.6	45.4	<6.0	20.6	0.51	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.3
	12.06.2023 to13.06.2023	Sample 8	39.0	19.6	9.7	34.5	0.41	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.27
	Values for AAQ-4	**Min**	**34.6**	**15.8**	**8.5**	**20.6**	**0.4**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.2**
		Max	**95.6**	**45.4**	**10.3**	**39.9**	**0.7**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.3**
		Average	**52.6**	**25.4**	**9.4**	**30.8**	**0.5**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.3**
		98 Percentile	**90.92**	**43.62**	**10.23**	**39.41**	**0.64**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.33**

Monitoring Location	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)
	--	NAAQS, Standards (24 hours)	100	60	80	80	02 (8 hours)	--	1	--	20 (Annual)	6 (Annual)	--	--
	--	WBG EHS (24 hours)	150 (Interim target 1) 100 (Interim target 2) 75 (Interim target 3) 50 (WBG EHS guideline)	75 (Interim target 1) 50 (Interim target 2) 37.5 (Interim target 3) 25 (WBG EHS guideline)	125 (Interim target 1) 50 (Interim target 2) 20 (WBG EHS guideline)	1 year: 40 (WBG EHS guideline) 1 hour: 200 (WBG EHS guideline)	--	--	--	--	--	--	--	--

Table 5-14 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
Dioxin						
--	--	--	Ambient Temp:29ºC Date: 19.06.2023	Ambient Temp:29ºC Date: 19.06.2023	--	--
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	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	
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	
Octachlorodibenzo-p-dioxin	ng.TEQ/N m³		<0.000015	<0.000015	0.1	

Parameter	Units	Method	D&F1	D&F 2	SWM Rules, 2016 (Stack Monitoring)	WBG EHS guidelines for Waste Management facilities
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

5.3.9.1.1 Analysis of Ambient Air Quality Monitoring

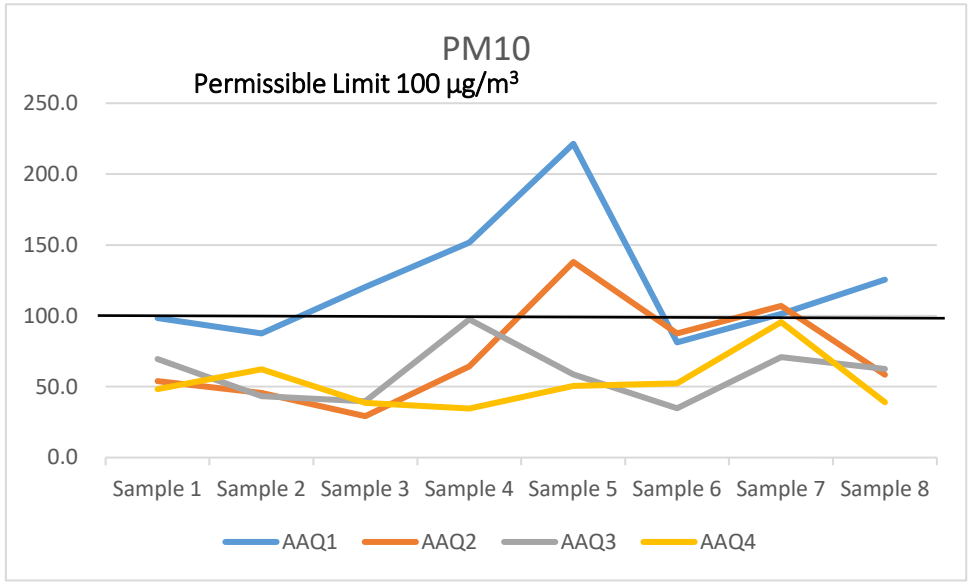
As per the above results, parameters such as Sulphur Dioxide (SO_2), Oxides of Nitrogen (NO_X) and Carbon Monoxide (CO), Cadmium, Lead, Mercury (Hg), Nickel (Ni), Arsenic (Ar), Hydrogen Fluoride (HF), Hydrochloric Acid (HCL) were found to be within NAAQS CPCB permissible limits as well as WBG EHS guidelines, whereas exceedance was observed for PM 10 and PM 2.5 values, where the 24 hours sample values were found to be exceeding the NAAQS as well as WBG EHS Interim target-1 and 2 values.

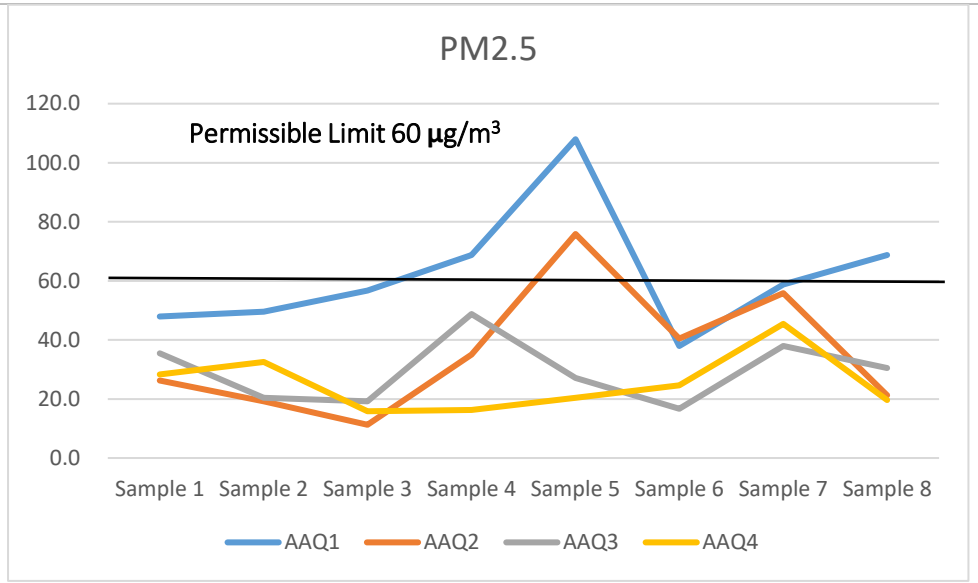
	PM10	PM 2.5
AAQ-1	5 samples are exceeding the NAAQS as well as Interim Target-2	Three samples are exceeding the NAAQS. And all samples are exceeding WBG EHS Guideline values, of which five samples are exceeding Interim Target-2
AAQ-2	2 samples are exceeding the NAAQS as well as Interim Target-2	One Sample is exceeding the NAAQS standards. And 3 samples are exceeding WBG EHS Guideline values, of which one sample is exceeding Interim target-1, two samples are exceeding Interim target-2 and 3 sample is exceeding Interim Target-3.
AAQ-3	All samples well within the NAAQS standards however 5 samples are exceeding WBG EHS guidelines, and one samples are exceeding the Interim target-3 and WBG EHS guideline values	All the samples are well within the NAAQS standard and 2 samples are exceeding the IFC Interim Target-3 and. Only 1 sample is exceeding Interim Target-1 WBG EHS guideline values as well.
AAQ-4	All samples well within the NAAQS standards however 4 samples are exceeding WBG EHS guidelines, and one samples are exceeding the Interim target-3 and WBG EHS guideline values	All samples well within the NAAQS standards however 3 samples are exceeding WBG EHS guidelines and one sample is exceeding the Interim target-3 and WBG EHS guideline values

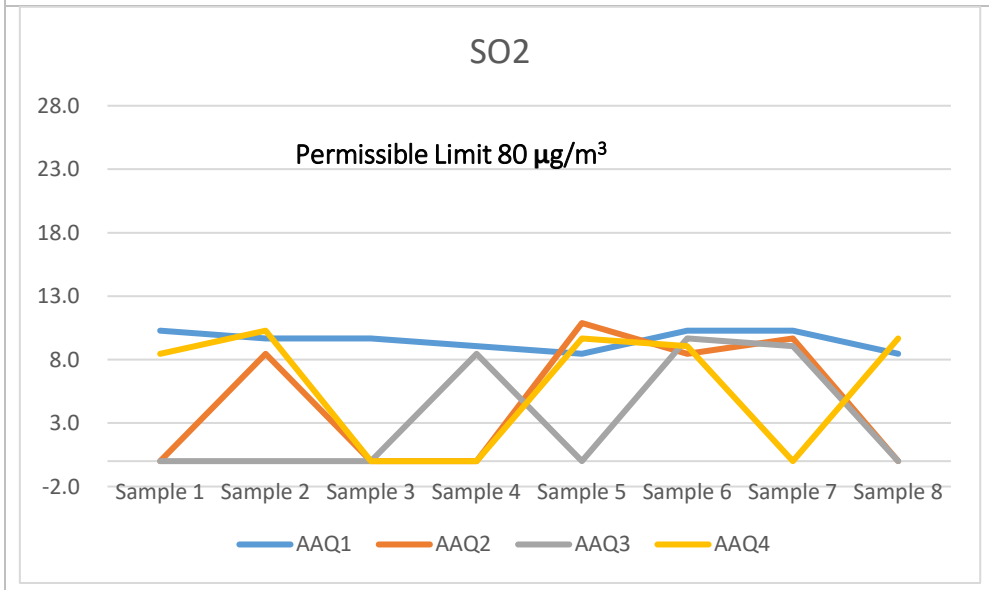
The exceedance in the values for PM10 and PM2.5 for AAQ-1 can be attributed to ongoing bio-mining activities in the vicinity, waste dumping, waste transportation, presence of dirt roads in the area and other activities along with the moderate wind speeds in that area during the monitoring period. Also, exceedance in the values of AAQ-2, AAQ-3 and AAQ-4 can be attributed to moderate wind speeds in the regions, presence of scrub lands in the area along with presence of dirt roads in area used by all the vehicles leading to increase in the PM 10 and PM2.5 Values. Referring to the secondary air quality data from 2014-15 (refer ***Table 5-12***), the values for PM10 are also exceeding the NAAQS values. The project is operational since 2021 and the secondary data for 2014-15 was referred, considering the exceedance in the PM 10 values, exceedance in the PM10 and PM 2.5 values cannot be attributed only to the operational project.

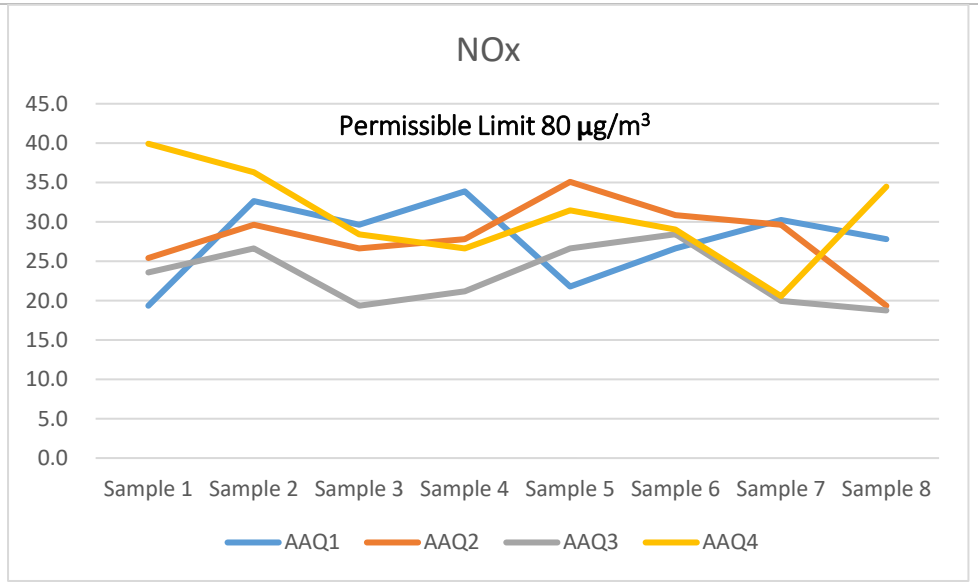
Since no national or international regulations exist to assess the presence of dioxin and furan in the ambient air, the results for dioxin and furan in ambient air was compared against the international and national emission standards from the stack for Municipal solid waste incineration process. The results for Dioxin and Furan were well within the SWM rule 2016 and Air emission standards for MSW incinerators as per WBG EHS Guidelines for waste management facilities. Stack emission monitoring dated 11.02.2023 (the plant was operating at a capacity of 3.8MW at the time of monitoring) and dioxin & furan monitoring dated 02.12.2022 (the plant was operating at a capacity of 3.5MW at the time of monitoring) conducted by third party agency engaged by GWJPL were reviewed, to conform the parameters were within CPCB limits and International standards. The dioxin and furan from the stack were 0.0214 ng TEQ/Nm3.

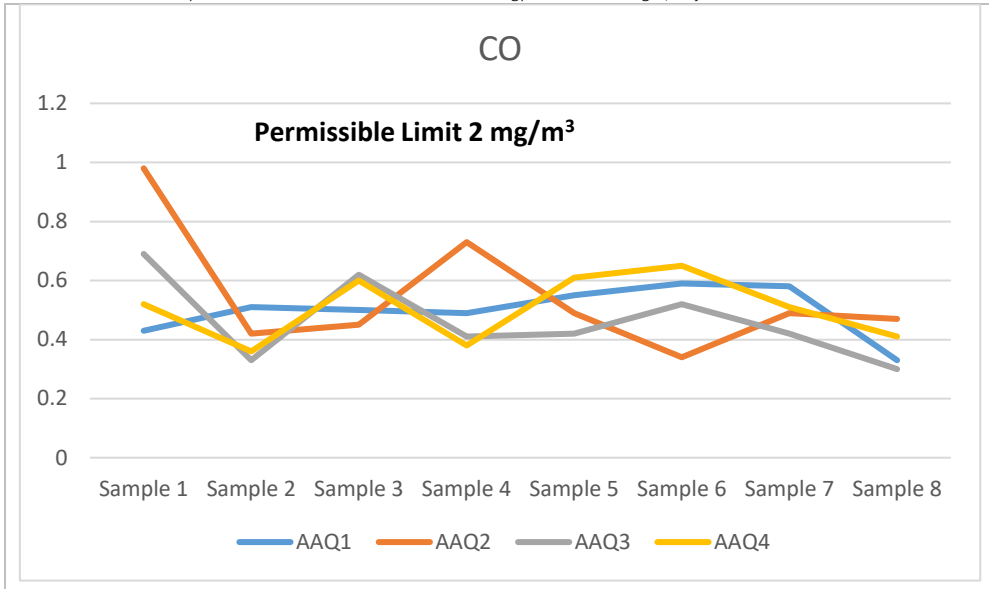
Figure 5-18 Air Quality Analysis Graph

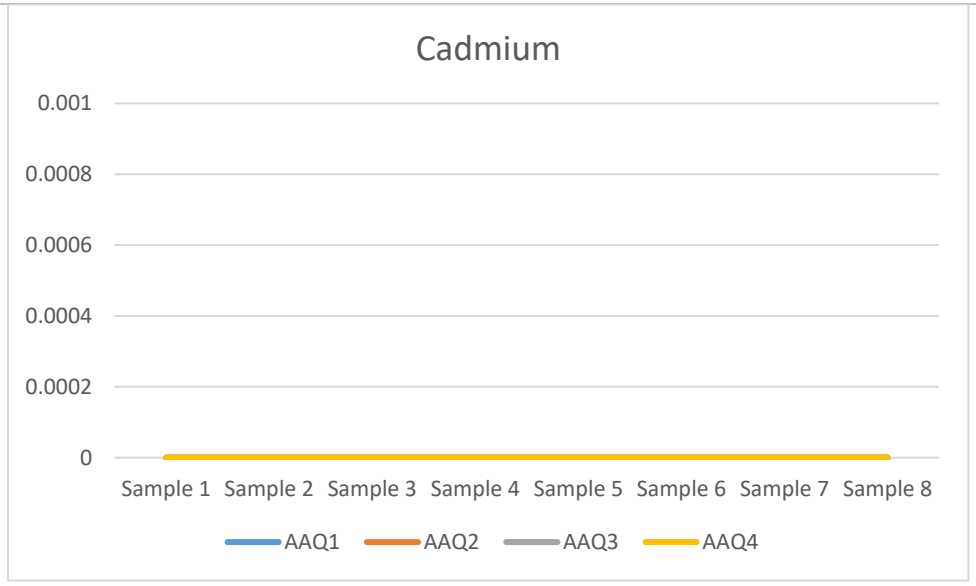


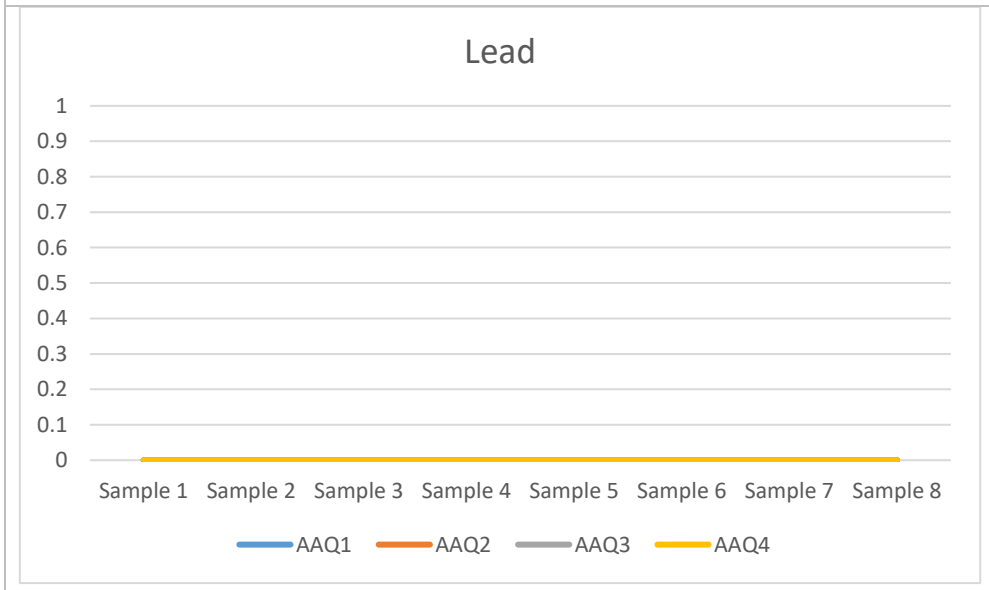


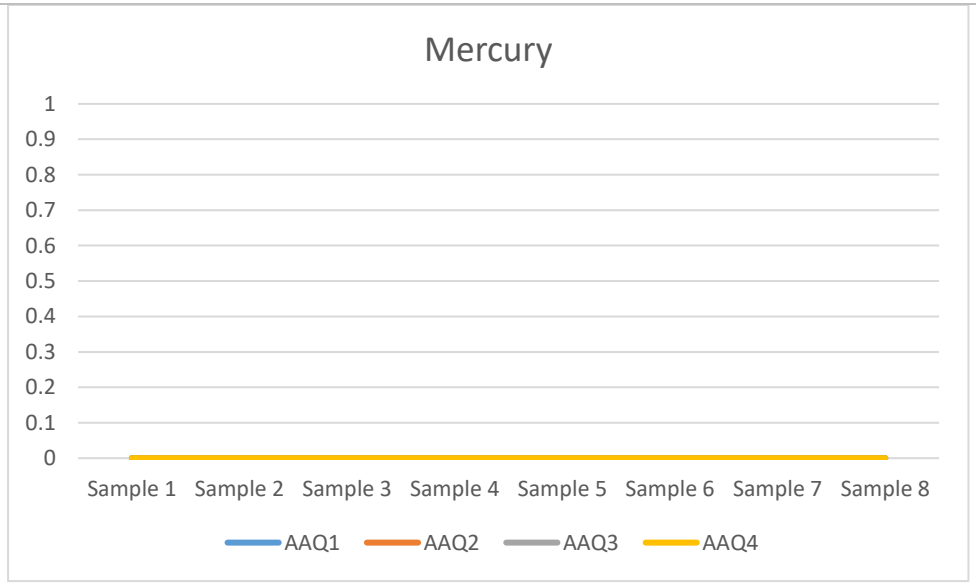


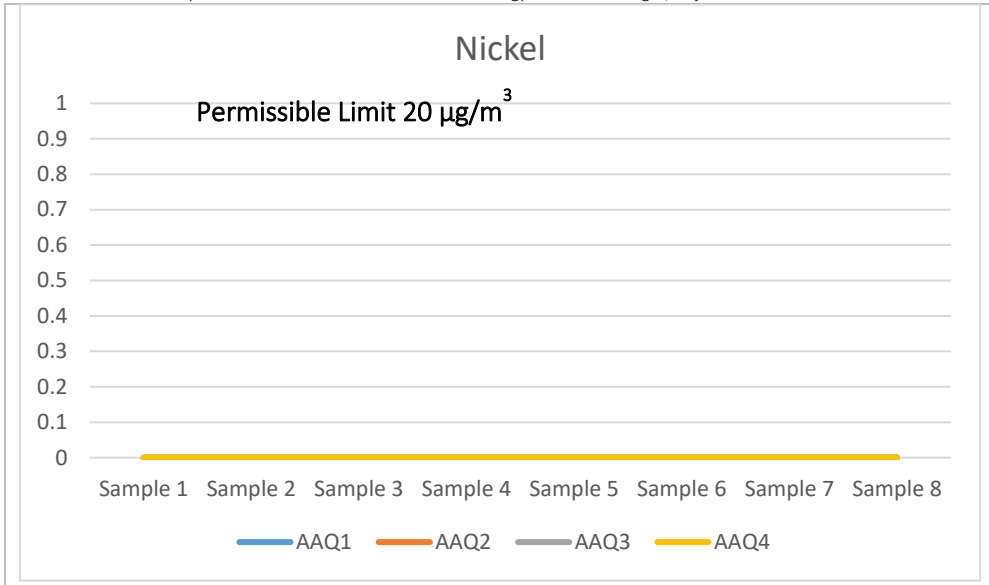


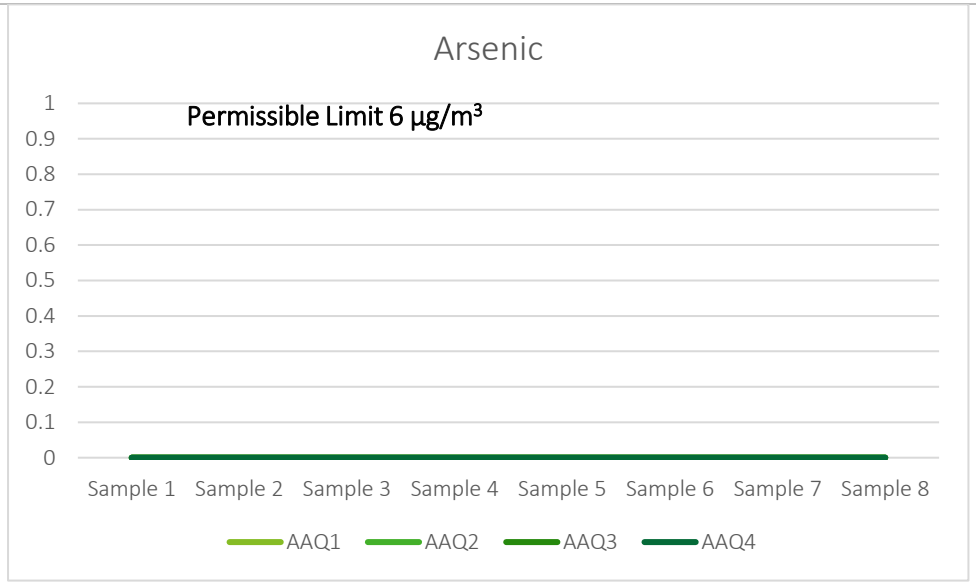


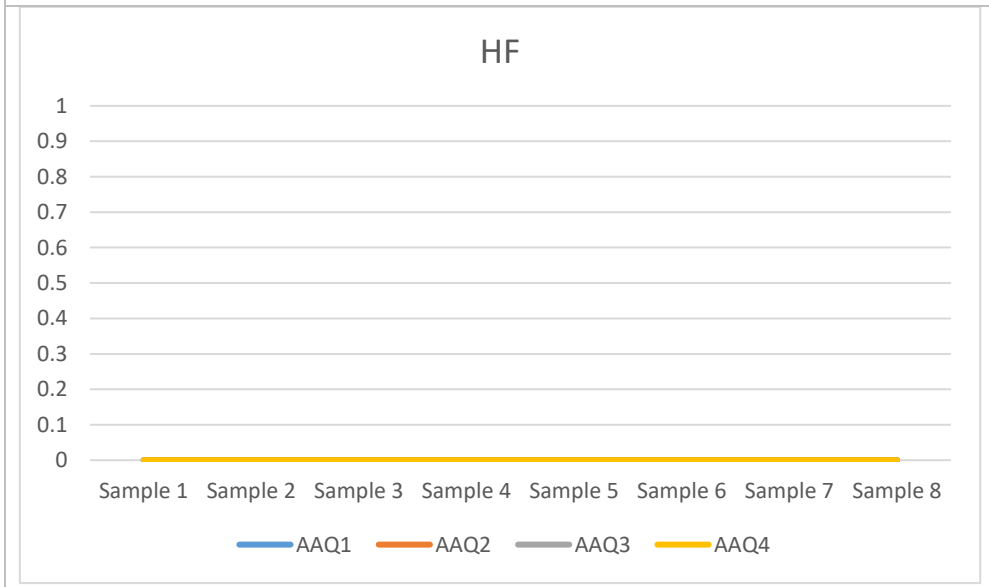


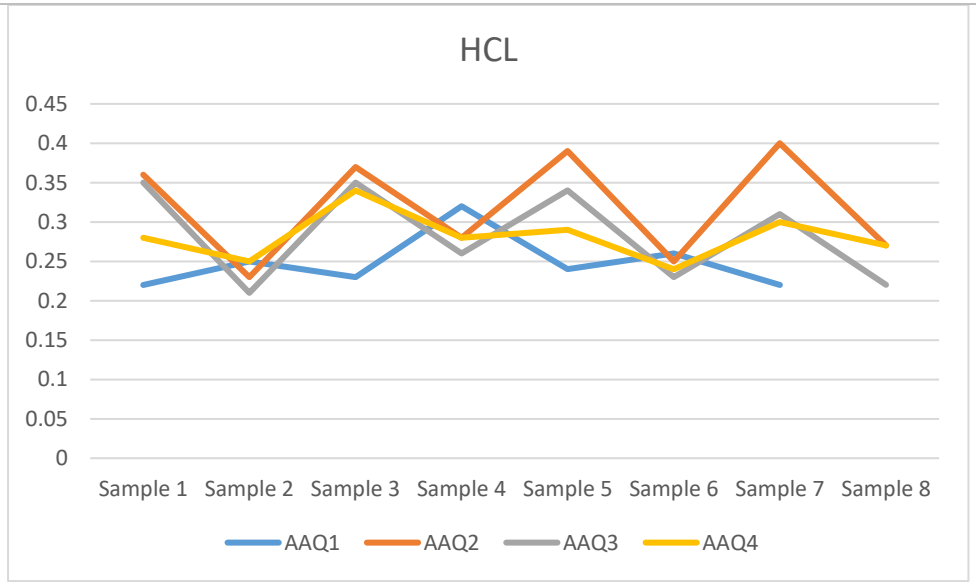












Source: NABL Accredited Lab

5.3.10 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 noise monitoring locations has been presented in ***Table 5-2*** and the results of the assessment has been presented in ***Table 5-15***. Map showing monitoring locations has been presented in ***Figure 5-2***.

Figure 5-19 Noise Level monitoring conducted in Study Area

N 1 Location	N 2 Location	N 3 Location	N4 Location

Table 5-15 Ambient Noise Quality Monitoring in Study Area

S. No	Sampling ID	Results Leq dB(A)	
		Leq Day	Leq Night
1.	N1 (Industrial Area)	71.55	51.3
2.	N2 (Commercial Area)	58	49.05
3.	N3 (Residential Area)	61.4	41.3
4.	N4 (Residential Area)	60.95	40.65
Limit As per CPCB (Environment Protection Rules, 1986)			
Receptor		**Day Time 0600 to 2200 hours**	**Night Time 2200 to 0600 hours**
Industrial Area Leq dB(A)		75	70
Commercial Area Leq dB(A)		65	55
Residential Area Leq dB(A)		55	45
WBG EHS, 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

5.3.10.1 Analysis of Noise Quality Monitoring

The sampling locations are located in industrial and residential areas respectively, therefore, as per the above results 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 whereas as per WBG General EHS guidelines Leq day values are slightly exceeding the values of 70 dB(A). Similarly, for sample N2 (Commercial), N3 & N4 (residential area), values of Leq night were within the CPCB limit as well as WBG General

EHS Guideline values for residential and commercial areas. Leq day values for N2 were within the CPCB limit as well as WBG General EHS Guideline values whereas N3 and N4 are exceeding the values prescribed by CPCB as well as IFC/WB guidelines which are at an aerial distance of 1.83 and 1.99km respectively. This can be attributed to the fact that since the monitoring location was located near the school, activities such as morning assembly and other anthropogenic activities from small industries, temples and road may have led to increase in noise level which was also contribute to the noise in the area . Also, The increase in noise can also be attributed to high wind speeds in the region at the time of monitoring.

5.3.11 Traffic Survey

The primary traffic survey was conducted near the access roads for the Jamnagar site.

The Kutcha road connecting to INS Valsura road (i.e. the road that is leading from Navgam Ghed city) which will be the main access road to reach the WTE plant, Traffic Monitoring was done on this road (T-1). It is understood that the project will and is currently using the road during operation phase. This road is partially unpaved road and limited use of the road by village residents and community and is mainly to use to access the adjoining farmlands by the villagers.

T-2, Bedi Road, Currently this road is being used for waste collection and transportation and is also used by the residents of the city. The waste is being brought in using this road till the time the project is connected to main access road which is planned to be constructed in 1- 2 years' time.

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 ***Table 5-2*** and ***Figure 5-20*** and the results of the survey has been presented in ***Table 5-16***.

Figure 5-20 Traffic Survey Monitoring conducted in Study Area

Traffic Survey at T1 Location (Up and Down)

Traffic Survey at T2 Location (Up and Down)

Table 5-16 Traffic Density Monitoring Results in Study Area

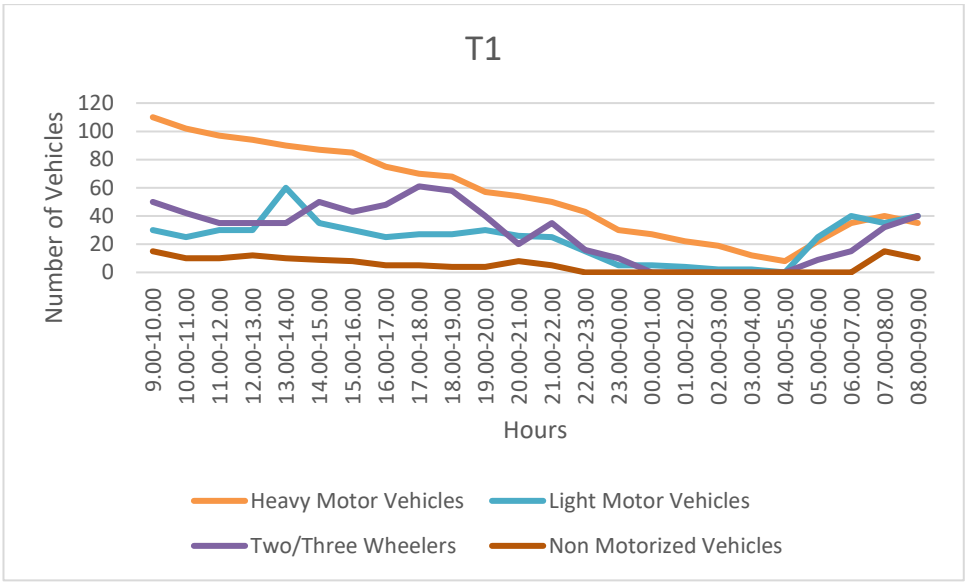
Sr. No.	Motorized Vehicles			Non-Motorized Vehicles	Total Vehicles
	Heavy Motor Vehicles (Truck, Bus, Dumper, Tanker, Trailer)	Light Motor Vehicles (Car, Jeep, Van, Matador, Tractor, Tempo)	Two/Three Wheelers (Scooter, M. Cycle, Auto, Moped)	Bicycle, Tricycle	
T1 (Up and Down)					
1.	1332	573	674	130	2709
T2 (Up and Down)					
3.	241	1604	1169	556	3570

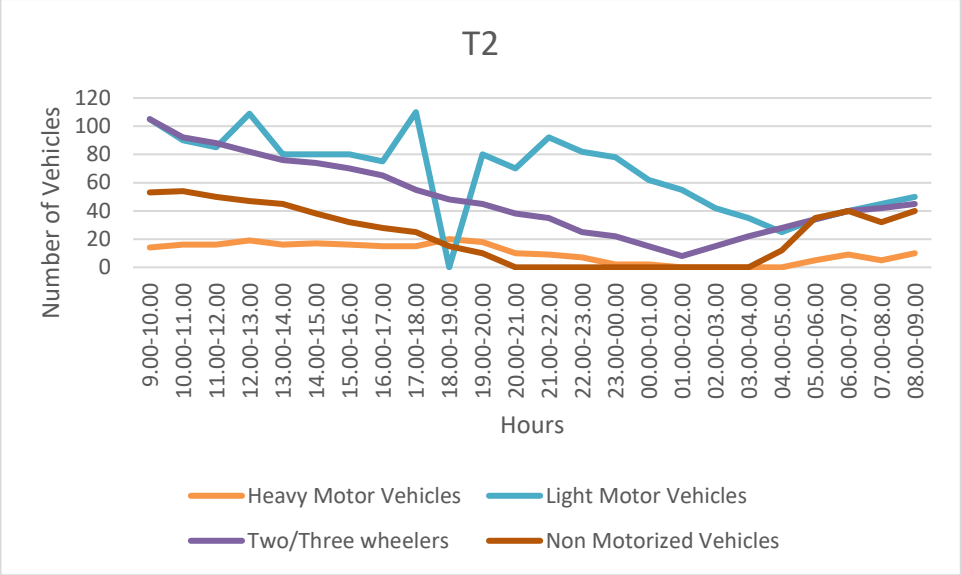
Source: Survey conducted by NABL accredited lab in June 2023

5.3.11.1 Analysis of Traffic Survey

Based on the traffic survey data presented in ***Table 5-16*** and hourly traffic scenario presented in ***Figure 5-21***, it is observed that T2 is busier than T1 with daily traffic accounting for 6279 vehicles. The hourly traffic scenario depicted that the majority of traffic in the T2 road is due to movement of Light Motor vehicles travelling up and down the roads followed by two/three-wheeler vehicles comprising of Scooter, Motorcycle, Auto and Moped. The movement of Heavy motor vehicles in T1 location paves for majority of the traffic in T1 location. The movement of Light Motor vehicles contributed towards 26% of the total vehicles deployed whereas two/three-wheeler vehicles contributed to 19% of the total vehicles deployed on T2 location. Similarly, movement of Heavy motor vehicles contributed towards 21%, whereas movement of Light Motor vehicles contributed towards 9% of the total vehicles deployed on T1 Location. Detailed traffic density data has been presented as ***Figure 5-21***.

Figure 5-21 Hourly Road Traffic Scenario





Source: Survey conducted by NABL accredited lab in June 2023

5.3.12 Natural Hazards

District Disaster Management Plan, DDMP-2022, Collector & District Magistrate Jamnagar, and Building Materials & Technology Promotion Council (BMTPC), Government of India, have published hazard maps of Gujarat. According to the District Disaster Management Plan, drought, floods, wind and earthquake are the main natural hazards that can cause damage to life and property in Jamnagar district, where the Project site falls, the Project level details with respect to natural hazards have been presented in below.

Drought: According to the District Disaster Management Plan, DDMP-20221, Collector & District Magistrate Jamnagar, the probability and impact of the drought is low for the whole district.

Wind/Cyclone: According to the Building Materials & Technology Promotion Council (BMTPC), Government of India, the Project site is located in an area that experiences very high wind velocities Vb= 50 m/s and the zone is classified as very high damage risk zone for cyclones. According to the District Disaster Management Plan, DDMP-2022, Collector & District Magistrate Jamnagar, 1.717 million population and 17 ports in the district are likely to be affected including 3 Taluka (Jodia, Jamnagar and some parts of Lalpur taluka). The below ***Figure 5-22*** presents the wind hazard map which indicates the project area lies in the very high damage risk zone.

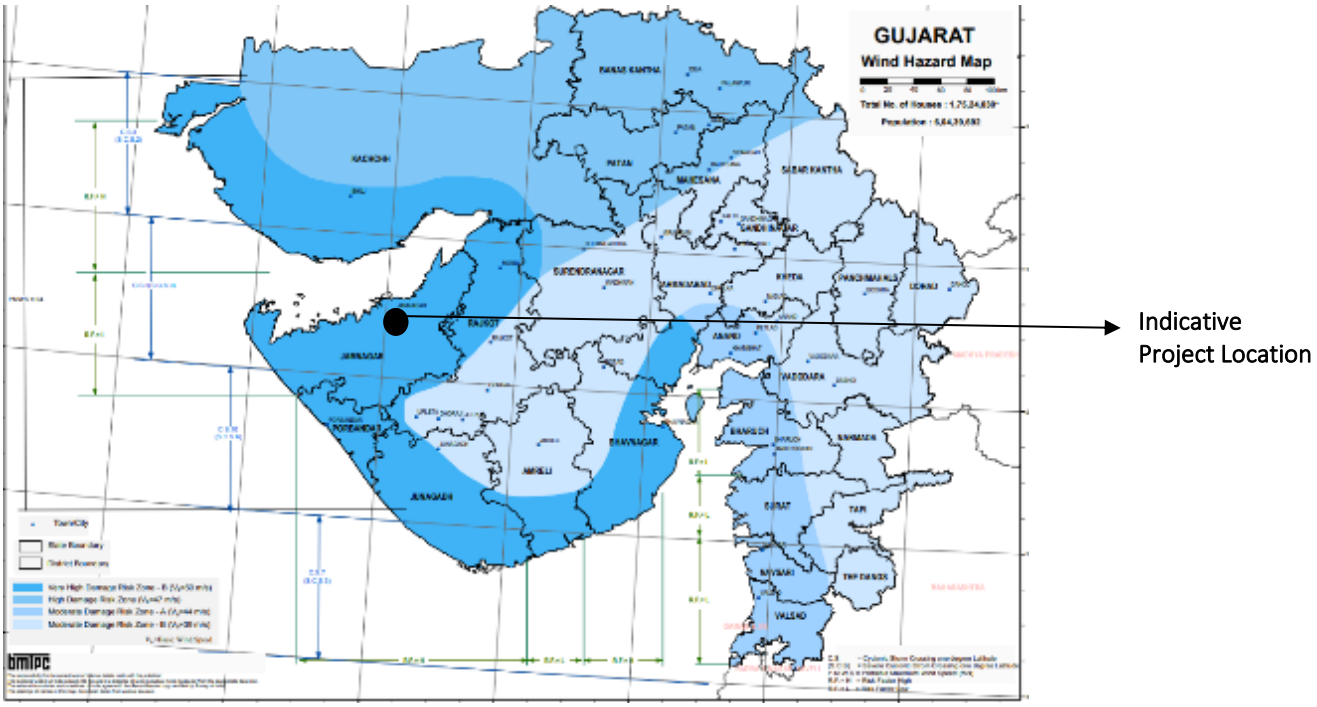
Floods: According to the Building Materials & Technology Promotion Council (BMTPC), Government of India, the Project site falls in an area which is not prone to flooding incidents. However, as per information available on public domain, there had been instances of flood in Jamnagar in 2021[34], 2022[35] and 2023[36] due to heavy rainfall. Additionally, as per District Disaster Management Plan for Jamnagar, 2022, Jamnagar has faced flood in 2013 of magnitude 4 due to heavy rainfall which caused 12 human deaths and 70 cattle loss. The below ***Figure 5-23*** presents the flood prone map showing the project area does not lie in the flood prone zone.

Earthquake: According to the Building Materials & Technology Promotion Council (BMTPC), Government of India, the Project is located in an area that is designated as Zone IV that corresponds to MSK VIII. This is classified as a high damage risk zone in terms of earthquake occurrence. The earthquake map in shown ***Figure 5-24.***

Tsunami: According to the District Disaster Management Plan, DDMP-2022, Collector & District Magistrate Jamnagar, the project area is likely to be affected by tsunami, as they are present in the coastal belt. Jamnagar district has 5 coastal talukas and as per analysis of mean sea level of Jamnagar district, there are 25 villages of 3 coastal talukas are less than 2 km far from sea and on less than 10 m of height from ocean level.

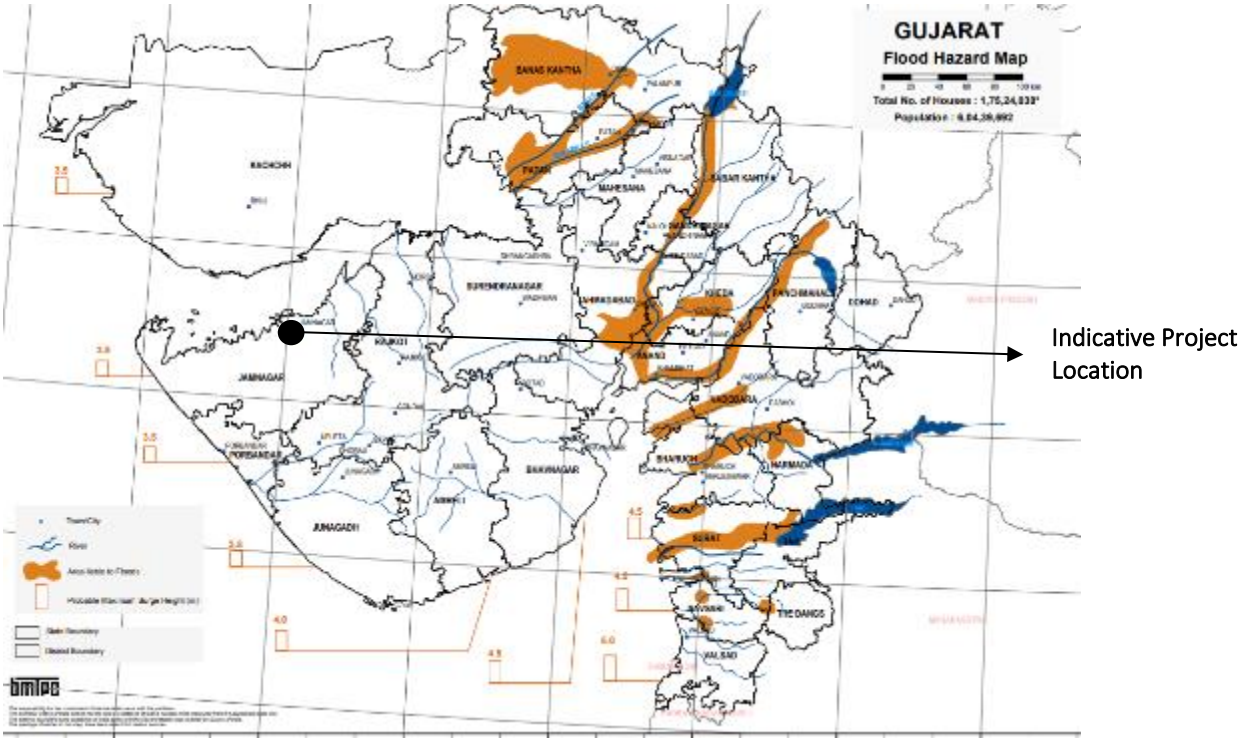
[34] https://www.indiatoday.in/india/story/gujarat-floods-ndrf-rescues-stranded-villagers-kalavad-jamnagar-1852321-2021-09-13
[35] https://zeenews.india.com/video/india/breaking-news-floods-ravage-gujarats-jamnagar-2482804.html
[36] https://www.newindianexpress.com/nation/2023/jul/02/heavy-rains-cause-floods-in-gujaratdharampurgets-234-mm-in-24-hours-2590709.html

Figure 5-22 Map showing Wind Hazard Map of Gujarat



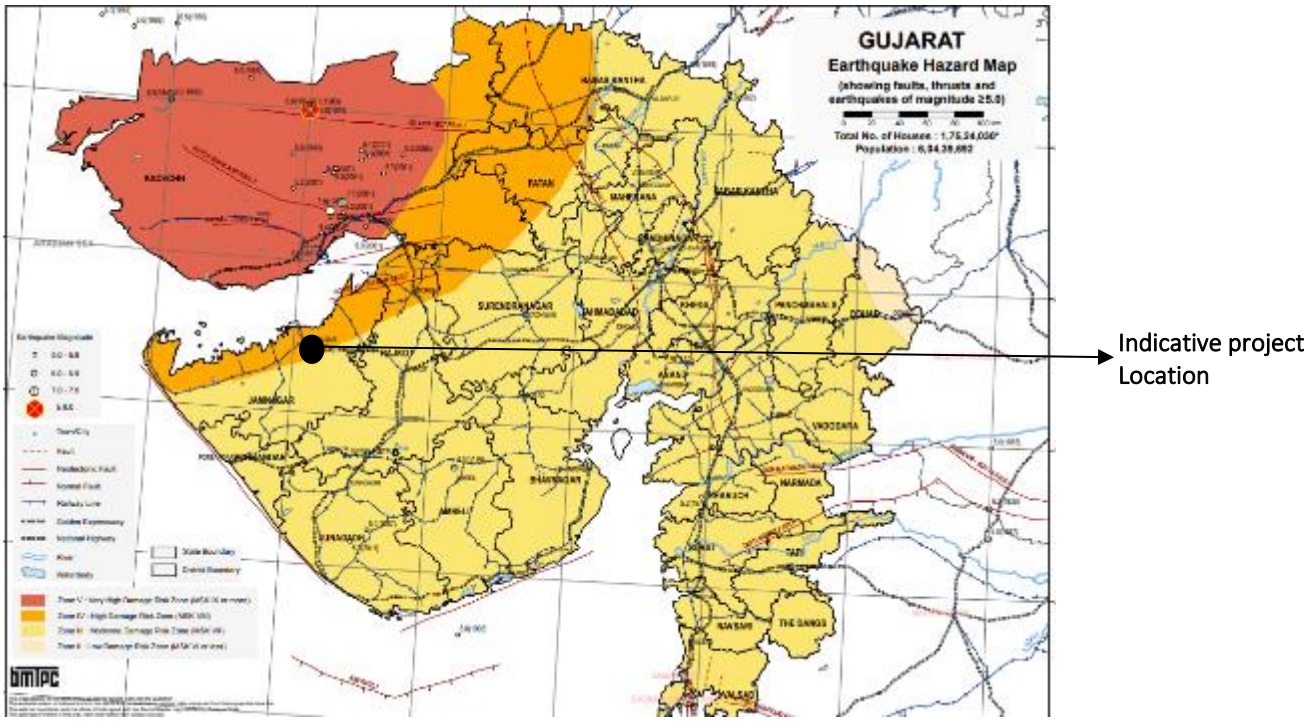
Source: The Building Materials & Technology Promotion Council (BMTPC)

Figure 5-23 Map showing Flood Prone Areas



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

Figure 5-24 Map showing Earthquake Hazard Zones of Gujarat



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

5.4 Socio-economic Sensitivity

5.4.1 Approach

The project has adopted a participatory approach. 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

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 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 5 km 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 (grazing and agricultural land) and increased vehicular activity in remote areas.
- Study area: Project footprint = Core zone (5 km) + buffer zone (10 km).

5.4.3 Primary data/information collection/site consultation

As part of the baseline data collection process, consultations were undertaken with the local stakeholders identified for the Project. The *Table 5-17* below provides a list of consultation undertaken as part of the site visit.

Table 5-17 Consultation undertaken during site visit

Sr. No.	Stakeholders' details	Objective of the consultation	Remarks
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	Discussion /interview with affected Person	• To understand the impacts • Assess the potential loss / income. • Payment of Compensation & R&R Assistances	
3.	Consultation with Jamnagar Municipal Corporation contracted agency running material recovery facility at the transfer station	• Overview of the facility • Number of workers working at the facility • Earning done by the workers (Male and female wise) • Understanding the waste procurement, segregation and selling of segregated waste	

5.4.4 Review of secondary information

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

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

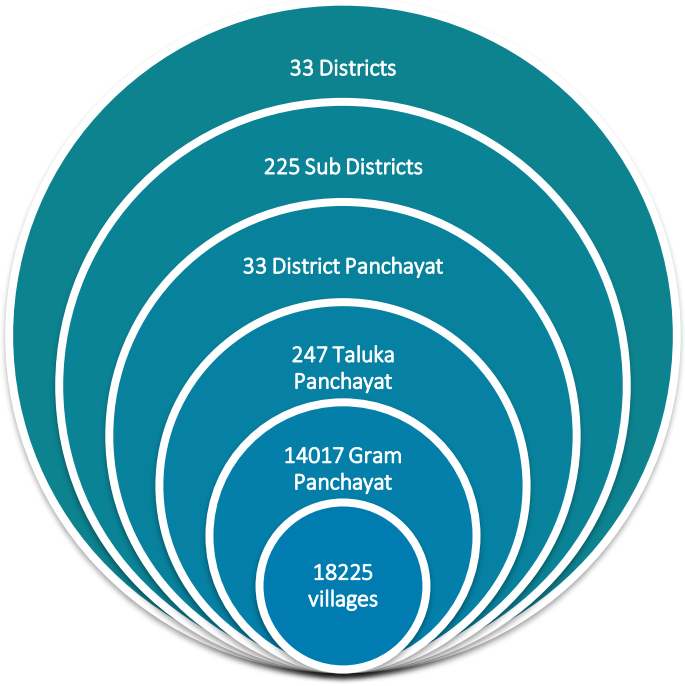
The project falls under Jamnagar district. The snapshot of the project affected district is given in the subsequent sections below.

5.4.5 State Profile: Gujarat

The state, situated in the western part of India, is spread over an area of 196,024 sq. km which is approximately 6.4% of the total geographical area of the country (Census 2011). Gujarat State is bounded in the west by the Arabian Sea and in the north by the Rann of Kutch and Rajasthan desert; to the NE and east its limits are marked by the Aravalli ranges, and the hills of Vindhya. Satpura and Western Ghats extending up to Umbergaon and Dadra Nagar Haveli at the Southern tip (Kulkarni, n.d.)[37]. The mainland Gujarat extends from Umbergaon (Maharashtra border) in the south to Mt. Abu (Rajasthan) in the north, and from hill ranges with forests in the east to the Arabian Sea, Gulf of Cambay, Saurashtra, and Rann in the west (Kulkarni, n.d.).

Figure 5-25 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: 2011 Census of India

As per the Census 2011, total area of Gujarat is 196,244 square km. Thus, the population density of Gujarat is 308 per square km which is lower than national average 382 per square km (Census 2011). Gujarat has total population of

[37] Kulkarni, V. N. (n.d.). *PHYSICAL GEOLOGY OF GUJARAT (https://guj-nwrws.gujarat.gov.in/downloads/phy_geology_gujarat_eng.pdf).*

60,439,692, hence the population growth is 19.2% compared to 2001 population of 50,671,017. The male population accordance to 2011 census were 31,491,260 while females were 28,948,432. Gujarat has total child population (0-6 age) of 14,81,748, out of which 7,79,166 are males and 7,02,582 are females.

The total figure of household in 2011 was 1,22,48,428, out of which 67,73,558 were rural household and 54,74,870 were urban. The average household size was 5 as per census 2011.

The sex-ratio of Gujarat state is 919 compared to 943 which is national average of India, 2011. The sex ratio of child population (0-6 age) is 890 per 1000 male child. The literacy rate of Gujarat state is 67.99% out of which 74.54% males are literate and 60.86% females are literate.

Table 5-18 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	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)	67.9
Male Literacy Rate (percentage)	74.5
Female Literacy Rate (percentage)	60.8

Source: 2011 Census of India

5.4.6 District Profile: Jamnagar

Jamnagar District Is located in the Northwest of Gujarat State. It is bounded partly by Gulf and partly by the desert of Kutch in the North, Junagadh District in the South, Jamnagar District in the East and Arabian Sea in the West. The district has a geographical area of 14125 sq. Kms. It is spread between 21.42 to 22.57 Latitude and 68.57 to 70.37 Longitudes (MSME, n.d.)[38].

Table 5-19 District profile of Jamnagar

Variables	Jamnagar District
rea (sq. km)	14,184
Total Population	21,60,119
Males	11,14,192

[38] MSME, D. I. (n.d.). Brief Industrial Profile of Jamnagar District (https://dcmsme.gov.in/old/dips/DIP%20of%20Jamnagar.pdf).

Variables	Jamnagar District
Females	10,45,927
Population Growth (percentage)	13
Total Households	4,30,941
Rural Households	2,30,303
Urban Households	2,00,638
Average Household Size	5
Sex Ratio	939
Population density (sq. km)	152
Total Literacy Rate (percent)	64.65
Male Literacy Rate (percentage)	71.36
Female Literacy Rate (percentage)	57.50

Source: 2011 Census of India

As per the Census India 2011, the total area of Jamnagar is 14,184 sq.km with population density of 152 per sq.km. Population of Jamnagar is 21,60,119, , hence the population growth is 13% compared to 2001 population of 1,904,278 of which 11,14,192 are males and 10,45,927 are females.

Jamnagar district has 430941 households, out of which 2,30,303 were rural household and 2,00,638 were urban. The average household size was 5 as per census 2011.

The sex-ratio of Jamnagar district is around 939 compared to 919 which is average of Gujarat state, census 2011. The literacy rate of Jamnagar district is 64.65% out of which 71.36% males are literate and 57.50% females are literate.

5.4.7 Tehsil Profile: Jamnagar

Jamnagar tehsil of the Jamnagar district has total population of 8,51,948 as per the Census 2011. Out of which 4,43,742 are males while 4,08,206 are females. The average sex ratio of the tehsil is 920, which is lower than Jamnagar district sex-ratio of 939.

The total literacy rate of the tehsil is 70.54%. The male literacy rate is 75.67% and the female literacy rate is 64.97% in the tehsil.

Table 5-20 Tehsil profile of Jamnagar

Variables	Jamnagar Tehsil
Total Population	8,51,948
Males	4,43,742
Females	4,08,206
Sex Ratio	920
Total Literacy Rate (percent)	70.54
Male Literacy Rate (percentage)	75.67
Female Literacy Rate (percentage)	64.97

Source: 2011 Census of India

Working Population – Jamnagar Tehsil

In the tehsil out of the total working population of 3,07,784 engaged in work activities. 88% of workers describe their work as main work (employment of earning more than 6 months) while 12% were involved in Marginal activity providing

livelihood for less than 6 months. Of 2,70,933 workers engaged in main work, 27,445 were cultivators (owner or co-owner) while 16,001 were agricultural labourer.

Table 5-21 Working profile of Jamnagar tehsil

Jamnagar Tehsil	Total	Male	Female
Main Workers	2,70,933	2,33,977	36,956
Cultivators	27,445	22,245	5,200
Agriculture Labourers	16,001	11,717	4,284
Household Industries	5,281	3,622	1,659
Other Workers	2,22,206	1,96,393	25,813
Marginal Workers	36,851	19,996	16,855
Non-Working	5,44,164	1,89,769	3,54,395

Source: 2011 Census of India

5.4.8 Tehsil Profile: Kalavad

Kalavad tehsil of the Jamnagar district has total population of 1,39,729 which is less than Jamnagar tehsil 8,51,948 as per the Census 2011. Out of which 70,977 are males while 68,752 are females. The average sex ratio of the tehsil is 969, which is higher than Jamnagar tehsil sex-ratio of 920 and Jamnagar district sex-ratio of 939.

The total literacy rate of the tehsil is 66.07%. The male literacy rate is 72.27% and the female literacy rate is 59.67% in the tehsil.

Table 5-22 Tehsil profile of Kalavad

Variables	Kalavad Tehsil
Total Population	1,39,729
Males	70,977
Females	68,752
Sex Ratio	969
Total Literacy Rate (percent)	66.07
Male Literacy Rate (percentage)	72.27
Female Literacy Rate (percentage)	59.67

Source: 2011 Census of India

Working Population – Kalavad Tehsil

In the tehsil out of the total working population of 65,547 engaged in work activities. 82% of workers describe their work as main work (employment of earning more than 6 months) while 18% were involved in Marginal activity providing livelihood for less than 6 months. Of 53,496 workers engaged in main work, 28,210 were cultivators (owner or co-owner) while 10,428 were agricultural labourer.

Table 5-23 Working profile of Kalavad

Kalavad Tehsil	Total	Male	Female
Main Workers	53,496	43,317	10<179
Cultivators	28,210	22,610	5,600
Agriculture Labourers	10,428	7,575	2,853
Household Industries	497	338	159

Kalavad Tehsil	Total	Male	Female
Other Workers	14,361	12,794	1,567
Marginal Workers	12,051	2,115	9,936
Non-Working	74,182	25,545	48,637

Source: 2011 Census of India

5.4.9 Study area

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 zone - The core zone is defined as the radius extending from the Project footprint area which would have majority of the impacts (during 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 5 km 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 (grazing and agricultural land) and increased vehicular activity in remote areas.
- Study area: Project footprint = Core zone (5 km) + buffer zone (10 km).

5.4.10 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 5-24 Demographic profile of study area

Villages	No. of HH	Population	Average HH Size	Sex Ratio	% SC	% ST	% Lit	% F Lit
				Core area				
Nava Nagna	770	4,371	6	923	0.55	0.18	71.01	60.53
Juna Nagna	604	3,329	6	902	11.11	0.00	65.85	55.67
Navagam	592	2,272	4	972	0.97	0.00	69.23	63.13
Total Core	**1,966**	**9,972**	**5**	**927**	**4.17**	**0.08**	**68.88**	**59.54**
				Buffer area				
Gordhanpar	168	945	6	1002	0.42	0.00	64.34	58.14
Dhinchda	729	3,759	5	915	6.92	0.00	66.16	57.63
Dhunvav	1154	6,249	5	946	3.17	0.00	63.98	55.45
Khijadiya	443	2,246	5	926	7.84	0.00	65.58	55.83
Naghedi	740	3,758	5	892	7.40	0.00	52.50	41.37
Kansumara	444	2,546	6	949	11.15	0.00	58.33	50.81
Morkanda	792	4,459	6	916	13.46	0.00	73.40	69.09
Theba	683	3,534	5	925	8.89	0.00	68.93	61.01
Hapa	287	1,538	5	915	1.82	0.00	62.68	52.65
Khimaliya	542	3,067	6	957	12.03	0.00	71.80	65.13
Jamnagar (OG) WARD NO.-0019 (Rural MDDS CODE:513673)	8396	38,826	5	919	8.42	0.47	76.91	72.40
Total Buffer	**14,378**	**70,927**	**5**	**924**	**8.15**	**0.26**	**71.57**	**65.46**

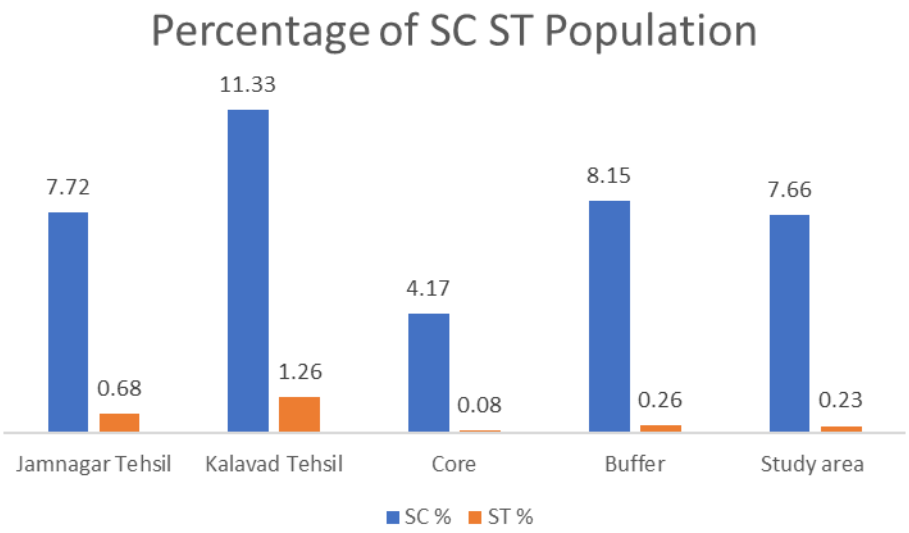
Villages	No. of HH	Population	Average HH Size	Sex Ratio	% SC	% ST	% Lit	% F Lit
Total study area	16,344	80,899	5	924	7.66	0.23	71.24	31.09

Source: 2011 Census of India

The core zone of the study area comprises 3 village while the buffer zone comprises 10 villages and 1 ward. The total household in the core area is 1,966 inhabited by a population of 9,972. The average size of the households in the core area is 5. Whereas the total household in the buffer area is 14,378 inhabited by a population of 70,927. The average household size of the households in the buffer area is 5. The total household in the study area is 16,344, which is inhabited by 80,899 of the total study area population. According to above table the average household size in the study area is 5.

The total sex ratio in the study area is 924, which is less than the sex ratio of Jamnagar district 939. The sex ratio of the study area is less than the sex ratio of the core area (927), however, same as the sex ratio of buffer area (924). Gordhanpar village from the buffer area indicate a positive sex ratio at 1,002 per 1000 males. The lowest sex ratio can be seen in Naghedi village from the buffer area at 892 per 1000 males.

Figure 5-26 Proportion of SC/ST population in the villages of core area, buffer area, study area, and Tehsils



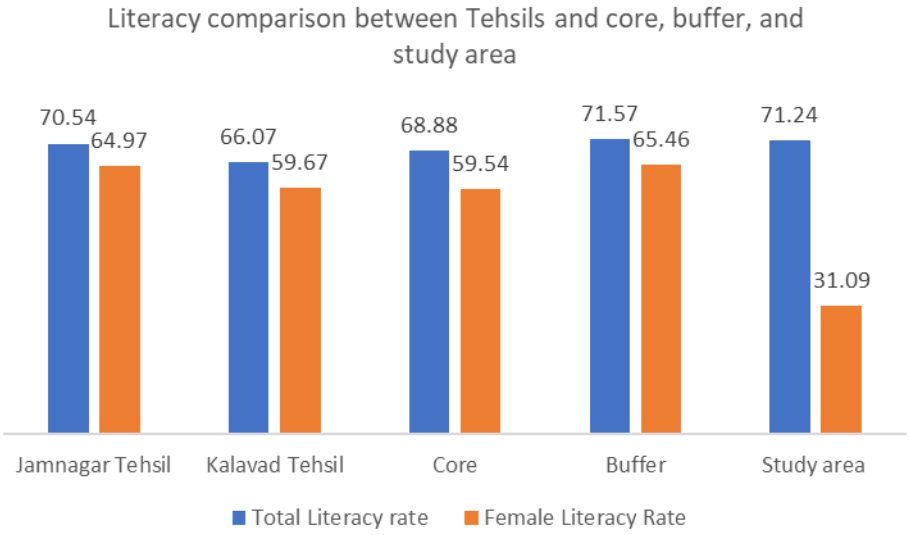
Source: 2011 Census of India

The highest proportion of the SC[39] population from the core, buffer, study area and the Tehsils can be seen in Kalavad Tehsil (11.33%). The lowest proportion of the SC population can be seen in the core area (4.17%).

The Kalavad Tehsil reflects the highest proportion of the ST[40] population (1.26%) compared to all other Tehsils and core, buffer, and study area. The lowest ST population again can be seen in the core area (0.08%).

[39] Schedule Caste
[40] Schedule Tribe

Figure 5-27 Literacy and education



Source: 2011 Census of India

According to **Figure 5-27**, if we compare the total literacy rate between the tehsil/core/buffer/study area, the total literacy rate of Jamnagar tehsil (70.54%), buffer (71.57%), and study area (71.24) are almost similar. Total literacy rate in Kalavad tehsil (66.07%), and core (68.88%) are almost similar.

Similarly, in female literacy the lowest can be seen in the study area (31.09%), and the highest in buffer area (65.46%).

5.4.11 Land use pattern

This section presents an overview of the ownership and use of land in the study area, based on the census 2011. The Net sown area is highest in core (76%), buffer (74%), and AoI (74%) compared to all other land use pattern. The table for the land utilization reiterates the heavy dependence of people on agriculture, making it one of the primary sources of their livelihood.

Table 5-25 Land use break-up in the study area

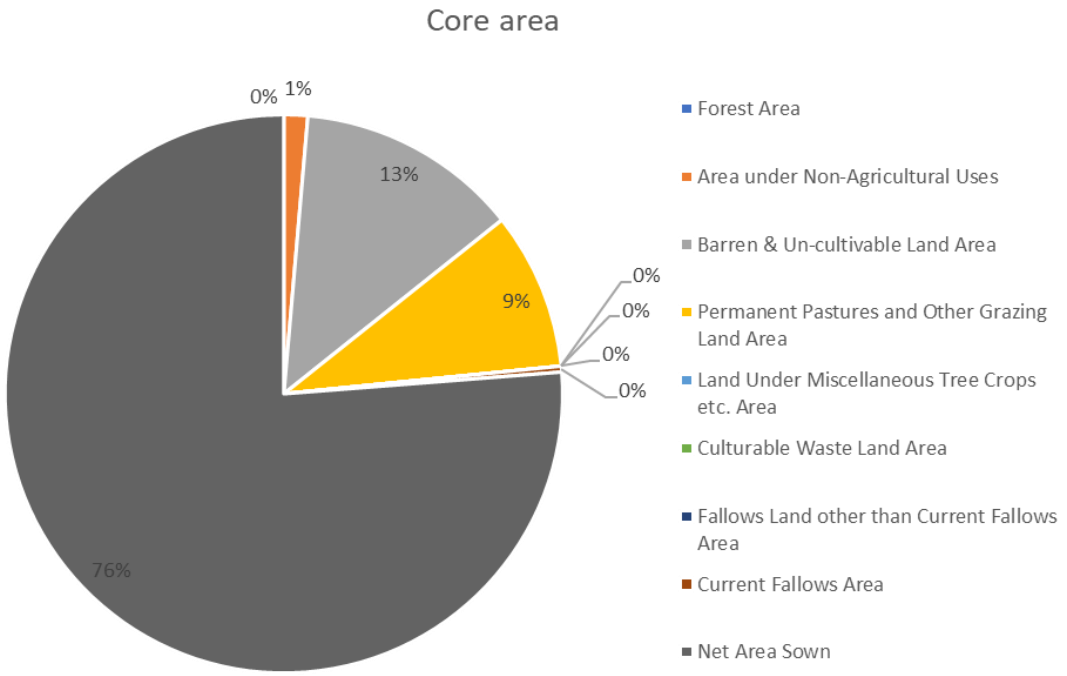
Name of the village	Total Geographical Area[41] (in Hectares)	Forest Area[42] (in Hectares)	Area under Non-Agricultural Uses[43] (in Hectares)	Barren & Un-cultivable Land Area[44] (in Hectares)	Permanent Pastures and Other Grazing Land Area[45] (in Hectares)	Land Under Miscellaneous Tree Crops etc. Area[46] (in Hectares)	Culturable Waste Land Area[47] (in Hectares)	Fallows Land other than Current Fallows Area[48] (in Hectares)	Current Fallows Area (in Hectares)	Net Area Sown[49] (in Hectares)
Core area										
Nava Nagna	212.74	0%	6%	9%	9%	0%	0%	0%	0%	75%

[41] Forest area is land under natural or planted stands of trees
[42] Areas under non-agricultural use include lands occupied by buildings, roads, and railways, or land under water
[43] This includes all land covered by mountains, deserts, etc
[44] A permanent pasture is pastureland that is a result of natural growth
[45] This includes all cultivable land which is not included in 'Net area sown' but is put to some agricultural uses
[46] Land available for cultivation, either taken up or just not taken up once for harvesting, but not harvested over the last five years more than in sequence, including that of the current year
[47] All land which was taken up for cultivation but is temporarily out of cultivation for a period of not less than one year and not more than five years
[48] Cropped area which is kept fallow during the current year
[49] Net sown area represents the total area sown with crops and orchards

Name of the village	Total Geographical Area[41] (in Hectares)	Forest Area[42] (in Hectares)	Area under Non-Agricultural Uses[43] (in Hectares)	Barren & Un-cultivable Land Area[44] (in Hectares)	Permanent Pastures and Other Grazing Land Area[45] (in Hectares)	Land Under Miscellaneous Tree Crops etc. Area[46] (in Hectares)	Culturable Waste Land Area[47] (in Hectares)	Fallows Land other than Current Fallows Area[48] (in Hectares)	Current Fallows Area (in Hectares)	Net Area Sown[49] (in Hectares)
Juna Nagna	321.61	0%	3%	12%	1%	0%	0%	0%	2%	83%
Navagam	1474.66	0%	0%	14%	11%	0%	0%	0%	0%	75%
Total Core	**2009.01**	**0%**	**1%**	**13%**	**9%**	**0%**	**0%**	**0%**	**0%**	**76%**
					Buffer area					
Gordhanpar	493.15	0%	1%	38%	11%	0.00	7%	0%	0%	45%
Dhinchda	1235.53	0%	1%	18%	4%	0.09	2%	1%	0%	65%
Dhunvav	1573.65	0%	1%	1%	7%	0.06	6%	0%	9%	69%
Khijadiya	1076.87	0%	1%	0%	8%	0.00	3%	0%	0%	87%
Naghedi	649.04	0%	4%	25%	1%	0.00	1%	0%	6%	61%
Kansumara	928.67	0%	4%	6%	10%	0.02	4%	0%	0%	76%
Morkanda	573.19	0%	7%	0%	12%	0.00	0%	0%	0%	80%
Theba	706.75	0%	5%	0%	19%	0.00	0%	0%	0%	76%
Hapa	666.96	0%	0%	5%	13%	0.00	0%	0%	0%	81%
Khimaliya	1062.95	0%	1%	0%	6%	0.00	9%	0%	0%	84%
Jamnagar (OG) WARD NO.-0019 (Rural MDDS CODE:513673)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total Buffer	**8966.76**	**0%**	**2%**	**8%**	**8%**	**3%**	**4%**	**0%**	**2%**	**74%**
Total study area	**10975.77**	**0%**	**2%**	**9%**	**8%**	**2%**	**3%**	**0%**	**2%**	**74%**

Source: 2011 Census of India

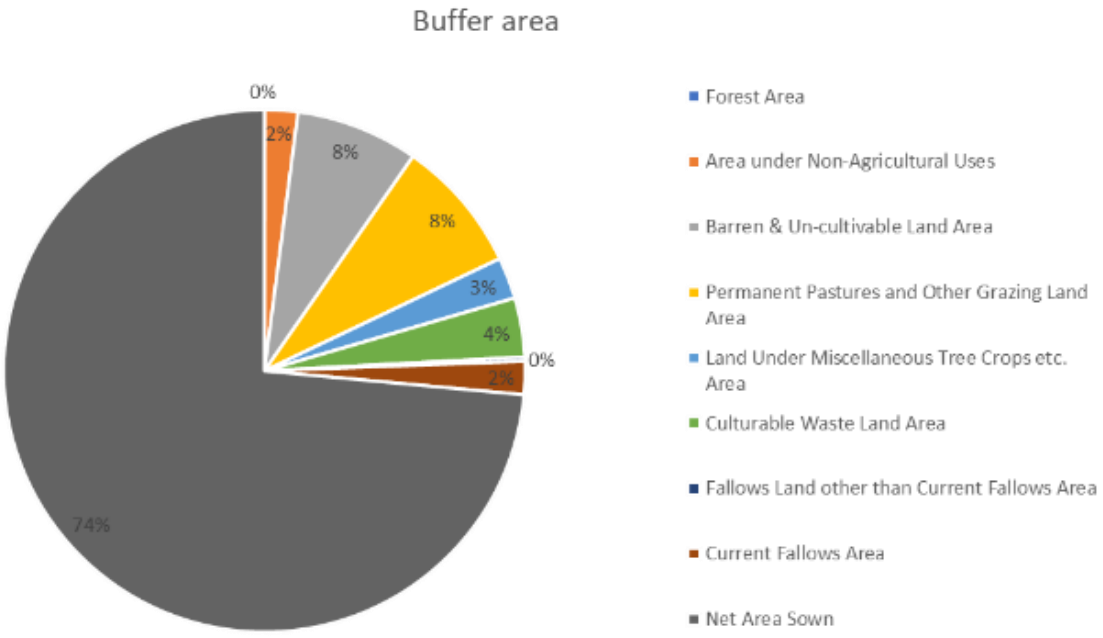
Figure 5-28 Land use patter in core area



Source: 2011 Census of India

Figure 5-28 represent that highest proportion of land area falls under the net area sown (76%). Barren & un-cultivable land covers an area of 13%, permanent pasture and other grazing land covers 9%, and area under non-agricultural land covers 1%. Rest land use pattern is under miscellaneous tree crops etc., Culturable waste land, fallows land other than current fallow land, and current fallows area has 0% land coverage out of the total geographical area.

Figure 5-29 Land use pattern in buffer area



Source: 2011 Census of India

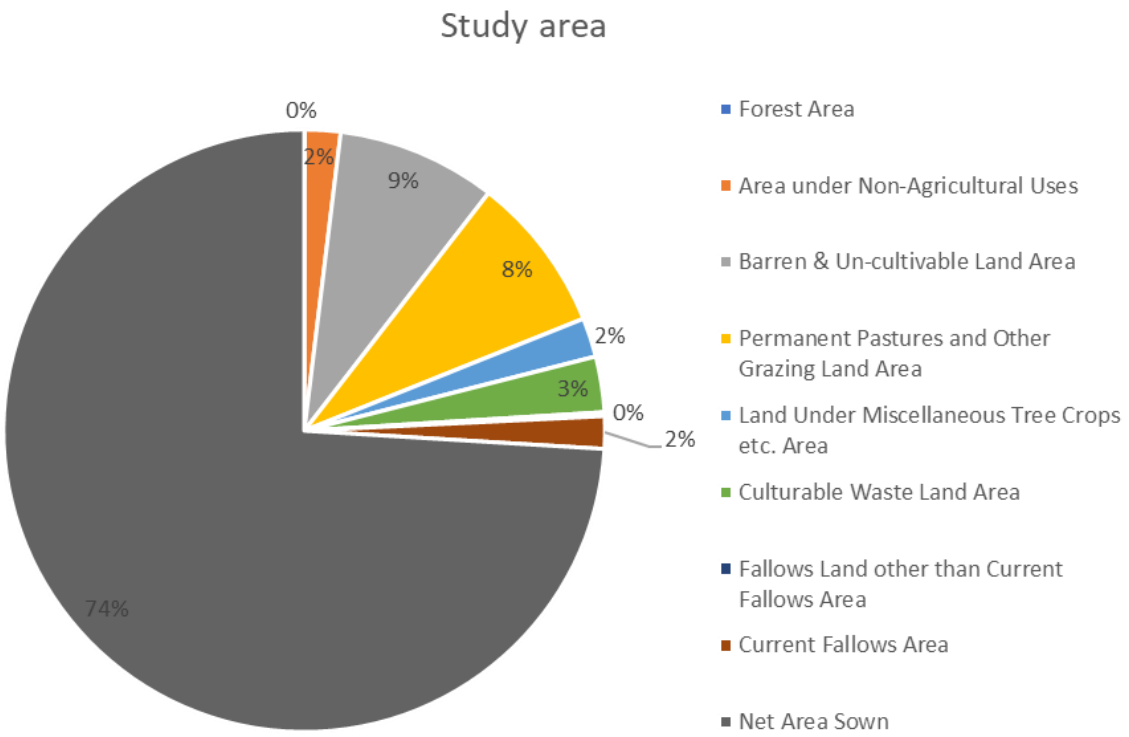
Figure 5-29, represent that highest proportion of land area falls under the net area sown (74%). Area under non-agricultural uses covers 2%, Barren & un-cultivable land covers an area of 8%, permanent pasture and other grazing land covers 8%, land use pattern: other forest area covers 3%, Culturable waste land covers 4%, and current fallows area covers 2%. Rest, forest area, and fallows land other than current fallow land has 0% land coverage out of the total geographical area.

Further, based on the site visit, the total land falling under the transmission line and water pipeline with land use category is provided below:

Project Component	Total Length (meters)	Easement Rights (in acres)	Total land requirement (acres)	Land Category	Land use Remarks
WTE Plant		-	16.70	Government owned barren land (as per the government record)	The total land was baren land.
Underground transmission line	56.5	0.01398	0.01398	Government owned land	**Land Use Category** / **Area (acres)** Project Land (10.38 meters) – 0.002568 Road Land (28.93 meters) – 0.007158 Substation Land (17.18 meters) – 0.01398 **Total (56.4 meters)** – **0.01398**
Underground water pipeline	324	0.0800	0.0800	Government owned land	**Land Use Category** / **Area (acres)** Project Land (5 meters) – 0.001235 Road Land (36.42 meters) – 0.008993 Substation Land (17.19 meters) – 0.069773 **Total (324 meters)** – **0.0800**

After analyzing the land allotted for the project and examining the land use patterns, it was found that most of the land is barren or designated for non-agricultural use. This means that the land allotment process will not affect the local community in terms of agricultural land reduction or encroachment into forested areas.

Figure 5-30 Land use pattern in Study area



Source: 2011 Census of India

Figure 5-30 represent that highest proportion of land area falls under the net area sown (74%). Area under non-agricultural uses covers 2%, Barren & un-cultivable land covers an area of 9%, permanent pastured and other grazing land covers 8%, land use pattern: forest area covers 2%, Culturable waste land covers 3%, and current fallows area covers 2%. Rest, forest area, and fallows land other than current fallow land has 0% land coverage out of the total geographical area.

5.4.12 Occupational Profile

Table 5-26 Working population in the study area

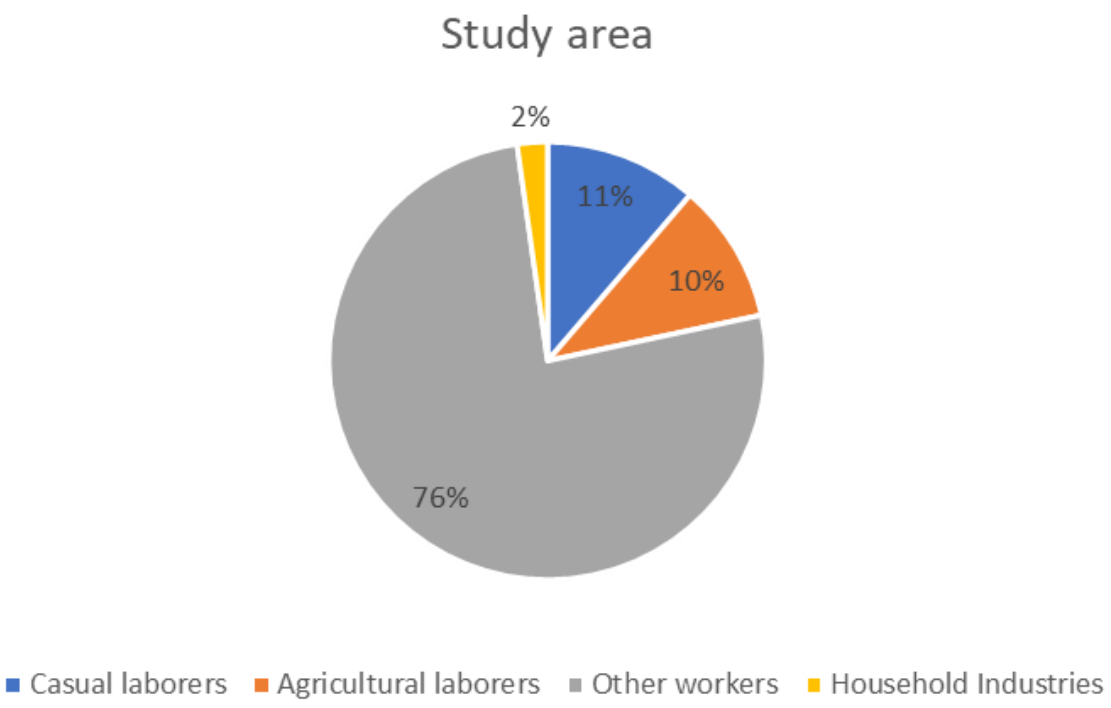
Villages	Working Population Ratio	Main worker (% of total working population)	Main work Male (% of WPR)	Main worker Female (% of WPR)	Marginal (% of total working population)	Marginal worker male (% of WPR)	Marginal worker female (% of WPR)	Non-working population (% of total population)
				Core area				
Nava Nagna	41.87	92.46	72.90	19.56	7.54	3.06	4.48	58.13
Juna Nagna	38.54	87.22	73.42	13.80	12.78	7.56	5.22	61.46
Navagam	54.49	94.51	60.34	34.17	5.49	1.29	4.20	45.51
Total Core	**43.63**	**91.50**	**75.94**	**22.02**	**8.50**	**3.88**	**4.62**	**129.19**
				Buffer area				
Gordhanpar	39.26	100.00	77.36	22.64	0.00	0.00	0.00	60.74
Dhinchda	34.03	83.74	87.49	10.48	16.26	12.28	3.99	65.97
Dhunvav	33.22	93.64	85.96	13.15	6.36	4.77	1.59	66.78

Villages	Working Population Ratio	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)
Khijadiya	41.32	95.91	80.67	18.53	4.09	2.26	1.83	58.68
Naghedi	42.66	88.65	75.02	22.15	11.35	5.05	6.30	57.34
Kansumara	35.70	87.13	90.53	8.25	12.87	6.93	5.94	64.30
Morkanda	35.10	97.25	88.04	11.63	2.75	0.83	1.92	64.90
Theba	37.44	96.07	84.34	15.04	3.93	2.87	1.06	62.56
Hapa	42.72	69.56	90.81	6.39	30.44	8.37	22.07	57.28
Khimaliya	46.17	90.18	65.15	31.43	9.82	2.68	7.13	53.83
Jamnagar (OG) WARD NO.-0019 (Rural MDDS CODE:513673)	35.43	89.15	85.64	12.80	10.85	7.20	3.66	64.57
Total Buffer	**36.49**	**89.94**	**84.01**	**14.38**	**10.06**	**6.01**	**4.05**	**63.51**
Total study area	**37.37**	**90.16**	**82.83**	**15.48**	**9.84**	**5.70**	**4.13**	**62.63**

Source: 2011 Census of India

As per the census data given in ***Figure 5-31*** out of the main working population, majority of the population is categorized as other workers which is 76% of the total main working population in the study area, which means area is having typical characteristics of urban areas where most of the people are engaged in activities other than agriculture. . As per the Census data, nearly 11% of the total main workers in the study area are engaged as casual laborers. The proportion of Agricultural labour in the study area is nearly 10%. The proportion of Household workers is negligible (2 per cent) across the study area, as depicted in the figure below.

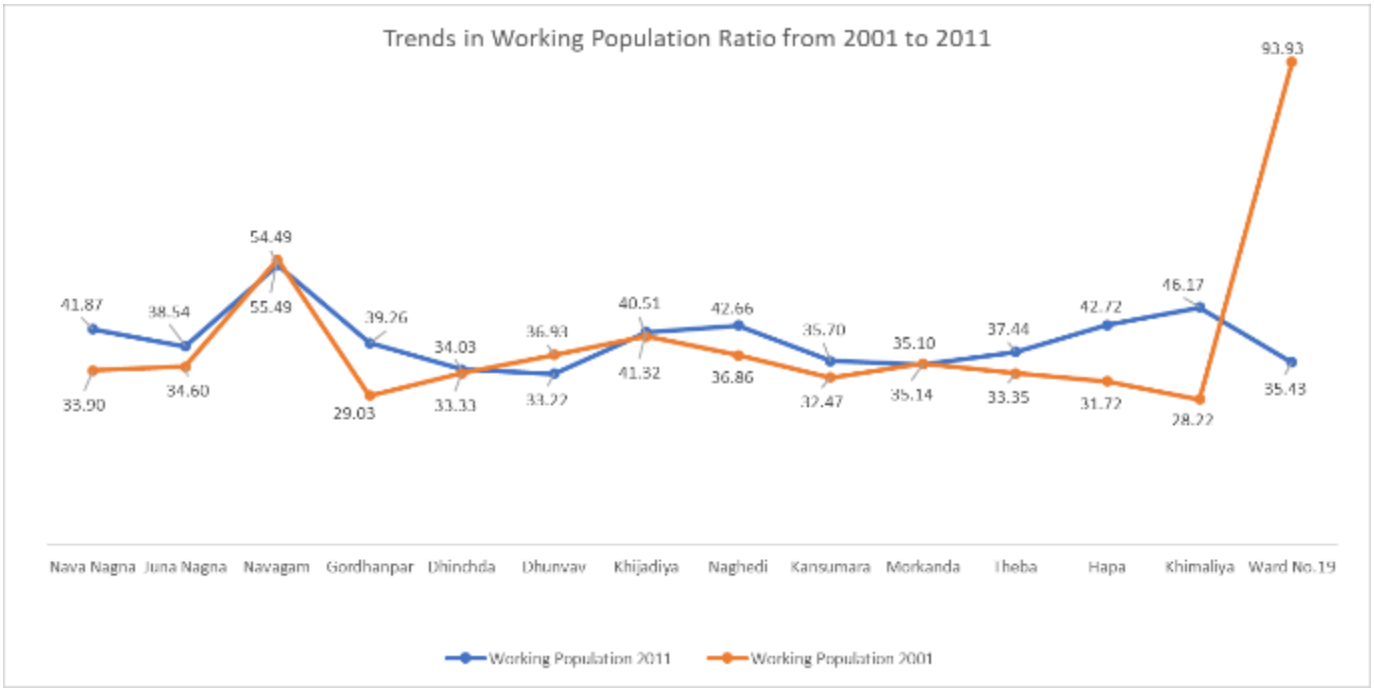
Figure 5-31 Distribution of main working population in the study area



Source: 2011 Census of India

Further, provided the trend comparison of working population as per census 2011 and 2001 data.

Figure 5-32 Trends on working population ratio from 2001 to 2011.



Source: 2011 Census of India

The blue line represents data from 2011, while the orange line represents data from 2001. The x-axis lists different locations including Nava Nagina, Juna Nagina, Navagam, and others up to Ward No.19. The y-axis shows numerical values indicating the working population ratios ranging approximately from around mid-20s to high-90s.

Based on the graph, we can see that the working population ratio has increased in most of the locations from 2001 to 2011. However, the spike in Ward No.19 is particularly noteworthy. This is due to the migration of working population from ward no. 19 to the Jamnagar city.

Farm based livelihood and cropping Pattern.

The district shows a dominance of cash crops (oil seed and lint) over the food crops (cereal and pulse). The reason is that the preference for the high value crop (cotton, groundnut) got introduced through the extension services of public and private players. The main crops of the district are Millet (Jowar), bajri, wheat, and cotton. Groundnut and cotton are important commercial crops, whereas wheat constitutes the irrigated crops. Along with these, fruit crops are also grown in the district of Jamnagar. The fruits commonly grown and preferred includes are Mango, Coconut, Chikoo, Papaya and Ber (zizypus). The vegetable crops grown in the district includes Potato, Onion, Brengle, Tomato etc. (Gujarat Social Infrastructure Development Society (GSIDS), 2015)[50].

Livestock based Livelihood.

Animal husbandry is complementary to and inseparable from agriculture. Livestock rearing as an economic activity is pursued by certain sections of the community who have made grazing and breeding of livestock as their traditional occupation. Livestock like cattle, buffalo, goat, and sheep are reared in the district (Gujarat Social Infrastructure Development Society (GSIDS), 2015)[50].

Non-farm-based livelihood

Fisheries and marine resources constitute another important source of livelihood in the coastal talukas. The sea coast is the main source of fisheries in Jamnagar. With agriculture not giving the return as one would expect and with declining productivity and declining alternative employment opportunities within the district, seasonal migration becomes imperative for ensuring livelihoods (Gujarat Social Infrastructure Development Society (GSIDS), 2015) [50]

5.4.13 Physical infrastructure

Water supply and sanitation

As per the consultation with the local community it was understood that the villagers are not dependent on the ground water as the ground water is saline or having high TDS which not fit for drinking. Thus, the local community is dependent on govt water supply for drinking, individuals have also installed RO water units. Although as per census data here are no government installed water pipeline in the area but as the census data is nearly 10 years old and since then there must have been development in the area which was not captured in the census 2011.

Table 5-27 Source of water in the study area

Name of the village	Tap Water-Treated	Covered Well	Hand Pump	Tube Wells/Borehole	Spring	River/Canal	Tank/Pond/Lake Others	
				Core area				
Nava Nagna	0	0	1	0	0	0	0	0
Juna Nagna	0	1	1	0	0	1	0	0
Navagam	0	0	1	1	0	1	0	0
Total Core	**0**	**1**	**3**	**1**	**0**	**2**	**0**	**0**
				Buffer area				
Gordhanpar	0	0	1	0	1	0	0	0
Dhinchda	0	0	1	1	0	0	0	0
Dhunvav	0	0	0	1	0	1	0	0

[50] Gujarat Social Infrastructure Development Society (GSIDS). (2015). District Human Development Report.https://www.undp.org/sites/g/files/zskgke326/files/migration/in/5918d875fd2269094a51b690f9126fcb430e4be1033a8bd4a42d9f48aba38461.pdf (Accessed on 28th August 2023)

Name of the village	Tap Water-Treated	Covered Well	Hand Pump	Tube Wells/Borehole	Spring	River/Canal	Tank/Pond/Lake	Others
Khijadiya	0	0	1	0	0	0	1	0
Naghedi	0	0	1	0	0	1	0	0
Kansumara	0	0	1	1	0	0	0	0
Morkanda	0	0	1	1	0	1	0	0
Theba	0	0	0	0	0	1	0	0
Hapa	0	1	1	0	0	1	0	0
Khimaliya	0	0	0	1	0	1	0	0
Jamnagar (OG) WARD NO.-0019 (Rural MDDS CODE:513673)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total Buffer	**0**	**1**	**7**	**5**	**1**	**6**	**1**	**0**
Total study area	**0**	**2**	**10**	**6**	**1**	**8**	**1**	**0**

Source: 2011 Census of India

From ***Table 5-27*** it can be observed that most people in the districts are mostly dependent on hand pump as it is available in 3 villages from core, and 7 from buffer. It is visible that the facility of tap water and others is not available in both core and buffer zones. The table indicates that there are only 1 spring, 8 river/canal, 2 Covered well, 6 tube wells/borehole, and 1 tank/pond/lake is available in the study area.

Health Facilities and Health Seeking Behaviour

According to ***Table 5-28*** Primary health centres is available in one of the villages in the study area. There are 6 Primary Health Sub Centres, 1 Veterinary Hospital, and 2 Non-Government Medical facilities Outpatients. Rest all the facilities are unavailable in the study area.

Table 5-28 Health facility infrastructure in the study area

Name of Village	Community Health Centre	Primary Health Centre	Primary Health Sub Centre	Maternity And Child Welfare Centre	TB Clinic	Dispensary	Veterinary Hospital	Family Welfare Centre	Non-Government Medical facilities Outpatient
					Core area				
Nava Nagna	0	0	1	0	0	0	0	0	0
Juna Nagna	0	0	0	0	0	0	0	0	0
Navagam	0	1	1	0	0	0	1	0	2
Total Core	**0**	**1**	**2**	**0**	**0**	**0**	**1**	**0**	**2**
					Buffer area				
Gordhanpar	0	0	0	0	0	0	0	0	0
Dhinchda	0	0	0	0	0	0	0	0	0
Dhunvav	0	0	1	0	0	0	0	0	0
Khijadiya	0	0	1	0	0	0	0	0	0
Naghedi	0	0	0	0	0	0	0	0	0

Name of Village	Community Health Centre	Primary Health Centre	Primary Health Sub Centre	Maternity And Child Welfare Centre	TB Clinic	Dispensary	Veterinary Hospital	Family Welfare Centre	Non-Government Medical facilities Outpatient
Kansumara	0	0	1	0	0	0	0	0	0
Morkanda	0	0	0	0	0	0	0	0	0
Theba	0	0	1	0	0	0	0	0	0
Hapa	0	0	0	0	0	0	0	0	0
Khimaliya	0	0	0	0	0	0	0	0	0
Jamnagar (OG) WARD NO.-0019 (Rural MDDS CODE:513673)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total Buffer	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**0**
Total study area	**0**	**1**	**6**	**0**	**0**	**0**	**1**	**0**	**2**

Source: 2011 Census of India

5.4.14 Education infrastructure

As per the data provided in ***Table 5-29*** below, we can identify that there are 13 villages with access to government primary school in the study area. 6 villages have the access to government secondary school in the study area. Rest all educational infrastructure are unavailable in the study area.

Table 5-29 Educational infrastructure in the study area

Village Name	Government Pre - Primary School (Nursery/LKG/UKG)	Government Primary School	Government Middle School	Government Secondary School	Government Senior Secondary School
			Core area		
Nava Nagna	0	1	0	1	0
Juna Nagna	0	1	0	0	0
Navagam	0	1	0	1	0
Total Core	**0**	**3**	**0**	**2**	**0**
			Buffer area		
Gordhanpar	0	1	0	0	0
Dhinchda	0	1	0	0	0
Dhunvav	0	1	0	1	0
Khijadiya	0	1	0	0	0
Naghedi	0	1	0	0	0
Kansumara	0	1	0	0	0
Morkanda	0	1	0	1	0

Village Name	Government Pre - Primary School (Nursery/LKG/UKG)	Government Primary School	Government Middle School	Government Secondary School	Government Senior Secondary School
Theba	0	1	0	1	0
Hapa	0	1	0	1	0
Khimaliya	0	1	0	0	0
Jamnagar (OG) WARD NO.-0019 (Rural MDDS CODE:513673)	N/A	N/A	N/A	N/A	N/A
Total Buffer	**0**	**10**	**0**	**4**	**0**
Total study area	**0**	**13**	**0**	**6**	**0**

Source: 2011 Census of India

5.4.15 Energy usage

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.

5.4.16 Brief Profile of Ragpickers

After conducting a site visit to both the landfill area and the transfer station, it was observed that there were no ragpickers present at the Jamnagar Municipal Corporation (JMC) Theba landfill. However, a limited number of ragpickers were found engaged in rag picking activities at the transfer station. 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	10 females The number is based on the consultation and physical presence of ragpickers during the site visit.
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 either the General category or the Other Backward Class (OBC).
Migration	All ragpickers have migrated from Madhya Pradesh to Gujarat in search of better income opportunities, a move they made approximately 8-10 years ago. The distance from their native place to Jamnagar is approximately 1,000 kilometers.
Literacy among the family	All the family members of ragpickers are illiterate.
Number of year since involved in rag picking	8 years
Average income from repicking	INR 250-300/day
Other source of income	Primarily, females engage in rag picking, while males of the households pursue alternative sources of income such as employment as drivers in the JMC waste collection process, casual labor, and agricultural work, earning between INR 450-550 per day. Rag picking serves as a supplementary income source for the family.
Process of collection of waste and selling by Ragpickers	Ragpickers collects the recyclable from the freshly dumped waste at the transfer station. 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

Aspects	Description
	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 transfer stations (the transfer station is there even the plant is in operation phase). Furthermore, the project is currently in the operational phase, and there is no anticipated impact on the economic displacement of any ragpickers due to project operations. Additionally, the Project does not exercise control over the dumpsite and has not imposed any restrictions on access to the landfill site for ragpickers. During a recent site visit to the landfill, it was observed that no ragpickers were collecting waste at the landfill itself. However, there are ragpickers actively engaged in ragpicking activities at the transfer station. As reported, the operation of the project will not disrupt the functioning of the transfer station, and the ragpickers will continue to collect waste at the transfer station as they have been doing.
Accessibility of health infrastructure	All the ragpickers are going to the government owned hospital at the Jamnagar to avail the health facilities.

Source: Consultation with Ragpickers at Happa transfer station

5.5 Ecological Baseline

To understand the ecological sensitivity and to establish an ecological baseline (flora and fauna) of the study area, an ecological survey was conducted between 13th – 15th 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.

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.
- Identification of different habitats (natural, modified, and critical) falling within core and buffer zones.
- Documentation of floral and faunal [specifically herpetofauna (reptiles + amphibians), birds, and mammals] species based on direct sightings, calls, pugmarks (if any), etc.
- Trace out of any endangered or protected or restricted range floral species. Identification of any threatened (as per IUCN Red List), scheduled (as per Wildlife (Protection) Act, 1972), Endemic or restricted-range and migratory or congregatory faunal species (as defined in IFC PS 6) from the study area.
- Identification of wildlife migratory corridors, avian migratory routes, and other important areas for ecological reasons such as breeding, nesting, foraging, resting, etc.

5.5.2 Ecological Baseline - Data Collection Methods

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

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 habitat of IUCN Threatened and Restricted-range species; and Key Biodiversity Areas (KBAs), which include Important Bird and Biodiversity Areas (IBAs) in and around the project location. A list of floral and faunal species was also prepared along with their conservation status

(as per IUCN) and their status in the list of scheduled species [as per Wildlife (Protection) Act, 1972] utilizing collected secondary data during literature review. The dominant habitats in and around the project location was also identified with the help of google earth imagery and other available secondary data. The recognized (internationally and/or nationally) wildlife migratory corridors, and avian migratory routes were also identified with the available information.

5.5.2.2 Field Data Collection

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

5.5.2.2.1 Habitat Survey

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

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 were typically obtained from the authentic sources[51, 52];
III. Identification and classification of any species recognized as Threatened (in accordance with International Union for the Conservation of Nature [IUCN] Red List Online Version 2022-1) and according to the schedules of the Wildlife (Protection) Act, 1972; and
IV. Identification of areas which are important or sensitive for ecological reasons including their breeding, nesting, foraging, resting, overwintering areas including wildlife migratory corridors/avian migratory routes.

5.5.3 Ecological Baseline - Results

5.5.3.1 Literature Review - eBird Database

The historical data regarding the presence of birds in the region was extracted from the eBird Database[53]. The database indicates the presence of at least 325 avifaunal species in the area (10-15 km around the project site) (Appendix 18). The major objective to extract this information was to see the incidence of IUCN threatened birds, vultures, raptors, and migratory birds in the area. The eBird Database indicates the presence of three (03) Endangered [Great Knot (*Calidris tenuirostris*), Indian Skimmer (*Rynchops albicollis*), & Steppe Eagle (*Aquila nipalensis*)]; 6 Vulnerable [Asian Houbara (*Chlamydotis macqueenii*), Common Pochard (*Aythya farina*), Greater Spotted Eagle (*Clanga clanga*), Indian Spotted Eagle (*Clanga hastata*), River Tern (*Sterna aurantia*), & Sarus Crane (*Antigone antigone*)]; nineteen (19) Near Threatened [Alexandrine Parakeet (*Palaeornis eupatria*), Asian Dowitcher (*Limnodromus semipalmatus*), Asian Woollyneck (*Ciconia episcopus*), Bar-tailed Godwit (*Limosa lapponica*), Black-headed Ibis (*Threskiornis melanocephalus*), Black-necked Stork (*Ephippiorhynchus asiaticus*), Black-tailed Godwit (*Limosa limosa*), Curlew Sandpiper (*Calidris ferruginea*), Dalmatian Pelican (*Pelecanus crispus*), Eurasian Curlew (*Numenius arquata*), Eurasian Oystercatcher (*Haematopus ostralegus*), Falcated Duck (*Mareca falcata*), Ferruginous Duck (*Aythya nyroca*), Great Thick-Knee (*Esacus recurvirostris*), Lesser Flamingo (*Phoeniconaias minor*), Oriental Darter (*Anhinga melanogaster*), Painted Stork (*Mycteria leucocephala*), Pallid Harrier (*Circus macrourus*), & Red Knot (*Calidris canutus*)]; and 21 Schedule I [Bonelli's Eagle, Booted Eagle, Brahminy Kite, Crested Serpent-Eagle, Eurasian Buzzard, Eurasian Sparrowhawk, Eurasian Spoonbill, Greater Spotted Eagle, Indian Grey Hornbill, Indian Peafowl, Long-legged Buzzard, Montagu's Harrier, Osprey, Pallid Harrier, Peregrine Falcon, Red-necked

[51] 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.

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

[53] https://ebird.org/barchart?byr=2001&eyr=2023&bmo=1&emo=12&r=L3779178,L10716817,L3779051,L3778642,L2136331,L2586216,L8887056,L3794282,L3517352,L3794757,L4535214,L5095702,L3517377,L3809607,L14907241,L3794727,L3916588

Falcon, Shikra, Short-toed Snake-Eagle, Steppe Eagle, Western Marsh-Harrier, & White-eyed Buzzard] species in the area (***Table 5-30***). This secondary information also reports 29 raptor species from the region (***Table 5-31***); while no vulture was reported from the region. As per the database, at least 161 migratory birds including two Endangered [Great Knot (*Calidris tenuirostris*), & Steppe Eagle (*Aquila nipalensis*)]; three Vulnerable [Asian Houbara (*Chlamydotis macqueenii*), Common Pochard (*Aythya ferina*), & Greater Spotted Eagle (*Clanga clanga*)]; eleven Near Threatened [Asian Dowitcher (*Limnodromus semipalmatus*), Bar-tailed Godwit (*Limosa lapponica*), Black-tailed Godwit (*Limosa limosa*), Curlew Sandpiper (*Calidris ferruginea*), Dalmatian Pelican (*Pelecanus crispus*), Eurasian Curlew (*Numenius arquata*), Eurasian Oystercatcher (*Haematopus ostralegus*), Falcated Duck (*Mareca falcata*), Ferruginous Duck (*Aythya nyroca*), Pallid Harrier (*Circus macrourus*), & Red Knot (*Calidris canutus*)] and 12 Schedule I [Booted Eagle, Crested Serpent-Eagle, Eurasian Buzzard, Eurasian Sparrowhawk, Greater Spotted Eagle, Long-legged Buzzard, Montagu's Harrier, Osprey, Pallid Harrier, Red-necked Falcon, Steppe Eagle, & Western Marsh-Harrier] species were reported from the area. As per the available secondary data[54], Greater Flamingo, Lesser Flamingo, Ruff, Demoiselle Crane, Common Coot, Gadwall, Common Crane, Whiskered Tern, Northern Shoveler, Common Teal, & Eurasian Oystercatcher are the key migratory and/or congregatory species from the area.

Table 5-30 Threatened and Near 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	Great Knot	*Calidris tenuirostris*	M	Endangered	Schedule IV
2	Steppe Eagle	*Aquila nipalensis*	M	Endangered	Schedule I
3	Asian Houbara (Macqueen's Bustard)	*Chlamydotis macqueenii*	M	Vulnerable	Not Listed
4	Common Pochard	*Aythya ferina*	M	Vulnerable	Schedule IV
5	Greater Spotted Eagle	*Clanga clanga*	M	Vulnerable	Schedule I
6	Asian Dowitcher	*Limnodromus semipalmatus*	M	Near Threatened	Schedule IV
7	Bar-tailed Godwit	*Limosa lapponica*	M	Near Threatened	Schedule IV
8	Black-tailed Godwit	*Limosa limosa*	M	Near Threatened	Schedule IV
9	Curlew Sandpiper	*Calidris ferruginea*	M	Near Threatened	Schedule IV
10	Dalmatian Pelican	*Pelecanus crispus*	M	Near Threatened	Schedule IV
11	Eurasian Curlew	*Numenius arquata*	M	Near Threatened	Schedule IV
12	Eurasian Oystercatcher	*Haematopus ostralegus*	M	Near Threatened	Schedule IV
13	Falcated Duck	*Mareca falcata*	M	Near Threatened	Schedule IV
14	Ferruginous Duck	*Aythya nyroca*	M	Near Threatened	Schedule IV
15	Pallid Harrier	*Circus macrourus*	M	Near Threatened	Schedule I
16	Red Knot	*Calidris canutus*	M	Near Threatened	Schedule IV

Table 5-31 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	Amur Falcon	*Falco amurensis*	M	Least Concern	Schedule IV
2	Black Kite	*Milvus migrans*	R	Least Concern	Schedule II
3	Black-winged Kite	*Elanus caeruleus*	R	Least Concern	Schedule II

[54] eBird Database [https://ebird.org/hotspot/L2136331; https://ebird.org/hotspot/L3517352; https://ebird.org/hotspot/L3794727; https://ebird.org/hotspot/L3916588; https://ebird.org/hotspot/L3517377; https://ebird.org/hotspot/L3779051; https://ebird.org/hotspot/L3779178; https://ebird.org/hotspot/L14907241; https://ebird.org/hotspot/L10716817; https://ebird.org/hotspot/L2586216; https://ebird.org/hotspot/L3778642; https://ebird.org/hotspot/L8887056; https://ebird.org/hotspot/L3794282; https://ebird.org/hotspot/L3809607; https://ebird.org/hotspot/L3794757; https://ebird.org/hotspot/L4535214; https://ebird.org/hotspot/L5095702]

S.N.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
4	Bonelli's Eagle	*Aquila fasciata*	R	Least Concern	Schedule I
5	Booted Eagle	*Hieraaetus pennatus*	M	Least Concern	Schedule I
6	Brahminy Kite	*Haliastur indus*	R	Least Concern	Schedule I
7	Common Kestrel	*Falco tinnunculus*	M	Least Concern	Schedule IV
8	Crested Serpent-Eagle	*Spilornis cheela*	M	Least Concern	Schedule I
9	Eurasian Buzzard	*Buteo buteo*	M	Least Concern	Schedule I
10	Eurasian Hobby	*Falco subbuteo*	M	Least Concern	Schedule IV
11	Eurasian Sparrowhawk	*Accipiter nisus*	M	Least Concern	Schedule I
12	Greater Spotted Eagle	*Clanga clanga*	M	Vulnerable	Schedule I
13	Indian Scops-owl	*Otus bakkamoena*	R	Least Concern	Schedule IV
14	Indian Spotted Eagle	*Clanga hastata*	R	Vulnerable	Not Listed
15	Long-legged Buzzard	*Buteo rufinus*	M	Least Concern	Schedule I
16	Montagu's Harrier	*Circus pygargus*	M	Least Concern	Schedule I
17	Oriental Honey-buzzard	*Pernis ptilorhynchus*	R	Least Concern	Schedule II
18	Osprey	*Pandion haliaetus*	M	Least Concern	Schedule I
19	Pallid Harrier	*Circus macrourus*	M	Near Threatened	Schedule I
20	Pallid Scops-Owl	*Otus brucei*	M	Least Concern	Schedule IV
21	Peregrine Falcon	*Falco peregrinus*	R	Least Concern	Schedule I
22	Red-necked Falcon	*Falco ruficollis*	M	Least Concern	Schedule I
23	Shikra	*Accipiter badius*	R	Least Concern	Schedule I
24	Short-eared Owl	*Asio flammeus*	M	Least Concern	Schedule IV
25	Short-toed Snake-Eagle	*Circaetus gallicus*	R	Least Concern	Schedule I
26	Spotted Owlet	*Athene brama*	R	Least Concern	Schedule IV
27	Steppe Eagle	*Aquila nipalensis*	M	Endangered	Schedule I
28	Western Marsh-Harrier	*Circus aeruginosus*	M	Least Concern	Schedule I
29	White-eyed Buzzard	*Butastur teesa*	R	Least Concern	Schedule I

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[55] [Open Scrub, Wetland (Mangroves), Water Body], and modified habitats[56] [Salt Pans, & Agricultural Lands]. 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***.

[55] Natural habitats are not to be interpreted as untouched or pristine habitats. It is likely that the majority of habitats designated as natural will have undergone some degree of historical or recent anthropogenic impact. The question is the degree of impact. If, in the judgement of a competent professional, the habitat still largely contains the principal characteristics and functions of a native ecosystem(s), it should be considered a natural habitat regardless of some degree of degradation and/or the presence of some invasive alien species, secondary forest, human habitation, or other human-induced alteration.

[56] Modified habitats are areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area's primary ecological functions and species composition. It may include areas managed for agriculture, forest plantations, reclaimed coastal zones, and reclaimed wetlands.

The project is located on municipal corporation land. The area covered by different habitats in the study area has been provided in ***Table 5-32***. Among the natural habitats, wetland (mangroves) is the dominate one with about 54.03 km^2 area, while the agricultural land is the dominant modified habitat with about 73.65 km^2 area of the total land in the study area.

Table 5-32 Area covered by different habitats in the study area

Natural Habitats	Area covered	
	km²	%
Wetland (Mangroves)	54.03	17.31
Sea	44.81	14.35
Water bodies	4.10	1.31
Rivers	2.54	0.81

Modified Habitats	Area covered	
	km²	%
Agricultural Land	73.65	23.59
Settlements	62.76	20.11
Salt Pans	25.53	8.18
Aiport	6.81	2.18
Roads	4.75	1.52
Railway Line	2.05	0.66

Figure 5-33 Distribution of habitats in the study area

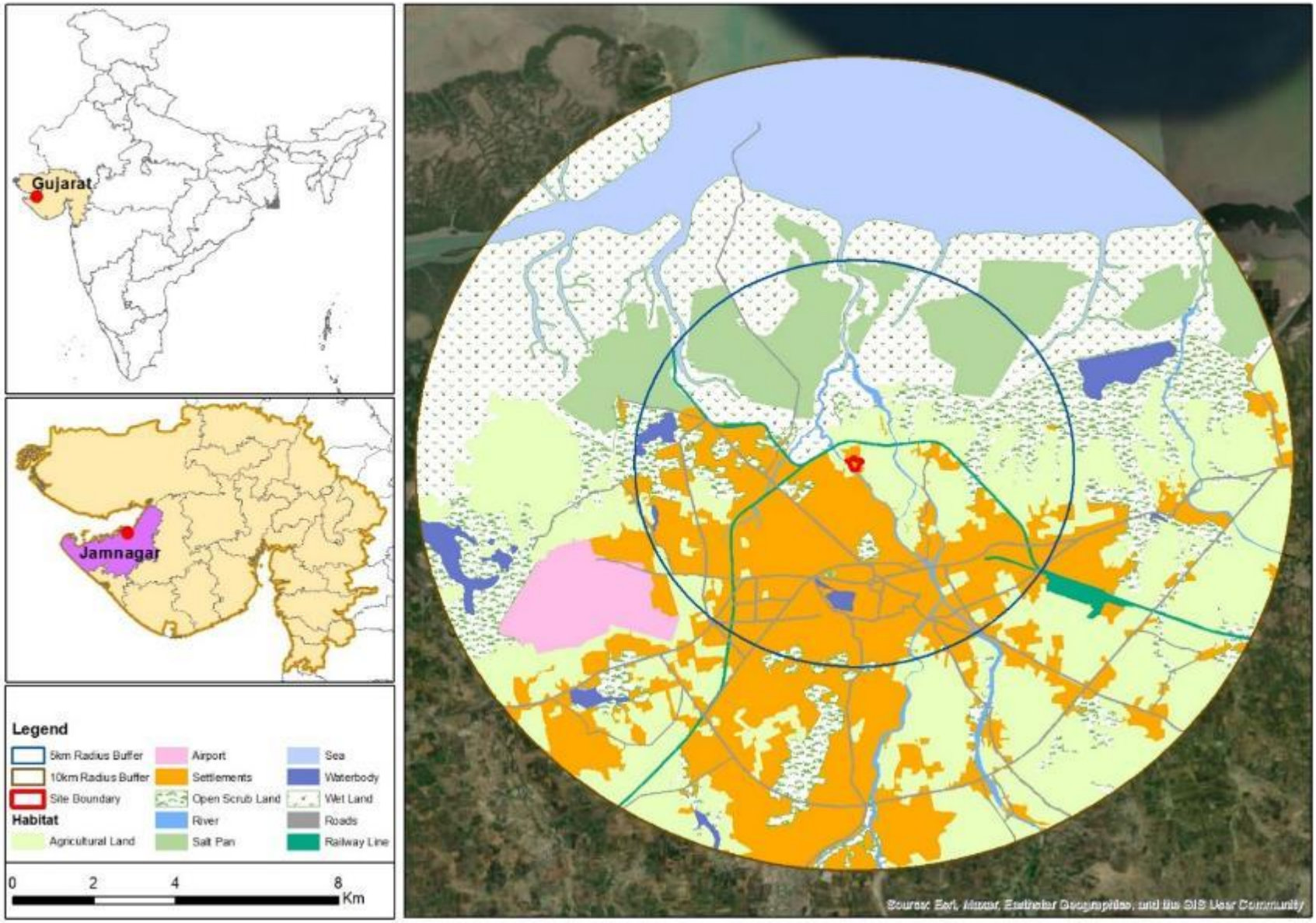


Figure 5-34 Habitats in the study area

Open Scrub

Wetland (Mangroves)

Water Body

Salt pan

Agricultural Land

5.5.3.3 Floral Survey

5.5.3.3.1 Vegetation Profile

As per the available information, the project is coming on the Semi - Arid – Gujarat Rajputana (4B) Biogeographical Province of India[57], Deccan Plateau (Malwa Plateau, Gujarat plains and Kathiawar peninsula) (Hot, Semi-arid eco-region with moderately deep black soils) Agro-ecological Region[58] and Gujarat plains and hills region (XII) Agro-Climatic Region[59]. The vegetation of the region may be defined as Northern Tropical thorn forest (6B) according to forest classification of Champion and Seth (1968)[60].

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 fifty-seven (57) floral species belonging to twenty-one (25) families were observed in the study area. Fabaceae was the most dominating family in the area with 12 species. None 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 5-33***.

Table 5-33 Floral diversity of the study area

S.N.	Binomial Scientific Name	Family	Life form	IUCN Red List - Categories
1	*Abutilon indicum* (L.) Sweet	Malvaceae	Herb	Not assessed
2	*Acacia nilotica* (L.) Delile	Fabaceae	Tree	Least Concern

[57] 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.

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

[59] http://iasri.res.in/agridata//12data%5Cchapter1%5Cdb2012tb1_2.pdf

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

S.N.	Binomial Scientific Name	Family	Life form	IUCN Red List - Categories
3	*Acalypha indica* L.	Euphorbiaceae	Herb	Not assessed
4	*Achyranthes aspera* L.	Amaranthaceae	Herb	Not assessed
5	*Aerva lanata* (L.) Juss. ex Schult.	Amaranthaceae	Herb	Not assessed
6	*Ailanthus excelsa* Roxb.	Simaroubaceae	Tree	Not assessed
7	*Alstonia scholaris* (L.) R. Br.	Apocynaceae	Tree	Least Concern
8	*Alternanthera sessilis* (L.) R.Br. ex DC.	Amaranthaceae	Herb	Least Concern
9	*Avicennia marina* (Forssk.) Vierh.	Acanthaceae	Tree	Least Concern
10	*Azadirachta indica* A.Juss.	Meliaceae	Tree	Least Concern
11	*Balanites roxburghii* Planch.	Zygophyllaceae	Tree	Not assessed
12	*Calotropis gigantea* (L.) Dryand.	Apocynaceae	Tree	Not assessed
13	*Calotropis procera* (Aiton) Dryand.	Apocynaceae	Shrub	Least Concern
14	*Capparis decidua* (Forssk.) Edgew.	Capparaceae	Shrub	Least Concern
15	*Cassia fistula* L.	Fabaceae	Tree	Least Concern
16	*Casuarina equisetifolia* L.	Casuarinaceae	Tree	Least Concern
17	*Celosia argentea* L.	Amaranthaceae	Herb	Least Concern
18	*Cocos nucifera* L.	Arecaceae	Tree	Not assessed
19	*Dactyloctenium aegyptium* (L.) Willd.	Poaceae	Grass	Not assessed
20	*Datura innoxia* Mill.	Solanaceae	Herb	Not assessed
21	*Delonix regia* (Hook.) Raf.	Fabaceae	Tree	Least Concern
23	*Euphorbia caducifolia* Haines	Euphorbiaceae	Tree	Not assessed
24	*Euphorbia hirta* L.	Euphorbiaceae	Herb	Not assessed
25	*Euphorbia tirucalli* L.	Euphorbiaceae	Tree	Least Concern
26	*Ficus benghalensis* L.	Moraceae	Tree	Not assessed
27	*Ficus racemosa* L.	Moraceae	Tree	Least Concern
28	*Ficus religiosa* L.	Moraceae	Tree	Least Concern
29	*Ficus virens* Aiton	Moraceae	Tree	Least Concern
30	*Ipomoea aquatica* Forssk.	Convolvulaceae	Herb	Least Concern
31	*Ipomoea carnea* Jacq.	Convolvulaceae	Shrub	Not assessed
32	*Lantana camara* L.	Verbenaceae	Shrub	Not assessed
33	*Launaea procumbens* (Roxb.) Ramayya & Rajagopal	Asteraceae	Herb	Not assessed
34	*Leucaena leucocephala* (Lam.) de Wit	Fabaceae	Tree	Not assessed
35	*Mangifera indica* L.	Anacardiaceae	Tree	Data Deficient
36	*Moringa oleifera* Lam.	Moringaceae	Tree	Least Concern
37	*Operculina turpethum* (L.) Silva Manso	Convolvulaceae	Climber	Not assessed
38	*Parkinsonia aculeata* L.	Fabaceae	Tree	Least Concern
39	*Passiflora foetida* L.	Passifloraceae	Climber	Not assessed
40	*Peltophorum pterocarpum* (DC.) K.Heyne	Fabaceae	Tree	Not assessed
41	*Phoenix sylvestris* (L.) Roxb.	Arecaceae	Tree	Not assessed

S.N.	Binomial Scientific Name	Family	Life form	IUCN Red List - Categories
42	*Pithecellobium dulce* (Roxb.) Benth.	Fabaceae	Tree	Least Concern
43	*Pongamia pinnata* (L.) Pierre	Fabaceae	Tree	Least Concern
44	*Prosopis juliflora* (Sw.) DC.	Fabaceae	Tree	Not assessed
45	*Ricinus communis* L.	Euphorbiaceae	Small Tree	Not assessed
46	*Salvadora persica* L.	Salvadoraceae	Tree	Least Concern
47	*Senna occidentalis* (L.) Link	Fabaceae	Herb	Least Concern
48	*Senna siamea* (Lam.) H.S.Irwin & Barneby	Fabaceae	Tree	Least Concern
49	*Solanum nigrum* L.	Solanaceae	Herb	Not assessed
50	*Solanum virginianum* L.	Solanaceae	Herb	Not assessed
51	*Spathodea campanulata* P.Beauv.	Bignoniaceae	Tree	Least Concern
52	*Suaeda maritima* (L.) Dumort.	Amaranthaceae	Herb	Not assessed
53	*Tamarindus indica* L.	Fabaceae	Tree	Least Concern
54	*Tridax procumbens* (L.) L.	Asteraceae	Herb	Not assessed
55	*Xanthium strumarium* L.	Asteraceae	Herb	Not assessed
56	*Ziziphus mauritiana* Lamk.	Rhamnaceae	Tree	Least Concern
57	*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[61], local consultation and field survey, 13 herpetofauna (reptiles + amphibians) species were reported / observed from the study area. Indian Softshell Turtle (*Nilssonia gangetica*) was categorized as Endangered, and Bengal Monitor Lizard (*Varanus bengalensis*) was categorized as Near Threatened category of the IUCN Red List (Online Version 2022-2). Bengal Monitor Lizard and Indian Softshell Turtle were also listed under the Schedule I category as per the Wildlife (Protection) Act, 1972 (***Table 5-34***).

Table 5-34 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	Asiatic Water Snake	*Fowlea piscator*	Not assessed	Schedule II	Observed
2	Bengal Monitor Lizard	*Varanus bengalensis*	Near Threatened	Schedule I	Observed
3	Common Krait	*Bungarus caeruleus*	Not assessed	Schedule IV	Reported
4	Common Skittering Frog	*Euphlyctis cyanophlyctis*	Least Concern	Schedule IV	Observed
5	Golden Skink	*Eutropis carinata*	Least Concern	Not listed	Reported
6	Hardwicke's Bloodsucker	*Calotes minor*	Data Deficient	Not listed	Reported
7	Indian Bullfrog	*Hoplobatrachus tigerinus*	Least Concern	Schedule IV	Reported
8	Indian Cobra	*Naja naja*	Least Concern	Schedule II	Reported
9	Indian Softshell Turtle	*Nilssonia gangetica*	Endangered	Schedule I	Reported
10	Oriental Garden Lizard	*Calotes versicolor*	Not assessed	Not listed	Observed
11	Oriental Ratsnake	*Ptyas mucosa*	Not assessed	Schedule II	Reported

[61] https://www.inaturalist.org/places/jamnagar#taxon=26036

S.N.	Common English Name	Binomial Scientific Name	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules	Reported / Observed
12	Russell's Viper	*Daboia russelii*	Least Concern	Schedule II	Reported
13	Saw-scaled Vipers	*Echis carinatus*	Least Concern	Not listed	Reported

5.5.3.4.2 Avifauna (Birds)

During the field survey, 56 avifaunal species were observed from the study area, which include one Vulnerable [River Tern (Sterna aurantia)]; and four Near Threatened [Black-headed Ibis (*Threskiornis melanocephalus*), Black-necked Stork (*Ephippiorhynchus asiaticus*), Oriental Darter (*Anhinga melanogaster*), & Painted Stork (*Mycteria leucocephala*)] as per IUCN Red List (Online Version 2022-2). Six (06) Schedule I species (as per the Wildlife (Protection) Act, 1972) - Black Kite, Black-winged Kite, Brahminy Kite, Eurasian Spoonbill, Indian Peafowl, & Shikra were also observed from the area. Only three (03) Migratory [Common Coot (*Fulica atra*), Common Sandpiper (*Actitis hypoleucos*), & Little Stint (*Calidris minuta*)], and 04 Raptors [Black Kite (*Milvus migrans*), Black-winged Kite (*Elanus caeruleus*), Brahminy Kite (*Haliastur indus*), & Shikra (*Accipiter badius*)] species were also observed in the study area (***Table 5-35***). The survey was conducted in mid of May 2023, which is outside the migratory season. Thus, based on this primary observation, it may not be concluded that the area has not been supporting migratory bird species in the winter.

Table 5-35 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	African Comb Duck	*Sarkidiornis melanotos*	R	Least Concern	Schedule IV
2	Ashy Prinia	*Prinia socialis*	R	Least Concern	Schedule IV
3	Asian Green Bee-eater	*Merops orientalis*	R	Least Concern	Schedule IV
4	Asian Koel	*Eudynamys scolopaceus*	R	Least Concern	Schedule IV
5	Baya Weaver	*Ploceus philippinus*	R	Least Concern	Schedule IV
6	Black Drongo	*Dicrurus macrocercus*	R	Least Concern	Schedule IV
7	Black Kite	*Milvus migrans*	R	Least Concern	Schedule II
8	Black-headed Ibis	*Threskiornis melanocephalus*	R	Near Threatened	Schedule IV
9	Black-necked Stork	*Ephippiorhynchus asiaticus*	R	Near Threatened	Schedule IV
10	Black-winged Kite	*Elanus caeruleus*	R	Least Concern	Schedule II
11	Black-winged Stilt	*Himantopus himantopus*	R	Least Concern	Schedule IV
12	Brahminy Kite	*Haliastur indus*	R	Least Concern	Schedule I
13	Cattle Egret	*Bubulcus ibis*	R	Least Concern	Schedule IV
14	Common Babbler	*Argya caudata*	R	Least Concern	Schedule IV
15	Common Coot	*Fulica atra*	M	Least Concern	Schedule IV
16	Common Hoopoe	*Upupa epops*	R	Least Concern	Not Listed
17	Common Myna	*Acridotheres tristis*	R	Least Concern	Schedule IV
18	Common Sandpiper	*Actitis hypoleucos*	M	Least Concern	Schedule IV
19	Eurasian Collared-Dove	*Streptopelia decaocto*	R	Least Concern	Schedule IV
20	Eurasian Spoonbill	*Platalea leucorodia*	R	Least Concern	Schedule I
21	Great Cormorant	*Phalacrocorax carbo*	R	Least Concern	Schedule IV
22	Greater Coucal	*Centropus sinensis*	R	Least Concern	Schedule IV
23	Greater Flamingo	*Phoenicopterus roseus*	R	Least Concern	Schedule IV
24	Grey Francolin	*Francolinus pondicerianus*	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
25	Grey Heron	*Ardea cinerea*	R	Least Concern	Schedule IV
26	House Crow	*Corvus splendens*	R	Least Concern	Schedule V
27	House Sparrow	*Passer domesticus*	R	Least Concern	Schedule IV
28	Indian Cormorant	*Phalacrocorax fuscicollis*	R	Least Concern	Schedule IV
29	Indian Peafowl	*Pavo cristatus*	R	Least Concern	Schedule I
30	Indian Robin	*Saxicoloides fulicata*	R	Least Concern	Schedule IV
31	Indian Roller	*Coracias benghalensis*	R	Least Concern	Schedule IV
32	Indian Spot-billed Duck	*Anas poecilorhyncha*	R	Least Concern	Schedule IV
33	Intermediate Egret	*Ardea intermedia*	R	Least Concern	Schedule IV
34	Laughing Dove	*Streptopelia senegalensis*	R	Least Concern	Schedule IV
35	Lesser Whistling-duck	*Dendrocygna javanica*	R	Least Concern	Schedule IV
36	Little Cormorant	*Microcarbo niger*	R	Least Concern	Schedule IV
37	Little Egret	*Egretta garzetta*	R	Least Concern	Schedule IV
38	Little Grebe	*Tachybaptus ruficollis*	R	Least Concern	Schedule IV
39	Little Stint	*Calidris minuta*	M	Least Concern	Schedule IV
40	Oriental Darter	*Anhinga melanogaster*	R	Near Threatened	Schedule IV
41	Oriental Magpie-Robin	*Copsychus saularis*	R	Least Concern	Schedule IV
42	Painted Stork	*Mycteria leucocephala*	R	Near Threatened	Schedule IV
43	Purple Sunbird	*Nectarinia asiatica*	R	Least Concern	Schedule IV
44	Purple Swamphen	*Porphyrio porphyrio*	R	Least Concern	Schedule IV
45	Red-naped Ibis	*Pseudibis papillosa*	R	Least Concern	Schedule IV
46	Red-vented Bulbul	*Pycnonotus cafer*	R	Least Concern	Schedule IV
47	Red-wattled Lapwing	*Vanellus indicus*	R	Least Concern	Schedule IV
48	River Tern	*Sterna aurantia*	R	Vulnerable	Schedule IV
49	Rock Dove	*Columba livia*	R	Least Concern	Schedule IV
50	Rose-ringed Parakeet	*Psittacula krameri*	R	Least Concern	Schedule IV
51	Shikra	*Accipiter badius*	R	Least Concern	Schedule I
52	Western Reef-Egret	*Egretta gularis*	R	Least Concern	Schedule IV
53	White-breasted Kingfisher	*Halcyon smyrnensis*	R	Least Concern	Schedule IV
54	White-breasted Waterhen	*Amaurornis phoenicurus*	R	Least Concern	Schedule IV
55	White-browed Wagtail	*Motacilla maderaspatensis*	R	Least Concern	Schedule IV
56	White-eared Bulbul	*Pycnonotus leucotis*	R	Least Concern	Schedule IV

5.5.3.4.3 Mammals

As per the literature review[62, 63], local consultation and field survey, 09 mammals were recorded (reported and observed) from the study area. None of the species was categorized under Threatened category of the IUCN Red List (Online Version

[62] https://jamnagar.nic.in/tourist-place/khijadia-bird-sanctuary/
[63] https://forests.gujarat.gov.in/khijadia-sanctuary.htm

2022-2); three species, Bengal Fox (*Vulpes bengalensis*), Jungle Cat (*Felis chaus*), & Golden Jackal (*Canis aureus*) were listed under the Schedule I category as per the Wildlife (Protection) Act, 1972 (***Table 5-36***).

Table 5-36 Mammals from the study area

S.N.	Common English Name	Binomial Scientific Name	IUCN Red List - Categories	Wildlife (Protection) Act. 1972 - Schedules	Reported / Observed
1	Bengal Fox	*Vulpes bengalensis*	Least Concern	Schedule I	Reported
2	Five-striped Palm Squirrel	*Funambulus pennantii*	Least Concern	Schedule IV	Observed
3	Golden Jackal	*Canis aureus*	Least Concern	Schedule I	Reported
4	Indian Flying Fox	*Pteropus giganteus*	Least Concern	Schedule II	Reported
5	Indian Grey Mongoose	*Herpestes edwardsii*	Least Concern	Schedule II	Observed
6	Indian Hare	*Lepus nigricollis*	Least Concern	Schedule II	Observed
7	Jungle Cat	*Felis chaus*	Least Concern	Schedule I	Reported
8	Nilgai	*Boselaphus tragocamelus*	Least Concern	Schedule II	Observed
9	Wild Boar	*Sus scrofa*	Least Concern	Schedule II	Observed

5.5.3.5 Protected and Key Biodiversity Areas[64], [65]

Marine Sanctuary is the nearest protected area, situated about 1.8 km from the project location in north direction; while Marine National Park is situated about 9.5 km away from the project area in northwest direction. Another protected area as well as Important Bird and Biodiversity Areas (IBA) and Samsar site, Khejadiya Wildlife Sanctuary ais situated about 5 km away from the project location in East-Northeast directions (***Figure 5-35***).

The project is about 300 m away from the nearest boundary of Coastal Regulation Zone II (CRZ II) -Developed Land Areas (Municipal Limits / Urban Areas)[66] (***Figure 5-36***).

5.5.3.5.1 Marine National Park and Sanctuary[67],[68]

The Marine National Park (16,289 ha) and Sanctuary (29,503 ha) is located in the inter-tidal zone, extending over, 170 km along the coast of Jamnagar in the Gulf of Kutch, and includes 42 islands. As per the final Eco-Sensitive Zone (ESZ) notification dated: 22.08.2013, "boundary of the ESZ from coastal boundary towards landward side extends up to a length of one kilometer". A total of 86 waterbirds was recorded in the salt works, and 80 species on the islands and coasts along the Gulf of Kutch[69]. It holds the only breeding populations of Greater Flamingo (*Phoenicopterus roseus*), Lesser Flamingo (*Phoeniconaias minor*), Great White Pelican (*Pelecanus onocrotalus*), and Pied Avocet (*Recurvirostra avosetta*) in the country. There are 42 islands in Marine National Park, with Pirotan as the star attraction. Some of these islands have breeding colonies of Painted Stork (*Mycteria leucocephala*), Grey Heron (*Ardea cinerea*), Great Egret (*Casmerodius albus*), Black-crowned Night-heron (*Nycticorax nycticorax*), Striated Heron (*Butorides striatus*), Black-headed Ibis (*Threskiornis melanocephalus*), and Eurasian Spoonbill (*Platalea leucorodia*). Of the 42 islands, 33 have coral reefs and these, with the mangroves along the coast and the intertidal areas, support several species of marine biota. Studies carried out by various institutions record 70 species of sponges, 56 species of hard and soft corals, 180 species of fishes, 27 species of prawns, 30 species of crabs, more than 200 species of molluscs, over 12 species of echinoderms, five species of annelids, many species

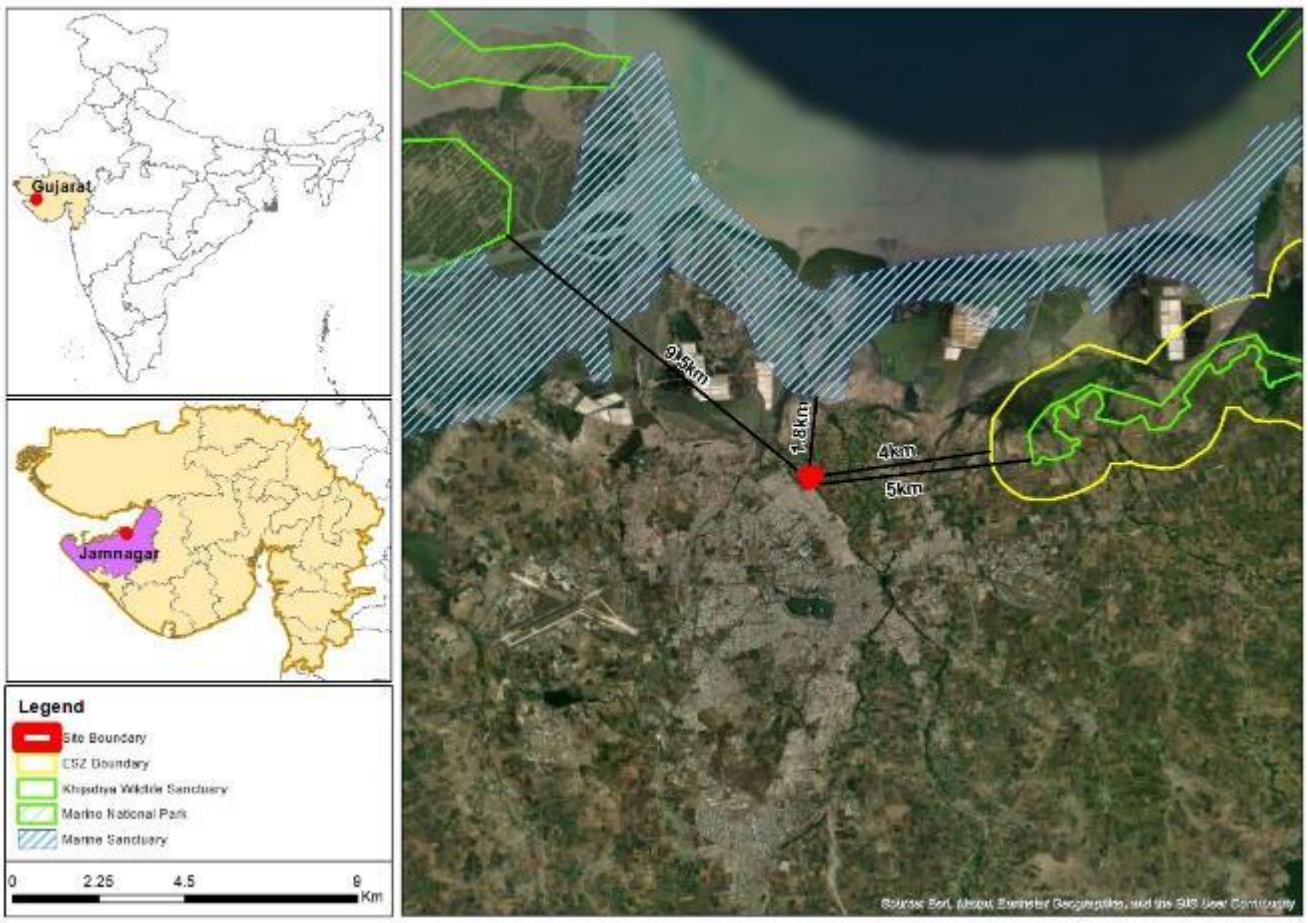
[64] http://wiienvis.nic.in/Database/Maps_PAs_1267.aspx
[65] Rahmani A.R., Islam M.Z. and Kasambe R.M. (2016) Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated). Bombay Natural History Society, Indian Bird Conservation Network, Royal Society for the Protection of Birds and BirdLife International (U.K.), p. 1992 + xii.
[66] https://czmp.ncscm.res.in/
[67] https://moef.gov.in/wp-content/uploads/2017/06/S.O.%202561%20%5B22.08.2013%5D%20Final%20ESZ%20Notification%20on%20Marine%20National%20and%20Marine%20Sanctuary%2C%20Gujarat.pdf
[68] Rahmani A.R., Islam M.Z. and Kasambe R.M. (2016) Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated). Bombay Natural History Society, Indian Bird Conservation Network, Royal Society for the Protection of Birds and BirdLife International (U.K.), p. 1992 + xii.
[69] Naik R.M., Murthy M.S., Mansuri A.P., Rao Y.N., Pervez R., Mundkur T., Krishan S., Faldu P.J. and Krishan T.S.V.R. (1991) Coastal Marine Ecosystems and Anthropogenic Pressure in the Gulf of Kachchh. WWF-India sponsored Research Project: Final Report. Department of Biosciences, Saurashtra University, Jamnagar. pp. 287.

of reptiles (including three species of endangered sea turtles), and three species of marine mammals [Dugong (*Dugong dugon*), Common Dolphin (*Delphinus delphis*), & Whale (*Physeter catodon*)] from the national park and sanctuary area.

5.5.3.5.2 Khejadiya Wildlife Sanctuary[70],[71]

Khijadiya Bird Sanctuary is a group of three shallow freshwater lakes and extensive marshes adjacent to a large area of salt pans and salt marshes. It lies on the southern shore of the Gulf of Kutch, about 10 km from Jamnagar. The primary allure of Khijadia Wildlife Sanctuary lies in its abundant variety of avifauna, establishing it as a significant waterbird habitat in North-West India. It represents a distinctive blend of "Saltwater-Freshwater" ecosystems encompassing diverse habitat types that provide a home to 312 bird species, including a range of species classified under different categories within the IUCN Red List. The sanctuary offers an ideal environment for both resident water and land birds, fulfilling roles as breeding, feeding, and roosting grounds. Its strategic positioning near the Gulf of Kachchh and along the Central Asian Flyway (CAF) makes it a vital location for migratory waterbirds, functioning as a crucial wintering and stopover destination during their migration. Among these migratory species are endangered and vulnerable ones, including the Common Pochard (*Aythya ferina*) and the Indian Skimmer (*Rynchops albicollis*). More than 200 species of birds have been recorded from the sanctuary including 90 species of waterfowl and waders. Sanctuary also supports 5 species of fishes, 4 species of prawns, 21 species of butterflies, 7 species reptiles, 183 species of plants and 7 species of mammals.

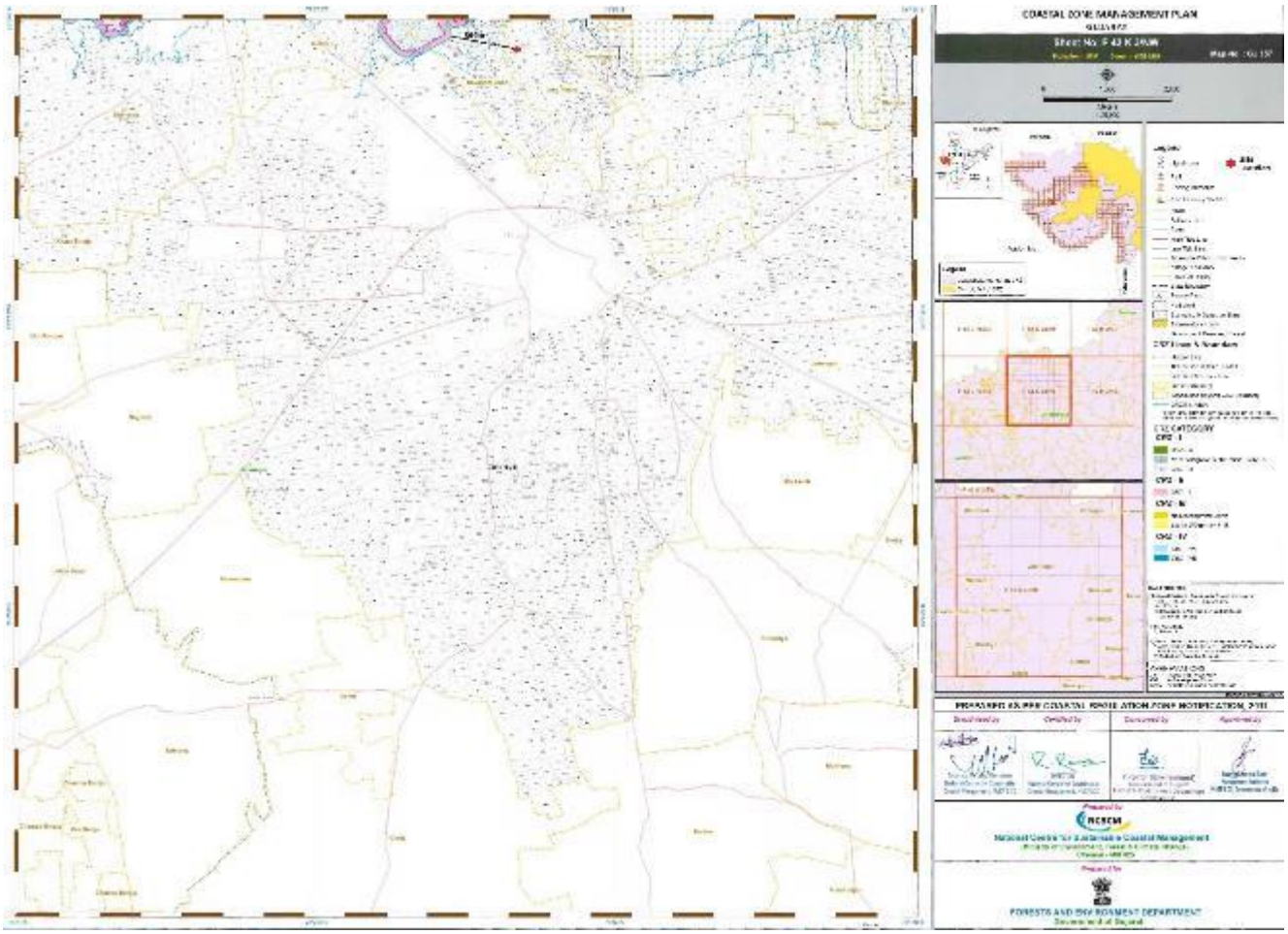
Figure 5-35 Protected and Key Biodiversity Areas around the project site



[70] https://moef.gov.in/wp-content/uploads/2017/06/khijadia.pdf

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

Figure 5-36 Coastal Regulation Zone around the project site



5.5.3.6 Bird Migration Flyways

India majorly lies in the Central Asian Flyway[72] (***Figure 5-37***). More than 300 species travel along the Central Asian Flyway, including a significant movement of the family Anatidae (Ducks, Geese and Swan), Gruidae (Cranes), etc. that travel from Europe/North Asia to the Indian subcontinent and occupy medium to large water bodies.

As per the eBird Database[73], at least 161 migratory birds including two Endangered [Great Knot (*Calidris tenuirostris*), & Steppe Eagle (*Aquila nipalensis*)]; three Vulnerable [Asian Houbara (*Chlamydotis macqueenii*), Common Pochard (*Aythya ferina*), & Greater Spotted Eagle (*Clanga clanga*)]; eleven Near Threatened [Asian Dowitcher (*Limnodromus semipalmatus*), Bar-tailed Godwit (*Limosa lapponica*), Black-tailed Godwit (*Limosa limosa*), Curlew Sandpiper (*Calidris ferruginea*), Dalmatian Pelican (*Pelecanus crispus*), Eurasian Curlew (*Numenius arquata*), Eurasian Oystercatcher (*Haematopus ostralegus*), Falcated Duck (*Mareca falcata*), Ferruginous Duck (*Aythya nyroca*), Pallid Harrier (*Circus macrourus*), & Red Knot (*Calidris canutus*)] and 12 Schedule I [Booted Eagle, Crested Serpent-Eagle, Eurasian Buzzard, Eurasian Sparrowhawk, Greater Spotted Eagle, Long-legged Buzzard, Montagu's Harrier, Osprey, Pallid Harrier, Red-necked Falcon, Steppe Eagle, & Western Marsh-Harrier] species were reported from the region (***Table 5-30***). This secondary information also reports 29 raptor species from the region (***Table 5-31***). Greater Flamingo, Lesser Flamingo, Ruff, Demoiselle Crane, Common Coot, Gadwall, Common Crane, Whiskered Tern, Northern Shoveler, Common Teal, & Eurasian Oystercatcher are the key congregatory species from the region[74].

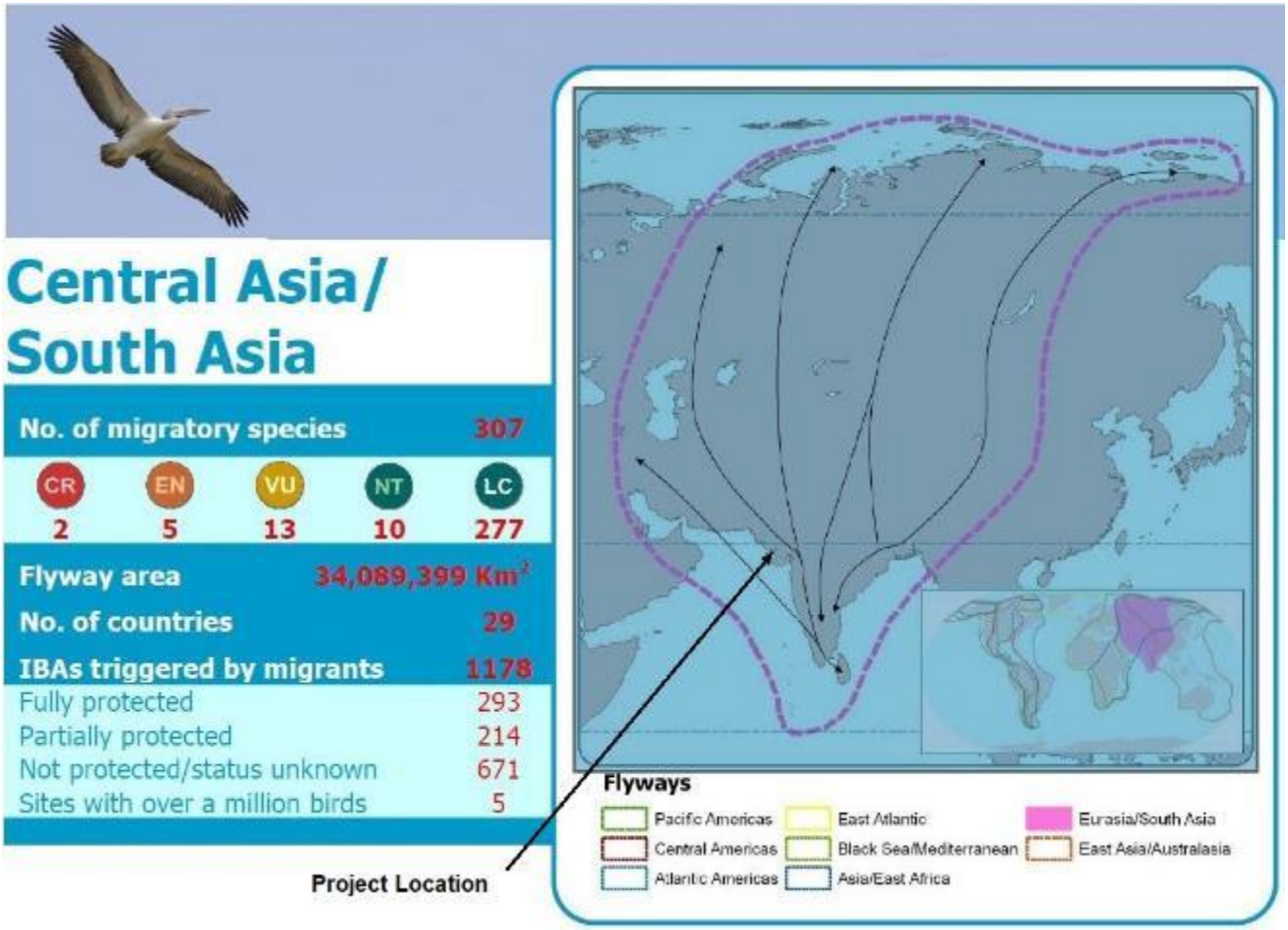
[72] http://datazone.birdlife.org/userfiles/file/sowb/flyways/7_Central_Asia_Factsheet.pdf

[73] https://ebird.org/barchart?byr=2001&eyr=2023&bmo=1&emo=12&r=L3779178,L10716817,L3779051,L3778642,L2136331,L2586216,L8887056,L3794282,L3517352,L3794757,L4535214,L5095702,L3517377,L3809607,L14907241,L3794727,L3916588

[74] eBird Database [https://ebird.org/hotspot/L2136331; https://ebird.org/hotspot/L3517352; https://ebird.org/hotspot/L3794727; https://ebird.org/hotspot/L3916588; https://ebird.org/hotspot/L3517377; https://ebird.org/hotspot/L3779051; https://ebird.org/hotspot/L3779178; https://ebird.org/hotspot/L14907241; https://ebird.org/hotspot/L10716817; https://ebird.org/hotspot/L2586216; https://ebird.org/hotspot/L3778642;

Since there are no overhead transmission lines (TL) within the scope of this project, the risk of birds colliding with or being electrocuted by TL infrastructure is non-existent.

Figure 5-37 Location of Project Site in the Central Asian Flyway



5.5.3.7 Critical Habitat Screening

5.5.3.7.1 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 10-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.

This EAAA encompasses portions of two protected as well as two Important Bird and Biodiversity Areas (IBA), Marine National Park and Sanctuary and Khejadiya Wildlife Sanctuary. It's worth noting that while the boundaries of both the protected areas extend beyond the 10-kilometer radius, the EAAA was limited to this range due to variations in habitat within the EAAA and the remaining parts of protected areas. It's important to understand that this conceptualized EAAA is provisional and subject to change following a comprehensive survey for Critical Habitat Assessment.

5.5.3.7.2 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

https://ebird.org/hotspot/L8887056; https://ebird.org/hotspot/L3794282; https://ebird.org/hotspot/L3809607; https://ebird.org/hotspot/L3794757; https://ebird.org/hotspot/L4535214; https://ebird.org/hotspot/L5095702]

species likely to occur in and around the project location is presented in **Appendix 21**. Based on this exercise, a list of screened-in species for Critical Habitat Assessment has been identified and presented in ***Table 5-37*** below.

Table 5-37 List of Species Screened In for Critical Habitat Assessment

S.N.	Common English Name	Binomial Scientific Name	CHA Criteria
1	Indian Skimmer	(*Rynchops albicollis*)	1a,c
2	Dalmatian Pelican	(*Pelecanus crispus*)	3a
3	Demoiselle Crane	(*Anthropoides virgo*)	3a

The above species would need to be confirmed through the detailed site assessment as per the scope of Critical Habitat Assessment, to confirm the presence and abundance of these species as well as their suitable habitat(s); undertake stakeholder consultations; and discuss with species-specific experts in the area to further assess whether the Project site can be classified as 'Critical Habitat'.

6 Stakeholder Identification and Engagement

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.

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 plan applies to the operation phase of the Project.

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 6-1*** given below:

Table 6-1 Stakeholder group categorisation

Category	Primary Stakeholders	Secondary Stakeholder
Community	• Opinion holders • Community leaders • Local communities living near the WTE plant. • Ragpickers involved in Rag picking at happa transfer station	
Institutional Stakeholders	• Jamnagar Municipal Corporation • Project Investors	• Village Institutions (education and health department) • Political Parties
Government Bodies	• Jamnagar Municipal Corporation • Regulatory Authorities • District Administration	• State Administration
Other Groups	• 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 stage. 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 persons, groups, institutions, or organization who have interest/influence over project., it is difficult to identify all potential stakeholders and gauge their level of influence over 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 project lifecycle.

Table 6-2 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					
Local Communities living near the plants	Refer to ***Section 5.4*** 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 (WTE) 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	The local community living near the waste-to-energy (WTE) 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	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	• 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
		during waste transportation to minimize disruptions and ensure the safety of residents.	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 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	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. • 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.	

Relevant Stakeholders	Profile	Concerns and Expectations from the project	Influence of Stakeholder on Project	Influence of Project on Stakeholder	Influence Rating
			transparency and ensures that concerns are promptly addressed, fostering a positive relationship		
Opinion Holder and Community Leaders	Municipality where the WTE plant is located. The WTE plant is located in Navagam gram panchayat.	• The expectations and concerns of this group from the project includes: – Receiving benefits from the project in terms of employment and development of infrastructure and the community – Regular updates on the project activities and the opportunities from the same	• This group 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**
Ragpickers involved in rag picking at the transfer station.	There are 10 ragpickers are involved in rag picking at the Happa Transfer station (refer to ***Section 5.4.16*** for more details)	Ragpickers may have limited concerns and expectations related to the Project: • No stoppage of them from collecting waste from the transfer station. • 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 rag picking on the Project can manifest in several ways: • 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. • The relationship between the project and the ragpicker community can significantly influence the	The influence of the Project on ragpickers with primary occupation in rag picking, are provided below: • 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,	• 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
			project's acceptance and success. Building positive relations involves addressing concerns, providing support, and considering the socio-economic aspects of the ragpicker community.	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.	
Jamnagar Municipal Corporation (JMC)	The Jamnagar Municipal Corporation (JMC) serves as the local governing body entrusted with the oversight of civic infrastructure and administration in the city of Jamnagar, Gujarat, India. Positioned as a pivotal local government entity, JMC assumes responsibility for the management of diverse urban services, with a particular emphasis on waste management. In the context of the Waste-to-Energy (WTE) Plant project within the city, JMC assumes a central role as the governing authority. This is underscored by the formal agreement issued by JMC, sanctioning the	The Jamnagar Municipal Corporation (JMC) 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 JMC 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	The Jamnagar Municipal Corporation (JMC) can have a significant influence on the Project at various stages of its lifecycle. Provided below key aspects of JMC's potential influence on the Project: • JMC 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 JMC. • JMC plays a pivotal role in the selection of the site for the waste-to-energy plant, ensuring compliance with	The influence of the Project on the Jamnagar Municipal Corporation (JMC) 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 Jamnagar by providing an alternative and sustainable method for waste disposal. It may lead to reduced landfill through usage of bio mined waste in the energy producing process.	• Influence of Stakeholder: **HIGH** • 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
	construction and operation of the Project. Notably, JMC 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 JMC's pivotal role in the execution and success of the Project.	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 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 JMC and the Project.	local zoning regulations and municipal planning considerations. • As the entity responsible for waste management in the city, JMC 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. • JMC 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. • JMC 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 JMC and the project developers depends on the performance, compliance, and mutual satisfaction.	• Project's environmentally friendly technologies, can positively influence JMC's efforts to mitigate the environmental impact of waste disposal, addressing concerns related to pollution and land use. • The project can enhance JMC'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 JMC's 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	

Relevant Stakeholders	Profile	Concerns and Expectations from the project	Influence of Stakeholder on Project	Influence of Project on Stakeholder	Influence Rating
			JMC's influence is evident in negotiations for contract renewals	sites, and minimizing environmental degradation. • A successful and environmentally responsible waste-to-energy project can enhance JMC'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. JMC 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 JMC & 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	The key expectations and concerns of the group from the project include: • Project's compliance to the regulatory requirements	• This stakeholder group is critical for obtaining various permits/clearances required for the commissioning of	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
	through the decentralization process.	• Timely disclosure of information and provisioning of updates throughout the life of the project	the project and its smooth functioning thereafter. • This group serves as important points of contact between the state 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 • Business continuity • Payment of wages and other concerns related to Labor welfares.	• 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	• 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
		• 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		the well-being of the project workforce.	
Contractual workers	This group is comprised of skilled and semi-skilled workers, involved in the project on a contractual basis.	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	• 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	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**

Relevant Stakeholders	Profile	Concerns and Expectations from the project	Influence of Stakeholder on Project	Influence of Project on Stakeholder	Influence Rating
		generation and a source of income. • Timely settlement of dues and payments in keeping with the legal requirements • Continued work opportunities. • Safety at work.	formation of public opinion towards the project		
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	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: • 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
		• Adequate community development activities throughout the life of the project; and • Timely disclosure of information pertaining to the project activities.			
State Administration	The state administration is comprised of the state level agencies of the various departments/authorities such as industries department, revenue department, labour department and land department etc.	The main expectations and concerns of the stakeholder group from the project include: • Compliance to the regulatory requirements for the project • Project's role in the development of the area • Timely disclosure of information pertaining to the project activities	This stakeholder group is also critical for the obtaining of the various permits/clearances required for the commissioning of the project.	The influence of the project on the stakeholders pertains to the role the project will play in the development of energy in the state	• Influence of Stakeholder: **HIGH** • Influence of Project: **LOW**
Media	The media, comprising of both print and visual media, has a presence in the district. They are known to have played an extremely important role in generating awareness amongst the community.	The main expectations and concerns of the stakeholder from the project include: • Media may express concerns about the potential environmental impact of the Project, such as air emissions, ash disposal, and overall sustainability. • 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	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: • Media coverage shapes public perception of the WTE project. Positive coverage can generate support, while negative stories may lead to scepticism or opposition. • Media can influence community	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 communication helps journalists and reporters in creating well-informed narratives. • The project can facilitate media access to key information,	• 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
		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	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	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 first-hand 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.	

Relevant Stakeholders	Profile	Concerns and Expectations from the project	Influence of Stakeholder on Project	Influence of Project on Stakeholder	Influence Rating
		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.	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.		

6.1 Engagement undertaken – Pre-impact assessment.

According to the discussions undertaken with the project team and other stakeholders, 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 Jamnagar municipal corporation.

6.2 Engagement as part of the Impact assessment – this assignment

As part of ESIA process, consultations were carried out with the project team, staff, workers and affected family. These consultations were carried to assess the potential impacts of the project on the different stakeholders, and the potential risks and concerns of the stakeholders. The subsequent section provides an understanding of the engagement activities undertaken as part of the ESIA process. The summary of the discussion carried out during the ESIA process is given in ***Table 6-3*** below:

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, , 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
Project site	Head of Affected Family (HH)	Discussion with head of the affected family whose ~`3-acre land was acquired for the project. Discission was carried to understand the land ownership, tenure of status on land, potential impacts , payment of compensation and other livelihood assistance provided . As informed the by the HH , land which was acquired for the project which was traditionally owned by their family however they don't have the valid documents for the land. And due to absence of land documents Project has treated them as interested persons and reportedly had given compensation of land and for livelihood restoration offered job to the head of the household. Currently he is engaged in the plant operations and was working as gardener (Mali). As informed, he was very happy and satisfied with the project and has no potential concerns with the project.

7 Impact Assessment & Mitigation Measures

This section assesses the manner in which the Project interacts with elements of the physical, ecological or social environment to produce impacts on resources/ receptors.

7.1 Project Activities

An overview of the activities during operation phase of the Project has been summarised below.

Note: *Since the project is in operation and maintenance phase, impacts for the completed construction activities and Pre-construction and mobilization Phase has been scoped out.*

Table 7-1 Project Activities

Sr. No.	Project Phase	Activities
1.	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 • 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 operation phase 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 7-4** along with Key environmental and social impacts due to project interaction as 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 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	• 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 Jamnagar tehsil falls is an area marked as “safe” in terms of groundwater development, • The project has been allocated 1 million litres per day (MLD) secondary treated water from 70 MLD sewage treatment plant (STP) operated by JMC for industrial requirement and 7.5 m3/day groundwater from Central Ground Water Authority (CGWA) for domestic purpose. Approximately 770 m3/day water is required in total. • 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 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 operation phase may have impact on the aforementioned receptors.
4	Impact on Ambient Noise	• 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 operation activities involves a range of occupational health and safety risks and hazards mainly for the contractors and workers (local and/or migrant) who are involved in the operation phase. • Lack of relevant PPEs, training on health and safety, absence of adequate H&S system increases the risk of worker’s exposure to operation hazards. Some of the serious risks during 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. Workers may be exposed to odour, pathogens, flue gas emission from boiler, exposure to fly ash which may cause skin and respiratory disorders. • Impacts of Accidental Spillage of Stored Chemicals and Untreated Effluents
6	Increased employment and livelihood	• Based on the current understanding of the project the project is having potential of generating employment during operation stage. Nearly 170 staff including subcontracted staff are working during operations stage.

Sr. No.	Potential Risk/ Impact	Risks Identified
7	Human-Wildlife Conflicts	• The power project is surrounded by natural [Open Scrub, Wetland (Mangroves), Water Body] and modified [Salt Pans, & Agricultural Lands] habitats; and Marine National Park & Sanctuary and Khejadiya Wildlife Sanctuary are also present within the 10 km buffer. Rangamati river stream also flows adjacent to the project boundary in the southwest direction. These habitats and protected areas support several herpetofauna, avifauna, and mammals (as described in the ecological baseline). Access of these wildlife in the project compound as well as their movement along the boundary of the project during the operation phase may cause a risk of Human-Wildlife conflicts.
8	Impact of increased traffic / vehicle movement	• Although the transportation of municipal waste to the Waste to Energy plant comes under the scope of Jamnagar Municipal Corporation (JMC), however the potential impact of Increased Traffic / Vehicle Movement has been assessed here as it is a linked activity.

7.2.1.1 Scoped Out-Potential Interactions

Since the project is in operation phase, therefore the impacts on the following resources during construction phase have been scoped out.

Table 7-3 Scoped Out-Potential Interactions

<table>
<tr><th>S.no.</th><th>Aspect</th><th>Rationale for Scoping Out</th></tr>
<tr><td>1.</td><td>Pre-Construction, Construction and Mobilization activities</td><td>The Project is currently in Operation phase since November 2021. Therefore, impact pertaining to pre-construction, construction and mobilization phase on soil, topography & drainage, air, ground water from the project as well as project components have been scoped out</td></tr>
<tr><td>2.</td><td>Land Use</td><td>The previous land use for the project was barren land, while 18% was cultivated by a single household. Land was leased from Jamnagar Municipal Corporation for a period of 25 years. Hence, change is land use is scoped out.

Also, laying of underground water pipeline and portion of underground transmission line does not impact the land use of the route, therefore has been scoped out

Further, based on the site visit, the total land falling under the transmission line and water pipeline with land use category is provided below:

Transmission Line
<table>
<tr><th>Land Use Category</th><th>Area (acres)</th></tr>
<tr><td>Project Land (10.38 meters)</td><td>0.002568</td></tr>
<tr><td>Road Land (28.93 meters)</td><td>0.007158</td></tr>
<tr><td>Substation Land (17.18 meters)</td><td>0.0043</td></tr>
<tr><td>Total (56.4 meters)</td><td>0.01398</td></tr>
</table>

Water Pipeline
<table>
<tr><th>Land Use Category</th><th>Area (acres)</th></tr>
<tr><td>Project Land (5 meters)</td><td>0.001235</td></tr>
<tr><td>Road Land (36.42 meters)</td><td>0.008993</td></tr>
<tr><td>Substation Land (282.36 meters)</td><td>0.069773</td></tr>
<tr><td>Total (324 meters)</td><td>0.0800</td></tr>
</table>
</td></tr>
</table>

S.no.	Aspect	Rationale for Scoping Out
3	Ambient Air Quality Impacts due to O&M of transmission line and water pipeline	During operation phase, no significant impact on air quality is envisaged since transmission line is non-polluting and does 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.
4	Habitat Modification and Loss due to Vegetation Clearance	Around 82% of the land area within the Project site was designated as barren or unused, with the remaining 18% comprising cultivated land. The project has been operational since November 2021, with initial construction activities commencing between February and March 2019. Consequently, the assessment of habitat modification and loss resulting from site clearance is not feasible and has been scoped out.
5	Impacts on the Habitat and Species due to Construction Activities	Given that the construction activities for the Project began in February-March 2019 and the project has been operational since November 2021, evaluating the effects of construction activities on the habitat and species is currently impractical. Therefore, the assessment of such impacts has been scoped out.
6	Collision and Electrocution Risk to the Avifaunal species	Since there are no overhead transmission lines (TL) within the scope of this project, the Collision and Electrocution Risk to the Avifaunal species by TL infrastructure has been scoped out.

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	Occupational Health and	Community
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 facilities such as 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 operation phase 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 the Project foot prints 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 1 month;
	Medium Duration	when impact is likely to be restricted for duration of more than 1 month 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 operation of the project

The potential impacts from 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	Short	High	Substantial
	Medium	Moderate	
	Medium	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	
	Permanent	High	

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

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

- Low
- Medium
- High.

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

- Unexpected
- Possible
- Expected

Table 7-5 Criteria for Receptor Vulnerability

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

Table 7-6 Probability of Incidence Occurrence

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

7.4 Impacts Assessment-Operation Phase

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

Table 7-7 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

7.4.1 Air Quality

Primary sources of air emission from the project 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
- Dust generation during legacy waste collection, sorting and transportation.
- 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.

Dust emissions from the vehicles are anticipated during transportation of waste to the plant. ~ 100 and 20 trucks per day transport fresh waste and legacy waste to the Project site.

Transportation of fresh waste from the garbage stations is done using trucks of capacity 5 tonnes with average waste transportation distance of about 20 km/vehicle and for legacy waste the average transportation distance is about 90-

100km. The fresh waste generated by the Jamnagar city is being brought straight to the plant and limited quantity of waste is also being routed through Happa transfer station post sorting and segregation. All the waste vehicles currently use the road that is leading from Nava Gam Ghed city. The road is proposed by JMC, which is an unpaved road leading to significant dust generation from movement of vehicles. This road will be developed by JMC and will be the main access roads for all the incoming waste and outgoing vehicles from the plant. Currently, village residents and community use the road mainly to access the adjoining farmlands. The road is planned to be constructed in 1- 2 years' time. The dust emissions from the waste transportation are present due to the project, however the waste collection and waste transportation to the plant is in the scope of the Jamnagar Municipal Corporation.

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 (~ 100 TPD of ash is being 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 operates at 40 KG pressure and 410-degree temperature. Major emissions from the boiler stack are Poly Chlorinated-p-dioxins (PCDD) and related furans (PCDF), SOx, NOx, CO, HCL, HF, Mercury, and its compounds, PM10, PM2.5, Cadmium + Thorium and their compounds, Scandium + Arsenic + Lead + cobalt + Chromium + Copper + Manganese + Nickel + Vanadium and their compounds. The flue gas emission from the boilers disperses 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 used to clean the flue gas to achieve the prescribed norms is as tabulated hereunder.

Table 7-8 Technology adopted for cleaning of Flue gas

Flue Gas Component	Adopted 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 or sodium bicarbonate
Mercury and its compounds	• Activated carbon injection for mercury adsorption.
PM10, PM2.5	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 that is used to reduce acid gas emissions
Scandium + Arsenic + Lead + cobalt + Chromium + Copper + Manganese + Nickel + Vanadium and their compounds	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

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). GWJPL suppresses the formation of dioxin and furan by reducing the retention time in the above-mentioned temperature.

Odor 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 1500 MT) with incoming waste ~ 450 tonnes per day generates odor due to the decomposition of organic substances. Odor generated impacts the workers present within the project site, especially H_2S, when inhaling in high concentrations.

7.4.1.1 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 Meteorological data of 2022 (1st January 2022- 31st December 2022) for normal and worst-case condition and Incremental Ground Level Concentration (GLC) 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.

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. One stack has been considered for calculation of emission factor to get ground level concentration.
2. Emission parameter values have been calculated based on operating data of plant.

3. Two Conditions are considered for Plant operation one is Normal condition with APCD installed and another is worst condition with failure of APCD. Plant operation is considered under two conditions: normal with APCD installed and worst with APCD failure.
4. Plant operation conditions are considered as 24 hrs. in normal (with APCD).
5. Worst Case Scenario has also been considered for 1 Hour, taking into account failure of APCD.
6. 99% efficiency of Air Pollution Control Devices (ESP and Bag house filter) has been considered for removal for Particulate Matters
7. For the removal of gases (NO2 and SO2), 50% removal efficiency of the Air Pollution Control Device (Hydrated lime injection System) is considered, with approximately 50% of gas released from the stack into the ambient.
8. CO values are considered for both conditions. In normal conditions, values align with average daily data as per MSW Norms, 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. Line source model has been used for calculation of Fugitive Dust emission from Transportation.
10. Fugitive dust emission calculated for PM10 and PM2.5 in Normal condition.
11. For worst condition only point source considered.
12. Small segments of line source have been taken as the road is divided into several segments. Generations of fugitive dust from the segments are considered to be equally distributed along the segment (as per the consideration of the model).
13. 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.
14. 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).
15. All the inputs related to positions of source and receptors are taken in UTM (Universal Transverse Mercator).
16. Rectangular grids receptors are considered for dispersion result with 500m x 500m grid.
17. Location is falling under datum 42Q.
18. Orientation Angle has been taken 0° as North and accordingly locations of sources have been defined in clockwise direction.
19. Operating data limits have been calculated along with efficiency of APCD for calculation of emission factors for Normal and worst-case conditions.
20. The ground level concentration on settlements has been calculated on the basis of isopleth superimposed on the Google Earth.
21. As this is an operational plant so emissions have been calculated as the 98 percentile from the source emission i.e. from Boiler stack

Identification of Source

The operational plant is a waste to energy-based power plant; one stack has been considered as the point source for emission. MSW (Segregated Waste), and RDF is used in boiler. Flue Gas cleaning system is installed after complete heat recovery from hot gas. This controls all defined emissions as per emission norms before it leaves to atmosphere through boiler Chimney (stack). Fugitive emission is considered as line source. The major pollutants are considered as PM_{10}, $PM_{2.5}$, NOx, SO_2 and CO only from stack. Sources of pollutants this includes:

- Process Stack – PM10, PM2.5, NOx, SO2, CO
- Road Transport (internal and external considering paved and unpaved roads)– Fugitive dust

Table 7-9 Details of Boiler

Sr. No.	Parameter	Unit	Operation of Boiler
1.	Capacity	TPH	40
2.	Stack Height	m	40
3.	Stack Diameter	m	2.1
4.	Velocity	m/s	10-15

Details of traffic used for modelling is presented in ***Table 7-10*** below:

Table 7-10 Vehicular Movement

Sr. No.	Material Type	Vehicle Type	Vehicle Model	Loading Capacity in MT	Avg Moving Vehicle / Day	Avg Max Vehicle Mov/ Hour	Avg Min Vehicle Mov/ Hour	Time Period
1	MSW	Tipper (BS IV), diesel based	ACE Mega / SK 407	1.03 / 2.3	100	10	5	07:00 to 19:00
2	MSW	Compactor (BS IV), diesel based	1109 Ex2	6.5	8	2	1	
3	MSW	Dumper (BS IV), diesel based	SK 1613 / LPT 2518	11.7 / 25	20	2	1	
4	MSW	Chhagada (BS IV), diesel based	Gem Cargo	0.5	2	1	0	
5	RDFs	Truck (BS IV), diesel based	3118	24	18	5	3	19:00 to 07:00

Table 7-11 Emissions in Normal and Worst-Case Scenario

Emissions in Normal and Worst-Case Scenario from stack				
Sr. No.	Pollutant	Emission rate (mg/Nm3)	Emission rate in Normal Condition (g/s)	Emission rate in Worst Condition (g/s)
1.	PM10	46.28	1.910	191.04
2.	PM2.5	46.28	1.910	191.04
3.	NOx	91.9	3.794	7.587
4.	SO_2	71.06	2.933	5.865
5.	CO	10.38	0.428	0.642

Emission Rate for Fugitive Dust Emission			
Sr. No.	Pollutant	Emission rate in Normal Condition (g/s-m2)	
		Paved Road	Unpaved Road
6.	PM10	5.27611E-06	8.362E-07
7.	PM2.5	1.26168E-06	8.362E-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 center of site as the center 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 the 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 procured 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. Life of the plant is 25 years, significant changes in the met data in another 25 years is not anticipated.

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 for all the pollutants was modelled.

Based on the 24 hours averaging period results, maximum incremental GLC (24 hours averaging period, in normal conditions and 1 hour for worst case scenario) for the PM10, PM2.5, NOx, SO_2 and CO (8 hours averaging period, in normal conditions) on the baseline conditions are:

Normal Case

- PM10 – 4.041 ug/m3
- PM2.5 – 4.018 ug/m3
- NOx – 8.233 ug/m3
- CO- 4.899 ug/m3 (8 hours average)
- SO_2- 8.18 ug/m3

Worst Case (1 hour)

- PM10 –3308.82 ug/m3
- PM2.5 – 3308.82 ug/m3
- NOx – 135.693 ug/m3
- CO- 14.208 ug/m3
- SO_2- 109.85 ug/m3

Detailed Results for 24 hour averaging period (for PM 10, PM2.5, 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* below.

Referring to the modelling results:

- PM10: Maximum GLC is observed to be 4.04µg/m^3 at a distance of 340m from the Project Site. With the increase in distance, GLC is getting reduced and by 1.65 km distance, the concentration is getting reduced to 1.0µg/m^3.
- PM2.5: Maximum GLC is observed to be 4.01 µg/m^3 at a distance of 340m from the Project Site. With the increase in distance, GLC is getting reduced and by 1.65 km distance, the concentration is getting reduced to 1.0µg/m^3
- NOx: Maximum GLC is observed to be 8.23 µg/m^3 at 350 m away from the project site. With the increase in distance, GLC is getting reduced and by 1.2 km distance, the concentration is getting reduced to 3.0 µg/m^3.
- SO2: Maximum GLC is observed to be 8.18 µg/m^3 at the Project site. With the increase in distance from the Project, GLC is getting reduced and by 950 m distance, the concentration is getting reduced to 3.0 µg/m^3.
- CO: Maximum GLC concentration is observed to be 4.89 µg/m^3 at Project Site itself.

Table 7-12 Results for Incremental Ground Level Concentrations at the sensitive receptors within 10 km radius for NO_x[75]

Sr. No.	Sensitive Receptors	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	Navanagna	611482	2488378	1.7 Km; E	1	3	30	NAAQS Permissible Limits for NO_2 (24 Hr) : 80 µg/m³ IFC/WB Ambient Air Quality Standards for NO_2 (WHO Guidelines): 1 year: 40 µg/m³ 1 hour: 200 µg/m³
2	Navagam	610215	2486824	1.3 Km; SE	1	3	30	
3	Naghedi	603897	2481484	8.8 Km; SW	1	3	8	
4	Kansumara	606090	2480584	8.3 Km; SW	0.5	1	8	
5	Khimliya	613484	2479674	9.2 Km; SE	0.3	0.6	8	
6	Theba	616541	2481777	9.2 Km; SE	0.3	0.6	8	
7	Hapa	617764	2483542	9.2 Km; SE	0.3	0.6	8	
8	Hapa Industrial Area Jamnagar	614987	2485648	5.7 Km; SE	0.5	1	8	
9	Dhunvav	616830	2487095	7.2 Km; SE	0.5	1	10	
10	Khijadiya	618896	2489554	9.3 Km; NE	0.3	0.6	5	
11	Jamnagar	608588	2484573	3.7 Km; SW	1	2	20	
12	Morkanda	612904	2481631	7.2 Km; SE	0.3	0.8	8	
13	Lalapur	607767	2482666	5.8 Km; SW	0.5	1	10	
14	Dhichada	604853	2487538	4.8 Km; W	0.5	1	10	
15	Kadiawad	610713	2484922	3.3 Km; SE	1	2	20	
16	INS Valsura	607836	2492119	4.4 Km; NW	0.1	0.3	5	
17	Gordhanpar	601066	2483902	9.6 Km; SW	0.3	0.6	6	
18	Vibhapar	612684	2487113	3.0 Km; SE	1	2	20	
19	Khodiyar colony	607939	2485629	2.8 Km; SE	1	3	30	
20	Shantivan Society	612351	2484882	4.0 Km; SE	0.8	2	20	
21	Industrial Estate	607671	2487044	2.2 Km; SW	1	2	20	
22	Bedeswer	606627	2488058	3.0 Km; W	0.6	1	10	
23	Bedi	607410	2488274	2.3 Km; W	0.8	2	20	
24	Green City	609632	2480858	7.0 Km; S	0.6	1	10	
25	Lumbini Nagar	615087	2482423	7.6 Km; SE	0.3	0.8	8	
26	Defense Colony	606078	2485890	4.1 Km; SW	0.8	2	20	

[75] 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 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.

Table 7-13 Results for Incremental Ground Level Concentrations at the sensitive receptors within 10 km radius for PM_{10}

Sr. No.	Sensitive Receptors	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	Navanagna	611482	2488378	1.7 Km; E	1	100	200	NAAQS Permissible Limits (24 Hr) : 100 µg/m³ IFC/WB Ambient Air Quality Standards (WHO Guidelines): 24 hour values 150 µg/m³ (Interim target 1) 100 µg/m³ (Interim target 2) 75 µg/m³ (Interim target 3) 50 µg/m³ (guideline)
2	Navagam	610215	2486824	1.3 Km; SE	1	70	400	
3	Naghedi	603897	2481484	8.8 Km; SW	0.2	10	100	
4	Kansumara	606090	2480584	8.3 Km; SW	0.2	10	100	
5	Khimliya	613484	2479674	9.2 Km; SE	0.1	10	200	
6	Theba	616541	2481777	9.2 Km; SE	0.1	10	200	
7	Hapa	617764	2483542	9.2 Km; SE	0.1	10	100	
8	Hapa Industrial Area Jamnagar	614987	2485648	5.7 Km; SE	0.2	10	200	
9	Dhunvav	616830	2487095	7.2 Km; SE	0.2	10	200	
10	Khijadiya	618896	2489554	9.3 Km; NE	0.1	10	60	
11	Jamnagar	608588	2484573	3.7 Km; SW	0.5	50	200	
12	Morkanda	612904	2481631	7.2 Km; SE	0.2	10	200	
13	Lalapur	607767	2482666	5.8 Km; SW	0.2	10	200	
14	Dhichada	604853	2487538	4.8 Km; W	0.2	10	100	
15	Kadiawad	610713	2484922	3.3 Km; SE	0.5	50	200	
16	INS Valsura	607836	2492119	4.4 Km; NW	0.1	10	100	
17	Gordhanpar	601066	2483902	9.6 Km; SW	0.1	10	100	
18	Vibhapar	612684	2487113	3.0 Km; SE	0.6	50	200	
19	Khodiyar colony	607939	2485629	2.8 Km; SE	0.6	70	200	
20	Shantivan Society	612351	2484882	4.0 Km; SE	0.4	30	200	
21	Industrial Estate	607671	2487044	2.2 Km; SW	0.6	50	400	
22	Bedeswer	606627	2488058	3.0 Km; W	0.2	30	200	
23	Bedi	607410	2488274	2.3 Km; W	0.4	30	200	
24	Green City	609632	2480858	7.0 Km; S	0.2	30	200	
25	Lumbini Nagar	615087	2482423	7.6 Km; SE	0.2	10	100	
26	Defense Colony	606078	2485890	4.1 Km; SW	0.2	30	200	

Table 7-14 Results for Incremental Ground Level Concentrations at the sensitive receptors within 10 km radius for $PM_{2.5}$

Sr. No.	Sensitive Receptors	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	Navanagna	611482	2488378	1.7 Km; E	1	100	200	NAAQS Permissible Limits (24 Hr) : 60 µg/m³ IFC/WB Ambient Air Quality Standards (WHO Guidelines): 24 hour values (µg/m³) 75 (Interim target 1) 50 (Interim target 2) 37.5 (Interim target 3) 25 (guideline)
2	Navagam	610215	2486824	1.3 Km; SE	1	70	400	
3	Naghedi	603897	2481484	8.8 Km; SW	0.2	10	100	
4	Kansumara	606090	2480584	8.3 Km; SW	0.2	10	100	
5	Khimliya	613484	2479674	9.2 Km; SE	0.1	10	200	
6	Theba	616541	2481777	9.2 Km; SE	0.1	10	200	
7	Hapa	617764	2483542	9.2 Km; SE	0.1	10	100	
8	Hapa Industrial Area Jamnagar	614987	2485648	5.7 Km; SE	0.2	10	200	
9	Dhunvav	616830	2487095	7.2 Km; SE	0.2	10	200	
10	Khijadiya	618896	2489554	9.3 Km; NE	0.1	10	60	
11	Jamnagar	608588	2484573	3.7 Km; SW	0.5	50	200	
12	Morkanda	612904	2481631	7.2 Km; SE	0.2	10	200	
13	Lalapur	607767	2482666	5.8 Km; SW	0.2	10	200	
14	Dhichada	604853	2487538	4.8 Km; W	0.2	10	100	
15	Kadiawad	610713	2484922	3.3 Km; SE	0.5	50	200	
16	INS Valsura	607836	2492119	4.4 Km; NW	0.1	10	100	
17	Gordhanpar	601066	2483902	9.6 Km; SW	0.1	10	100	
18	Vibhapar	612684	2487113	3.0 Km; SE	0.6	50	200	
19	Khodiyar colony	607939	2485629	2.8 Km; SE	0.6	70	200	
20	Shantivan Society	612351	2484882	4.0 Km; SE	0.4	30	200	
21	Industrial Estate	607671	2487044	2.2 Km; SW	0.6	50	400	
22	Bedeswer	606627	2488058	3.0 Km; W	0.2	30	200	
23	Bedi	607410	2488274	2.3 Km; W	0.4	30	200	
24	Green City	609632	2480858	7.0 Km; S	0.2	30	200	
25	Lumbini Nagar	615087	2482423	7.6 Km; SE	0.2	10	100	
26	Defense Colony	606078	2485890	4.1 Km; SW	0.2	30	200	

Table 7-15 Results for Incremental Ground Level Concentrations at the sensitive receptors within 10 km radius for SO_2

Sr. No.	Sensitive Receptors	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	Navanagna	611482	2488378	1.7 Km; E	1	3	10	**NAAQS Permissible Limits (24 Hr):** 80 µg/m³ **IFC/WB Ambient Air Quality Standards (WHO Guidelines): 24 hour values (µg/m³)** 125 (Interim target 1) 50 (Interim target 2) 20 (guideline)
2	Navagam	610215	2486824	1.3 Km; SE	1	3	10	
3	Naghedi	603897	2481484	8.8 Km; SW	0.1	0.5	5	
4	Kansumara	606090	2480584	8.3 Km; SW	0.1	0.5	5	
5	Khimliya	613484	2479674	9.2 Km; SE	0.1	0.3	3	
6	Theba	616541	2481777	9.2 Km; SE	0.1	0.3	3	
7	Hapa	617764	2483542	9.2 Km; SE	0.1	0.3	3	
8	Hapa Industrial Area Jamnagar	614987	2485648	5.7 Km; SE	0.3	0.5	5	
9	Dhunvav	616830	2487095	7.2 Km; SE	0.3	0.5	3	
10	Khijadiya	618896	2489554	9.3 Km; NE	0.1	0.5	3	
11	Jamnagar	608588	2484573	3.7 Km; SW	0.6	1	10	
12	Morkanda	612904	2481631	7.2 Km; SE	0.1	0.5	5	
13	Lalapur	607767	2482666	5.8 Km; SW	0.3	0.8	5	
14	Dhichada	604853	2487538	4.8 Km; W	0.3	0.5	5	
15	Kadiawad	610713	2484922	3.3 Km; SE	0.8	1	10	
16	INS Valsura	607836	2492119	4.4 Km; NW	0.1	0.3	5	
17	Gordhanpar	601066	2483902	9.6 Km; SW	0.1	0.3	3	
18	Vibhapar	612684	2487113	3.0 Km; SE	0.8	1	5	
19	Khodiyar colony	607939	2485629	2.8 Km; SE	1.0	1	10	
20	Shantivan Society	612351	2484882	4.0 Km; SE	0.3	1	8	
21	Industrial Estate	607671	2487044	2.2 Km; SW	0.8	1	10	
22	Bedeswer	606627	2488058	3.0 Km; W	0.5	1	8	
23	Bedi	607410	2488274	2.3 Km; W	0.8	1	8	
24	Green City	609632	2480858	7.0 Km; S	0.3	0.8	5	
25	Lumbini Nagar	615087	2482423	7.6 Km; SE	0.3	0.5	5	
26	Defense Colony	606078	2485890	4.1 Km; SW	0.3	1	5	

Table 7-16 Results for Incremental Ground Level Concentrations at the sensitive receptors within 10 km radius for CO

Sr. No.	Sensitive Receptors	X coordinates	Y Coordinates	Distance & Direction	Ground Level Concentration (µg/m³)			Applicable Standards
					Normal Condition (8 hour)	Worst case Condition (8 hour)	Worst case Condition (1 hour)	
1	Navanagna	611482	2488378	1.7 Km; E	0.6	0.9	1	NAAQS Permissible Limits (8 Hr): 2 mg/m³ (2000 µg/m³)
2	Navagam	610215	2486824	1.3 Km; SE	1	1	1	
3	Naghedi	603897	2481484	8.8 Km; SW	0.1	0.1	0.5	
4	Kansumara	606090	2480584	8.3 Km; SW	0.1	0.1	0.8	
5	Khimliya	613484	2479674	9.2 Km; SE	0.1	0.1	0.5	
6	Theba	616541	2481777	9.2 Km; SE	0.08	0.1	0.5	
7	Hapa	617764	2483542	9.2 Km; SE	0.08	0.1	0.5	
8	Hapa Industrial Area Jamnagar	614987	2485648	5.7 Km; SE	0.1	0.1	0.5	
9	Dhunvav	616830	2487095	7.2 Km; SE	0.1	0.1	1	
10	Khijadiya	618896	2489554	9.3 Km; NE	0.06	0.1	0.18	
11	Jamnagar	608588	2484573	3.7 Km; SW	0.2	0.3	1	
12	Morkanda	612904	2481631	7.2 Km; SE	0.1	0.1	0.5	
13	Lalapur	607767	2482666	5.8 Km; SW	0.2	0.1	1	
14	Dhichada	604853	2487538	4.8 Km; W	0.2	0.1	0.5	
15	Kadiawad	610713	2484922	3.3 Km; SE	0.5	0.5	1	
16	INS Valsura	607836	2492119	4.4 Km; NW	0.1	0.1	0.5	
17	Gordhanpar	601066	2483902	9.6 Km; SW	0.1	0.1	0.5	
18	Vibhapar	612684	2487113	3.0 Km; SE	0.2	0.3	1	
19	Khodiyar colony	607939	2485629	2.8 Km; SE	0.4	0.5	1	
20	Shantivan Society	612351	2484882	4.0 Km; SE	0.2	0.3	1	
21	Industrial Estate	607671	2487044	2.2 Km; SW	0.5	0.5	1	
22	Bedeswer	606627	2488058	3.0 Km; W	0.2	0.3	0.8	
23	Bedi	607410	2488274	2.3 Km; W	0.4	0.5	1	
24	Green City	609632	2480858	7.0 Km; S	0.2	0.3	0.8	
25	Lumbini Nagar	615087	2482423	7.6 Km; SE	0.1	0.1	0.5	
26	Defense Colony	606078	2485890	4.1 Km; SW	0.2	0.3	1	

The ground level concentration (GLC) of various pollutants due to the emission from the waste to energy plant for all the sensitive receptors (settlements) within 10 km radius are well within the National Ambient Air Quality Standards as well as WBG Ambient Air Quality Standards (WHO Guidelines) for normal scenarios for 24 hours values. As confirmed by the GWJPL, the plant always has 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) has been installed at the stack to monitor the pollutants.

The impact during normal case scenario is limited to 10 km radius from the project site. With proper functioning of Air Pollution Control Devices, Incremental ground level concentration has minimal impact. Also, the emissions from the plant (refer ***Table 7-9***) 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 7-17) presents the Resultant Pollution Load in normal working conditions (i.e. all the Air Pollution Control Devices (APCD) devices are fully functional) of the 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 observed from all the parameters the incremental GLC for PM_{10}, $PM_{2.5}$, NO_x, SO_2 & CO are within the permissible limits as per WBG EHS Ambient Air Quality Standards as well as NAAQS at the receptors within 3 km radius. Therefore the impact due to waste to energy plant does not have any considerable change in the baseline values of the ambient air quality. Analysis of results from ambient air monitoring undertaken for the project indicates that 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 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 EHS guideline value as well as Interim target-2. Therefore the ambient air is already degraded for PM10 and PM 2.5 (Refer *section 5.3.11.1.1*).

The modeling results (refer ***Table 7-17***), indicate that there is no significant change in the existing ambient air quality parameters due to the project operations. As per modeling results, ground level concentration of PM 10, PM2.5, NO_X, SO_2, and CO at the nearest receptors from the project where monitoring was undertaken was recorded to be 56.64 -127.44 $\mu g/m^3$, 29.418-66.018 $\mu g/m^3$, 31.33-39.03 $\mu g/m^3$, 17.28-17.68 $\mu g/m^3$ and 0.505-0.605mg $/m^3$ respectively. The PM10 and PM2.5 values are exceeding the NAAQS standard, PM10 and MPM 2.5 values are also exceeding the WBG EHS AAQ interim target-2 and Interim target 3 values. For NO_X, SO_2, and CO the values are well within the NAAQS as well as WBG EHS AAQ standards.

The airshed is already degraded, the % increase in the pollutant load in ambient air quality lies in the range of 3.27-7.68 and 6.48-15.82% respectively for 24 hours values with APCD devices for PM 10 & PM 2.5. It is to be noted that 98 percentile of the reliability test CEMS data has been used to estimate emission rate. To reduce this incremental impact, Project is considering a) increasing of efficiency of bag filters by making changes such as installing more modules of bag filters b) increasing, or decreasing the frequency of maintenance cleaning c) checking upon the quality of bag filters to maintain the differential pressure at the baghouse and d) increase the efficiency of the dust extraction system. The proposed improvements will result in reduction of PM10 and PM2.5 emission and incremental impact will be reduced to a small fraction (2 to 5%) of the standard.

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 0.817-0.980, 86.05 -89.84, 26.73-35.64% respectively for 24 hours values with APCD devices (Refer ***Table 7-17***). The baseline values for CO, SO_2 and NO_x is quite low and well within the limits and the emission by the plant are also well below the standards.

Table 7-17 Resultant Concentration for Pollutants at the Monitoring Locations (Receptors within 3km radius)

Sample	Location	Baseline concentration (average) (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	123.4	4.041	3308.82	340 m from Project Site	127.441	3432.22	4.041	3308.82	3.27	2681.37	**NAAQS Permissible Limits (24 Hr) :** 100 µg/m³ **IFC/WB 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	Jalaram Nagar	73.0				77.041	3381.82			5.54	4532.62	
AAQ3	Navanagna village	59.6				63.641	3368.42			6.78	5551.70	
AAQ4	Juna Nagna	52.6				56.641	3361.42			7.68	6290.52	
$PM_{2.5}$												
AAQ1	Project Site	62.0	4.018	3308.82	340 m from Project site	66.018	3370.82	6.70	5514.70	6.48	5336.81	**NAAQS Permissible Limits (24 Hr) :** 60 µg/m³ **IFC/WB Ambient Air Quality Standards (WHO Guidelines): 24-hour values** • 75 (Interim target-1) • 50 (Interim target-2) • 37.5 (Interim target-3) • 25 (WBG EHS guideline)
AAQ2	Jalaram Nagar	35.6				39.618	3344.42			11.29	9294.44	
AAQ3	Navanagna village	29.5				33.518	3338.32			13.62	11216.34	
AAQ4	Juna Nagna	25.4				29.418	3334.22			15.82	13026.85	
NO_x												
AAQ1	Project Site	27.7	8.233	135.693		35.933	163.393	10.29	169.62	29.72	489.87	

Sample	Location	Baseline concentration (average) (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)	
AAQ2	Jalaram Nagar	28.0			350m away from the Project Site	36.233	163.693			29.40	484.62	NAAQS Permissible Limits (24 Hr) : 80 µg/m³ IFC/WB Ambient Air Quality Standards (WHO Guidelines): • 1 year: 40 • 1 hour: 200
AAQ3	Navanagna village	23.1				31.333	158.793			35.64	587.42	
AAQ4	Juna Nagna	30.8				39.033	166.493			26.73	440.56	
					SO2							
AAQ1	Project Site	9.5	8.18	109.85	Project site	17.68	119.35	10.219	137.31	86.05	1156.29	NAAQS Permissible Limits (24 Hr) : 80 µg/m³ IFC/WB Ambient Air Quality Standards (WHO Guidelines): 24 hour values • 125 (Interim target-1) • 50 (Interim target-2) • 20 (guideline)
AAQ2	Jalaram Nagar	9.4				17.58	119.25			86.97	1168.60	
AAQ3	Navanagna village	9.1				17.28	118.95			89.84	1207.12	
AAQ4	Juna Nagna	9.4				17.58	119.25			86.97	1168.60	
					CO (8 hour) (mg/m³)							
AAQ1	Project Site	0.5 mg/m³	4.899(µg/m³) 0.004899(mg/m³)	14.208 (µg/m³) 0.014208(mg/m³)	Project Site	0.505	0.514	0.245	0.710	0.980	2.842	NAAQS Permissible Limits (8 Hr): 2 mg/m³ (2000 µg/m³)
AAQ2	Jalaram Nagar	0.5mg/m³				0.505	0.514			0.980	2.842	
AAQ3	Navanagna village	0.6 mg/m³				0.605	0.614			0.817	2.368	
AAQ4	Juna Nagna	0.6 mg/m³				0.605	0.614			0.817	2.368	

Implemented Control Measures

- The waste is transported in closed and covered waste collection trucks
- Provision of closed waste handling and storage areas is available
- Use of negative pressure in processing buildings to manage odor
- Mist cooling is developed to keep down dusts, especially during and prior to loading or other handling procedures
- Waste segregation and/or presorting is undertaken 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 is 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.
- Waste introduction into the incinerator only after the optimum temperature is reached in the final combustion chamber
- Waste is incinerated at high temperatures and no chemical treated with any chlorinated disinfectants will be undertaken prior to incineration
- Internal Roads are made of Concrete instead of asphalt and least distance is travelled by the material within the facility.
- 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
- Minimization of formation of dioxins and furans by maintaining the boiler temperature above 800°C. The project has installed a ~38 TPH boiler based on "Suspended Firing Combustion System". The waste is fed into the boiler at a height of about 12.887 m which is the combustion zone, having temperature in the range of 900- 950^{0}C. As the fuel moves higher, the temperature of the boiler decreases but remains in the range of 850^{0}C for about 2 seconds. Dioxins and furans are typically formed in a temperature zone of 200-400^{0}C and are minimized/destroyed in a temperature zone of 800-900^{0}C. This boiler system is therefore designed to help in achieving complete combustion and ensuring destruction of harmful emissions before flue gas enters heat recovery area
- GWJPL has implemented a combination of both ESP and high efficiency of bag filters in series. ESP acts act as a pre-dedusting mechanism (Efficiency of ESP design is around 80-85%) 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.
- Periodic monitoring (Half Yearly) 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.
- The Project has installed a comprehensive flue gas cleaning system with dust extraction, to control emission of dioxin, furan and heavy metals, emission of acidic gases and particulate matter emission
- Installed continuous emission monitoring systems (CEMS) to monitor the plant's emissions (SO_2, NO_2, CO, SPM) in real-time. Regular reporting of emissions data to relevant environmental authorities which promotes transparency and compliance with air quality regulations.
- Project is considering increasing the efficiency of bag filters by making changes such as installing more modules of bag filters, increasing, or decreasing the frequency of maintenance cleaning or checking upon the quality of bag filters to maintain the differential pressure at the baghouse[76] and increase the efficiency of the dust extraction system.
- The dust extraction system within the boiler comprises of bag filters and Electrostatic precipitator (ESP). It was reported that around 600 bags are currently installed, and the project has planned to install additional 720 bags which will totalized to 1320 bag filters in near future. The efficiency of bag filters are at 99% and for ESP is 80%.
- Apart from CEMS, the project is also undertaking ambient air quality monitoring as well as stack monitoring on half yearly basis
- The chimney(s) vents attached to various sources of emission are designed by numbers such as S-1, S-2, etc. and are painted/displayed to facilitate identification.

[76] It was reported that around 600 bags are currently installed, and the project has planned to install 1320 bag filters in near future. However, it was noted that the differential pressure readings indicated at the baghouse system is high, which could be due to lesser available surface area of the filters. This is likely to affect the efficiency of the dust extraction system within the boiler.

- The MRF Facility is implemented with AI driven technology with no/minimum human intervention.
- Greenbelt and landscape area has been developed within the Project premises.
- Ash handling system with silos, hoppers, and submerging of bottom ash is being undertaken
- Steam Turbine complies with the relevant International Electro-technical Commission (IEC) standards or equivalent
- Use of odor-neutralizing sprays whenever necessary

Additional Mitigation Measures

- All equipment to be periodically checked to ensure compliance to the emission standards.
- 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
- Periodic maintenance of the bag filter & ESP to be carried out to avoid dust emissions during removal of fly ash.
- 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%.
- 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.
- Water Sprinkling to be done at the access road to manage dust emissions from the vehicles transporting waste to the plant.
- Fly Ash to be transported in covered trucks and tippers to the fly ash recipients. Fly ash generated from bag filter should be sent to cement plants. GWJPL to discuss with JMC 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[77].
- GWJPL to provide GPCB with the NOC received from Ministry of Defense and amend the stack height of the boiler to 40 m within the CTO to remain compliant to the condition of the CCA w.r.t stack height of the boiler
- GWJPL should conduct environmental audit annually and submit environmental statement pertaining to previous year to GPCB by 30th September every year in compliance to the CCA.

	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 to Moderate	**Small to Substantial**

7.4.2 Ambient Noise

Major sources of noise generation in the operational Waste to Energy (WTE) plant including handling, transporting, processing of solid waste or RDF and generation of electricity units 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.

The project has deployed approximately 58 on roll workers and 93 contractual workers who are exposed to the noise emissions. Workers were not observed to be using the adequate PPE such as Earmuffs or earplugs while operating the machines and while working near the turbine, pump room etc. during site visit. Furthermore, nearest settlement is located

[77] Though these guidelines cover only coal or lignite based thermal power plants (inclusive of Captive and/or co generating stations), and do not include MSW based waste to energy plants, however Project is recommended to explore these options for ash disposal after discussion with JMC

at an aerial distance of 350m south from site. These permanent residential receptors within 500 m are anticipated to be impacted due to the Project activities.

7.4.2.1 Modelling

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 7-18 Details of Point Sources

Source ID	X Coordinate	Y Coordinate	SPL dB(A)
Pre-processing area	609727	2488058	68.49
Boiler fuel feeding - bunker	609733	2488085	67.88
Boiler Aux fuel feeding - bunker	609733	2488085	67.88
Turbine	609692	2488103	88.3
Primary water Treatment Plan	609667	2488129	70.39
Boiler water treatment plant	609667	2488129	72.61
Condenser Water Colling system	609691	2488103	80
Boiler	609712	2488103	69.88
Fans – Boiler	609725	2488105	69.88
Flue Gas Cleaning System	609687	2488099	68.98
Ash Handling Area	609711	2488113	69.89
Air Compressor	609711	2488097	72.29
Substation	609739	2488230	71.13

Table 7-19 Details of Vehicular Movement

Sr. No.	Material Type	Vehicle Type	Vehicle Make	Vehicle Model	Loading Capacity in MT	Avg Moving Vehicle / Day	Avg Max Vehicle Mov/ Hour	Avg Min Vehicle Mov/ Hour	Time Period
1	MSW	Tipper	Tata	ACE Mega / SK 407	1.03 / 2.3	100	10	5	07:00 to 19:00
2	MSW	Compactor	Tata	1109 Ex2	6.5	8	2	1	
3	MSW	Dumper	Tata	SK 1613 / LPT 2518	11.7 / 25	20	2	1	
4	MSW	Chhagada	Atul	Gem Cargo	0.5	2	1	0	
5	RDFs	Truck	Tata / Askok Leylond	3118	24	18	5	3	19:00 to 07:00

Table 7-20 Boundary Details

Source ID	X1 Coordinate	Y1 Coordinate	X2 Coordinate	Y2 Coordinate	Height
B_001	609760	2488179	609825	2488183	5
B_002	609825	2488183	609825	2488171	5
B_003	609825	2488171	609850	2488179	5
B_004	609850	2488179	609858	2488171	5
B_005	609858	2488171	609879	2488165	5
B_006	609879	2488165	609877	2488195	5
B_007	609877	2488195	609916	2488132	5
B_008	609916	2488132	609883	2488121	5
B_009	609883	2488121	609862	2488095	5
B_010	609862	2488095	609812	2488015	5
B_011	609812	2488015	609750	2488037	5
B_013	609792	2487975	609676	2487975	5
B_014	609676	2487975	609676	2488045	5
B_015	609676	2488045	609659	2488045	5
B_016	609659	2488045	609653	2488115	5
B_017	609653	2488115	609618	2488119	5
B_018	609618	2488119	609615	2488171	5
B_019	609615	2488171	609653	2488177	5
B_021	609663	2488181	609671	2488197	5
B_022	609671	2488197	609729	2488191	5
B_023	609729	2488191	609729	2488218	5

The turbine is the primary source of noise, with the highest sound pressure level (SPL) of 88.3 dB(A) among the other equipment. Consequently, it is identified as the major contributor to noise pollution. To assess the potential impact of noise on surrounding areas, a comprehensive sound propagation model was utilized, considering a worst-case scenario. This scenario assumes the simultaneous operation of all equipment, including the turbine, and accounts for the presence of a boundary wall. The model aims to gauge the extent of noise propagation and its consequent impact on nearby areas. It factors in variables such as distance, terrain, atmospheric conditions, and barriers to accurately simulate the spread of sound waves from the turbine and other equipment. By analyzing these variables, the model predicts noise levels attributable to the project at nearby receptors, providing valuable insights into the expected impact of the project on its surroundings.

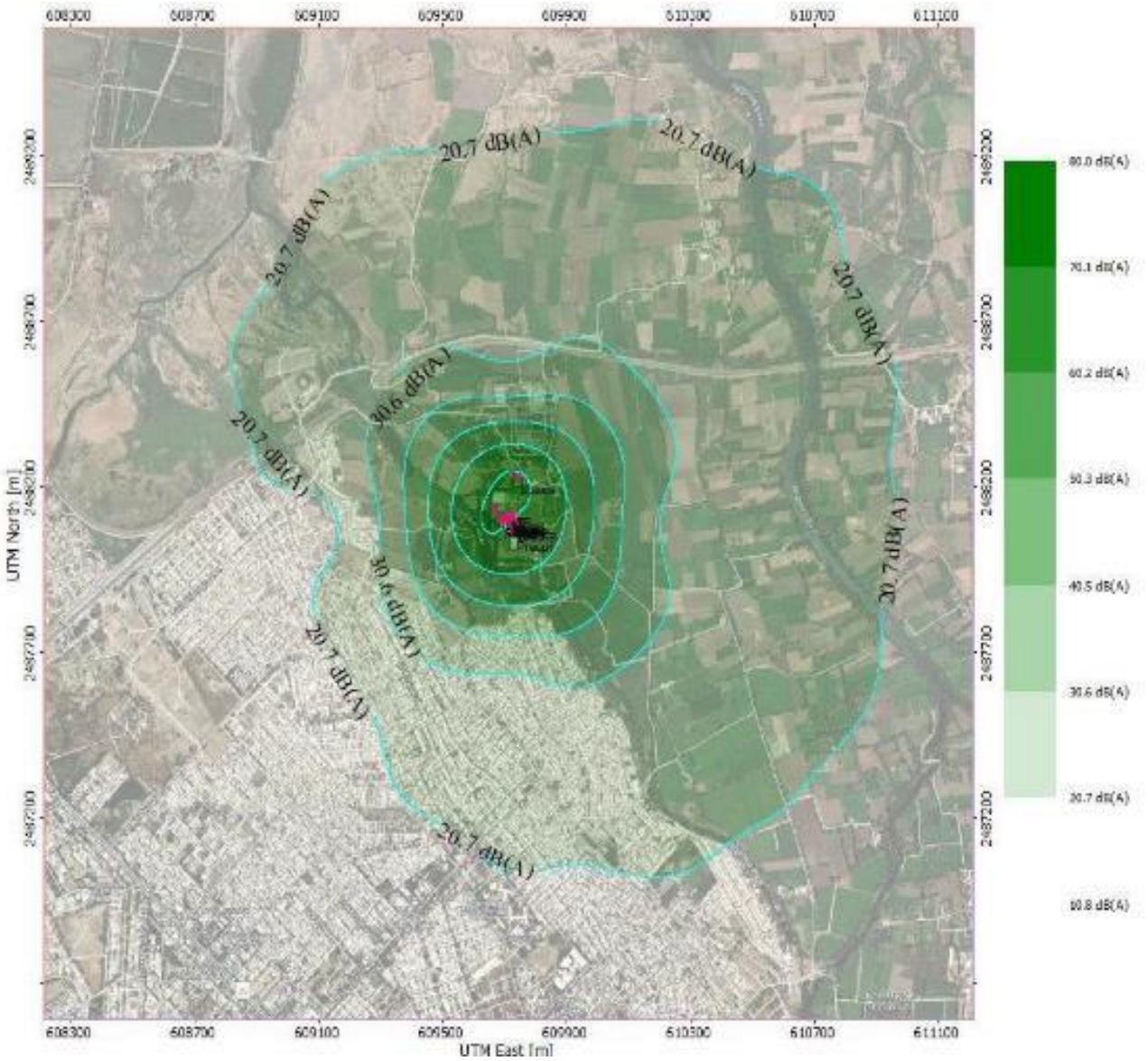
Table 7-21 below presents the predicted noise levels at various grid locations due to the project. These locations allowing for a spatial distribution analysis of noise levels across the study area. The predicted noise levels are depicted in decibels (dB(A)), facilitating a comprehensive understanding of how noise varies spatially. The spatial distribution is presented in intervals of 10 dB(A), allowing for clear visualization of noise level variations. This information is crucial for assessing the potential impact of noise pollution and informing mitigation measures to minimize adverse effects on the surrounding environment and community.

Table 7-21 Predicted Noise Level Resulting from the Project

Receptor ID	Grid Location		Predicted Level (dB(A))*
	X-Coordinate	Y-Coordinate	
Grid	611213	2489586	17.3
Grid	610713	2489586	18.5
Grid	610213	2489586	19.5
Grid	609713	2489586	19.7
Grid	609213	2489586	18.7
Grid	608713	2489586	17.2
Grid	608213	2489586	15.5
Grid	611213	2489086	18.6
Grid	610713	2489086	20.7
Grid	610213	2489086	22.8
Grid	609713	2489086	23.4
Grid	609213	2489086	21.6
Grid	608713	2489086	18.6
Grid	608213	2489086	16.2

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

Figure 7-1 Spatial Distribution of Noise Levels



According to the noise monitoring results presented in ***Table 5-15,*** 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 whereas as per WBG General guidelines Leq day values are slightly exceeding the values of 70 dB(A). For sample N2 (Commercial), N3 & N4 (residential area), values of Leq night were within the CPCB limit as well as WBG General EHS Guideline values for residential and commercial areas. Leq day values for N2 were within the CPCB limit as well as WBG General EHS Guideline values whereas N3 and N4 are exceeding the values prescribed by CPCB as well as WBG General guidelines which are at an aerial distance of 1.83 and 1.99km respectively from the Project site.

The estimation of additional noise exposure due to plant operations, based on baseline noise level and incremental noise levels from above modelling exercise is as presented in ***Table 7-22*** below:

Table 7-22 Additional Noise Exposure from the Project

Nearest Noise Monitoring location	Incremental Noise in dB(A)	Baseline Noise in dB(A)		Resultant Noise in dB(A)		Additional Exposure due to Plant Operations	
		Day	Night	Day	Night	Day	Night
N2 (Commercial Area)	25.6	58.00	49.03	58.00	49.05	0.00	0.02
N3 (Residential Area)	20	61.40	41.27	61.40	41.30	0.00	0.03
N4 (Residential Area)	19	60.95	40.62	60.95	40.65	0.00	0.03

It is to be noted that additional noise exposure due to the plant operations at the noise monitoring locations where the receptors are located are within permissible limit of 3 dB(A).

Implemented Control Measures

- Enclosures, noise and vibration mufflers, acoustic barriers and anti-vibration mats are be provided at few places with high noise generation process or machineries.
- The area of the greenbelt is 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 60 dBA[78]
- Periodic maintenance of the equipment used. Worn out parts are replaced and rotating parts are lubricated to minimized noise emissions
- Periodic noise monitoring is conducted on half yearly basis for the project operations at site.
- Anti-honking sign boards are placed in the parking areas and at entry / exit points.

Impact Magnitude

The project is located in an Industrial area with residential settlements present within 500m radius of the project. Therefore residents as well as workers present within the plant are impacted as they are working with high noise emitting/generating equipment's or machineries. Since the noise levels during operation phase are exceeding the anticipated noise limits, therefore additional mitigation measures are to be incorporated. Furthermore, overall baseline noise level at N3 and N4 exceed the applicable standard for residential area areas during day and night-time. It is to be noted that baseline noise levels monitored in the study area already includes the noise level from plant operations along with other sources of noise emissions. Therefore the spread has been classified as local spread with permanent duration. The noise generation is a routine activity as the machineries and equipment are 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

- Noise zone assessment to be carried out to understand high noise generating areas.
- Plantation at the Project boundary to be increased.
- The project to restrict the noise generation from steam turbine generator and other major equipment ≤ 85 dB(A) at a distance of 1 m to comply with the Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2010 by regular maintenance and optimized operations (adjusting speed and load without compromising efficiency).
- Enclosures, noise and vibration mufflers, acoustic barriers and anti-vibration mats to be provided at all places with high noise generation process or machineries.
- Installing silencers for fans and suitable mufflers on engine exhausts and compressor components

[78] 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.

- Pump operators (near STP, storage tanks, hoppers etc.) are generally exposed to higher noise. Housing / casing to be provided for all noise generating machines.
- Adequate PPE's (earmuffs, earplugs) to be provided to all employees (on roll as well as contractual) working in high noise generation area's and machineries.
- Quarterly indoor noise monitoring to be undertaken (while the plant is fully operational) to mitigate or manage high noise levels and implementation of noise management measures.
- 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.
- Project should ensure ambient noise levels are within WBG EHS ambient noise quality standards.
- GWJPL to implement management procedures on ambient as well as indoor noise pollution.

	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**

7.4.3 Soil Contamination due to Improper Waste Management

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

- Used oil, waste and residue containing oil (0.65 MT/year)
- Discarded containers/ Barrel Liners/ Contaminated with Hazardous chemicals (0.09 MT/year)
- Bag Filter Ash (2796 MT/Year)
- Spent Ion exchange resin from DM Plant (1.50MT/Year)
- Neutralization Tank Sludge (3 MT/Year)
- Leachate from waste storage bunker and incoming waste
- E-waste, battery waste etc. from site office and the plant
- Inert Waste, Scrap, MSW

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. The project is storing the fly ash in the silos, however the bottom ash submerged in the water is currently stored on the unpaved ground near the ash submerging belt area which is then loaded on the JMC trucks for disposal. The bottom ash stored on unpaved ground is/may lead to soil contamination.

During site visit, dark stains were observed on unpaved surface, inside the transformer area, probably due to the leakage of transformer oil. Based on discussion with site team, it was confirmed that dark stain on the ground was due to oil spillage that took place during the oil charging activity at the transformer area. Considering the above, and in the absence of a contaminant-based soil and groundwater baseline report for the site, potential impacts to subsurface soil is anticipated.

Based on review of the project design, it is understood that GWJPL has provision for leachate collection system comprising of underground leachate collection pit at the waste collection bunker area and 2 no.s of leachate drying beds. However, no dedicated areas for leachate drying beds have been identified by the project. Additionally, a leachate pit was observed at the site of capacity 1.5m x 1.5m x 2.5m. Considering the project location, which is in the vicinity of Rangamati river, Coastal zone and salt pans in the region and falling in low lying area, the Jamnagar project is prone to cyclones and precipitation

and is also prone to floodings. Therefore, in case of monsoon/cyclones/heavy rainfall/sea level rise, excessive leachate generation is expected at the site. However, till date, as reported, there has been no significant formation of leachate due to waste decay at the project. Therefore, the leachate collection system has not been used till date. Improper management of leachate along with leaks and spills is anticipated to impact the soil quality of the area, which may further impact the water quality as well.

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.

Implemented Control Measure

- Bottom ash and Fly ash are collected separately from other flue gas treatment residues to avoid contamination of the bottom ash.
- Bottom ash generated from the boilers are disposed from the project to the landfill through Jamnagar Municipal Corporation (JMC) owned trucks.
- Fly ash collected from bag house is contamination and is hazardous in nature. ESP has been added as pre-deduster which has significantly reduced the quantity of hazardous fly ash from bag house.
- Bottom Ash quenching is done using the waste water generated from the project operations.
- Hazardous waste such as waste oil from transformers and other machineries were stored in designated enclosed hazardous waste storage area on paved surface.
- Hazardous waste generated on site are disposed through M/s Saurashtra Enviro Projects Private Limited[79] and M/s Aztec recycling Hub Private Limited.
- Inert waste collected post screening of the MSW received at the project premises, are transferred from the screening station to the trucks which are further reported to be disposed at the landfill.
- Silos have been developed for Fly ash handling and the bottom ash is managed by submerging in water using submerged belt
- Glass and metal are collected and stored within the plant and are further be disposed of through authorized scrap vendors.
- Only covered and closed trucks are allowed to enter the site for unloading of municipal solid waste
- Generated biodegradable waste from the canteen, kitchen, office etc. is utilized within the plant.
- Environmental monitoring for soil is conducted on half yearly basis.
- As per the conditions under and Hazardous and other waste (Management & Transboundary Movement Rules) 2016, the project has displayed online data outside the main factory gate with regard to quantity and nature of hazardous chemicals being handled in the plant including wastewater and air emission and solid hazardous waste generated within the factory premises

Impact Magnitude

Nature of impact due to hazardous and hon hazardous waste generation during operation phase is 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 waste/oil/chemicals 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

- Development of Leachate Drying beds for management of leachate

[79] For disposal of spent ion exchange resins and sludge as per CCA

- Options for leachate disposal to be adopted such as disposal of the dried leachate sludge at the Theba landfill and use of leachate water for bottom ash quenching or alternatively injection of the leachate within the boiler.
- Project to discuss with JMC for disposal of ash in line with MoEFCC draft notification no. G.S.R. 285(E) dated 22/04/2021, with previous notification on 201680. Project to discuss with JMC for disposal of ash in line with MoEFCC draft notification no. G.S.R. 285(E) dated 22/04/2021, with previous notification on 201681.
- GWJPL to conduct characterization analysis (occasionally) of ash as per IS 3812 covering all the parameters stipulated by BIS to identify any hazardous content before its disposal through JMC trucks. If fly ash is identified as hazardous, it is to be sent to hazardous waste landfill site through authorized hazardous waste recycler. 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.
- GWJPL is recommended to obtain chain of custody documents from Jamnagar 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.
- GWJPL 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, GWJPL 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 GWJPL is uncertain that the disposal conducted by JMC is as per the applicable rules, GWJPL 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.
- Project should store the ash in closed area or in silos to avoid air emission and soil contamination (in case ash contains hazardous content), if there is delay in ash collection by JMC trucks/ authorized hazardous waste recyclers due to unforeseen condition.
- GWJPL 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. GWJPL to ensure that the covered trucks are used by JMC to dispose the bottom ash in the nearest sanitary landfill. GWJPL to track bottom ash generation and disposal.
- Fly ash generated from bag filter should be sent to cement plants
- GWJPL to not store hazardous waste more than 90 days. Hazardous waste to be disposed regularly via the identified authorized hazardous waste vendor.
- Separate ferrous and non-ferrous metals from bottom ash as far as practicably and economically viable, for their recovery
- 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)
- 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
- Good housekeeping and best practices of waste handling to be adopted to eliminate/minimized the risks of soil contamination
- Instituting a washing program for waste collection vehicles and for company-rented waste collection and transfer containers.
- 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

[80] Though these guidelines cover only coal or lignite based thermal power plants (inclusive of Captive and/or co generating stations), and do not include MSW based waste to energy plants, however Project is recommended to explore these options for ash disposal after discussion with JMC

[81] Though these guidelines cover only coal or lignite based thermal power plants (inclusive of Captive and/or co generating stations), and do not include MSW based waste to energy plants, however Project is recommended to explore these options for ash disposal after discussion with JMC

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.
- 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 is generated and present within the project premises, GWJPL 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.
- GWJPL should conduct environmental audit annually and submit environmental statement pertaining to previous year to GPCB by 30th September every year in compliance to the CCA.

	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**

7.4.4 Water Resources- Availability & Quality

Sources of water pollution at Project includes:

- Sewage generated from domestic activities of workers at the site
- 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 results 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 is 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. Leachate can migrate further and contaminate soil, surface water, and groundwater potentially causing additional impacts such as eutrophication and acidification of surface water and contamination of water supplies.
- 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 and as observed on site, river Rangamati flows along the southwestern-western boundary of the project, and also there are multiple dendritic drainage channels as well as small water bodies such as ponds and passing through out the project area. The ***Figure 5-13*** shows that the depth to water level during pre-monsoon, the project

lies in are an area where WL is between 5-20 mbgl and during post monsoon, the project lies between 2-10 mbgl which increases the risk of ground water contamination as any case of leaks, spill, overflows of leachate, bottom ash quenching fluid and stacking of received waste in uncontained areas.

According to the water utilization plan, approximately 770 m3/day water is required for project operations, the water requirement is be sourced from the STP. According to the water balance diagram ***(refer Figure 2-9***) the daily water requirement for industrial purpose within the WTE plant is 770m3/day, for which pre-treatment is required for 925 m3/day of treated wastewater from STP and the project has received permission for receiving 1 MLD water from the STP. The project treats 925m3/day of treated STP water and all reject water (73m3/day) in the form of backwash/regeneration/reject from MGF, ACF, Softener & RO etc. is sent back to STP Inlet for further treatment at the STP plant itself. Thus, reduction in quantity of treated water i.e. 770m3/day is transported via 324 m underground water pipeline. The Pre-treated water is then further treated (secondary treatment) on-site prior to use in the boiler (Refer ***section 2.7.8***)

The project is abstracting ground water for drinking and domestic use. The project has obtained permission to extract water from the existing borewell within the project premises. As per the categorization, Jamnagar falls in an area categorized as safe 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. The project abstracts 7.5m3/day of ground water for domestic purposes only. Results of Phase II study undertaken at site indicates that ground water is not fit for domestic purpose and can be only used for flushing.

Implemented Control Measures

- Leachate collection is done in a designated leachate collection tank using a series of underground pipes connecting the leachate collection area to the tank. Three distinct leachate collection pit interconnected and made of solid concrete material with water proof plaster inside has been developed at the plant.
- Impervious surface area is developed for leachate collection and a Screen is 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 have been installed for Fly ash handling and the bottom ash is submerged using reject water.
- Treated Water obtained from the STP is further treated at the Pre-Treatment plant at the STP premises and Secondary treatment at the project site.
- The rejected water generated from secondary treatment and mist blow down is used in bottom ash quenching and plantation after verification of the Total Dissolved Solid (TDS) to ensure suitability of rejected water for plantation purpose
- Use of treated water for cooling using misting systems
- Any sludge generated from secondary treatment is sent to the Theba landfill through JMC trucks
- RO water and Boiler Blow down water is used to make up for the evaporation loss
- Reject water form Secondary treatment is blended with water from STP and used for landscaping.
- Project utilizes 100% of the procured water for project operation and negligible amount of water is discharged from the plant into municipal drains.
- The project has installed water efficient plumbing fixtures that use less water without any reduction in quality and service
- GWJPL has obtained No Objection Certificate (NOC) from CGWA on 14.09.2022 valid up to 13.09.2025. As per the NOC, the project can abstract 7.5 m3/day water from one existing borewell within the project premises. Based on review of waterlog, it was observed that project is abstracting 7.5 m3/day water from the borewell for domestic purpose only which is in compliance to the NOC obtained
- GWJPL has obtained No Objection Certificate from JMC dated 15.01.2019 to procure 1 MLD secondary treated water from 70 MLD STP located 60 m (aerial distance) from the project boundary for meeting water requirement for industrial purpose. GWJPL has also obtained permission to lay underground pipeline of length 324 m connecting the STP to the Project's pump house.
- In addition to the above, GWJPL has also obtained permission from JMC dated 19.09.2022 to return excess STP water (if any) for further treatment back to the STP during project lifecycle.
- Environmental monitoring such as for groundwater, sewage water is being conducted on half yearly basis. Based on the review of monitoring reports (February and August 2022, February 2023), all the parameters were observed to be within the limit, set by the CPCB.

- Domestic wastewater generated from the project is stored in soak pit and septic tanks. As reported, the septic tanks and soak pits are cleaned half yearly or on need basis.

Additional Mitigation Measures

- Ensure compliance with requirements of Combined Consent Authorization, as received by the project
  - GWJPL to provide CCTV camera with24*7 surveillance monitoring and at least 15-day record storage on the boundary wall towards Rangamati River and continuous monitoring to be done
  - The quantity of the domestic wastewater (Sewage) shall not exceed 6 KL/Day
  - GWJPL to provide flow meter on inlet & outlet of plant as well as shall maintain records for the same
  - GWJPL to provided flow meter on different outlet of rejected water and to maintain records and also link with the CPCB site for prescribed parameters like pH, TDS, TOC etc.
  - GWJPL to provided pipeline network along with flow meter for the discharge for plantation and gardening purpose for process effluent & maintain its records.
  - 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
  - GWJPL should conduct environmental audit annually and submit environmental statement pertaining to previous year to GPCB by 30th September every year in compliance to the CCA.
- 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.
- GWJPL to ensure leachate beds are developed in compliance to the Project design to ensure adequate leachate collection and disposal, when generated in future
- 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.
- Measure and record the quantity and quality of leachate generated. Changes in leachate quantity or quality attributable to weather or other factors to be accounted for.
- A dedicated leachate management SOP to 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
- 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.
- Workers should be sensitized on water conservation measures and encourage optimal use of water
- Regular inspection should be carried out for identifying water leaks and preventing water wastage
- Regular monitoring of ground water level and quality to 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
- 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 plant utilizes the water within the project operations and non-contact purposes. 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 is being used for landscaping purpose. The freshwater 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**

7.4.5 Human-Wildlife Conflicts

The Project is surrounded by natural [Open Scrub, Wetland (Mangroves), Water Body] and modified [Salt Pans, & Agricultural Lands] habitats; and Marine National Park & Sanctuary and Khejadiya Wildlife Sanctuary are also present within the 10 km buffer. Rangamati river stream also flows adjacent to the project boundary in the southwest direction. These habitats and protected areas support several herpetofauna, avifauna, and mammals (as described in the ecological baseline). Access of these wildlife in the project compound as well as their movement along the boundary of the project during the operation phase may cause a risk of Human-Wildlife conflicts.

As per the baseline, one Schedule I reptiles, Bengal Monitor Lizard (*Varanus bengalensis*) (Wildlife (Protection) Act, 1972) and three mammals, Bengal Fox (*Vulpes bengalensis*), Golden Jackal (*Canis aureus*), Jungle Cat (*Felis chaus*), 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*), Russell's Viper (*Daboia russelii*) and Saw-scaled Vipers (*Echis carinatus*) were also reported from the study area which can also access the project boundary.

Control Measures planned for the Project.

No information available.

Impact Magnitude

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 ***Small*** based on the impact significance criteria (***7.3.2***).

Additional Mitigation Measures

The mitigations proposed to minimize the impact(s) on bird species have been given as,

- Frequent checking of the boundary wall to avoid any space for wildlife entrance into project compound

- Training programs for project personnel should be conducted to educate them on how to handle encounters with wildlife safely and responsibly
- An emergency response protocol to handle any human-wildlife conflicts should be develop which should include procedures for safely managing encounters and contacting relevant authorities if needed
- Good housekeeping practices can help to create an environment in the project site that is less appealing to wildlife, thus we can minimize their presence within the project compound

	Nature of Impact	Spread of Impact	Duration	Intensity	Receptor Vulnerability	Significance of Impact
Without Mitigation Measures	Negative	Local	Permanent	Moderate	Low (Species)	**Small**
With Mitigation Measures	Negative	Local	Permanent	Low	Low (Species)	**Small**

7.4.6 Impacts of Increased Traffic / Vehicle Movement

Although the transportation of municipal waste to the Waste to Energy plant comes under the scope of Jamnagar Municipal Corporation (JMC), however the potential impact of Increased Traffic / Vehicle Movement has been assessed here as it is a linked activity.

During the operation phase, the municipal waste will be collected from different area of the city and transported to the Waste to Energy plant. The Jamnagar project is currently receiving fresh waste from JMC through small trucks/trailers. About 100 numbers of JMC trucks carry the waste to plant. Apart from this, about 20 trucks bring bio-mined waste from Rajkot MSW landfill site on daily basis. This will contribute to the overall traffic / vehicle movement on the major roads of the city. Positively, no movement of these trucks was identified in the wildlife prone protected area.

The key impact on the local community and wildlife due to increase in traffic and transportation of waste to the WTE Plant:

- Increase in air pollution resulting from the transportation of waste.
- Increase in noise and unpleasant odors emanating from transportation of waste.
- Concerns about increase traffic, congestion and potential safety hazards associated with the transportation of waste to the WTE plant.
- One Schedule I reptiles, Bengal Monitor Lizard (*Varanus bengalensis*) (Wildlife (Protection) Act, 1972) and three Schedule I mammals, Bengal Fox (*Vulpes bengalensis*), Golden Jackal (*Canis aureus*), & Jungle Cat (*Felis chaus*) have been recorded from the study area. Beside these species, Nilgai (*Boselaphus tragocamelus*), Wild Boar (*Sus scrofa*), Common Krait (*Bungarus caeruleus*), Indian cobra (*Naja naja*), Oriental Ratsnake (*Ptyas mucosa*), Russell's Viper (*Daboia russelii*) and Saw-scaled Vipers (*Echis carinatus*) were also reported from the study area. Any addition to the regular traffic / vehicle movement may raise the risk of road hits/kills of wildlife.

Control Measures planned for the Project

Transportation of municipal waste is in the scope of Jamnagar Municipal Corporation (JMC).

Impact Magnitude

As the project is established for a long time and transportation of municipal waste will continue till the life of the project, thus the **Duration** has been *permanent*. 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. Thus, the impact magnitude has been classified as ***Substantial*** based on the impact significance criteria (***7.3.2***).

Additional Mitigation Measures

The proposed mitigations to minimize the impacts of increased traffic / vehicle movement have been given as,

- 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 trucks/trailers drivers should be instructed not to blow horns unnecessary.
- The drivers should follow the speed limit instructed by highway authorities (in the form of signboards)
- Annual awareness/training programs should be conducted for drivers to minimize the risk of wildlife hitting and/or being killed on highways and road safety.

	Nature of Impact	Spread of Impact	Duration	Intensity	Receptor Vulnerability	Significance of Impact
Without Mitigation Measures	Negative	Medium	Permanent	Moderate	Low (Species)	**Substantial**
With Mitigation Measures	Negative	Local	Permanent	Low	Low (Species)	**Small**

7.4.7 Increased local Employment & livelihood

As per the available data it was understood that total manpower requirement for the project is nearly 158 persons, it includes both skilled and nonskilled workers. The work force is mostly migrant workers working for different contractors.

Besides direct employment opportunities project was also 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.

Implemented Mitigation Measures

As per the discussions with the management (although there are no specific policies towards local employment etc.) and employment is mostly need based where possible efforts are made to use the available local resources which broadly includes local procurement of ration, engaging local labor and transporters etc.

Impact Magnitude

As the project provides employment to 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 **small**

Additional Mitigation measures

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.
- 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 should 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	long	Permanent	Routine	**Low**	**Small**
With Mitigation Measures	**Positive**	High	Long	Permanent	Routine	**Low**	**Small**

7.4.8 Legacy Issue and Land Induced Economic Displacement

Based on the information gathered through review of google imagery and consultation with the local community, it has been identified that approximately 12 bigha (3 acres) of the government land allocated for the project was previously utilize by a household for agricultural activities. The household had been engaged in agricultural activities for the past 60 years.

Control measures in Place

Upon the allocation the land for the project, the household discontinued their agricultural activities. However, in order to mitigate the economic displacement impact on the households, the project has taken a proactive step by providing a contractual job of a gardener to the head of the impacted household through its appointed contractor.

Impact Magnitude

A thorough consultation with the head of the impacted households has revealed a noteworthy paradigm shift in economic dynamics. The head of the household, along with his brother and nephew, has secured employment within the project, aligning with the preferential employment initiative designed for members of the displaced households.

According to the reported data, the family's current earnings from project-provided employment significantly exceed their previous agricultural income. A comprehensive breakdown illustrates the shift in income sources:

Income source	Total Income (INR – Annually)
Income from Agriculture	1,50,000 to 2,00,000
Income from Salary provided by Project	2,96,67682

This analysis delineates a substantial increase in income, ranging from 148% to 197%. The positive trajectory in income generation underscores a beneficial impact on the affected households, signifying an improvement in their economic well-being. This transformation is indicative of the project's constructive influence on local livelihood.

7.4.9 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 Jamnagar Municipal Corporation (JMC) through its authorized 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 trans Efficient logistics and transportation are vital to maintaining the continuity of waste supply to the plant.

- The project will also deal with legacy waste obtained through biomining activities. Biomining includes the extraction of valuable materials from existing landfill sites. The biomining activity is the critical part of the supply chain of the project.

7.4.9.1 Control Measures planned for the Project's Supply Chain

The project has not put in place any control measure.

7.4.9.2 Impact Magnitude

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 Jamnagar Municipal Corporation (JMC).
   - **Risk of Child Labour:** During site visits, it was noted that the appointment of drivers and helpers by the contractors lacks direct supervision by JMC, 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.
3. Biomining Waste Operations
   - **Independent Contractor Involvement:** Biomining activities, a crucial phase in waste processing, are outsourced to independent contractors.
   - **Child Involvement:** Site visits have revealed the presence of children in biomining activities, indicating a significant risk of child labour within this aspect of the Project's supply chain.

7.4.9.3 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 JMC to undertake the monitoring, or the project shall undertake the monitoring in support of JMC.
     - 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. Contractual Obligations on Biomining Contractors:
   - Action Steps:
     - Embed child labour prohibition clauses in the contracts with biomining contractors.
     - Include stringent penalties for non-compliance with ethical employment practices.
     - Mandate biomining contractors to provide evidence of their commitment to child labour-free operations.
3. 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.
4. 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

7.4.10 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, the compliance status of the contractor in against the applicable labour national regulations is provided as part of the **Appendix 19**.

7.4.10.1 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, GWJPL 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, GWJPL has prepared a legal and statutory compliance period checklist. The checklist is filled by GWJPL against the compliance status of the appointed contractor. The key acts and their requirements covered by the checklist is outlined below:

Figure 7-2 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	-	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
			g. Damage/loss register h. Fine Register 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

7.4.10.2 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.

7.4.10.3 Proposed Mitigation Measures

Proposed mitigation measures for contractor management:

- Provide comprehensive training to contractors on the established contractual agreements, emphasizing compliance with labor 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 labor laws, safety regulations, and ethical labor 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 labor laws and industry best practices. Regularly update contractors on policy changes and provide the necessary support for implementation.
- GWJPL shall ensure that all the employed workers shall receive benefits as per the Employees' Provident Funds and Miscellaneous Provisions Act, 1952.
- GWJPL shall ensure that M/s Vijay Singh and M/s Aditya Enterprises shall obtained the registration under the Employees' State Insurance Act, 1948.

	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**

7.4.11 Impact on Ragpickers

The project's total waste requirement amounts to 650-750 TPD (Tons Per Day). Of this, 250-300 TPD corresponds to freshly generated waste from Jamnagar city, while the remaining 400-500 TPD is sourced from legacy waste biomining at the Rajkot Municipal Solid Waste (MSW) landfill. As the 250 TPD of waste previously dumped in Jamnagar is now redirected to the landfill for the project, it is anticipated that ragpickers engaged in ragpicking may have faced challenges of earning livelihood or decrease in livelihood earning opportunities due to the unavailability of freshly dumped waste. However, it's important to note that the project has been operational since November 2021.

During a site visit to the Jamnagar landfill, no ragpickers were identified or present for consultation at the Jamnagar MSW landfill. Consequently, the full extent of the impact remains uncertain at this assessment stage. Nevertheless, consultations have been conducted at the Happa transfer station to understand the socio-economic profiles of ragpickers and address any concerns related to the cessation of livelihood activities due to the project's operation. According to response from

ragpickers at the transfer station, they do not foresee any disruption to their livelihoods as the transfer station has been operational, and they have been actively involved in rag picking for the past eight years.

7.4.11.1 Control Measures

The project, in collaboration with the Jamnagar Municipal Corporation (JMC), does not impede or restrict ragpickers from collecting freshly dumped waste at the transfer station.

7.4.11.2 Impact Magnitude

Given the presence of ragpickers at the operational transfer station despite the project being in operation, and no cessation of their activities at the site, it is deemed that the Project's impact on the livelihoods of ragpickers is **Negligible.**

7.4.11.3 Proposed Mitigation Measures

- The project will incorporate ragpickers into its established grievance redressal mechanism.
- Moreover, if any ragpicker previously employed at the Jamnagar MSW landfill approaches the project, they will be considered for preferential employment opportunities at the WTE plant, given their technical skills suitable for the Project. However, the ragpicker(s) who approach the project for employment shall obtain the certificate from JMC claiming he/she previously has worked at the landfill site.

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

7.4.12 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, GWJPL has also developed 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.

Implemented Control Measures

- GWJPL has developed a site-specific Emergency Response Plan identifying both onsite and offsite emergencies along with management measures and Emergency response team to respond to emergencies on time. GWJPL is responsible to respond to any off-site emergencies in a radius of 500 m from the plant and beyond 500 m radius, however appointed Disaster Control Director (DCD) shall decide whether or not the plant team shall respond to the emergency.
- The plant is equipped with fire detectors, alarm systems, and fire-fighting equipment.
- GWJPL has installed 17 hose boxes with 34 hose pipes and 13 hose reels with nozzle at different locations within the plant. The project has also installed 34 no.s of dry powder and CO2 based fire extinguishers at designated locations as per the fire plan. As reported, the firefighting arrangements are inspected by Security Head on monthly basis and the same is tested and refilled on yearly basis by external agency named Vijaya Fire Engineering Works Private Limited.
- GWJPL has installed fire hydrant line connected with one fire hydrant pump and two Mist Cooling Water (MCW) pumps. Fire Hydrant has a flow capacity of 108 m3/hr flow with 70 mWC head and each MCW Pump has a capacity of 2000 m3/hr. flow with 35 mWC. During operation of fire hydrant pump with two nozzles head, each nozzle will be with 35 mWC.
- The fire hydrant system is always pressurized due to normal operation of MCW pump which is required to operate when turbine is in operation. The fire hydrant pump can be used as stand by to MCW pump.
- GWJPL has selected submersible-type firefighting pumps and a provision of backup power with a diesel generator (DG Power) has been provided. Direct power is provided from the DG set through a changeover switch in the firefighting panel. So, In case of emergencies and shut down of main power, DG can be used, and power will be transferred to the firefighting pumps' panel for usage.
- Fire exit sign boards (In English language) have been displayed with adequate illumination at multiple locations. The staircase used for commuting was observed to be equipped with handrail.
- Workers are provided with trainings on fire safety, electrical safety, PPE trainings
- Fire safety arrangements such as fire hydrant, fire extinguishers, sand buckets, smoke detectors, automatic water sprinklers etc. were observed to be installed at the identified locations inside the Plant premises
- Pre-employment and annual medical examination of the workers are being undertaken wherein to examine the workers for general physical examination, eye test, skin examination, vaccination, and communicable diseases. Record for the same is maintained. All the workers, on the payroll of the Company are covered under group insurance.

- Work permit system pertaining to non-routine activities such as any civil work, hot work, working in confined space working at height etc. has been developed implemented at the Plant.
- Adequate ventilation of enclosed processing areas (e.g., dust in waste size reduction areas, VOCs driven off by high temperatures during composting) has been provided
- The pre-proccing area including boiler main bunker always remains in negative air pressure, forced draft fan sucks primary air from these areas. Thus any formation of methane due stacking of prepared RDF in main boiler bunker is sucked into the boiler.
- All other areas of pre-processing and transfer have adequate volume of overall processing area. The average height of preprocessing is about 8 meters from finish floor level which ensures 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.
- Provision of adequate personnel facilities, including washing areas and areas to change clothes before and after work.
- 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
- Adequate no of lavatory facilities (4) is provided for the on roll and contractual employees working in shifts and allowances have been made for segregated facilities. Toilet facilities are also 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.
- Deactivation and proper grounding of live power equipment and distribution lines according to applicable legislation and guidelines whenever possible before work is performed on.
- Hand, knee and foot railings have been installed on stairs, fixed ladders, platforms, permanent and interim floor openings etc.
- Negative air pressure for management of Odor
- Greenbelt development has been done along the layout boundary along with adequate green buffers between facilities and utilities/common areas.
- Hazardous areas (electrical rooms, compressor rooms, etc.), installations, materials, safety measures, and emergency exits, etc. are be marked appropriately.

Additional Mitigation Measures

- The ERP should also 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
- GWJPL should provide at least two exits at the pre-processing unit which can be used by workers for evacuation in case of fire emergency.
- The spiral staircase to be replaced with straight staircase to avoid accidents during emergency evacuation.
- Since hazardous waste and material is generated and present within the project premises, GWJPL to implement 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 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.
- First aid box at the Plant to be maintained in accordance with the type and quantity of first aid materials in the box was not adequate as per 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.

- GWJPL to undertake HIRA and JSA to identify occupational Health & Safety risks associated with plant operations and establish specific H&S management SOPs that are commensurate with identified risks.
- Workplace monitoring programme to be developed and implemented which should include temperature, ventilation, lux levels, humidity levels, noise etc. for the workplace.
- Implementation of incident investigation and reporting procedure as developed as part of the ESIA.
- Training with respect to transportation safety (such as vehicular safety checks, driver health, traffic movement, driver safety etc.) to be included in the training schedule/calendar of the Plant and same shall be conducted to the drivers/helpers and other workers involved in the transportation and loading/unloading activities.
- 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.

	Nature of Impact	Spread of Impact	Duration	Intensity	Frequency	Significance of Impact
Without Mitigation Measures	Negative	Local	Short-Long	High	Routine	**Major**
With Mitigation Measures	Negative	Local	Short-Long	Low	Routine	**Small Substantial**

7.4.13 Community Health & Safety

As observed that the Navgam Ghed city is located 130 m (aerial distance) towards south direction and 300 m (aerial distance) towards west direction. The Jamnagar project is currently receiving fresh waste from Jamnagar Municipal Corporation (JMC) through small trucks/ trailers. About 100 no.s of JMC trucks carry the waste to plant. Apart from this, about 20 trucks bring bio-mined waste from Rajkot MSW landfill site on daily basis. All the waste vehicles currently use the road that is leading towards Navgam Ghed city. The road currently being used for bringing the waste to the site is an alternate road proposed by JMC on temporary basis, till the time the project is connected to main access road which is planned to be constructed in 1- 2 years' time. The major community health and safety risks include movement of vehicles and waste collection trucks and commuters via the 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. Residential community is present along this alternate route and there is limited use of the road by village residents and community, and it is mainly to access the adjoining farmlands.

Also, the movement of waste to the project site is done by JMC, however major increase in impact is not anticipated as the waste would have been collected and transported to for dumping to land fill site/dumping area the same waste is being unloaded at the plant. 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. Impacts to community health and safety are as follows:

- 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. Buffer stock will be maintained at the Plant which will be a couple of days stock, hence odour modelling will be conducted and management measures, as required will be implemented.

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 as well as WtE plant impacts the workers and the surrounding community.

Visitors and trespassers at waste management facilities maybe subject to many of the hazards described for site workers.

STP is located in near vicinity to the Plant. Cumulative health & safety impacts due to operations of STP and Waste to Energy Plant can include air pollution, noise and potential hazards from transportation activity.

- Both STP and WtE plant release odour which can lead to community discomfort.
- Operation of STP and WtE plant involves machinery and other equipment that generate noise. Continuous noise can be disruptive to the nearby residents.

Implemented Control Measures

- 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
- Limiting the hours of operation for specific pieces of equipment or operations, especially high noise generating equipment
- Noise monitoring is carried out on half yearly basis for the purposes of verifying operational phase noise levels.
- Entry of covered/closed Trucks/ dumpers only.
- Use of dedicated route for deployment of heavy-duty vehicles/ waste etc. for the project

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

- Reducing project traffic routing through community areas wherever possible

- Traffic management of vehicles engaged during operational phase. Traffic management plan to be implemented as developed.
- 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.
- 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**

7.4.14 Climate Change Impacts

According to Climate Change Department, Government of Gujarat[84], 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[85], 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[86].

Note: It should be noted that this is a very 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 adaptation.

Precipitation

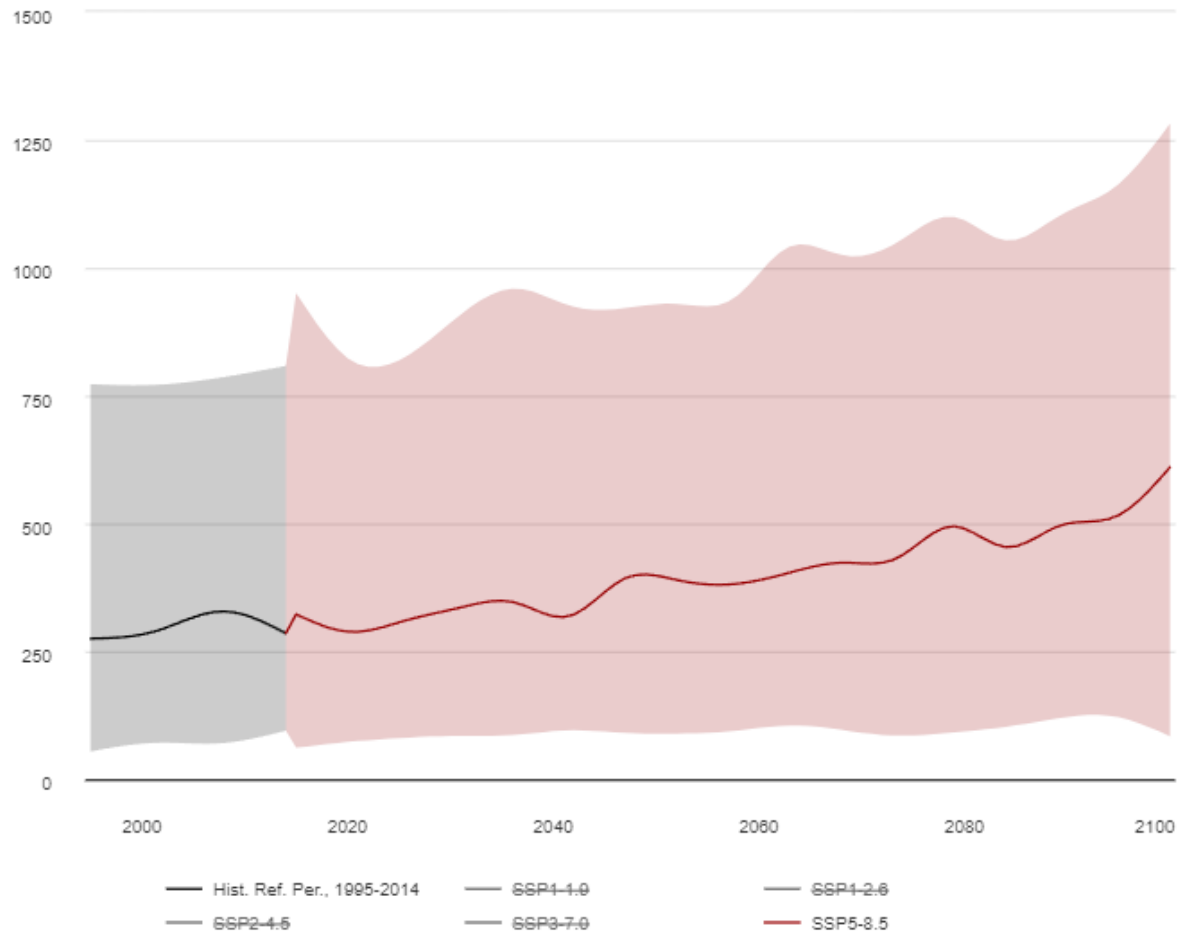
The projection period for precipitation has been considered as 2020-2039. The projected precipitation anomaly for Gujarat has been presented in ***Figure 7-3*** (reference period as 1995-2014) for selected scenarios i.e., CMIP6 SSP5-8.5[87]. Average

[84] https://ccd.gujarat.gov.in/
[85] https://ccd.gujarat.gov.in/Images/Gujarat-State-Action-Plan-on-Climate-Change.pdf
[86] https://climateknowledgeportal.worldbank.org/
[87] SSP5–8.5 represents the high end of the range of future pathways, corresponding to RCP8. 5

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

As per the ***Figure 7-3*** 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 7-3 Mean Projected Precipitation in Gujarat for 2020-2039 (reference period: 1995-2014)

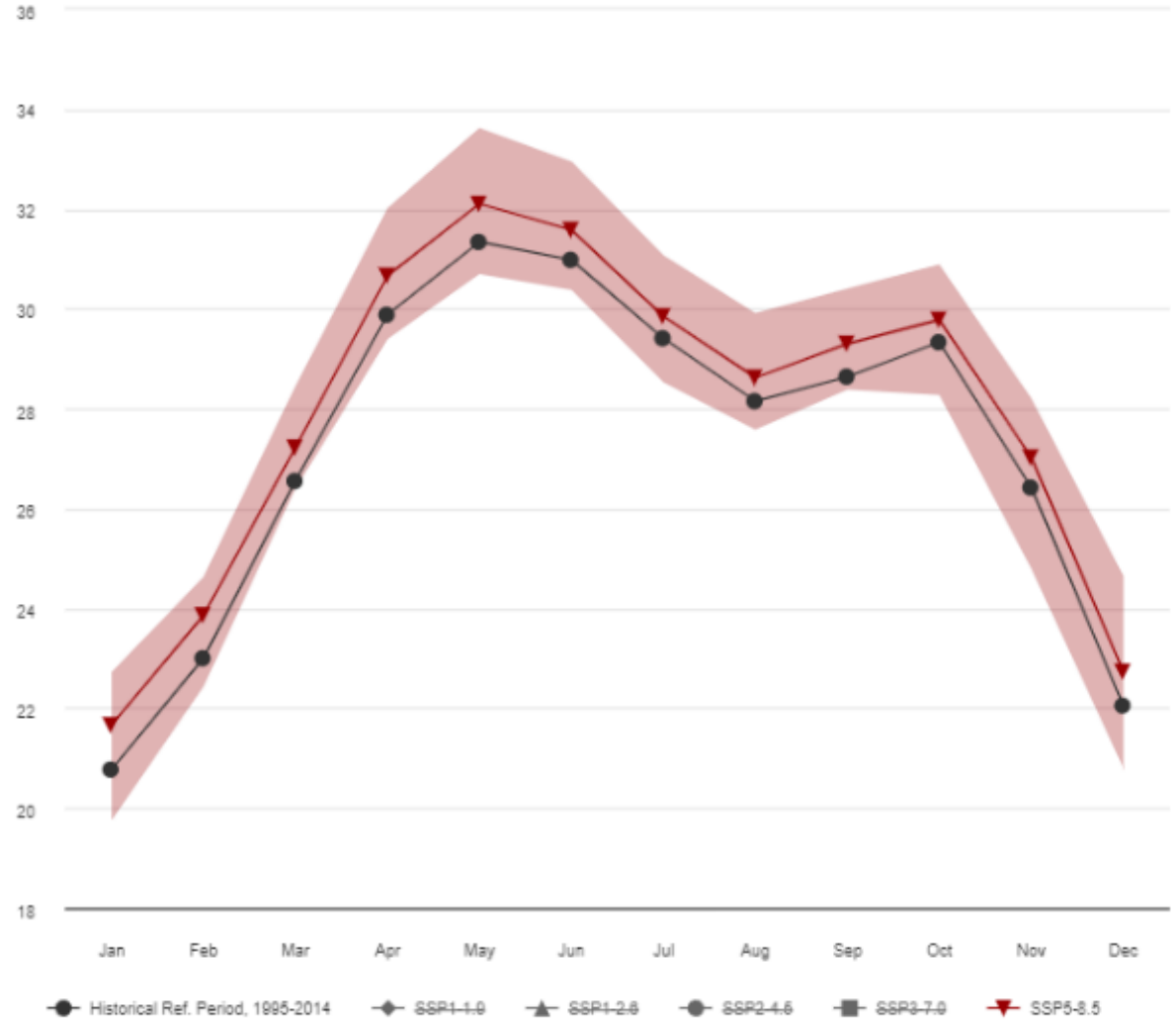


Source: World Bank Climate Change Knowledge Portal

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 7-4.*** 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 7-4 Projected Mean Temperature in Gujarat for 2020-2039 (reference period: 1995-2014)



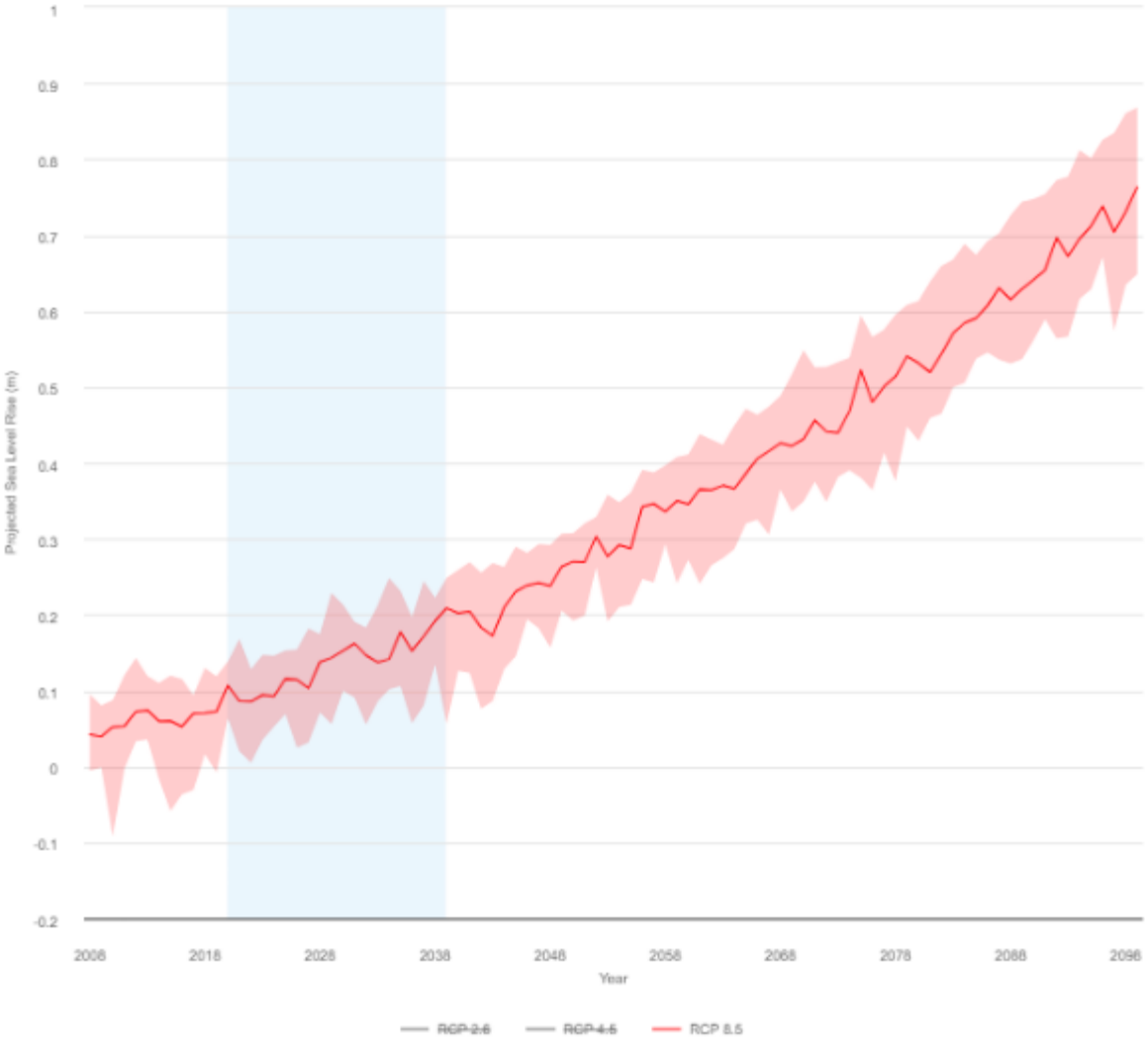
Source: World Bank Climate Change Knowledge Portal

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 7-5.*** 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 in 2039 in sea level as compared to the historical year of 2008.

Figure 7-5 Projected Sea Level Rise for Coastal Gujarat (2020-2039)



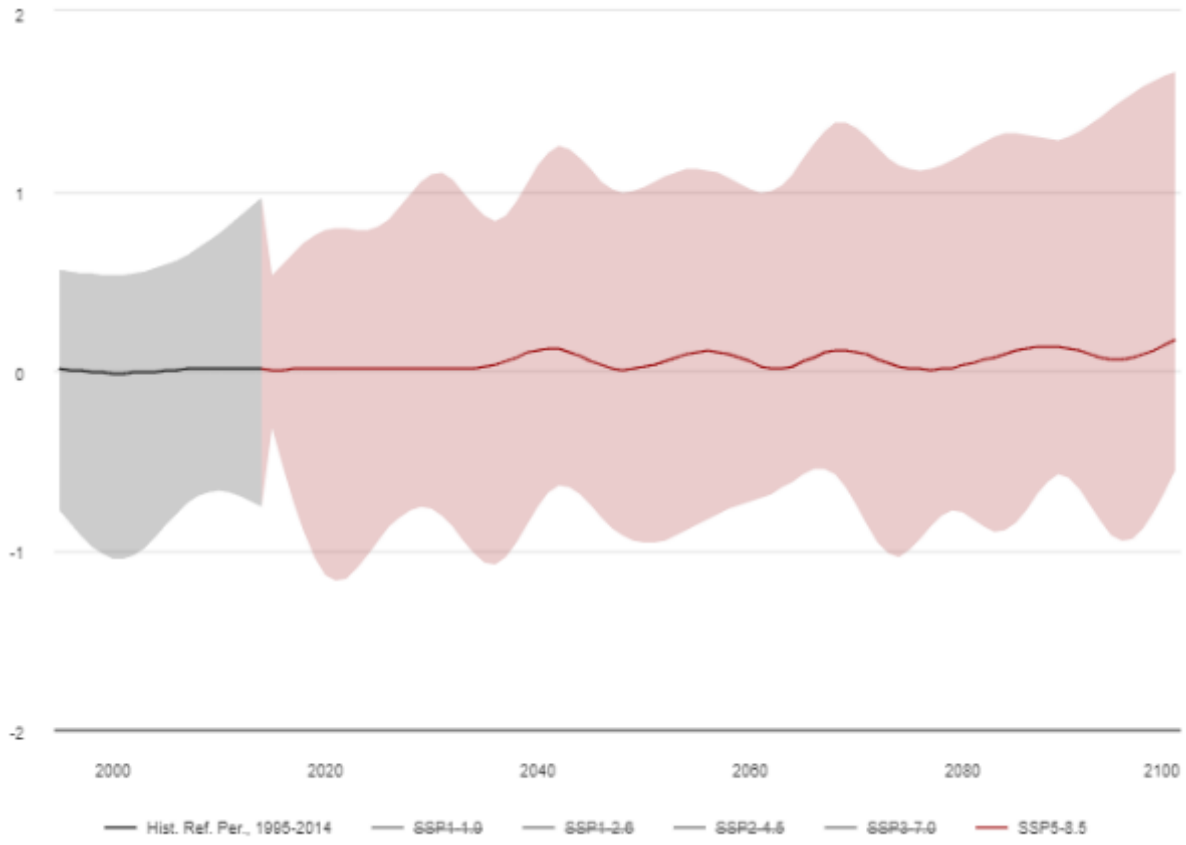
Source: World Bank Climate Change Knowledge Portal

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 7-6.*** 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 7-6 Projected Annual SPEI Drought Index, Gujarat, India (Reference Period: 1995-2014)



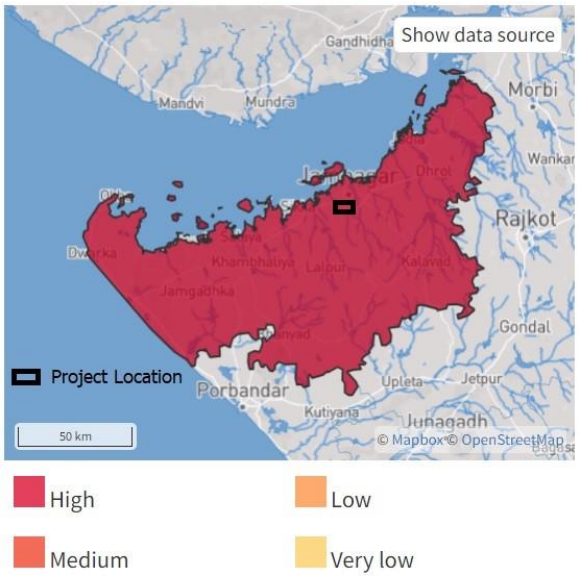
Source: World Bank Climate Change Knowledge Portal

Cyclone

A cyclone is a weather phenomenon characterized by strong winds rotating around a low-pressure centre. Cyclones form over warm ocean waters and can cause severe weather conditions including heavy rainfall, strong winds, storm surges, and sometimes tornadoes. Depending on their location and intensity, cyclones may be referred to as hurricanes, typhoons, or tropical cyclones. These storms can have significant impacts on coastal areas, leading to flooding, infrastructure damage, and loss of life.

The Cyclone Hazard Map as per ThinkHazard for the Project site is presented below. Present hazard level of the area is classified as high. The present hazard level in areas currently affected by tropical cyclones may increase in the long-term. Projects located in such areas should be robust to future increases in cyclone hazard.

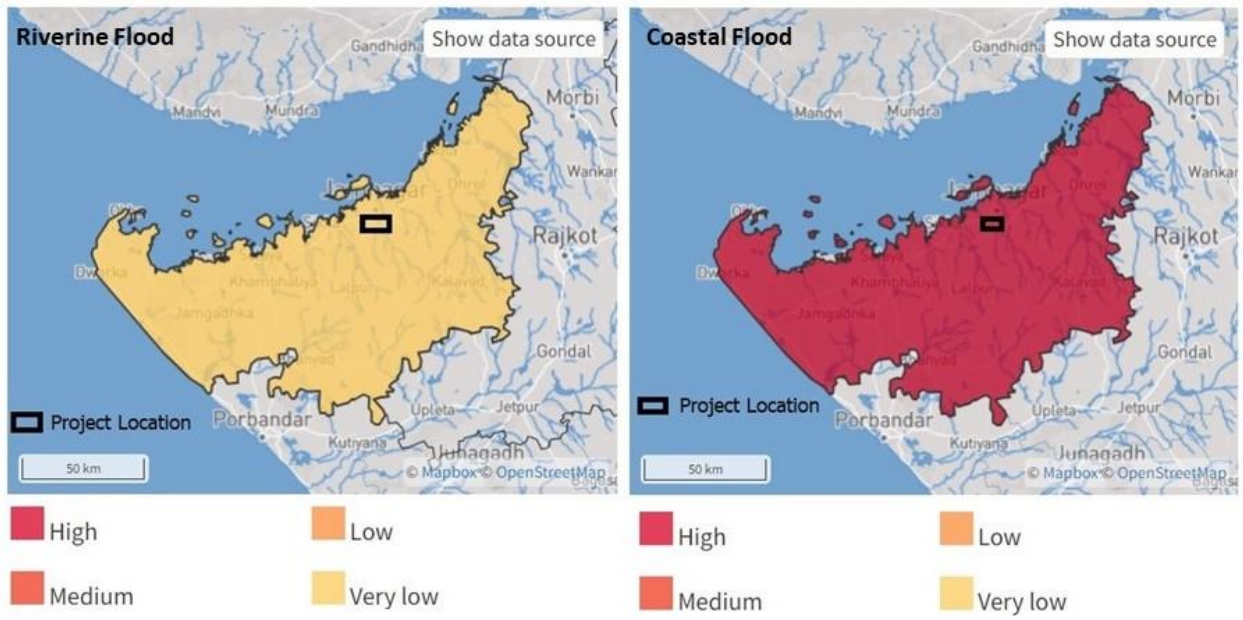
Figure 7-7 Cyclone Hazard Map



Flood

As per the information available in Think Hazard, riverine flood hazard risk is considered to be very low to low and coastal flood hazard is classified as high for the project location as presented in ***Figure 7-8*** below. Please section 2.8 for Flood Management measures implemented at Site.

Figure 7-8 Map showing Riverine and Costal Flood Risk at Project Site



Projected Vulnerability to Climate Change

The GWJPL project located in Jamnagar is anticipated to be vulnerable to precipitation, temperature and sea level rise based on the projected climate trends described above. The projected sea level rise data for period 2040-2059 makes the 7.5 MW WTE plant and its associated facilities vulnerable to sea level rise due to its location close to Gulf of Kutch (5 km aerial distance towards north direction of the project boundary). Increase in sea level may potentially lead to saltwater

intrusion in groundwater making it unfit for domestic purpose. Additionally, increase in precipitation in the project area in future may lead to increase in leachate deposition at the site due to storage of 450 TPD municipal solid waste at the preprocessing area. Increase in precipitation and sea level rise may potentially expose the project to cyclone and flood. Furthermore, since the project is also anticipated to be vulnerable to high temperature with heat wave, this may lead to decrease in water availability in future for domestic as well as industrial purpose.

8 Environment & Social Management and Monitoring Plan

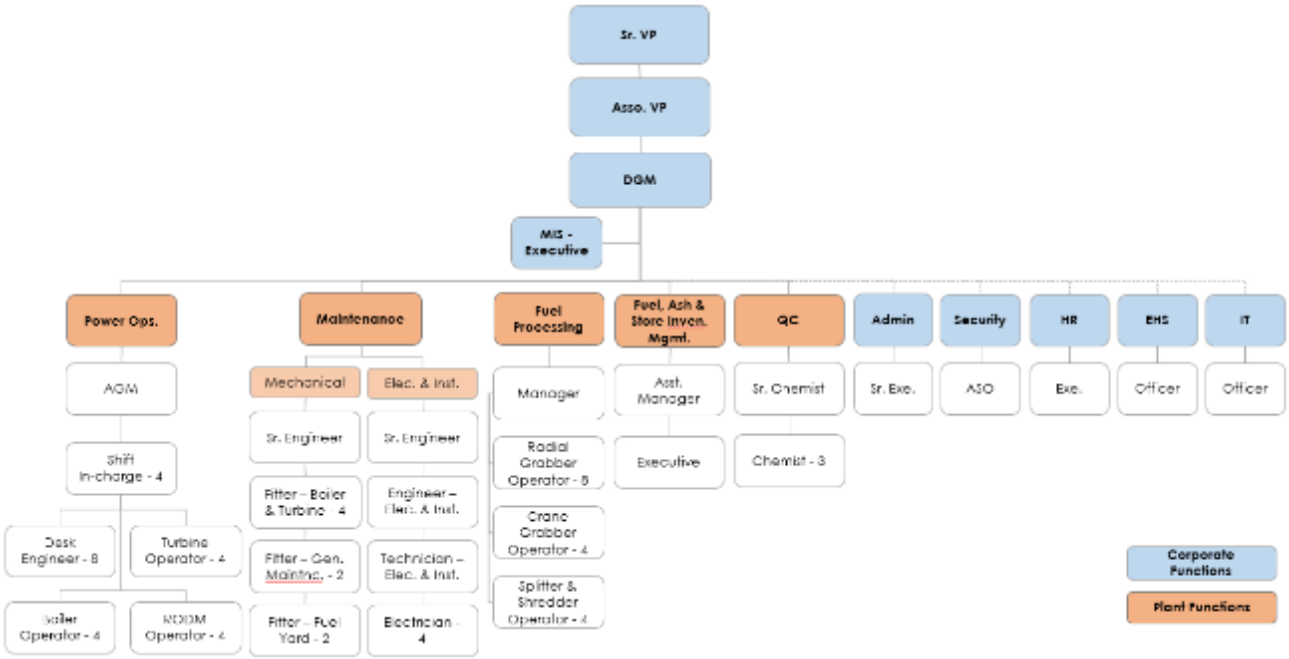
This section presents the Environmental and Social Management Plan (ESMP) for the Project. The purpose of this ESMP is to specify the standards and controls required to manage and monitor environmental and social impacts during operation phase. To achieve this, the ESMP identifies potential adverse impacts 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 7.5 MW Waste to Energy plant at the corporate level is headed by the ACEL's Senior Vice President who is supported by Associate Vice President and Deputy General Manager. The project is also monitored by Senior Executive from Administration department, Assistant Security Officer from Security department, HR executive, Information Technology (IT) Officer and EHS officer at the corporate. As reported by project team, 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.

At site level, the project is operated and monitored by GWJPL's team comprising of Assistant General Manager, Shift in Charges, Desk Engineers, Turbine Operators and Boiler Operators from Power Operations department, Mechanical and Electrical Engineers, Technicians and Electricians from Maintenance Department, Manager, Radial, Crane, Shredder Operators from Fuel Processing department, Chemist from Quality Check Department and Security Staffs. As reported by project team, GWJPL is under process of hiring a competent safety officer to monitor health and safety aspects at the plant.

Figure 8-1 Organizational Structure



Source: ACEL

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 during operation phase. GWJPL 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. GWJPL 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.

GWJPL during the operation phase of the project to 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.

Plant Head will act as bridging gap between the corporate (ACEL) and the project SPV (GWJPL). 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 HSE team for Operational 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 as mentioned *in Table 8-1* is given below:

Table 8-1 Roles & Responsibilities

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. • 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, and • To conducting meetings with the local communities

8.2 Existing Policies and 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 GWJPL 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:

- 1st shift – from 08:00 am to 04:00 pm (with a break of half an hour in rotation)
- 2nd shift – from 04:00 pm to 12:00 am (with a break of half an hour in rotation)
- 3rd shift – from 12: 00 am to 08:00 am (with a break of half an hour in rotation)
- 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:

- Provident Fund (PF) – as per provisions of the Employees' Provident Fund & Miscellaneous Provisions Act, 1952
- Employees' State Insurance (ESI) – as per provisions of the Employees' State Insurance Act, 1948
- Bonus – As per provisions of the Payment of Bonus Act, 1965
- Gratuity – As per provisions of the payment of Gratuity Act, 1972
- 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:

- Contractor shall submit necessary legal documents with seven (7) days of appointment and the personnel department will check the documents.
- Contractor shall obtain applicable legal licenses and registrations.
- Contractor must provide sufficient workers and maintain the workforce for assigned work as per terms and conditions of service agreement.
- Contractor must adhere to the company's 'Prohibition of child labour at workplace' policy.

- Contractor must issue gates pass, identity card and attendance card to all the workers deployed and distribute wages to the workers.
- 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.
- Contractor must submit the proof of remittance of Employee State Insurance (ESI) and Employee Provident Fund (EPF) every month on time.
- 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:

- No Employee will be retrenched under normal circumstances.
- 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.
- The company will follow the rule of 'last person to be employed to be retrenchment first' in that category.
- The company will give preference to the retrenched employees for re-employment at the time of future recruitment and selection.
- 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:

- No employees/contract workers will be compelled or allowed to work at plant for more than 48 hours a week.
- All employees/contract workers will be allowed half an hour rest in a day, after continuously working for 5 hours.
- Overtime might be needed to handle emergencies, heavy workloads, or other issues. But frequent and excessive overtime work will not be allowed.
- 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.
- The company will advise employees/contract workers to work overtime only when they have to finish urgent work, and up to the stipulated hours.
- 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:

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- Contractual Agreement: As a process, GWJPL 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, GWJPL has prepared a legal and statutory compliance period checklist. The checklist is filled by GWJPL against the compliance status of the appointed contractor. The key acts and their requirements covered by the checklist is outlined below:

Table 8-2 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	a. LWF - Challan	-

Sr. No.	Key Acts and associated rules	Acts' Requirements with frequency of auditing			
		Daily	Monthly	Half-yearly	Yearly
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	-	-
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 facility operators like 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 operations of a plant. Operation phase involves transportation of waste, export of waste residue & fly ash and movement of manpower to the plant. Such activities will thus have an 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 GWJPL, 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 WTE 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 operation phase. 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 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 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 include 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 operation & maintenance.
- Resource Efficiency and Conservation Management Plan: Proper resource efficiency and management planning of will enable GWJPL 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 Appendix 11
- Labor Management and Working Conditions including labor camps (Appendix 12): As per the site conditions the plant is operational and contracted workers are engaged in the operations of the plant , therefore in order to comply with the IFC PS 2 and national labor regulations, labor management plan is developed and same needs to be implemented during the lifecycle of the project and where necessary regular updates should be made. As a part of the labor management the future looking labor camps management plan is also developed although currently there are no labor camps at site however in case of any future development the same could be implemented. Details are given in ***Appendix 12***.

8.3 E&S Review and Communication

Regular inspection and monitoring of the environmental and social aspects as part of 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, GWJPL 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 GWJPL (project team) as well as corporate team (ACEL) and the entire process of inspections and audits/ monitoring will be documented.

GWJPL 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

GWJPL 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 8-3 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
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 wastewater • 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 grievances 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.

GWJPL 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, GWJPL will ensure that the conditions stipulated in various permits are complied. The inspections and audits will be done by trained personnel of GWJPL 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 8-4 Review & Reporting Schedule

Sr. No.	Type of Report	Development Responsibility	Supervisory Responsibility	Frequency
1	Report on Compliance to Work Plan including toolbox 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 updating 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 Training 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
- GWJPL will ensure that environmental health and safety induction training and job specific trainings are identified and given to the concerned personnel during 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 8-5 Training Requirement

Sr. 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	✓	✓

Sr. No.	Type of Training	Project Team	Contractors & Subcontractors
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 GWJPL 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 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 8-6***

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 8-6 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	Supervision responsibility	Reporting Requirements
1.	Air Quality	Flue gas emission, dust emission and vehicular emission, particulate matter etc.	• All equipment to be periodically checked to ensure compliance to the emission standards. • 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 • Periodic maintenance of the bag filter & ESP to be carried out to avoid dust emissions during removal of fly ash. • 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%. • 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. • Water Sprinkling to be done at the access road to manage dust emissions from the vehicles transporting waste to the plant. • Fly Ash to be transported in covered trucks and tippers to the fly ash recipients. Fly ash generated from bag filter should be sent to cement plants. GWJPL to discuss with JMC for disposal of ash in line with MoEFCC draft notification no. G.S.R. 285(E) dated 22/04/2021, with previous notification in 2016. • GWJPL to provide GPCB with the NOC received from Ministry of Defense and amend the stack height of the boiler to 40 m within the CTO to remain compliant to the condition of the CCA w.r.t stack height of the boiler. • GWJPL should conduct environmental audit annually and submit environmental statement pertaining to previous year to GPCB by 30th September every year in compliance to the CCA.	GWJPL EHS Manager	EHS Inspection	Quarterly	GWJPL Project Head	EHS Head at ACEL	Report from EHS team to Project head and further to corporate team
2.	Noise	Impact on receptors	• Noise zone assessment to be carried out to understand high noise generating areas. • Plantation at the Project boundary to be increased. • The project to restrict the noise generation from steam turbine generator and other major equipment ≤ 85 dB(A) at a distance of 1 m to comply with the Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2010 by regular maintenance and optimized operations (adjusting speed and load without compromising efficiency). • Enclosures, noise and vibration mufflers, acoustic barriers and anti-vibration mats to be provided at all 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 to be provided for all noise generating machines. • Adequate PPE's (earmuffs, earplugs) to be provided to all employees (on roll as well as contractual) working in high noise generation area's and machineries. • Quarterly indoor noise monitoring to be undertaken (while the plant is fully operational) to mitigate or manage high noise levels and implementation of noise management measures. • 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. • Project should ensure ambient noise levels are within IFC ambient noise quality standards. • GWJPL to implement management procedures on ambient as well as indoor noise pollution.	GWJPL EHS Manager	EHS Inspection	Quarterly	GWJPL Project Head	EHS Head at ACEL	Report from EHS team to Project head and further to corporate team
3.	Soil Environment	Soil Contamination	• Development of Leachate Drying beds for management of leachate	GWJPL EHS Manager	EHS Inspection	Quarterly	GWJPL Project Head	EHS Head at ACEL	Report from EHS team to Project head and

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	Supervision responsibility	Reporting Requirements
			• Options for leachate disposal to be adopted such as disposal of the dried leachate sludge at the Theba landfill and use of leachate water for bottom ash quenching or alternatively injection of the leachate within the boiler. • Project to discuss with JMC for disposal of ash in line with MoEFCC draft notification no. G.S.R. 285€ dated 22/04/2021, with previous notification in 2016. Project to discuss with JMC for disposal of ash in line with MoEFCC draft notification no. G.S.R. 285(E) dated 22/04/2021, with previous notification in 2016. • GWJPL 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 JMC trucks. If fly ash is identified as hazardous, it is to be sent to hazardous waste landfill site through authorized hazardous waste recycler. 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. • GWJPL is recommended to obtain chain of custody documents from Jamnagar 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. • GWJPL 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, GWJPL 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 by proper screening of industrial hazardous waste proposed to be handled and used as feedstock. • If GWJPL is uncertain that the disposal conducted by JMC is as per the applicable rules, GWJPL 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. • Project should store the ash in closed area or in silos to avoid air emission and soil contamination (in case ash contains hazardous content), if there is delay in ash collection by JMC trucks/ authorized hazardous waste recyclers due to unforeseen condition. • GWJPL 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. GWJPL to ensure that the covered trucks are used by JMC to dispose the bottom ash in the nearest sanitary landfill. GWJPL to track bottom ash generation and disposal. • Fly ash generated from bag filter should be sent to cement plants. • GWJPL to not store hazardous waste more than 90 days. Hazardous waste to be disposed regularly via the identified authorized hazardous waste vendor. • In case of failure of pollution control equipment, the production process connected to it shall be stopped. Remedial actions/measures shall be implemented immediately to bring entire situation normal. • Separate ferrous and non-ferrous metals from bottom ash as far as practicably and economically viable, for their recovery • 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) • 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. • Good housekeeping and best practices of waste handling to be adopted to eliminate/minimize the risks of soil contamination. • 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						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	Supervision responsibility	Reporting Requirements
			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. • Description or SOPs 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 is generated and present within the project premises, GWJPL 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. • GWJPL should conduct environmental audit annually and submit environmental statement pertaining to previous year to GPCB by 30th September every year in compliance to the CCA					
4.	Water Resource	Water Availability & Water Quality	• Ensure compliance with requirements of Combined Consent Authorization, as received by the project. o GWJPL to provide CCTV camera with24*7 surveillance monitoring and at least 15-day record storage on the boundary wall towards Rangamati River and continuous monitoring to be done. o The quantity of the domestic wastewater (Sewage) shall not exceed 6 KL/Day o GWJPL to provide flow meter on inlet & outlet of plant as well as shall maintain records for the same. o GWJPL to provided flow meter on different outlet of rejected water and to maintain records and also link with the CPCB site for prescribed parameters like pH, TDS, TOC etc. o GWJPL to provided pipeline network along with flow meter for the discharge for plantation and gardening purpose for process effluent & maintain its records. o Provide magnetic flow meters with totalizers at the outlet of facility. o 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. o GWJPL should conduct environmental audit annually and submit environmental statement pertaining to previous year to GPCB by 30th September every year in compliance to the CCA. • 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. • GWJPL to ensure leachate beds are developed in compliance to the Project design to ensure adequate leachate collection and disposal, when generated in future. • 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. • Measure and record the quantity and quality of leachate generated. Changes in leachate quantity or quality attributable to weather or other factors to be accounted for.	GWJPL EHS Manager	EHS Inspection	Quarterly	GWJPL 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	Supervision responsibility	Reporting Requirements
			• A dedicated leachate management SOP to 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. • 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. • Workers should be sensitized on water conservation measures and encourage optimal use of water. • Regular inspection should be carried out for identifying water leaks and preventing water wastage. • Regular monitoring of ground water level and quality to 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 • 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						
5.	Occupational Health & Safety	Impact on the health & safety of the workers on site	• The ERP should also 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 • GWJPL should provide at least two exits at the pre-processing unit which can be used by workers for evacuation in case of fire emergency. • The spiral staircase to be replaced with straight staircase to avoid accidents during emergency evacuation. • Since hazardous waste and material is generated and present within the project premises, GWJPL to implement 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 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 • First aid box at the Plant to be maintained in accordance with the type and quantity of first aid materials in the box was not adequate as per 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. • GWJPL to undertake HIRA and JSA to identify occupational Health & Safety risks associated with plant operations and establish specific H&S management SOPs that are commensurate with identified risks. • Workplace monitoring programme to be developed and implemented which should include temperature, ventilation, lux levels, humidity levels, noise etc. for the workplace	GWJPL EHS Manager	EHS Inspection	Quarterly	GWJPL 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	Supervision responsibility	Reporting Requirements
			• Implementation of incident investigation and reporting procedure as developed as part of the ESIA. • Training with respect to transportation safety (such as vehicular safety checks, driver health, traffic movement, driver safety etc.) to be included in the training schedule/calendar of the Plant and same shall be conducted to the drivers/helpers and other workers involved in the transportation and loading/unloading activities. • 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						
6.	Community Health & Safety	Impact on Health & Safety of the local community	• Reducing project traffic routing through community areas wherever possible • Traffic management of vehicles engaged during operational phase. Traffic management plan to be implemented as developed • 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 • 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	GWJPL EHS Manager	EHS Inspection	Quarterly	GWJPL Project Head	EHS Head at ACEL	Report from EHS team to Project head and further to corporate team
7.	Increased in local employment and Livelihood	Increased local employment and livelihood	• Project should develop guidelines/policies towards local employment and livelihood opportunity enhancement. • 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 should establish a mechanism to audit sub-contractors and suppliers with respect to compliance of utilizing local labor and resources	GWJPL – HR/CSR	Labour Audit, and EHS Inspection	Quarterly	GWJPL Project Head	HR/EHS Head at ACEL	Report from HR/CSR/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	Supervision responsibility	Reporting Requirements
8.	Contractor Management	Contractor Management	• Provide comprehensive training to contractors on the established contractual agreements, emphasizing compliance with labor 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 labor laws, safety regulations, and ethical labor 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 labor laws and industry best practices. Regularly update contractors on policy changes and provide the necessary support for implementation • GWJPL shall ensure that all the employed workers shall receive benefits as per the Employees' Provident Funds and Miscellaneous Provisions Act, 1952. • GWJPL shall ensure that M/s Vijay Singh and M/s Aditya Enterprises shall obtained the registration under the Employees' State Insurance Act, 1948.	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
9.	Supply Chain Management	Supply Chain management	• Implement stringent monitoring mechanisms for contractors involved in waste collection and transportation. The project shall request RMC to undertake the monitoring, or the project shall undertake the monitoring in support of RMC. • 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. • Embed child labour prohibition clauses in the contracts with biomining contractors. • Include stringent penalties for non-compliance with ethical employment practices. • Mandate biomining contractors to provide evidence of their commitment to child labour-free operations. • 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. • 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

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	Supervision responsibility	Reporting Requirements
10.	Impact on Ragpickers	Potential loss of livelihood	• The project will incorporate ragpickers into its established grievance redressal mechanism. • Moreover, if any ragpicker previously employed at the Jamnagar MSW landfill approaches the project, they will be considered for preferential employment opportunities at the WTE plant, given their technical skills suitable for the Project. However, the ragpicker(s) who approach the project for employment shall obtain the certificate from JMC claiming he/she previously has worked at the landfill site.	Project Incharge / HR/ EHS	Records of Grievances	During operation	Grievance officer	Project Incharge / EHS team	Internal Monitoring report
11.	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. • Training programs for project personnel should be conducted to educate them on how to handle encounters with wildlife safely and responsibly. • An emergency response protocol to handle any human-wildlife conflicts should be develop which should include procedures for safely managing encounters and contacting relevant authorities if needed. • Good housekeeping practices can help to create an environment in the project site that is less appealing to wildlife, thus we can minimize their presence within the project compound.	EHS Manager	Visual Observation and EHS Inspection	Quarterly	Project Head	EHS Head at ACEL	Quarterly report from EHS team to Project head and further to corporate team
12.	Impacts of Increased Traffic / Vehicle Movement	During the operation phase, the municipal waste will be collected from different area of the city and transported to the Waste to Energy plant. The Jamnagar project is currently receiving fresh waste from JMC through small trucks/trailers. About 100 numbers of JMC trucks carry the waste to plant. Apart from this, about 20 trucks bring bio-mined waste from Rajkot MSW landfill site on daily basis. This will contribute to the overall traffic / vehicle movement on the major roads of the city. Positively, no movement of these trucks was identified in the wildlife prone protected area. Vehicular movement will also contribute to vehicular	• 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 trucks/trailers drivers should be instructed not to blow horns unnecessary. • The drivers should follow the speed limit instructed by highway authorities (in the form of signboards) • Annual awareness/training programs should be conducted for drivers to minimize the risk of wildlife hitting and/or being killed on highways and road safety • Water sprinkling to be carried out, as required, on the unpaved road • Sudden acceleration or de-acceleration of vehicles produces more pollution than a vehicle maintaining a constant speed. Smoother flow of traffic within the parking area and within the project premises would ensure lesser pollution from the vehicles • Anti-honking sign boards to be placed in the parking areas and at entry / exit points • Regular inspection / maintenance of vehicles to be carried out	GWJPL EHS Manager	EHS Inspection	Quarterly	GWJPL Project Head	EHS Head at ACEL	Quarterly 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	Supervision responsibility	Reporting Requirements
		emission, fugitive dust emission (unpaved roads), noise and soil contamination in case of accidental leakage							

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 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 9-1*** 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	Long Term	Negative	Operation Phase	Substantial	Small- Substantial
Ambient Noise	Long Term	Negative	Operation Phase	Substantial	Small
Soil Contamination	Long Term	Negative	Operation Phase	Substantial	Small
Water Resources	Long Term	Negative	Operation Phase	Substantial	Small- Substantial
Social					
Occupational Health & Safety	Long Term	Negative	Operation Phase	Major	Small- Substantial
Community Health & Safety	Long Term	Negative	Operation Phase	Substantial	Small
Local Employment	Long Term	Positive	Operation Phase	Substantial	Major
Supply chain management	Long term	Negative	Operation Phase	Substantial	Negligible
Contractor Management	Long term	Negative	Operation phase	Substantial	Small
Impact on Ragpickers	Long Term	Negative	Operation Phase	Negligible	Negligible
Ecology					
Human-Wildlife Conflicts	Permanent	Negative	Operation Phase	Small	Small
Impacts of Increased Traffic / Vehicle Movement	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:

- During operation phase, the Project involves flue gas emission, ash deposition, leachate generation, noise, occupational health and safety 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, reversible and could be addressed through suggested mitigation measures.
- The induced economic displacement of one (1) household was identified during the land allocation process. However, the project has taken steps to mitigate this impact by providing a contractual job to the head of the impacted household. While economic displacement is a serious consideration, the scale and severity of this impact do not warrant categorizing the project in a higher-risk category.
- The project has been assessed to have no impact on Indigenous people and Cultural Heritage, further contribution to its categorisation as a Category B project.
- Currently project is in operational stage and potential issues with respect to labour and working conditions are taken care of by the respective contractors and monitoring is done by the plant level HR, which can be further strengthened through implementation of ESMP and management plans.

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
Source of Water
Waste Characterization
STP Water Permissions
Water Balance
HWM recycler
MSDS
Concession agreement MSW
Fire NOC
Combined Consent to Operate
Water Allocation
HR Policy
Grievance policy
List of contractors and workers

APPENDIX 2: PHOTOLOG

Some representatives of the floral diversity

Phoenix sylvestris (L.) Roxb.

Avicennia marina (Forssk.) Vierh.

Suaeda maritima (L.) Dumort.

Pithecellobium dulce (Roxb.) Benth.

Peltophorum pterocarpum (DC.) K.Heyne

Leucaena leucocephala (Lam.) de Wit

Azadirachta indica A.Juss.

Parkinsonia aculeata L.

Prosopis juliflora (Sw.) DC.

Ricinus communis L.

Salvadora persica L.

Lantana camara L.

Abutilon indicum (L.) Sweet

Solanum virginianum L.

Passiflora foetida L.

Some representatives of the Avifaunal diversity


Greater Flamingo


Painted Stork


Black-headed Ibis


Eurasian Spoonbill


Lesser Whistling-duck

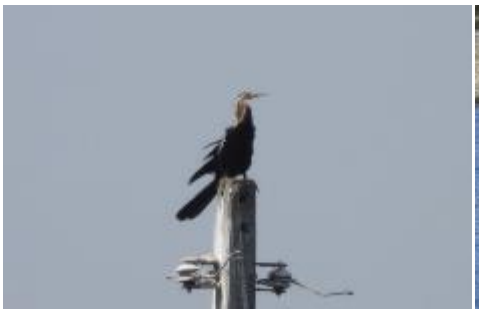

African Comb Duck


Indian Spot-billed Duck


Purple swamphen


Common Coot


Great Cormorant


Oriental Darter


Western Reef-Egret


White-breasted Kingfisher


Little Stint


Shikra

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 GWJPL 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 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 GWJPL 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 flammable materials of a gas cylinder, Oil/Diesel storage, Chemical, boiler 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 (AGM Operations acts as ECC)
   - 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

One Assembly point (in the garden area in front of the main building) have been identified for emergencies.

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 EHS Manager 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 firefighting 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

S.NO	Formats	NAME
4	Format IV	Emergency line of communication
5	Format V	List of chemicals / material safety data sheets
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 EHS Manager			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

	Accident Details								Detected Occupational Diseases						Incident /Dangerous Occurrence/ Emergency								
																		Person Affected					
Sr. No.	Date	Time	Place	Type of Accident	Nature of Injury	No of Person Injured	No. of Death	Days Lost	Name of Disease	Chemical Involved	Date of Detection	No. of Persons involved	Type of effect	Remedial Measures	Date	Time	Place	Chemical Involved/ Type of Incident /D.O	Inside		Out side		Duration of Emergency	Other Details
																			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

GWJPL 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

GWJPL 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

GWJPL 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 GWJPL 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 GWJPL 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 GWJPL. Some of the indicative clauses to be included as part of the Contractor Agreements are suggested below. GWJPL 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 requirement 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 GWJPL;
- Adherence to E&S management Plan for the site.
- Notice of any incident/accident on site or off-site to GWJPL 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 GWJPL 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, GWJPL 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 GWJPL 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 GWJPL's contractors or through extending the grievance redressal mechanism of the GWJPL

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 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 GWJPL and the contractor shall implement and maintain 100% PPE compliance.
- Toolbox talks should be conducted daily before starting the routine activities. A suitable format for recording the toolbox 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 an 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 is 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 an operation site.
- Walking pathways for the workers and the driveways for the vehicles should be kept separate and properly marked.
- Vehicle parking areas should be maintained outside the areas of operation activities and should be conspicuously marked.
- Adequate lighting arrangements should be made within the site if 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.
- GWJPL 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 GWJPL 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 GWJPL'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.
- GWJPL 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 labor 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 classroom 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

GWJPL shall monitor E&S performance of contractors and suppliers in operation phase. 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 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

GWJPL 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 in every quarter 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 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. *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
x. *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
xi. *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.

GWJPL 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 GWJPL'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. GWJPL 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, GWJPL 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 GWJPL. If significant impacts are occurring or imminent. GWJPL 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 be reduced by the amount paid to the appointed external party.

APPENDIX 6: POLLUTION PREVENTION AND MANAGEMENT PLAN

Project 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. GWJPL 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 GWJPL staff, contractors and sub-contractors. The Plan covers air emission, odour, leachate, fly ash, water, noise, waste management and outlines action 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 GWJPL and its contractors (and subcontractors), to achieve this.

Responsibility & Requirement

GWJPL has obtained 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 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
Operation phase Flue gas emissions, particulate matter emissions Leakages & shutdowns	Implemented Control Measures • The waste is transported in closed and covered waste collection trucks • Provision of closed waste handling and storage areas is available • Use of negative pressure in processing buildings to manage odor • Mist cooling is developed to keep down dusts, especially during and prior to loading or other handling procedures • Waste segregation and/or presorting is undertaken 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 is 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. • Waste introduction into the incinerator only after the optimum temperature is reached in the final combustion chamber • Waste is incinerated at high temperatures and no chemical treated with any chlorinated disinfectants will be undertaken prior to incineration • Internal Roads are made of Concrete instead of asphalt and least distance is travelled by the material within the facility. • 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

Activity	Mitigation Measures
	• Provision of flue gas treatment system to control acid gases, particulate matter, and other air pollutants • Minimization of formation of dioxins and furans by maintaining the boiler temperature above 800°C. The project has installed a ~38 TPH boiler based on "Suspended Firing Combustion System". The waste is fed into the boiler at a height of about 12.887 m which is the combustion zone, having temperature in the range of 900- 9500C. As the fuel moves higher, the temperature of the boiler decreases but remains in the range of 8500C for about 2 seconds. Dioxins and furans are typically formed in a temperature zone of 200-4000C and are minimized/destroyed in a temperature zone of 800-9000C. This boiler system is therefore designed to help in achieving complete combustion and ensuring destruction of harmful emissions before flue gas enters heat recovery area • GWJPL has implemented a combination of both ESP and high efficiency of bag filters in series. ESP acts act as a pre-dedusting mechanism (Efficiency of ESP design is around 80-85%) 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. • Periodic monitoring (Half Yearly) 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. • The Project has installed a comprehensive flue gas cleaning system with dust extraction, to control emission of dioxin, furan and heavy metals, emission of acidic gases and particulate matter emission • Installed continuous emission monitoring systems (CEMS) to monitor the plant's emissions (SO2, NO2, CO, SPM) in real-time. Regular reporting of emissions data to relevant environmental authorities which promotes transparency and compliance with air quality regulations. • Project is considering increasing the efficiency of bag filters by making changes such as installing more modules of bag filters, increasing, or decreasing the frequency of maintenance cleaning or checking upon the quality of bag filters to maintain the differential pressure at the baghouse[88] and increase the efficiency of the dust extraction system. • The dust extraction system within the boiler comprises of bag filters and Electrostatic precipitator (ESP). It was reported that around 600 bags are currently installed, and the project has planned to install additional 720 bags which will totalized to 1320 bag filters in near future. The efficiency of bag filters are at 99% and for ESP is 80%. • Apart from CEMS, the project is also undertaking ambient air quality monitoring as well as stack monitoring on half yearly basis • The chimney(s) vents attached to various sources of emission are designed by numbers such as S-1, S-2, etc. and are painted/displayed to facilitate identification. • The MRF Facility is implemented with AI driven technology with no/minimum human intervention. • Greenbelt and landscape area has been developed within the Project premises. • Ash handling system with silos, hoppers, and submerging of bottom ash is being undertaken • Steam Turbine complies with the relevant International Electro-technical Commission (IEC) standards or equivalent **Additional Recommended Measures** • All equipment to be periodically checked to ensure compliance to the emission standards.

[88] It was reported that around 600 bags are currently installed, and the project has planned to install 1320 bag filters in near future. However, it was noted that the differential pressure readings indicated at the baghouse system is high, which could be due to lesser available surface area of the filters. This is likely to affect the efficiency of the dust extraction system within the boiler.

Activity	Mitigation Measures
	• 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 • Periodic maintenance of the bag filter & ESP to be carried out to avoid dust emissions during removal of fly ash. • 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%. • 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. • Water Sprinkling to be done at the access road to manage dust emissions from the vehicles transporting waste to the plant. • Fly Ash to be transported in covered trucks and tippers to the fly ash recipients. Fly ash generated from bag filter should be sent to cement plants. GWJPL to discuss with JMC for disposal of ash in line with MoEFCC draft notification no. G.S.R. 285(E) dated 22/04/2021, with previous notification on 201689. • GWJPL to provide GPCB with the NOC received from Ministry of Defense and amend the stack height of the boiler to 40 m within the CTO to remain compliant to the condition of the CCA w.r.t stack height of the boiler

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, GWJPL 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 has been designed to provide a slight negative pressure, minimising the risk of any odours being released.
- 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 monthly) 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.

GWJPL 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

[89] Though these guidelines cover only coal or lignite based thermal power plants (inclusive of Captive and/or co generating stations), and do not include MSW based waste to energy plants, however Project is recommended to explore these options for ash disposal after discussion with JMC

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 not collected and treated, leachate can migrate and contaminate soil, groundwater, and surface water. GWJPL 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 the 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.

Currently multiple options for leachate disposal is being explored by the project team such as

- Disposal of the dried leachate sludge at the Theba landfill
- Use of leachate water for bottom ash quenching or alternatively injection of the leachate within the boiler
- Collection in the tankers to be sent to the nearest STP for disposal.

4. Fly Ash Management

Combustion of waste generates ash and other material remaining after incineration. GWJPL 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.

The bottom ash received from the boiler is disposed in the water submerged belt conveyor to reduce high temperature of bottom ash and also avoid unwanted air ingression in the boiler. The bottom ash temperature at the boiler is about 350 °C which is reduced to 100 °C at the submerged water belt conveyor. The bottom ash is transported to the sludge dying area for natural drying prior to its disposal through JMC trucks. Disposal of fly ash and bottom ash from the WTE plant to cement plants and designated landfill respectively falls under the purview of JMC. However, it was reported that currently, fly ash generated from the Project is not being disposed at the cement plants by JMC and all the types of ash (fly ash and bottom ash) generated from the boiler are disposed from the project to the landfill through Jamnagar Municipal Corporation (JMC) owned trucks.

In additions to above, GWJPL has implemented following control measures:

- Bottom ash and Fly ash are collected separately from other flue gas treatment residues to avoid contamination of the bottom ash.
- Bottom ash generated from the boilers are disposed from the project to the landfill through Jamnagar Municipal Corporation (JMC) owned trucks.
- Fly ash collected from bag house is contamination and is hazardous in nature. ESP has been added as pre-deduster which has significantly reduced the quantity of hazardous fly ash from bag house.
- Bottom Ash quenching is done using the wastewater generated from the project operations.
- Silos have been developed for Fly ash handling and the bottom ash is managed by submerging in water using submerged belt

Additional Mitigation Measures recommended includes:

- Project to discuss with JMC for disposal of ash in line with MoEFCC draft notification no. G.S.R. 285(E) dated 22/04/2021, with previous notification on 201690. Project to discuss with JMC for disposal of ash in line with MoEFCC draft notification no. G.S.R. 285(E) dated 22/04/2021, with previous notification on 201691.
- GWJPL to conduct characterization analysis (occasionally) of ash as per IS 3812 covering all the parameters stipulated by BIS to identify any hazardous content before its disposal through JMC trucks. If fly ash is identified as hazardous, it is to be sent to hazardous waste landfill site through authorized hazardous waste recycler. 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.
- GWJPL is recommended to obtain chain of custody documents from Jamnagar 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.
- GWJPL 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, GWJPL 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 GWJPL is uncertain that the disposal conducted by JMC is as per the applicable rules, GWJPL 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.
- Project should store the ash in closed area or in silos to avoid air emission and soil contamination (in case ash contains hazardous content), if there is delay in ash collection by JMC trucks/ authorized hazardous waste recyclers due to unforeseen condition.
- GWJPL 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. GWJPL to ensure that the covered trucks are used by JMC to dispose the bottom ash in the nearest sanitary landfill. GWJPL to track bottom ash generation and disposal.
- Fly ash generated from bag filter should be sent to cement plants
- Separate ferrous and non-ferrous metals from bottom ash as far as practicably and economically viable, for their recovery

5. Noise Management

GWJPL 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 daytime 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

[90] Though these guidelines cover only coal or lignite based thermal power plants (inclusive of Captive and/or co generating stations), and do not include MSW based waste to energy plants, however Project is recommended to explore these options for ash disposal after discussion with JMC

[91] Though these guidelines cover only coal or lignite based thermal power plants (inclusive of Captive and/or co generating stations), and do not include MSW based waste to energy plants, however Project is recommended to explore these options for ash disposal after discussion with JMC

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. Slope of the site is primarily towards west. All the recharging pits have been installed in north and east part of the plant which has no processing zone at all.

7. Flood Management

Following measures has been implemented to minimize impact of flooding /waterlogging:

- Provision of water barrier wall at all strategic plant locations
- Location of equipment that can be affected by flood/ water logging at elevated levels within plant building
- Water channel on south end of the plant (lowest part) for fast evacuation of water
- Installation of dewatering pumps to facilitate faster recovery from water logging, if any

8. Waste Management

Solid waste and hazardous waste will be generated due to plant operation activities. The solid waste generated by the project will consist of labour camp waste, garbage waste and metal scrap. The main types of waste that will be generated during 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 on site and will be disposed of at site as approved by local authority.
2	Wastewater	Project	A water treatment system will be developed within the project area and the wastewater will be treated as required. Also, the wastewater generated will be reused within the project site
3	All non- recyclables	Labour camps	Collected and disposed of by the contractor at designated landfill sites.
Hazardous waste			
4	Used oil/ waste oil, Waste Drum (Oil drums/ Chemical drum/ Misc. drum)	DG set	Collected and disposed of through approved recyclers in accordance with The Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.
5	Oil contaminated rags, Oil Sludge, Oil-Soaked Cotton, used insulation Material (Glass wool /Mineral Wool), Used Grease	Maintenance activities	

General Procedures

- The checklist shall be circulated to the respective contractors to list down the solid waste generated on a weekly basis. Record of all Solid Waste and Solid Waste Disposal on 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 waste such as domestic hazardous 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 in solid waste management procedures shall be part of the induction training for workers/ employees.

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 fed in the boiler can be sold to scrap dealers.
- Glass waste including empty glass bottles, broken glass, windowpanes shall be stored separately in a container/ skip and sold off.
- The dry trash items 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 operation phase as per the Hazardous and Other Wastes (Management and Trans-Boundary Movement) Rules, 2016 (HMR 2016).
- The company shall be responsible for safe and environmentally sound management of hazardous and other waste by sending or selling the waste to an 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.
- The 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.
- The company shall ensure provision of secured storage (with adequate secondary containment) for all hazardous waste 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 occurring 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 sum are to be treated as hazardous waste 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 a 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 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 waste, the facility shall provide the transporter with relevant information in Form 10 (Waste Manifest) and Form 11 regarding the hazardous nature of the waste 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 GWJPL’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 GWJPL’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 GWJPL 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.

- Wastewater 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 site 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 toolbox 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 toolbox talks and formal communications (email / memo), particularly where required for record purposes (e.g. variations, auditing and monitoring records);
- GWJPL 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

Traffic Management Plan includes waste transportation of RDF from biomining site and fresh waste from the waste collection centres) to the project location. A traffic management plan is crucial to ensure the safe and efficient movement of vehicles, minimize health and safety impact on community, and address potential impacts on the surrounding road network. The plan includes (but not limited to) following elements:

- Route Selection: Identify the most suitable routes for transporting biomining waste from the landfill to the project site. Consider factors such as road capacity, existing traffic conditions, proximity to residential areas, and any specific requirement or restriction related to heavy vehicle transportation.
- Timing and scheduling: Determine appropriate timing and scheduling for waste transportation to minimize congestion during peak traffic hours. Coordinate with local authorities and stakeholder to identify optimal timeframes for waste transport that have minimal impact on traffic flow.
- Vehicle Management: Ensure that vehicles used for waste transportation comply with relevant regulations and standards, including proper licensing vehicle maintenance, and driver qualifications.
- Communication and coordination: Establish effective communication channel with relevant stakeholders, including local authorities, law enforcement agencies and the project team, to inform them about waste transportation schedules, and potential disruptions. Regular coordination and information sharing will help address any concerns and facilitate smooth traffic flow.
- Monitoring and Evaluation: Continuously monitor and evaluate the effectiveness of the traffic management plan. Collect data on traffic volume, travel times, and any incidents or issues encountered during waste transportation. Use this information to identify areas for improvement and make necessary adjustments to the plan.
- It is essential to consult with local authorities, and relevant stakeholders to develop a comprehensive traffic management plan tailored to the specific project context. The plan should prioritize the safety of road use and local communities, minimize disruption to local communities, and ensure the efficient delivery of booming waste to the project site.

Scope

GWJPL 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 its 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 Jamnagar city 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.

Following mitigation measures shall be incorporated:

- 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.
- GWJPL shall ensure adequate lighting is provided within the plant premises
- Stopping/Parking of vehicles in between the roads to be discouraged.
- Pedestrians' walkways to be adequately marked with proper zebra crossings.
- Loading/ unloading area will be located within the plant premises. Entry/ exit of all the vehicles will be made via the entry area designated by GWJPL. 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 crossroads.
- 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.
- GWJPL 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.

Transportation of Bio mined Legacy Waste

- Vehicle route planning and alternative route map will be prepared and explained to the drivers
- 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
- Wheel washing on site and road sweeping will be carried out to keep the local highway clear of mud and debris.
- 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 vehicles entry will be via identified gates/routes and will make use of dedicated route to the loading/unloading area/ parking area. Sufficient number of loading/ unloading bays will be provided. A dedicated area for the turning of such vehicles will (if feasible) be formed and a banksman (helper) will oversee these movements whilst vehicles are manoeuvring.
- 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.
- Clear road markings like reflective paint and signs should be used to alert pedestrians and vehicle operators to traffic hazards in the plant. Signs may indicate:
    - Entry point
    - Exclusion and safety zones
    - Parking and no parking zones
    - Speed limits
    - Vehicle crossings
- Signs and road markings should be regularly checked and maintained so they can be easily seen and read and sealed when they fade.

Vehicle Maintenance & Management

This shall include the compliance of all vehicles with all safety related specifications (such as the fitting of the correct tires, 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.

GWJPL 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 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 of private vehicles.
- 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 GWJPL 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. GWJPL 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 training is not being provided by the municipal corporation, GWJPL either includes 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 a 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 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 crossovers	
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	

S.No.	Safe Practice	Remarks
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	
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

GWJPL 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.
- Ground water is contaminated as per the Phase 2 analysis reports; hence it cannot be used for domestic purpose except flushing. Alternate source of water including municipal supply shall be used for domestic purpose.
- 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 should 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.
- Energy Conservation,
- Water conservation measures
- 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.

The table below presents the typical causes of high resource consumption/wastage and can be used for analysis and to 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 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?		
1.	Records of technical components and batteries received and installed and maintained and kept up to date?		
2.	Are periodic spot checks conducted to verify the quantity and condition of material and waste stored, on the stock records?		
3.	Are adequate and proper steps taken to care and preserve storage items, so that losses are minimized?		

S. No.	Question	Yes/ No	Additional Information
Water			
1.	Is the water consumption being monitored on a 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). • Details on energy generated • Is the master list of energy using plant and equipment available? • Are the electricity bills and invoices for the 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 exercises to identify energy losses and to increase power generation efficiency?		
3.	Is preliminary energy usage analysis being carried out? 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 in energy management? Have they received any formal training in energy management?		
5.	Have 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.	Have other areas for reducing GHG emissions been identified? For example, • Reduction in vehicular/indirect type of emissions. • Reduction in Scope 3 emissions?		

APPENDIX 9: BIODIVERSITY MANAGEMENT PLAN

The operation of Waste to Energy project may have impact on fauna such as risk of Human-Wildlife Conflicts and Impacts of Increased Traffic / Vehicle Movement.

Some of the broad level measures followed during operation phase includes:

Human-Wildlife Conflicts

- Frequent checking of the boundary wall to avoid any space for wildlife entrance into project compound
- Good housekeeping practices in the project compound will help to reduce the faunal attraction
- Awareness and training programs will be conducted to explain the dos and don’ts to minimize the risk of Human-Wildlife Conflict

Impacts of Increased Traffic / Vehicle Movement

- The trucks/trailers drivers will be instructed not to blow horns unnecessary.
- The drivers will follow the speed limit instructed by highway authorities (in the form of signboards)
- Annual awareness/training programs will be conducted for drivers to minimize the risk of wildlife hitting and/or being killed on highways and road safety.

Trainings

To reduce the possible risks because of Waste to Energy project during the operational phase following awareness and training should be conducted,

- General awareness and training will be provided to the project staff, contractors, and laborers regarding the anti-poaching, trapping and hunting policy to be strictly enforced.
- Awareness and training programs will be conducted to explain the dos and don'ts to minimize the risk of Human-Wildlife Conflict.
- Awareness/training programs for drivers, will be conducted to minimize the risk of wildlife hitting and/or being killed on highways and roads.

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 rights human 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[92]. 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 stakeholders 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 with the management shall be applicable to all the company staff, contractors and especially private security agencies.

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

[92] 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 to 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 • Appoint /designate executive to investigate the potential issues of human rights violations • Form committee and procedure to resolve issues related to human rights violation	Formation Grievance cell Information disclosure to the stakeholders	Monthly Review	Project in charge / security head/ HR / CSR

S.No	UN - VP	Activity	Methods	Frequency	Responsibility
	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	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 trainers 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
	Private security contracting Inclusion of Voluntary Principles-related provisions in contracts with private security companies.	As understood the security arrangement will be taken care of 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 Sarajevo Code of Conduct for Private Security Companies[93] **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 the local communities where it operates.	Develop standard contract agreement	Before entering into contract agreement / renewal	Project in charge / security head/procurement

[93] 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

S.No	UN - VP	Activity	Methods	Frequency	Responsibility
		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 relevant human rights standards and guidelines and appropriate use of force. Training security personnel to exhibit appropriate conduct towards plant workers and neighboring communities; train security personnel to manage mock sessions of labor unrest and protests; and to receive grievances; also train security personnel on firefighting. **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			
	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

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 operation phase 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 in the operation phase. The 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[94]. Further, for the purpose of this document grievance is defined as "a concern or complaint 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 voice 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

[94] 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 facilities. 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*". Stakeholders thus vary in terms of the 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:

Table: Stakeholder Group Categorization

Category	Primary Stakeholders	Secondary Stakeholder
Community	• Rag Pickers • Opinion holders • Community leaders	Nil
Institutional Stakeholders	• Jamnagar Municipal Corporation • 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 needs 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 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 updated 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	These are the informal stakeholder group who are spread across the city and as well as in the study area and currently collecting waste at, collection centre and household level. This stakeholder group consist of Rag Pickers who are engaged in collection of waste and selling the waste to as far as the impact the respective scarp dealers. However, as the project is in operational, and no impact assessment study was conducted at the project construction/planning stage hence due to the absence of baseline data related to the projects impacts on the livelihood if any in the past could not be assessed.	• The expectations and concern of this group from the project: – The Key expectations are to continue the waste collection at collection centers and household level – project should not negatively affect their livelihood and there should be no risk economic displacement in future	• 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	• Project can be instrumental in bringing community development in their areas through CSR activities.	• Influence of Stakeholder : Low • 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
Opinion Holder and Community Leaders	This stakeholder group is comprised of those individuals of the local community who hold traditional and rational power. These stakeholder group members include the elders, community and political leaders in the village and play a critical role in the decision making in the local community	• The expectations and concerns of this group from the project includes: – Receiving benefits from the project in terms of employment and development of infrastructure and the community – Regular updates on the project activities and the opportunities from the same	• This group 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
Regulatory Authorities	This stakeholder group is comprised of the central, state and district level regulatory authorities including JMC & 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	The key expectations and concerns of the group from the project include: • Project's compliance to the regulatory requirements	• This stakeholder group is critical for obtaining various permits/clearances required for the commissioning	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
	decentralization process.	• Timely disclosure of information and provisioning of updates throughout the life of the project	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		
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: • 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.	The primary concerns and expectations of the stakeholder group pertaining to the project is as follows: • The role of the project in continued economic opportunity, work generation and a source of income • Timely settlement of dues and payments in keeping with the legal requirements • Continued work opportunities • Safety at work.	• This stakeholder group is critical for the smooth functioning and timely implementation of the project • This group may also play an important role in the formation of public opinion towards the project	The influence of the project on the group pertains to the roles of the project in the continuance of economic opportunities, timely payment of wages and ensuring the health and safety of the workers	• Influence of Stakeholder : MEDIUM • Influence of Project: HIGH
Secondary Stakeholders					
Village Institutions	This stakeholder group is comprised of health, education institutions and training centres at the village level. The institutions in the immediate vicinity of the project are the primary schools in the villages	The main concerns and expectations of the group from the project pertain to: • Adequacy of community development activities in the area • Contribution of the project towards the overall development of the area • Involvement in the formulation	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
		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 : • 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	This stakeholder group is also critical for the obtaining of the various permits/clearances required for the commissioning of the project	The influence of the project on the stakeholders pertains to the role the project will play in the development of energy in the state	• 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
		• Timely disclosure of information pertaining to the project activities			
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 operation phase 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

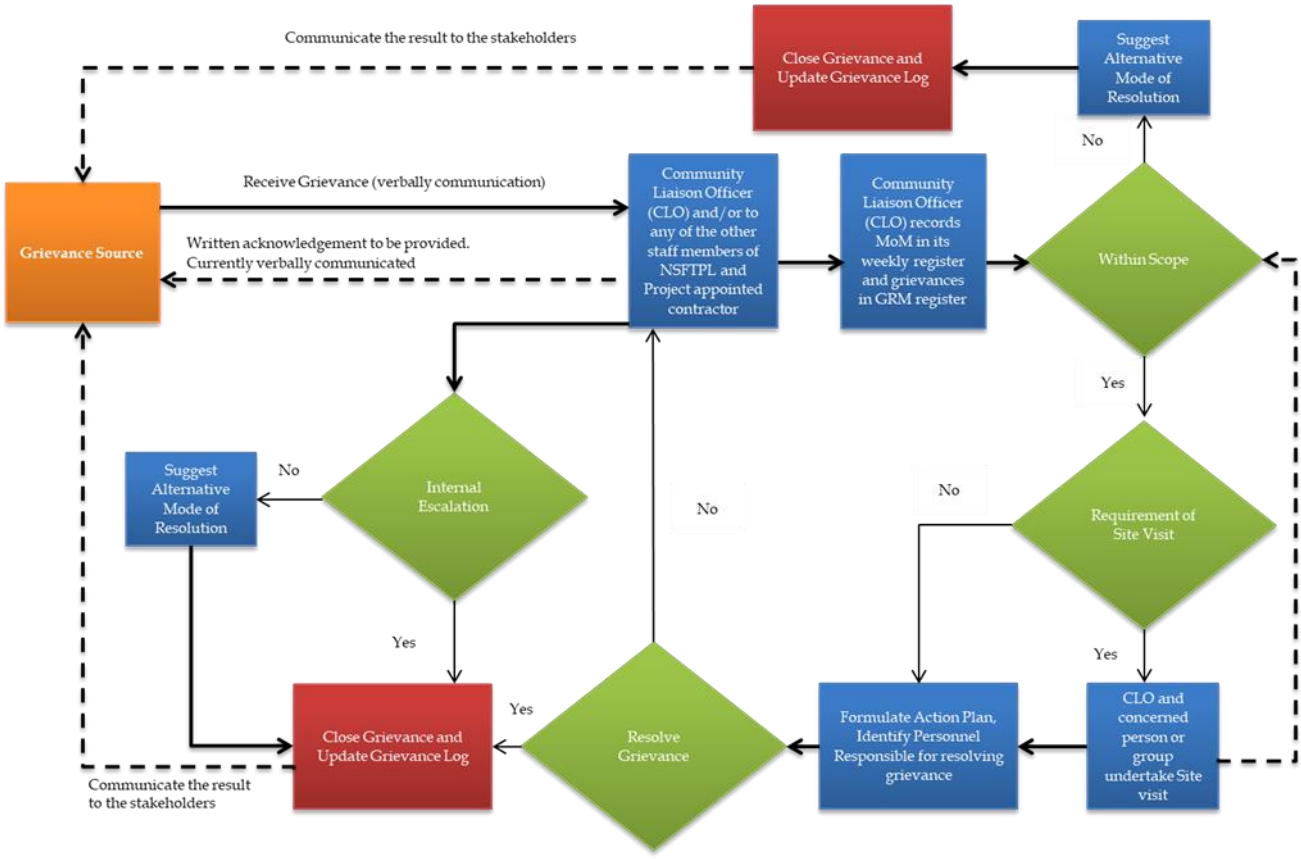
A grievance is a concern or complaint raised by an individual or a group within stakeholders affected by the company's operations. Both concerns and complaints can result from either real or perceived impacts of the company's operations and may be filed in the same manner and handled with the same procedure. 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 mediums to use for this purpose are public meetings, group discussions, and display of GRM provisions in Jamnagar Municipal Corporation, 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

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:

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 the 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	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

Entity	Responsibility
and grievance redressal committee	• 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 • 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
Operation heads	The role of 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	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:

Entity	Responsibility
head	• 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 • 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 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.

<u>Reporting back to stakeholders</u>

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: LABOUR 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 the project and its contractors.

In the context of the project, it requires a management plan that could provide guidance and become a monitoring tool to assess and align the labour and working conditions as per IFC PS 2.

Scope

This plan applies to the operational phase of the Project. This plan will be applicable for a project and its contractors and their workers that are going to be engaged in the 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. 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 operational phase 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
- 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 the operational phase of the Project.

- Adequately cover the contract Labourers 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 condition[95] and terms of employment[96] 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:

[95] 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

[96] 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	• Contractors 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 and terms of	• Provide all workers with a contract in their native language • Provide documented training on	• The working relationship policy can be a separate document, or it can be integrated with the HR policy. The working relationship policy	• Contracts for all workers • Policies and procedures related to worker

Sr. No.	Guiding Principles	Desired Actions	Special Remarks and Suggestions	Monitoring Indicators
	employment to all workers • Wages and benefits must be clearly communicated and understood by all workers	contracts, wages, benefits and deductions for all workers • Routinely provide workers with a clear record of pay calculations in the form of wage slips	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:	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,	• 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

Sr. No.	Guiding Principles	Desired Actions	Special Remarks and Suggestions	Monitoring Indicators
		including contractors, and employment agencies		• 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 interests 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. • 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 alternate grievance mechanism • The contractors shall have clear	• 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

Sr. No.	Guiding Principles	Desired Actions	Special Remarks and Suggestions	Monitoring Indicators
			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	• 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	• 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

Sr. No.	Guiding Principles	Desired Actions	Special Remarks and Suggestions	Monitoring Indicators
	or excluded groups and provides them special opportunities	workers to reach managers • 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	• 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

Sr. No.	Guiding Principles	Desired Actions	Special Remarks and Suggestions	Monitoring Indicators
		reduction will take place • Discussions with local NGOs about how the community impact of workforce reduction could be minimized		• Minutes from management 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	• 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 allows workers to file anonymous complaints as well. The grievance mechanism system should not impede the	• 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

Sr. No.	Guiding Principles	Desired Actions	Special Remarks and Suggestions	Monitoring Indicators
	defined by law or collective bargaining agreements		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 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 and its contractors will not employ workers under the minimum age for employment as defined by national law (.	• Write clearly defined policies and procedures for age verification – make them publicly available • Develop remediation plan for use in cases	• The migrant contract laborer may be expected to bring their family along. The family might also accompany the laborer to their workplace thus enhances the possibility of child	• Policies and procedures for age verification in hiring • Interviews with workers, local children, trade unions and NGOs

Sr. No.	Guiding Principles	Desired Actions	Special Remarks and Suggestions	Monitoring Indicators
	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.	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	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 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 plans for use in cases where children are unknowingly employed despite the clear policy and procedure of	• Visual observation • Pay records, medical records, birth certificates, panchayat certificate

Sr. No.	Guiding Principles	Desired Actions	Special Remarks and Suggestions	Monitoring Indicators
			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 • Pay all job-related training and equipment expenses	• Any involuntary work which is performed under threat of force or penalty is considered as forced labour. It can be in the 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 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 • Interviews with security guards
Occupational Health and Safety				
1	• Project & its contractors will take all reasonable precaution actions to protect the	• Structuring an OHS team and an OHS accountability framework	• Projects and their contractors are expected to have their own OHS system.	• Visual observation • Exposure to hazardous agents monitoring log

Sr. No.	Guiding Principles	Desired Actions	Special Remarks and Suggestions	Monitoring Indicators
	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	(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 electrical devices, cords	*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 • Communication[97]- Induction orientation, training	• 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

Sr. No.	Guiding Principles	Desired Actions	Special Remarks and Suggestions	Monitoring Indicators
	protective equipment • Document, investigate and 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 contractors involved also.	and lines with warning signs • Implementing proper monitoring systems of hazardous agents and proper control measures (eliminating risk, PPC, PPE) •		

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[98], 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 (labour camp) facilities for the 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 be maintained for worker accommodation. The details of code of conduct are delineated below:

- Renting arrangements 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

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:

[98] 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

Standard Parameter	Requirement as well monitoring indicators
Bathrooms and other Sanitary Facilities	• 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 • 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				
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 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				

Aspects	Yes	No	Not Applicable (N/A)	Comments
Has consideration been given to the 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?				
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?				
Is pest extermination, vector control and disinfection undertaken throughout the living facilities?				

Aspects	Yes	No	Not Applicable (N/A)	Comments
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?				
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?				

Aspects	Yes	No	Not Applicable (N/A)	Comments
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?				
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 adequate responsibility and authority to do so?				

Aspects	Yes	No	Not Applicable (N/A)	Comments
Are 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 people 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 rental 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 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?				

Aspects	Yes	No	Not Applicable (N/A)	Comments
Ware 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				
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?				

Aspects	Yes	No	Not Applicable (N/A)	Comments
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 13: ENVIRONMENTAL AND SOCIAL MONITORING PLAN

With regards to sustainable development, GWJPL 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 GWJPL 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 including works contractually assigned to third party agencies (contractors) adhering 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 River Rangamati
Analysis of Sludge	Half Yearly	1 sample

Records

The following records but not limited to the following shall be maintained by GWJPL.

- Environmental monitoring reports (air, noise, water and soil) as prescribed by the SPCB in the consents.
- Ash generation and its disposal.
- Wastewater 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 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

GWJPL is required to engage reputed and authorized laboratories to collect representative samples of ambient air/noise/water/fly ash/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 GWJPL and ACEL at corporate level as per the IFC/World Bank/ WHO guidelines.

1. Ambient Air Quality

The ambient air quality monitoring shall be applicable to operation phase.

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.

2. 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 WBG 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	

Sample Frequency (e.g. quarterly)	Air Emission Parameter	Flue Gas emission standards as WBG EHS Guidelines for Thermal Power Plant	India Regulatory Limits and units	Monitoring results (in comparable units) **
	Lead (Pb)			
	Mercury (Hg)			
	Nickel (as Ni)			
	Arsenic as As			
	HCL			
	HF			
	Dioxin/Furan			

** Monitoring results should be accompanied by reports submitted by laboratory

3. Ambient Noise

Ambient Noise Monitoring is applicable during operation phases. The results should be maintained for each monitoring location and sampling should be done during the 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.

4. Liquid Effluent Discharges and Sludge

Applicable during 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 it 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
	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
	The ambient temperature of receiving waters at the edge of the zone where mixing with effluent takes place (if not defined, 100 meters from discharge point).	3^0C (maximum increase is 3^0C)		^0C
	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 include 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	^oC	
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	

5. Ground Water Monitoring

Groundwater monitoring is applicable during 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

Sample Frequency (e.g. quarterly)	Ground Water 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
	Heavy Metals, Total	10 mg/L		mg/L
	(list other parameters) *	mg/L		mg/L

6. 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			

7. 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 toolbox 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 toolbox 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_2)		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 guideline 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.
- Nm^3 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 NO_x 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_2
  - 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) □g/m³	Annual Average*	50	20
	24 Hours**	80	80
Oxides of Nitrogen (NOx) □g/m³	Annual Average*	40	30
	24 Hours**	80	80
Particulate Matter (PM 10) □g/m³	Annual Average*	60	60
	24 Hours**	100	100
Particulate Matter (PM 2.5) □g/m3	Annual Average*	40	40
	24 Hours**	60	60
Ozone (O3) □g/m3	8 Hours**	100	100
	1 Hour**	180	180
Lead (Pb) □g/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) □g/m3	Annual*	100	100
	24 Hours**	400	400
Benzene (C6H6) □g/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 means 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*	Nighttime
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, Nighttime 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.

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.	Aluminium (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; It 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; It shall not be detectable in any 100 ml sample.	

Source: Central Pollution Control Board

General Standard for Treated wastewater 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 operation phases of the project. GWJPL will implement occupational health and safety management during 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 goods 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 routine maintenances work.
- 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 major maintenance works, the EPC contractor's EHS representative / site supervisor shall approve the PTW. The PTW will be issued only after ensuring that the person requesting the permit is trained to perform the concerned work and has the necessary PPEs. A copy of PTW to be displayed at the 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 extinguisher is easily identifiable. Automated fire detection systems and fire alarms will be provided in the office buildings. Firefighting systems 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. If any chemicals are stored, they will be accompanied by material safety data sheets (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 operation area without minimum mandatory PPEs such as safety shoes, safety helmet, high visibility vest etc.
- All personnel are responsible for ensuring 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 can 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 the 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.
- EHS 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. GWJPL 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 preferably 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: GWJPL should make available all previous inspection reports and other documentation to the inspector for review prior to the date of inspection.
- 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 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 workspace, the worker should determine if that workspace 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 the 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 GWJPL 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.
- GWJPL shall provide noise control measures such as acoustic hoods, silencers, enclosures etc. on the sources of noise generation.
- Working hours for workers working in high noise areas 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:
    - 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 GWJPL (operation 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 and natural disasters. Incidents are referred to as unusual occurrences on the site.
- *Near Miss*: Incidences that cause no actual harm but could cause harm if repeated.
- *Lost Time Injury*: Where an injured person is unable to attend work for one or more days because of an accident or illness. This does not include absence on the day or shift of the accident.
- *Reportable Lost Time Injury*: Lost time injury which prevents employees 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 recurrence.

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 causes rather than targeting affected employees 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 GWJPL 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 for 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.	EPC 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

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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	4.04182	ug/m^3	610238.50	2488096.75	28.00	0.00	28.00	15-09-2022, 24
24-HR	2ND	3.90337	ug/m^3	610238.50	2488096.75	28.00	0.00	28.00	10-05-2022, 24
24-HR	3RD	3.87549	ug/m^3	610238.50	2488096.75	28.00	0.00	28.00	11-05-2022, 24
24-HR	4TH	3.77573	ug/m^3	610238.50	2488096.75	28.00	0.00	28.00	09-05-2022, 24
24-HR	5TH	3.76800	ug/m^3	610238.50	2488096.75	28.00	0.00	28.00	02-06-2022, 24
24-HR	6TH	3.76533	ug/m^3	610238.50	2488096.75	28.00	0.00	28.00	12-05-2022, 24
24-HR	7TH	3.72185	ug/m^3	610238.50	2488096.75	28.00	0.00	28.00	01-06-2022, 24
24-HR	8TH	3.69208	ug/m^3	610238.50	2488096.75	28.00	0.00	28.00	25-06-2022, 24
24-HR	9TH	3.55664	ug/m^3	610238.50	2488096.75	28.00	0.00	28.00	13-09-2022, 24
24-HR	10TH	3.51948	ug/m^3	610238.50	2488096.75	28.00	0.00	28.00	26-06-2022, 24
24-HR	11TH	3.44066	ug/m^3	610238.50	2488096.75	28.00	0.00	28.00	19-03-2022, 24
24-HR	12TH	3.42273	ug/m^3	610238.50	2488096.75	28.00	0.00	28.00	20-03-2022, 24
24-HR	13TH	3.41807	ug/m^3	610238.50	2488096.75	28.00	0.00	28.00	05-08-2022, 24
24-HR	14TH	3.26686	ug/m^3	610238.50	2488096.75	28.00	0.00	28.00	22-01-2022, 24
24-HR	15TH	3.18396	ug/m^3	610238.50	2488096.75	28.00	0.00	28.00	14-09-2022, 24
24-HR	16TH	3.18005	ug/m^3	610238.50	2488096.75	28.00	0.00	28.00	19-04-2022, 24
24-HR	17TH	3.13365	ug/m^3	610238.50	2488096.75	28.00	0.00	28.00	14-04-2022, 24
24-HR	18TH	3.11731	ug/m^3	610238.50	2488096.75	28.00	0.00	28.00	20-04-2022, 24
24-HR	19TH	3.02079	ug/m^3	610238.50	2488096.75	28.00	0.00	28.00	24-06-2022, 24
24-HR	20TH	3.01831	ug/m^3	610238.50	2488096.75	28.00	0.00	28.00	04-06-2022, 24
24-HR	21ST	2.97764	ug/m^3	610238.50	2488096.75	28.00	0.00	28.00	06-08-2022, 24
24-HR	22ND	2.96567	ug/m^3	610238.50	2488096.75	28.00	0.00	28.00	04-09-2022, 24
24-HR	23RD	2.89157	ug/m^3	610238.50	2488096.75	28.00	0.00	28.00	20-01-2022, 24
24-HR	24TH	2.87254	ug/m^3	610238.50	2488096.75	28.00	0.00	28.00	03-06-2022, 24
ANNUAL		1.31895	ug/m^3	610238.50	2488096.75	28.00	0.00	28.00	

Result summary of 24-hour averaging period at Worst Condition

Results Summary

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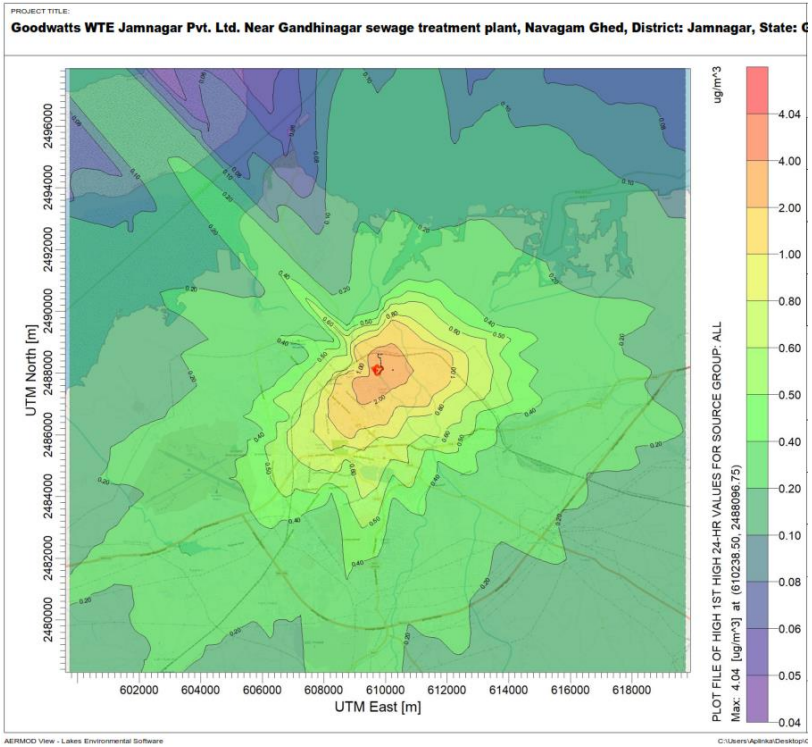
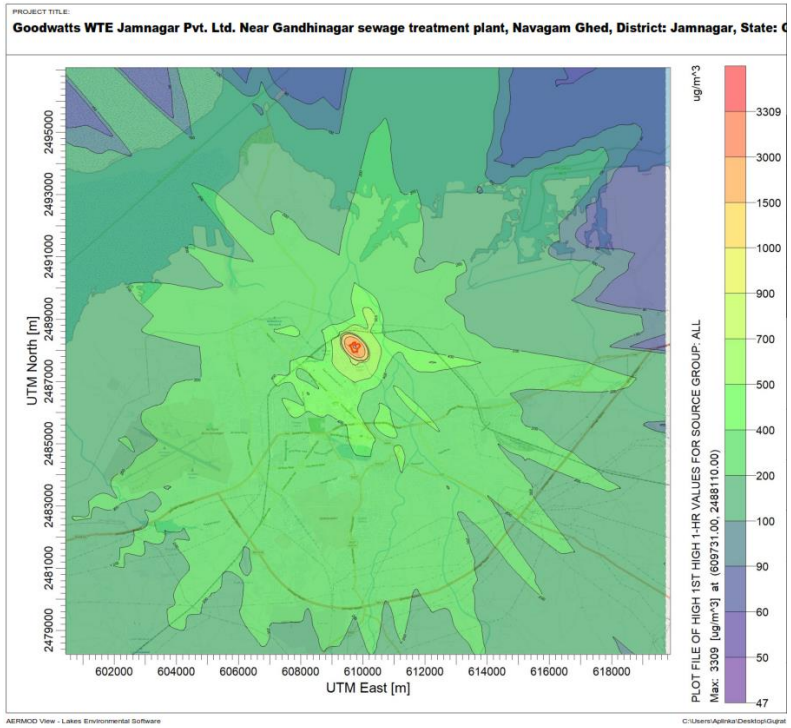
PM10 - Concentration - Source Group: ALL

Averaging Period	Rank	Peak	Units	X (m)	Y (m)	ZELEV (m)	ZFLAG (m)	ZHILL (m)	Peak Date, Start Hour
1-HR	1ST	3308.81660	ug/m^3	609731.00	2488110.00	0.00	0.00	0.00	14-07-2022, 13
24-HR	1ST	392.79185	ug/m^3	610231.00	2488110.00	0.00	0.00	0.00	15-09-2022, 24
ANNUAL		118.42102	ug/m^3	610231.00	2488110.00	0.00	0.00	0.00	

Isopleth For Normal Conditions ("First highest") 24-hour concentration (PM10)

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

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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	3308.81660	ug/m^3	609731.00	2488110.00	0.00	0.00	0.00	14-07-2022, 13
24-HR	1ST	392.79185	ug/m^3	610231.00	2488110.00	0.00	0.00	0.00	15-09-2022, 24
ANNUAL		118.42102	ug/m^3	610231.00	2488110.00	0.00	0.00	0.00	

Results Summary

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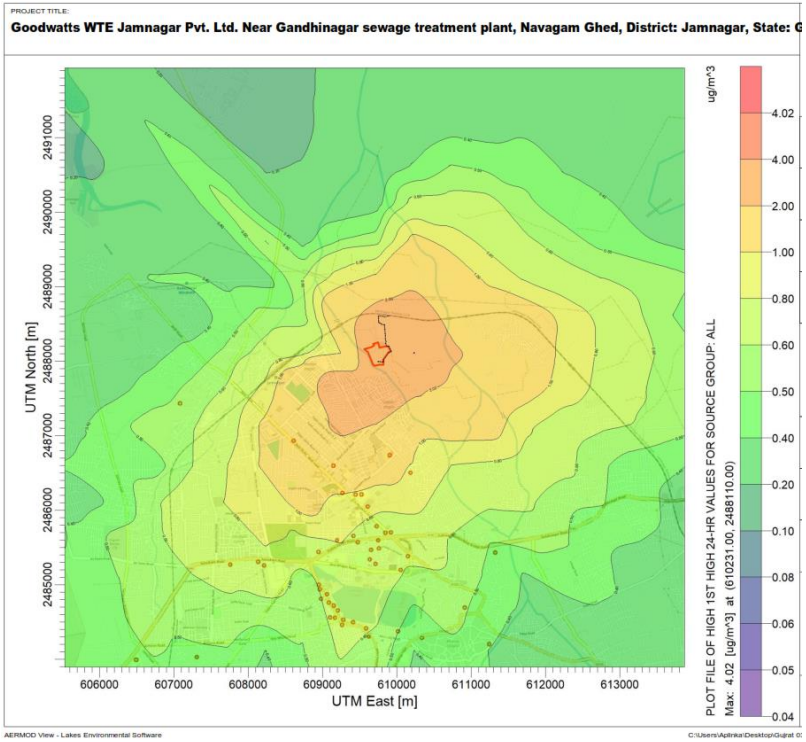
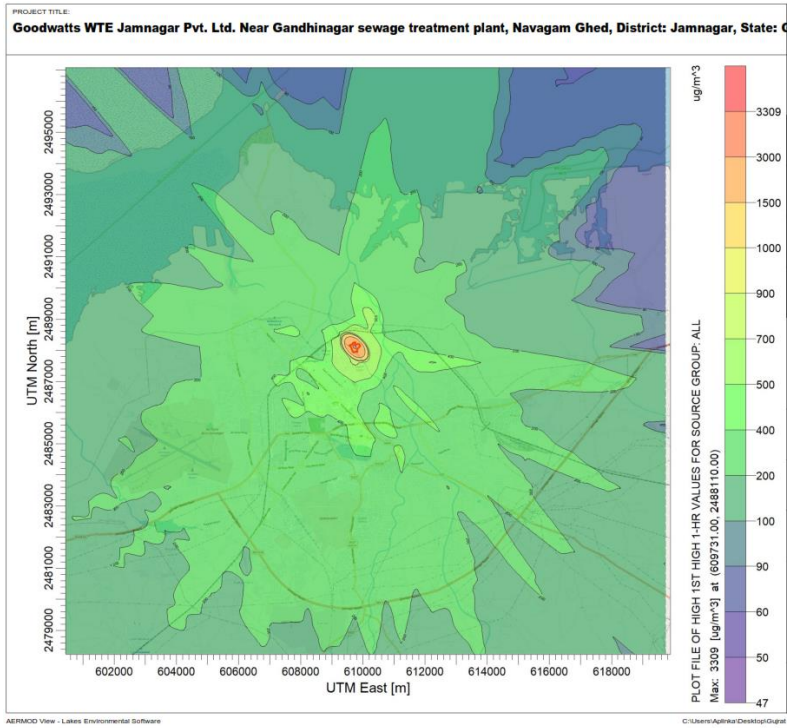
PM2.5 - Concentration - Source Group: ALL

Averaging Period	Rank	Peak	Units	X (m)	Y (m)	ZELEV (m)	ZFLAG (m)	ZHILL (m)	Peak Date, Start Hour
24-HR	1ST	4.01866	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	15-09-2022, 24
24-HR	2ND	3.81118	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	10-05-2022, 24
24-HR	3RD	3.80350	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	02-06-2022, 24
24-HR	4TH	3.79184	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	01-06-2022, 24
24-HR	5TH	3.68249	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	11-05-2022, 24
24-HR	6TH	3.62554	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	09-05-2022, 24
24-HR	7TH	3.61025	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	12-05-2022, 24
24-HR	8TH	3.58977	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	25-06-2022, 24
24-HR	9TH	3.44188	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	13-09-2022, 24
24-HR	10TH	3.37455	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	26-06-2022, 24
24-HR	11TH	3.26383	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	05-08-2022, 24
24-HR	12TH	3.25957	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	19-03-2022, 24
24-HR	13TH	3.25149	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	20-03-2022, 24
24-HR	14TH	3.20650	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	14-09-2022, 24
24-HR	15TH	3.11211	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	22-01-2022, 24
24-HR	16TH	3.07516	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	04-06-2022, 24
24-HR	17TH	3.05776	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	14-04-2022, 24
24-HR	18TH	3.04660	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	19-04-2022, 24
24-HR	19TH	2.96217	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	03-06-2022, 24
24-HR	20TH	2.94402	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	06-08-2022, 24
24-HR	21ST	2.91795	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	04-09-2022, 24
24-HR	22ND	2.83054	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	15-05-2022, 24
24-HR	23RD	2.82826	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	24-06-2022, 24
24-HR	24TH	2.82147	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	20-04-2022, 24
ANNUAL		1.25071	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	

Isopleth For Normal Conditions (“First highest”) 24-hour concentration

Isopleth For Worst Conditions (“First highest”) 1 hour concentration





SOx

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\3) JAMNAGAR

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	109.84827	ug/m^3	609731.00	2488110.00	0.00	0.00	0.00	14-07-2022, 13
24-HR	1ST	12.90946	ug/m^3	610231.00	2488110.00	0.00	0.00	0.00	15-09-2022, 24
ANNUAL		4.22907	ug/m^3	610231.00	2488110.00	0.00	0.00	0.00	

Results Summary

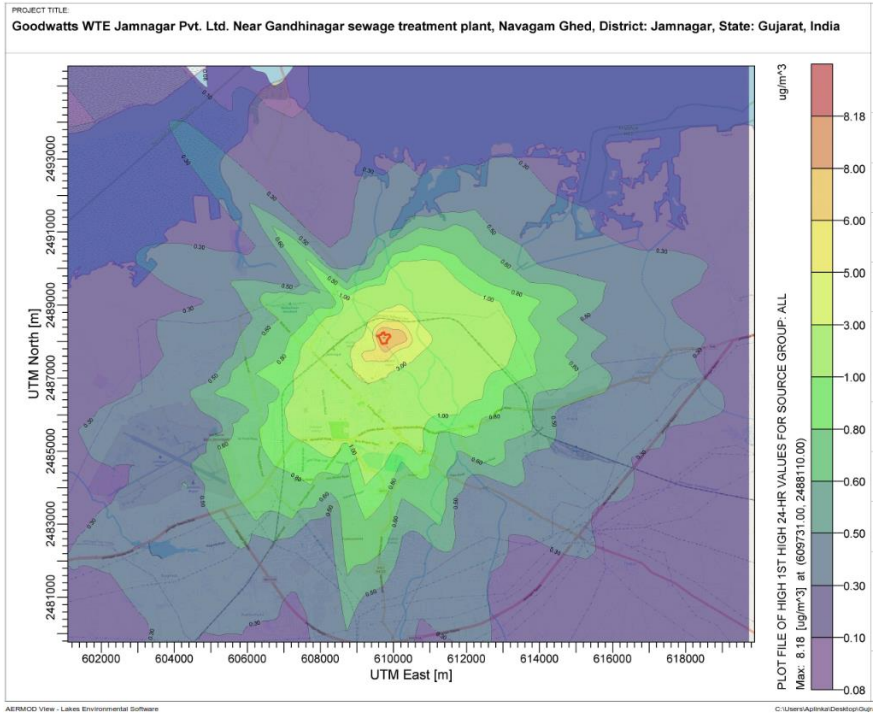
C:\Users\Aplinka\Desktop\2) Abellon Clean Energy Limited\3) JAMNAGAR

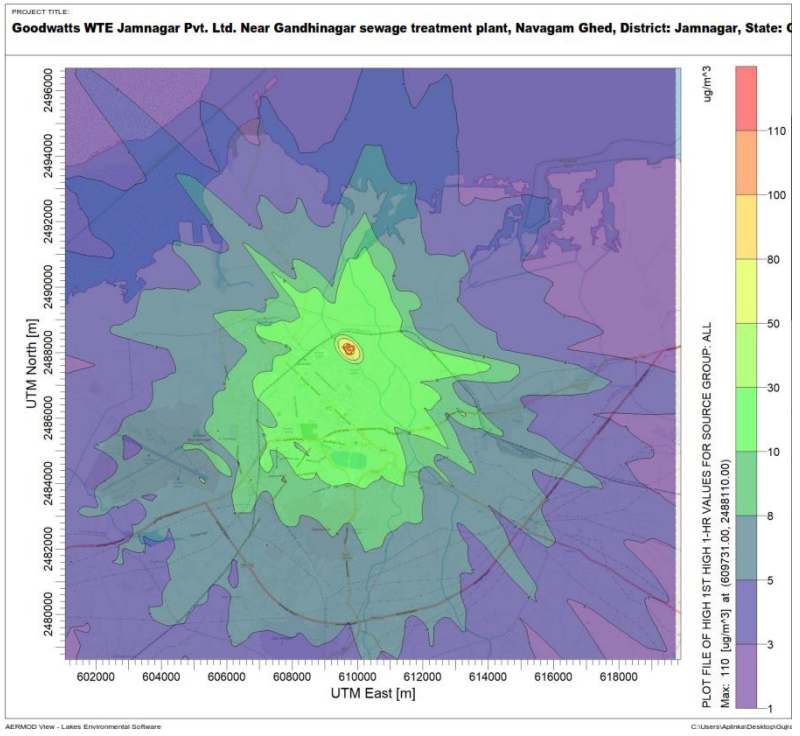
SO2 - Concentration - Source Group: ALL

Averaging Period	Rank	Peak	Units	X (m)	Y (m)	ZELEV (m)	ZFLAG (m)	ZHILL (m)	Peak Date, Start Hour
24-HR	1ST	8.17579	ug/m^3	609731.00	2488110.00	28.00	0.00	28.00	14-07-2022, 24
24-HR	2ND	6.81089	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	10-05-2022, 24
24-HR	3RD	6.61840	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	02-06-2022, 24
24-HR	4TH	6.52755	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	11-05-2022, 24
24-HR	5TH	6.51635	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	01-06-2022, 24
24-HR	6TH	6.49332	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	12-05-2022, 24
24-HR	7TH	6.34291	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	09-05-2022, 24
24-HR	8TH	6.25440	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	20-03-2022, 24
24-HR	9TH	6.24611	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	25-06-2022, 24
24-HR	10TH	6.24333	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	19-03-2022, 24
24-HR	11TH	6.17098	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	13-09-2022, 24
24-HR	12TH	5.94631	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	05-08-2022, 24
24-HR	13TH	5.83862	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	26-06-2022, 24
24-HR	14TH	5.66384	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	14-09-2022, 24
24-HR	15TH	5.65457	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	19-04-2022, 24
24-HR	16TH	5.60852	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	14-04-2022, 24
24-HR	17TH	5.46812	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	22-01-2022, 24
24-HR	18TH	5.42337	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	04-06-2022, 24
24-HR	19TH	5.31686	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	04-09-2022, 24
24-HR	20TH	5.31525	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	09-04-2022, 24
24-HR	21ST	5.28295	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	20-04-2022, 24
24-HR	22ND	5.18474	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	20-01-2022, 24
24-HR	23RD	5.17182	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	06-08-2022, 24
24-HR	24TH	5.17086	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	03-06-2022, 24
ANNUAL		2.41999	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	

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\3) JAMNAGAR

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	135.69342	ug/m^3	609731.00	2488110.00	28.00	0.00	28.00	14-07-2022, 13
24-HR	1ST	16.03169	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	15-09-2022, 24
ANNUAL		4.99954	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	

Results Summary

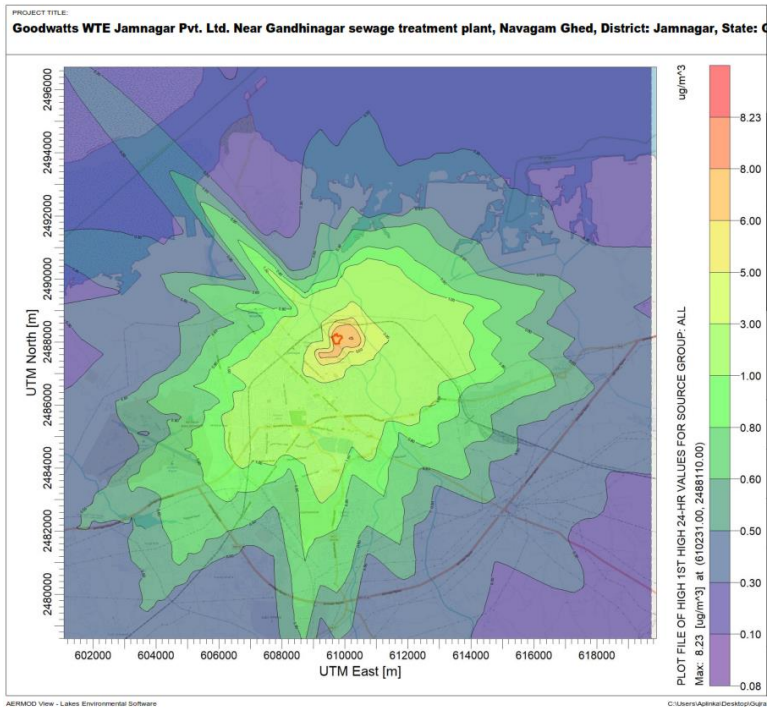
C:\Users\Aplinka\Desktop\2) Abellon Clean Energy Limited\3) JAMNAGAR

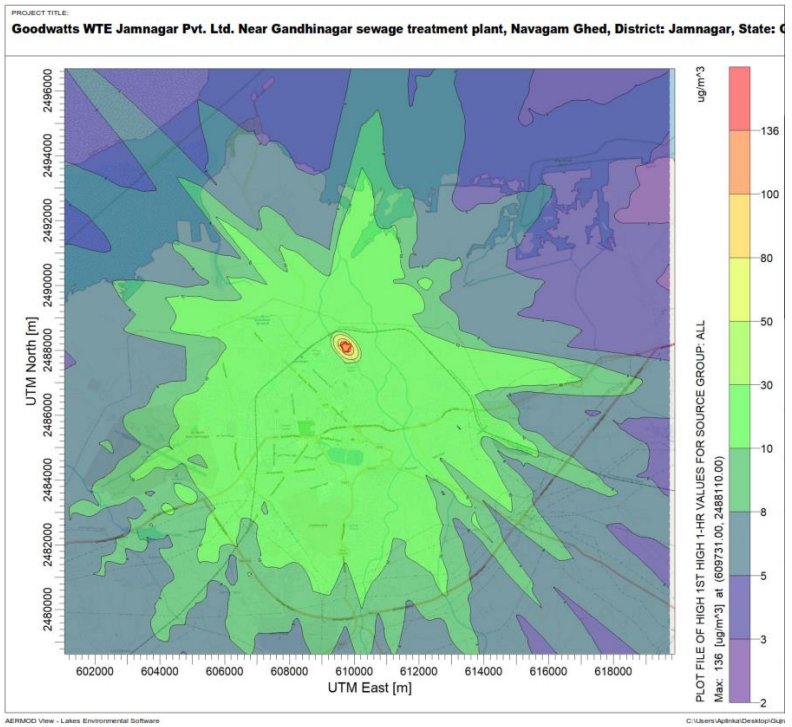
NOX - Concentration - Source Group: ALL

Averaging Period	Rank	Peak	Units	X (m)	Y (m)	ZELEV (m)	ZFLAG (m)	ZHILL (m)	Peak Date, Start Hour
24-HR	1ST	8.23310	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	15-09-2022, 24
24-HR	2ND	7.89863	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	10-05-2022, 24
24-HR	3RD	7.82311	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	02-06-2022, 24
24-HR	4TH	7.77127	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	01-06-2022, 24
24-HR	5TH	7.60864	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	11-05-2022, 24
24-HR	6TH	7.49533	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	12-05-2022, 24
24-HR	7TH	7.46276	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	09-05-2022, 24
24-HR	8TH	7.37863	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	25-06-2022, 24
24-HR	9TH	7.12782	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	13-09-2022, 24
24-HR	10TH	6.92457	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	26-06-2022, 24
24-HR	11TH	6.89156	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	20-03-2022, 24
24-HR	12TH	6.89097	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	19-03-2022, 24
24-HR	13TH	6.79090	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	05-08-2022, 24
24-HR	14TH	6.62193	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	14-09-2022, 24
24-HR	15TH	6.41309	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	22-01-2022, 24
24-HR	16TH	6.38473	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	14-04-2022, 24
24-HR	17TH	6.38363	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	19-04-2022, 24
24-HR	18TH	6.35002	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	04-06-2022, 24
24-HR	19TH	6.09897	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	03-06-2022, 24
24-HR	20TH	6.08110	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	04-09-2022, 24
24-HR	21ST	6.07116	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	06-08-2022, 24
24-HR	22ND	5.91501	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	20-04-2022, 24
24-HR	23RD	5.83346	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	15-05-2022, 24
24-HR	24TH	5.79053	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	24-06-2022, 24
ANNUAL		2.64887	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	

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\2) Abellon Clean Energy Limited\3) JAMNAGAR

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	4.89942	ug/m^3	609731.00	2488110.00	30.00	0.00	30.00	14-07-2022, 16
8-HR	2ND	2.96818	ug/m^3	609231.00	2488110.00	30.00	0.00	30.00	29-11-2022, 8
8-HR	3RD	2.50060	ug/m^3	609231.00	2488110.00	30.00	0.00	30.00	27-11-2022, 8
8-HR	4TH	2.44320	ug/m^3	609231.00	2488110.00	30.00	0.00	30.00	24-11-2022, 8
8-HR	5TH	2.40211	ug/m^3	609731.00	2488110.00	30.00	0.00	30.00	06-02-2022, 16
8-HR	6TH	2.33899	ug/m^3	609231.00	2488110.00	30.00	0.00	30.00	02-12-2022, 8
8-HR	7TH	2.28582	ug/m^3	609231.00	2488110.00	30.00	0.00	30.00	13-11-2022, 8
8-HR	8TH	2.22106	ug/m^3	609231.00	2488110.00	30.00	0.00	30.00	09-12-2022, 8
ANNUAL		0.50051	ug/m^3	609731.00	2488110.00	30.00	0.00	30.00	

Result summary of 8 hour averaging period at Worst Condition

Results Summary

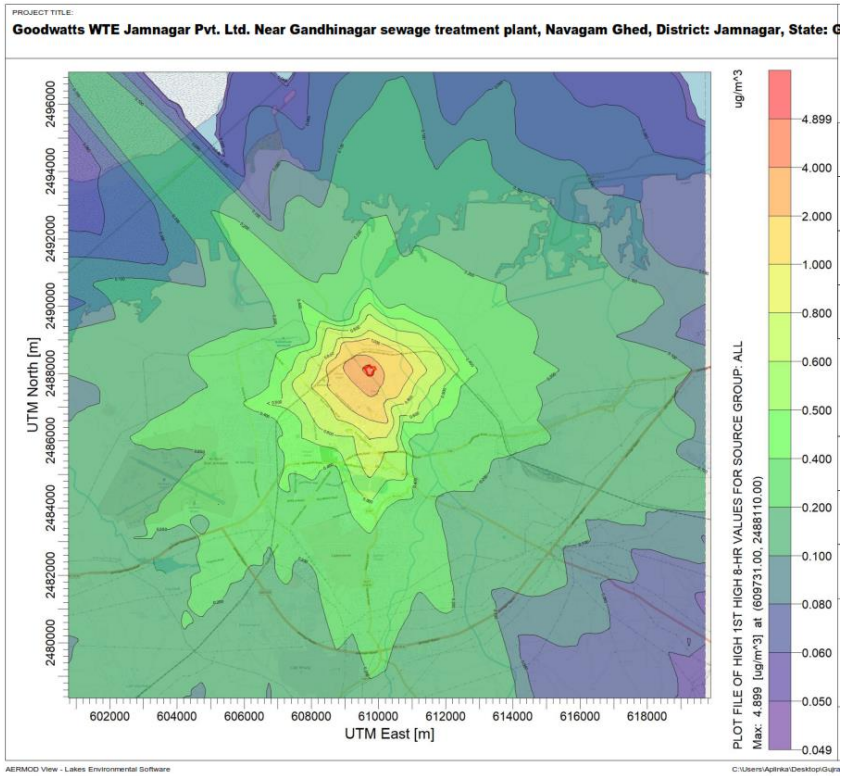
C:\Users\Aplinka\Desktop\2) Abellon Clean Energy Limited\3) JAMNAGAR

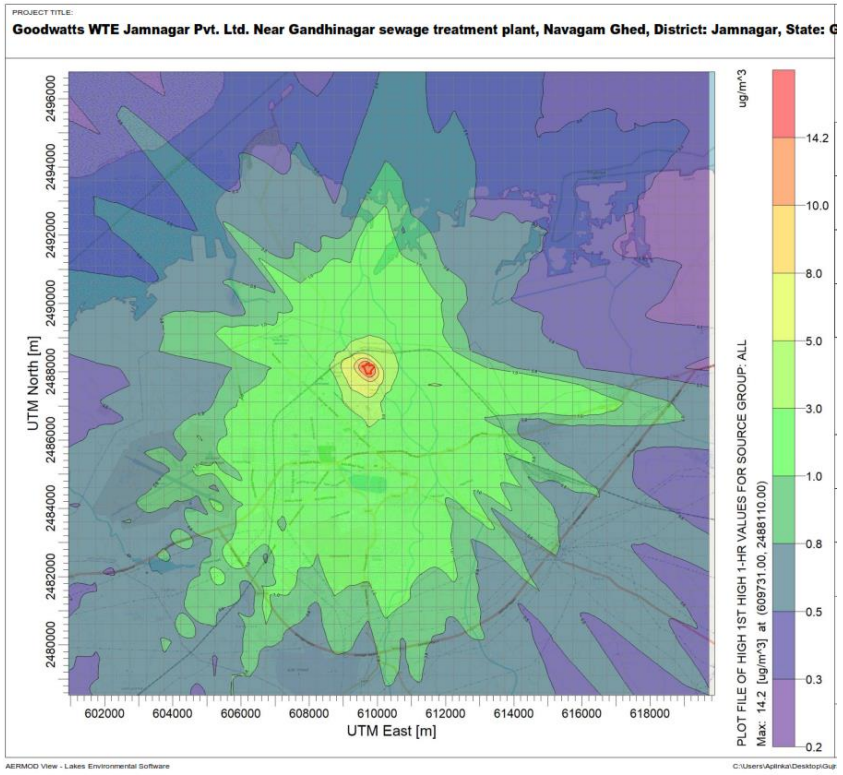
CO - Concentration - Source Group: ALL

Averaging Period	Rank	Peak	Units	X (m)	Y (m)	ZELEV (m)	ZFLAG (m)	ZHILL (m)	Peak Date, Start Hour
1-HR	1ST	14.20813	ug/m^3	609731.00	2488110.00	28.00	0.00	28.00	14-07-2022, 13
8-HR	1ST	5.81503	ug/m^3	609731.00	2488110.00	28.00	0.00	28.00	14-07-2022, 16
ANNUAL		0.61125	ug/m^3	610231.00	2488110.00	28.00	0.00	28.00	

Isopleth For Normal Conditions (“First highest”) 8-hour concentration

Isopleth For Worst Conditions (“First highest”) 1 hour concentration





Source Pathways for Air Modelling

PM10 – Normal

AERMOD

Point Sources

Source Type	Source ID	X Coordinate [m]	Y Coordinate [m]	Base Elevation (Optional)	Release Height [m]	Emission Rate [g/s]	Gas Exit Temp. [K]	Gas Exit Velocity [m/s]	Stack Inside Diameter [m]
POINT	1	609677.71 Stack-1	2488075.98	28.00	40.00	1.91044	413.15	12.00	2.09
POINT	2	609664.87 DG set 125KVA	2488083.85	28.00	20.00	0.02000	773.00	25.33	0.11

PM10 – Worst

Source Pathway - Source Inputs

AERMOD

Point Sources

Source Type	Source ID	X Coordinate [m]	Y Coordinate [m]	Base Elevation (Optional)	Release Height [m]	Emission Rate [g/s]	Gas Exit Temp. [K]	Gas Exit Velocity [m/s]	Stack Inside Diameter [m]
POINT	1	609677.71 Stack-1	2488075.98	28.00	40.00	191.04384	413.15	12.00	2.09
POINT	2	609664.87 DG set 125KVA	2488083.85	28.00	20.00	0.02000	773.00	25.33	0.11

Line Sources

Source Type	Source ID	X Coordinate [m]	Y Coordinate [m]	X2 Coordinate [m]	Y2 Coordinate [m]	Base Elevation (Optional)	Release Height [m]	Emission Rate [g/ (s-m^2)]	Width [m]	Initial Vertical Dim. [m]
LINE	3	609740.40 L12	2487995.19	609812.69	2487991.03	28.00	0.25	5.28E-6	9.00	
LINE	4	609812.69 L23	2487991.03	609821.23	2487992.84	28.00	0.25	5.28E-6	6.00	
LINE	5	609821.23 L34	2487992.84	609817.92	2488016.46	28.00	0.25	5.28E-6	6.00	
LINE	6	609817.92 L45	2488016.46	609890.24	2488113.52	28.00	0.25	5.28E-6	6.00	
LINE	7	609890.24 L56	2488113.52	609920.35	2488127.47	28.00	0.25	5.28E-6	6.00	
LINE	8	609920.35 L67	2488127.47	609922.97	2488135.52	28.00	0.25	5.28E-6	6.00	
LINE	9	609922.97 L78	2488135.52	609891.81	2488199.97	28.00	0.25	5.28E-6	6.00	
LINE	10	609891.81 L89	2488199.97	609877.82	2488203.23	28.00	0.25	5.28E-6	6.00	
LINE	11	609877.82 L910	2488203.23	609858.21	2488203.15	28.00	0.25	5.28E-6	6.00	
LINE	12	609858.21 L1011	2488203.15	609845.21	2488238.40	28.00	0.25	5.28E-6	6.00	
LINE	13	609845.21 L1112	2488238.40	609851.32	2488263.97	28.00	0.25	5.28E-6	6.00	
LINE	14	609851.32 L1213	2488263.97	609843.04	2488302.04	28.00	0.25	5.28E-6	6.00	
LINE	15	609843.04 L1314	2488302.04	609843.35	2488338.02	28.00	0.25	5.28E-6	6.00	

Source Pathway - Source Inputs

AERMOD

Source Type	Source ID	X Coordinate [m]	Y Coordinate [m]	X2 Coordinate [m]	Y2 Coordinate [m]	Base Elevation (Optional)	Release Height [m]	Emission Rate [g/ (s-m^2)]	Width [m]	Initial Vertical Dim. [m]
LINE	16	609843.35 L1415	2488338.02	609831.00	2488490.25	28.00	0.25	5.28E-6	6.00	
LINE	17	609831.00 L1516	2488490.25	609795.76	2488493.32	28.00	0.25	8.36E-7	6.00	
LINE	18	609795.76 L1617	2488493.32	609775.72	2488509.45	28.00	0.25	8.36E-7	6.00	
LINE	19	609775.72 L1718	2488509.45	609757.80	2488513.80	28.00	0.25	8.36E-7	6.00	
LINE	20	609757.80 L1819	2488513.80	609751.38	2488534.68	28.00	0.25	8.36E-7	6.00	
LINE	21	609751.38 L1920	2488534.68	609750.37	2488607.39	28.00	0.25	8.36E-7	6.00	
LINE	22	609750.37 L2021	2488607.39	609809.50	2488601.92	28.00	0.25	8.36E-7	6.00	
LINE	23	609809.50 L2122	2488601.92	609837.10	2488593.47	28.00	0.25	8.36E-7	6.00	
LINE	24	609837.10 L2223	2488593.47	609870.00	2488606.19	28.00	0.25	8.36E-7	6.00	
LINE	25	609870.00 L2324	2488606.19	609896.02	2488605.50	28.00	0.25	8.36E-7	6.00	

PM2.5- Normal

PM2.5- Worst

Source Pathway - Source Inputs

AERMOD

Point Sources

Source Type	Source ID	X Coordinate [m]	Y Coordinate [m]	Base Elevation (Optional)	Release Height [m]	Emission Rate [g/s]	Gas Exit Temp. [K]	Gas Exit Velocity [m/s]	Stack Inside Diameter [m]
POINT	1	609677.71 Stack-1	2488075.98	28.00	40.00	1.91044	413.15	12.00	2.09
POINT	2	609664.87 DG set 125KVA	2488083.85	28.00	20.00	0.02000	773.00	25.33	0.11

Source Pathway - Source Inputs

AERMOD

Line Sources

Source Type	Source ID	X Coordinate [m]	Y Coordinate [m]	X2 Coordinate [m]	Y2 Coordinate [m]	Base Elevation (Optional)	Release Height [m]	Emission Rate [g/ (s-m^2)]	Width [m]	Initial Vertical Dim. [m]
LINE	3	609740.40 L12	2487995.19	609812.69	2487991.03	28.00	0.25	1.26E-6	9.00	
LINE	4	609812.69 L23	2487991.03	609821.23	2487992.84	28.00	0.25	1.26E-6	6.00	
LINE	5	609821.23 L34	2487992.84	609817.92	2488016.46	28.00	0.25	1.26E-6	6.00	
LINE	6	609817.92 L45	2488016.46	609890.24	2488113.52	28.00	0.25	1.26E-6	6.00	
LINE	7	609890.24 L56	2488113.52	609920.35	2488127.47	28.00	0.25	1.26E-6	6.00	
LINE	8	609920.35 L67	2488127.47	609922.97	2488135.52	28.00	0.25	1.26E-6	6.00	
LINE	9	609922.97 L78	2488135.52	609891.81	2488199.97	28.00	0.25	1.26E-6	6.00	
LINE	10	609891.81 L89	2488199.97	609877.82	2488203.23	28.00	0.25	1.26E-6	6.00	
LINE	11	609877.82 L910	2488203.23	609858.21	2488203.15	28.00	0.25	1.26E-6	6.00	
LINE	12	609858.21 L1011	2488203.15	609845.21	2488238.40	28.00	0.25	1.26E-6	6.00	
LINE	13	609845.21 L1112	2488238.40	609851.32	2488263.97	28.00	0.25	1.26E-6	6.00	
LINE	14	609851.32 L1213	2488263.97	609843.04	2488302.04	28.00	0.25	1.26E-6	6.00	
LINE	15	609843.04 L1314	2488302.04	609843.35	2488338.02	28.00	0.25	1.26E-6	6.00	

Point Sources

Source Type	Source ID	X Coordinate [m]	Y Coordinate [m]	Base Elevation (Optional)	Release Height [m]	Emission Rate [g/s]	Gas Exit Temp. [K]	Gas Exit Velocity [m/s]	Stack Inside Diameter [m]
POINT	1	609677.71 Stack-1	2488075.98	28.00	40.00	191.04384	413.15	12.00	2.09
POINT	2	609664.87 DG set 125KVA	2488083.85	28.00	20.00	0.02000	773.00	25.33	0.11

Source Type	Source ID	X Coordinate [m]	Y Coordinate [m]	X2 Coordinate [m]	Y2 Coordinate [m]	Base Elevation (Optional)	Release Height [m]	Emission Rate [g/ (s-m^2)]	Width [m]	Initial Vertical Dim. [m]
LINE	16	609843.35 L1415	2488338.02	609831.00	2488490.25	28.00	0.25	1.26E-6	6.00	
LINE	17	609831.00 L1516	2488490.25	609795.76	2488493.32	28.00	0.25	8.36E-8	6.00	
LINE	18	609795.76 L1617	2488493.32	609775.72	2488509.45	28.00	0.25	8.36E-8	6.00	
LINE	19	609775.72 L1718	2488509.45	609757.80	2488513.80	28.00	0.25	8.36E-8	6.00	
LINE	20	609757.80 L1819	2488513.80	609751.38	2488534.68	28.00	0.25	8.36E-8	6.00	
LINE	21	609751.38 L1920	2488534.68	609750.37	2488607.39	28.00	0.25	8.36E-8	6.00	
LINE	22	609750.37 L2021	2488607.39	609809.50	2488601.92	28.00	0.25	8.36E-8	6.00	
LINE	23	609809.50 L2122	2488601.92	609837.10	2488593.47	28.00	0.25	8.36E-8	6.00	
LINE	24	609837.10 L2223	2488593.47	609870.00	2488606.19	28.00	0.25	8.36E-8	6.00	
LINE	25	609870.00 L2324	2488606.19	609896.02	2488605.50	28.00	0.25	8.36E-8	6.00	

CO- Normal

Point Sources

Source Type	Source ID	X Coordinate [m]	Y Coordinate [m]	Base Elevation (Optional)	Release Height [m]	Emission Rate [g/s]	Gas Exit Temp. [K]	Gas Exit Velocity [m/s]	Stack Inside Diameter [m]
POINT	1	609677.71 Stack-1	2488075.98	28.00	40.00	0.42849	413.15	12.00	2.09
POINT	2	609664.87 DG-125KVA	2488083.85	28.00	20.00	0.10000	773.00	25.33	0.11

CO- Worst

Point Sources

Source Type	Source ID	X Coordinate [m]	Y Coordinate [m]	Base Elevation (Optional)	Release Height [m]	Emission Rate [g/s]	Gas Exit Temp. [K]	Gas Exit Velocity [m/s]	Stack Inside Diameter [m]
POINT	1	609677.71 Stack-1	2488075.98	28.00	40.00	0.64273	413.15	12.00	2.09
POINT	2	609664.87 DG set 125KVA	2488083.85	28.00	20.00	0.10000	773.00	25.33	0.11

NOX- Normal

Point Sources

Source Type	Source ID	X Coordinate [m]	Y Coordinate [m]	Base Elevation (Optional)	Release Height [m]	Emission Rate [g/s]	Gas Exit Temp. [K]	Gas Exit Velocity [m/s]	Stack Inside Diameter [m]
POINT	1	609677.71 Stack-1	2488075.98	28.00	40.00	3.79363	413.15	12.00	2.09
POINT	2	609664.87 DG set 125KVA	2488083.85	28.00	20.00	0.14000	773.00	25.33	0.11

NOX- Worst

Point Sources

Source Type	Source ID	X Coordinate [m]	Y Coordinate [m]	Base Elevation (Optional)	Release Height [m]	Emission Rate [g/s]	Gas Exit Temp. [K]	Gas Exit Velocity [m/s]	Stack Inside Diameter [m]
POINT	1	609677.71 Stack-1	2488075.98	28.00	40.00	7.58726	413.15	12.00	2.09
POINT	3	609664.87 DG set 125KVA	2488083.85	28.00	20.00	0.14000	773.00	25.33	0.11

SO2 – Normal

SO2 – Worst

Point Sources

Source Type	Source ID	X Coordinate [m]	Y Coordinate [m]	Base Elevation (Optional)	Release Height [m]	Emission Rate [g/s]	Gas Exit Temp. [K]	Gas Exit Velocity [m/s]	Stack Inside Diameter [m]
POINT	1	609677.71	2488075.98	28.00	40.00	2.93294	413.15	12.00	2.09
		Stack-1							
POINT	2	609664.87	2488083.85	28.00	20.00	0.29000	773.00	25.33	0.11
		DG set 125KVA							

Point Sources

Source Type	Source ID	X Coordinate [m]	Y Coordinate [m]	Base Elevation (Optional)	Release Height [m]	Emission Rate [g/s]	Gas Exit Temp. [K]	Gas Exit Velocity [m/s]	Stack Inside Diameter [m]
POINT	1	609677.71	2488075.98	28.00	40.00	5.86589	413.15	12.00	2.09
		Stack-1							
POINT	3	609664.87	2488083.85	28.00	20.00	0.29000	773.00	25.33	0.11
		DG set 125KVA							

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 GWJPL basis the hazard analysis or HIRA to be undertaken prior to the 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 JMC and the third-party vendor contracted for transportation of legacy waste
- Groundwater pollution due to mismanagement of waste, especially hazardous.

The increased number of vehicles used to deliver materials and supplies for operational phase may result in a higher number of injuries and mortalities from traffic accidents, as well as spills of hazardous materials being transported. 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 operation phase

- Labour management plan (comprising of measures for maintaining relations with labour and community) will be developed and implemented
- 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 incidents. 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 liasoning 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 transmission tower location and other associated facilities of the WTE plant.
- Vehicles sourcing waste 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. The 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: GWJPL will be required to install barricades and boundaries around all of the 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: GWJPL will need to install warning and danger signs at the site, areas with risk of electrocution and other relevant areas. Project SPV will also need to 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 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: DETAILED ENVIRONMENTAL MONITORING RESULTS

RESULTS OF AAQ MONITORING

S.N.	Date of Monitoring	AAQ	PM 10	PM 2.5	SO2	NOx	CO	Cadmium as Cd	Lead (Pb)	Mercury (Hg)	Nickel (Ni)	Arsenic (As)	Hydrogen fluoride (HF)	Hydrochloric Acid (HCl)
1	18.05.2023 to 19.05.2023	AAQ 1	98.5	47.9	10.3	19.4	0.43	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.24
2	18.05.2023 to 19.05.2023	AAQ 3	69.6	35.4	<6.0	23.6	0.69	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.35
3	19.05.2023 to 20.05.2023	AAQ 2	53.9	26.3	<6.0	25.4	0.98	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.36
4	19.05.2023 to 20.05.2023	AAQ 4	48.2	28.3	8.5	39.9	0.52	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.28
5	22.05.2023 to 23.05.2023	AAQ 2	45.6	19.2	8.5	29.6	0.42	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.23
6	22.05.2023 to 23.05.2023	AAQ 4	62.2	32.5	10.3	36.3	0.36	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.25
7	23.05.2023 to 24.05.2023	AAQ 1	87.5	49.6	9.7	32.7	0.51	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.22
8	23.05.2023 to 24.05.2023	AAQ 3	43.2	20.4	<6.0	26.6	0.33	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.21
9	25.05.2023 to 26.05.2023	AAQ 1	120.2	56.7	9.7	29.6	0.5	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.25
10	25.05.2023 to 26.05.2023	AAQ 3	39.7	19.2	<6.0	19.4	0.62	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.35
11	26.05.2023 to 27.05.2023	AAQ 2	29.2	11.3	<6.0	26.6	0.45	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.37

S.N.	Date of Monitoring	AAQ	PM 10	PM 2.5	SO2	NOx	CO	Cadmium as Cd	Lead (Pb)	Mercury (Hg)	Nickel (Ni)	Arsenic (As)	Hydrogen fluoride (HF)	Hydrochloric Acid (HCl)
12	26.05.2023 to 27.05.2023	AAQ 4	38.6	15.8	<6.0	28.4	0.6	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.34
13	29.05.2023 to 30.05.2023	AAQ 2	64.4	35.0	<6.0	27.8	0.73	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.28
14	29.05.2023 to 30.05.2023	AAQ 4	34.6	16.3	<6.0	26.6	0.38	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.28
15	30.05.2023 to 31.05.2023	AAQ 1	151.7	68.8	9.1	33.9	0.49	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.23
16	30.05.2023 to 31.05.2023	AAQ 3	97.5	48.8	8.5	21.2	0.41	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.26
17	01.06.2023 to 02.06.2023	AAQ 1	221.4	107.9	8.5	21.8	0.55	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.32
18	01.06.2023 to 02.06.2023	AAQ 3	58.6	27.1	<6.0	26.6	0.42	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.34
19	02.06.2023 to 03.06.2023	AAQ 2	138.0	75.9	10.9	35.1	0.49	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.39
20	02.06.2023 to 03.06.2023	AAQ 4	50.6	20.4	9.7	31.5	0.61	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.29
21	05.06.2023 to 06.06.2023	AAQ 2	87.7	40.4	8.5	30.9	0.34	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.25
22	05.06.2023 to 06.06.2023	AAQ 4	52.3	24.6	9.1	29.0	0.65	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.24
23	06.06.2023 to 07.06.2023	AAQ 1	81.3	37.9	10.3	26.6	0.59	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.24

S.N.	Date of Monitoring	AAQ	PM 10	PM 2.5	SO2	NOx	CO	Cadmium as Cd	Lead (Pb)	Mercury (Hg)	Nickel (Ni)	Arsenic (As)	Hydrogen fluoride (HF)	Hydrochloric Acid (HCl)
24	06.06.2023 to 07.06.2023	AAQ 3	34.8	16.7	9.7	28.4	0.52	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.23
25	08.06.2023 to 09.06.2023	AAQ 1	101.4	58.8	10.3	30.2	0.58	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.26
26	08.06.2023 to 09.06.2023	AAQ 3	70.8	37.9	9.1	20.0	0.42	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.31
27	09.06.2023 to 10.06.2023	AAQ 2	106.9	55.8	9.7	29.6	0.49	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.4
28	09.06.2023 to 10.06.2023	AAQ 4	95.6	45.4	<6.0	20.6	0.51	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.3
29	12.06.2023 to 13.06.2023	AAQ 2	58.5	21.3	<6.0	19.4	0.47	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.27
30	12.06.2023 to 13.06.2023	AAQ 4	39.0	19.6	9.7	34.5	0.41	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.27
31	13.06.2023 to 14.06.2023	AAQ 1	125.5	68.8	8.5	27.8	0.33	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.22
32	13.06.2023 to 14.06.2023	AAQ 3	62.5	30.4	<6.0	18.8	0.3	<0.01	<0.01	<0.002	<5.0	<1.0	<0.01	0.22
	Min		29.21	11.25	8.46	18.75	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.21
	Max		221.39	107.95	10.88	39.92	0.98	0.00	0.00	0.00	0.00	0.00	0.00	0.40
	Mean		77.17	38.13	9.40	27.42	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.28
	Percentile 98%		178.19	88.05	10.65	37.67	0.83	0.00	0.00	0.00	0.00	0.00	0.00	0.39

TRAFFIC DENSITY

TRAFFIC DENSITY - DATA

LOCATION: Traffic Survey -2 (Bediport Road, Patel colony Jamnagar) Date of Monitoring: 20.06.2023

SL. NO.	TIME (Hours)	MOTORIZED VEHICLES			NON-MOTORIZED VEHICLES	TOTAL
		Heavy Motor Vehicles	Light Motor Vehicles	Two/Three Wheelers		
		(Truck, Bus, Dumper, Tanker, Trailer)	(Car, Jeep, Van, Metador, Tractor, Tempo, Mini Bus)	(Scooter, Motorcycle, Auto, Moped)	(Bicycle, Tricycle)	
1	9.00-10.00	14	105	105	53	**277**
2	10.00-11.00	16	90	92	54	**252**
3	11.00-12.00	16	85	88	50	**239**
4	12.00-13.00	19	109	82	47	**257**
5	13.00-14.00	16	80	76	45	**217**
6	14.00-15.00	17	80	74	38	**209**
7	15.00-16.00	16	80	70	32	**198**
8	16.00-17.00	15	75	65	28	**183**
9	17.00-18.00	15	110	55	25	**205**
10	18.00-19.00	20	0	48	15	**83**
11	19.00-20.00	18	80	45	10	**153**
12	20.00-21.00	10	70	38	0	**118**
13	21.00-22.00	9	92	35	0	**136**
14	22.00-23.00	7	82	25	0	**114**
15	23.00-00.00	2	78	22	0	**102**
16	00.00-01.00	2	62	15	0	**79**
17	01.00-02.00	0	55	8	0	**63**
18	02.00-03.00	0	42	15	0	**57**
19	03.00-04.00	0	35	22	0	**57**
20	04.00-05.00	0	25	28	12	**65**

21	05.00-06.00	5	34	34	35	**108**
22	06.00-07.00	9	40	40	40	**129**
23	07.00-08.00	5	45	42	32	**124**
24	08.00-09.00	10	50	45	40	**145**
Total Numbers		**241**	**1604**	**1169**	**556**	**3570**

LOCATION: Traffic Survey -1 (Valsura Road Jamnagar) Date of Monitoring: 09.06.2023

S. No	TIME (Hours)	MOTORIZED VEHICLES			NON-MOTORIZED VEHICLES	TOTAL
		Heavy Motor Vehicles	Light Motor Vehicles	Two/Three Wheelers		
		(Truck, Bus, Dumper, Tanker, Trailer)	(Car, Jeep, Van, Metador, Tractor, Tempo, Mini Bus)	(Scooter, Motor Cycle, Auto, Moped)	(Bicycle, Tricycle)	
1	9.00-10.00	110	30	50	15	**205**
2	10.00-11.00	102	25	42	10	**179**
3	11.00-12.00	97	30	35	10	**172**
4	12.00-13.00	94	30	35	12	**171**
5	13.00-14.00	90	60	35	10	**195**
6	14.00-15.00	87	35	50	9	**181**
7	15.00-16.00	85	30	43	8	**166**
8	16.00-17.00	75	25	48	5	**153**
9	17.00-18.00	70	27	61	5	**163**
10	18.00-19.00	68	27	58	4	**157**
11	19.00-20.00	57	30	40	4	**131**
12	20.00-21.00	54	26	20	8	**108**
13	21.00-22.00	50	25	35	5	**115**
14	22.00-23.00	43	15	16	0	**74**

15	23.00-00.00	30	5	10	0	**45**
16	00.00-01.00	27	5	0	0	**32**
17	01.00-02.00	22	4	0	0	**26**
18	02.00-03.00	19	2	0	0	**21**
19	03.00-04.00	12	2	0	0	**14**
20	04.00-05.00	8	0	0	0	**8**
21	05.00-06.00	22	25	9	0	**56**
22	06.00-07.00	35	40	15	0	**90**
23	07.00-08.00	40	35	32	15	**122**
24	08.00-09.00	35	40	40	10	**125**
Total Numbers		**1332**	**573**	**674**	**130**	**2709**

NOISE QUALITY

Time	NQ-1		NQ-2		NQ-3		NQ-4	
Date	12.06.2023		13.08.2023		19.06.2023		14.06.2023	
Classification	At Plant Premises		At Anand vihar bag		Nr Juna nagda road		At Nava nagda gram Panchayat	
Dist of Measurement from Src								
Leq dB (A)-6.00 am	52.3	62.0	51.7	63.0	40.4	39.2	38.2	39.3
Leq dB (A)-7.00 am	58.6	61.7	60.8	63.1	41.5	42.2	41.0	38.8
Leq dB (A)-8.00 am	56.2	62.2	58.6	63.1	50.2	44.1	40.2	42.8
Leq dB (A)-9.00 am	60.4	55.8	57.1	66.3	56.6	48.0	48.7	53.4
Leq dB (A)-10.00 am	60.4	43.6	54.0	61.1	66.8	57.4	58.9	59.4
Leq dB (A)-11.00 am	79.8	68.3	59.5	61.2	72.5	59.3	65.2	54.5
Leq dB (A)-12.00 pm	86.1	64.1	64.3	59.7	61.3	63.1	60.4	54.1
Leq dB (A)-13.00 pm	84.6	66.9	62.0	64.1	58.9	57.6	62.0	57.7
Leq dB (A)-14.00 pm	60.7	65.6	64.0	64.1	71.2	59.9	64.3	61.0
Leq dB (A)-15.00 pm	58.2	65.5	55.1	64.4	64.6	60.7	60.2	64.3
Leq dB (A)-16.00 pm	58.9	68.5	44.1	62.6	58.8	61.7	67.8	64.8
Leq dB (A)-17.00 pm	60.3	83.3	51.7	62.6	56.3	61.6	61.2	66.1
Leq dB (A)-18.00 pm	67.6	71.1	63.8	63.2	50.2	62.7	58.9	66.6
Leq dB (A)-19.00 pm	62.6	75.6	56.3	66.0	50.3	52.2	61.3	57.3
Leq dB (A)-20.00 pm	58.0	65.7	49.7	62.7	43.0	48.2	60.3	54.3
Leq dB (A)-21.00 pm	61.8	51.6	53.1	46.7	47.1	46.8	48.3	49.2
Leq dB (A)-22.00 pm	57.4	52.4	49.5	41.8	46.4	43.9	47.0	42.8
Leq dB (A)-23.00 am	55.5	59.6	49.8	46.1	42.9	41.6	39.0	40.2
Leq dB (A)-24.00 am	55.4	44.5	48.6	49.4	41.5	40.8	41.1	40.1
Leq dB (A)-1.00 am	53.6	44.8	44.8	49.9	39.7	38.5	39.2	40.7
Leq dB (A)-2.00 am	52.9	44.7	44.9	49.6	40.0	38.9	38.6	38.0
Leq dB (A)-3.00 am	52.2	45.4	43.6	49.5	39.5	39.9	39.9	38.1
Leq dB (A)-4.00 am	49.6	45.3	43.9	49.5	39.8	39.0	38.1	37.6
Leq dB (A)-5.00 am	51.0	57.4	43.5	49.7	40.2	40.3	38.9	38.6
Lday	73.7	69.4	56.1	59.9	64.3	58.5	61.2	60.7
Lnight	52.7	49.9	45.0	53.1	41.9	40.7	41.4	39.9

L MAX	86.1	83.3	64.3	66.3	72.5	63.1	67.8	66.6
LMIN	49.6	43.6	43.5	41.8	39.5	38.5	38.1	37.6

Ground Water Monitoring Reports

Mitra S. K. Private Limited

MSK TESTING • INSPECTION

Scan for Portal

TEST REPORT

Report No. : MSKGL/FD/2023-24/001159
Date : 03/07/2023
Sample No. : MSKGL/FD/2023-24/05/00306
Drawn/Submitted on : 18/05/2023
Customer Ref No & Date Wed, Feb 15, 7:03 PM, Date - 01/05/2023

We hereby certify that the following sample Drawn by us has been analyzed with the following results:

1. Description of sample (As declared by customer)	Jamnagar GW-01
2. Sample Mark (if any, given by the customer)	MSKGDM/ED/W7
3. Date of sampling	16/05/2023
4. Place of sampling	Near, JMC STP PLANT
5. Environmental conditions during sampling	Ambient Temperature : 31
6. Sampling Plan & Procedures used	IS:10500-2012

Report No. : MSKGL/FD/2023-24/001159 **Sample No. :** MSKGL/FD/2023-24/05/00306

ANALYSIS RESULT (As per DW (IS:10500-2012))

Physical

Sl No.	Test Parameters	Unit	Test Method	Desirable Limit	Permissible Limit	Result
1	Colour	Hazen	3025 (Part 4)-1983; Rffm:2002	5	15	BDL(DL:1.0)
2	Odour	None	3025 (Part 5)-1983; Rffm:2002	Agreeable	Agreeable	AGREEABLE
3	pH	at 25 Deg C	IS 3025 (Part 11)-1984 Rffm: 2012	6.5-8.5	No Relaxation	8.30
4	Taste	None	IS 3025 (Part 8)- 1983 Rffm: 2012	Agreeable	Agreeable	AGREEABLE
5	Turbidity	N.T.U.	3025 (Part 10)-1984; Rffm:2002	1	5	1.5
6	Total Dissolved Solids	mg/l	IS 3025 (Part 16) : 1984	500	2000	1146

Chemical

Sl No.	Test Parameters	Unit	Test Method	Desirable Limit	Permissible Limit	Result
7	Aluminium as Al	mg/l	IS 3025 (Part 2) : 2004	0.03	0.2	BDL(DL:0.01)
8	Ammonia (as total ammonia-N)	mg/l	IS 3025 (Part 34): 1988	0.5	No Relaxation	BDL(DL:0.1)
9	Anionic Detergents (as MBAS)	mg/l	IS 13428 (ANNEX K): 2005	0.2	1.0	BDL(DL:0.05)
10	Barium as Ba	mg/l	IS 3025 (Part 2) : 2004	0.7	No relaxation	BDL(DL:0.1)
11	Boron as B	mg/l	IS 3025 (Part 2) : 2004	0.5	1.0	BDL(DL:0.25)
12	Calcium as Ca	mg/l	IS 3025 (Part 40) : 1991	75	200	39.20
13	Chloramines	mg/l	IS 3025 (Part 26) : 1986	4.0	No Relaxation	BDL(DL:0.1)
14	Chloride as Cl	mg/l	IS 3025 (Part 32) : 1988	250	1000	558.43

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MSK TESTING • INSPECTION

Report No. : MSKGL/FD/2023-24/001159 **Sample No. :** MSKGL/FD/2023-24/05/00306

ANALYSIS RESULT (As per DW (IS:10500-2012))

Chemical						
Sl No.	**Test Parameters**	**Unit**	**Test Method**	**Desirable Limit**	**Permissible Limit**	**Result**
15	Copper as Cu	mg/l	IS 3025 (Part 2) : 2004	0.05	1.5	BDL(DL:0.02)
16	Fluoride as F	mg/l	IS 3025 (Part 60) : 2008	1.0	1.5	0.52
17	Residual Free Chlorine	mg/l	IS 3025 (Part 26) : 1986	0.2	1.0	BDL(DL:0.1)
18	Iron as Fe	mg/l	IS 3025 (Part 53): 2003	0.3	No Relaxation	BDL(DL:0.05)
19	Magnesium as Mg	mg/l	IS 3025 (Part 46) : 1994	30	100	14.11
20	Manganese as Mn	mg/l	IS 3025 (Part 2) : 2004	0.1	0.3	BDL(DL:0.02)
21	Mineral Oil	mg/l	IS 3025 (Part 39) : 1991	0.5	No Relaxation	BDL(DL:0.5)
22	Nitrate as NO3	mg/l	IS 3025 (Part 34) : 1988	45	No Relaxation	1.86
23	Phenolic Compounds as C6H5OH	mg/l	IS 3025 (Part 43) : 1992	0.001	0.002	BDL(DL:0.001)
24	Selenium as Se	mg/l	IS 3025 (Part 2) : 2004	0.01	No Relaxation	BDL(DL:0.005)
25	Silver as Ag	mg/l	IS 3025 (Part 2) : 2004	0.1	No Relaxation	BDL(DL:0.005)
26	Sulphate as SO4	mg/l	IS 3025 (Part 24) : 1986	200	400	10.6
27	Sulphide as H2S	mg/l	IS 3025 (Part 29) : 1986	0.05	No Relaxation	BDL(DL:0.02)
28	Total Alkalinity as CaCO3	mg/l	IS 3025 (Part 23) : 1986	200	600	122.4
29	Total Hardness as CaCO3	mg/l	IS 3025 (Part 21) : 2009	200	600	156.86
30	Zinc as Zn	mg/l	IS 3025 (Part 2) : 2004	5	15	BDL(DL:0.02)
31	Cadmium as Cd	mg/l	IS 3025 (Part 2) : 2004	0.003	No Relaxation	BDL(DL:0.001)
32	Cyanide as CN	mg/l	IS 3025 (Part 27) : 1986	0.05	No Relaxation	BDL(DL:0.01)
33	Lead as Pb	mg/l	IS 3025 (Part 2) : 2004	0.01	No Relaxation	BDL(DL:0.005)
34	Mercury as Hg	mg/l	IS 3025 (Part 48) : 1994	0.001	No Relaxation	BDL(DL:0.0002)
35	Molybdenum as Mo	mg/l	IS 3025 (Part 2) : 2004	0.07	No Relaxation	BDL(DL:0.05)
36	Nickel (as Ni)	mg/l	IS 3025 (Part 2) : 2004	0.02	No Relaxation	BDL(DL:0.01)
37	Polychlorinated biphenyls (PCB)	mg/l	USEPA 8082: 2007	0.0005	No Relaxation	BDL(DL:0.0005)
38	Polynuclear Aromatic Hydrocarbons (PAH)	mg/l	APHA (23rd Edition) 6440C: 2017	0.0001	No Relaxation	BDL(DL:0.0001)
39	Arsenic as As	mg/l	IS 3025 (Part 2) : 2004	0.01	0.05	BDL(DL:0.005)
40	Total Chromium as Cr	mg/l	IS 3025 (Part 2) : 2004	0.05	No Relaxation	BDL(DL:0.01)
41	Bromoform	mg/l	APHA (23rd Edition) 6232 B: 2017	0.1	No Relaxation	BDL(DL:0.01)
42	Dibromochloromethane	mg/l	APHA (23rd Edition) 6232 B: 2017	0.1	No Relaxation	BDL(DL:0.01)
43	Bromodichloromethane	mg/l	APHA (23rd Edition) 6232 B: 2017	0.06	No Relaxation	BDL(DL:0.01)
44	Chloroform	mg/l	APHA (23rd Edition) 6232 B: 2017	0.2	No Relaxation	BDL(DL:0.01)
45	Alachlor	micro gm/l	USEPA 525.2	Not specified	20	BDL(DL:0.02)
46	Atrazine	micro gm/l	USEPA 8141A: 2007	Not specified	2.0	BDL(DL:0.02)
47	Aldrin	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	0.03	BDL(DL:0.01)
48	Dieldrin	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	0.03	BDL(DL:0.01)
49	Alpha- HCH	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	0.01	BDL(DL:0.01)
50	Beta- HCH	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	0.04	BDL(DL:0.01)
51	Butachlor	micro gm/l	USEPA 8141A: 2007	Not specified	125	BDL(DL:0.02)
52	Chlorlopyrifos	micro gm/l	USEPA 8141 A	Not specified	30	BDL(DL:0.02)
53	Delta-HCH	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	0.04	BDL(DL:0.01)
54	2,4-Dichlorophenoxyacetic acid	micro gm/l	USEPA 515: 1981	Not specified	30	BDL(DL:0.01)
55	o,p DDT	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	1.0	BDL(DL:0.01)

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Mitra S. K. Private Limited

MSK TESTING • INSPECTION

Report No. : MSKGL/FD/2023-24/001159 **Sample No. :** MSKGL/FD/2023-24/05/00306

ANALYSIS RESULT (As per DW (IS:10500-2012))

Chemical

Sl No.	Test Parameters	Unit	Test Method	Desirable Limit	Permissible Limit	Result
56	p,p DDT	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	1.0	BDL(DL:0.01)
57	o,p DDE	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	1.0	BDL(DL:0.01)
58	p,p DDE	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	1.0	BDL(DL:0.01)
59	o,p DDD	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	1.0	BDL(DL:0.01)
60	p,p DDD	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	1.0	BDL(DL:0.01)
61	Alpha-Endosulfan	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	0.4	BDL(DL:0.01)
62	Beta-Endosulfan	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	0.4	BDL(DL:0.01)
63	Endosulfan Sulphate	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	0.4	BDL(DL:0.01)
64	Ethion	micro gm/l	US EPA 8141A: 2007	Not specified	3.0	BDL(DL:0.02)
65	Gama-HCH (Lindane)	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	2.0	BDL(DL:0.01)
66	Isoproturon	micro gm/l	USEPA 532: 2000	Not specified	9	BDL(DL:0.02)
67	Malathion	micro gm/l	USEPA 8141A: 2007	Not specified	190	BDL(DL:0.02)
68	Methyl Parathion	micro gm/l	USEPA 8141A: 2007	Not specified	0.3	BDL(DL:0.02)
69	Monocrotophos	micro gm/l	USEPA 8141A: 2007	Not specified	1.0	BDL(DL:0.02)
70	Phorate	micro gm/l	USEPA 8141A: 2007	Not specified	2.0	BDL(DL:0.02)

Micro Biology

Sl No.	Test Parameters	Unit	Test Method	Desirable Limit	Permissible Limit	Result
71	E. coli	/100ml	IS 15185:2016	NA	Not Detectable	Not Detected
72	Total coliform	/100ml	IS 15185:2016	NA	Not Detectable	Not Detected

DL : Detection Limit BDL : Below Detection Limit

Opinion :

----------END OF REPORT----------

Report Verified By

For Mitra S. K. Private Limited

Authorised Signatory

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MSK TESTING • INSPECTION

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TEST REPORT

Report No. : MSKGL/FD/2023-24/001160
Date : 03/07/2023
Sample No. : MSKGL/FD/2023-24/05/00307
Drawn/Submitted on : 18/05/2023
Customer Ref No & Date Wed, Feb 15, 7:03 PM, Date - 01/05/2023

We hereby certify that the following sample Drawn by us has been analyzed with the following results:

1. Description of sample (As declared by customer)	Jamnagar GW-02
2. Sample Mark (if any, given by the customer)	MSKGDM/ED/W8
3. Date of sampling	16/05/2023
4. Place of sampling	Behind the plang premises, JANARAM TEMPLE
5. Environmental conditions during sampling	Ambient Temperature : 31
6. Sampling Plan & Procedures used	IS:10500-2012

Report No. : MSKGL/FD/2023-24/001160 **Sample No. :** MSKGL/FD/2023-24/05/00307

ANALYSIS RESULT (As per DW (IS:10500-2012))

Physical

Sl No.	Test Parameters	Unit	Test Method	Desirable Limit	Permissible Limit	Result
1	Colour	Hazen	3025 (Part 4)-1983; Rflm:2002	5	15	BDL(DL:1.0)
2	Odour	None	3025 (Part 5)-1983; Rflm:2002	Agreeable	Agreeable	AGREEABLE
3	pH	at 25 Deg C	IS 3025 (Part 11)-1984 Rflm: 2012	6.5-8.5	No Relaxation	7.74
4	Taste	None	IS 3025 (Part 8)- 1983 Rflm: 2012	Agreeable	Agreeable	AGREEABLE
5	Turbidity	N.T.U.	3025 (Part 10)-1984; Rflm:2002	1	5	1.6
6	Total Dissolved Solids	mg/l	IS 3025 (Part 16) : 1984	500	2000	918

Chemical

Sl No.	Test Parameters	Unit	Test Method	Desirable Limit	Permissible Limit	Result
7	Aluminium as Al	mg/l	IS 3025 (Part 2) : 2004	0.03	0.2	BDL(DL:0.01)
8	Ammonia (as total ammonia-N)	mg/l	IS 3025 (Part 34): 1988	0.5	No Relaxation	BDL(DL:0.1)
9	Anionic Detergents (as MBAS)	mg/l	IS 13428 (ANNEX K): 2005	0.2	1.0	BDL(DL:0.05)
10	Barium as Ba	mg/l	IS 3025 (Part 2) : 2004	0.7	No relaxation	BDL(DL:0.1)
11	Boron as B	mg/l	IS 3025 (Part 2) : 2004	0.5	1.0	BDL(DL:0.25)
12	Calcium as Ca	mg/l	IS 3025 (Part 40) : 1991	75	200	39.20
13	Chloramines	mg/l	IS 3025 (Part 26) : 1986	4.0	No Relaxation	BDL(DL:0.1)
14	Chloride as Cl	mg/l	IS 3025 (Part 32) : 1988	250	1000	460.46

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MSK TESTING • INSPECTION

Report No. : MSKGL/FD/2023-24/001160 **Sample No. :** MSKGL/FD/2023-24/05/00307

ANALYSIS RESULT (As per DW (IS:10500-2012))

Chemical						
Sl No.	Test Parameters	Unit	Test Method	Desirable Limit	Permissible Limit	Result
15	Copper as Cu	mg/l	IS 3025 (Part 2) : 2004	0.05	1.5	BDL(DL:0.02)
16	Fluoride as F	mg/l	IS 3025 (Part 60) : 2008	1.0	1.5	0.48
17	Residual Free Chlorine	mg/l	IS 3025 (Part 26) : 1986	0.2	1.0	BDL(DL:0.1)
18	Iron as Fe	mg/l	IS 3025 (Part 53): 2003	0.3	No Relaxation	0.08
19	Magnesium as Mg	mg/l	IS 3025 (Part 46) : 1994	30	100	9.41
20	Manganese as Mn	mg/l	IS 3025 (Part 2) : 2004	0.1	0.3	BDL(DL:0.02)
21	Mineral Oil	mg/l	IS 3025 (Part 39) : 1991	0.5	No Relaxation	BDL(DL:0.5)
22	Nitrate as NO3	mg/l	IS 3025 (Part 34) : 1988	45	No Relaxation	1.05
23	Phenolic Compounds as C6H5OH	mg/l	IS 3025 (Part 43) : 1992	0.001	0.002	BDL(DL:0.001)
24	Selenium as Se	mg/l	IS 3025 (Part 2) : 2004	0.01	No Relaxation	BDL(DL:0.005)
25	Silver as Ag	mg/l	IS 3025 (Part 2) : 2004	0.1	No Relaxation	BDL(DL:0.005)
26	Sulphate as SO4	mg/l	IS 3025 (Part 24) : 1986	200	400	8.6
27	Sulphide as H2S	mg/l	IS 3025 (Part 29) : 1986	0.05	No Relaxation	BDL(DL:0.02)
28	Total Alkalinity as CaCO3	mg/l	IS 3025 (Part 23) : 1986	200	600	102
29	Total Hardness as CaCO3	mg/l	IS 3025 (Part 21) : 2009	200	600	137.20
30	Zinc as Zn	mg/l	IS 3025 (Part 2) : 2004	5	15	BDL(DL:0.02)
31	Cadmium as Cd	mg/l	IS 3025 (Part 2) : 2004	0.003	No Relaxation	BDL(DL:0.001)
32	Cyanide as CN	mg/l	IS 3025 (Part 27) : 1986	0.05	No Relaxation	BDL(DL:0.01)
33	Lead as Pb	mg/l	IS 3025 (Part 2) : 2004	0.01	No Relaxation	BDL(DL:0.005)
34	Mercury as Hg	mg/l	IS 3025 (Part 48) : 1994	0.001	No Relaxation	BDL(DL:0.0002)
35	Molybdenum as Mo	mg/l	IS 3025 (Part 2) : 2004	0.07	No Relaxation	BDL(DL:0.05)
36	Nickel (as Ni)	mg/l	IS 3025 (Part 2) : 2004	0.02	No Relaxation	BDL(DL:0.01)
37	Polychlorinated biphenyls (PCB)	mg/l	USEPA 8082: 2007	0.0005	No Relaxation	BDL(DL:0.0005)
38	Polynuclear Aromatic Hydrocarbons (PAH)	mg/l	APHA (23rd Edition) 6440C: 2017	0.0001	No Relaxation	BDL(DL:0.0001)
39	Arsenic as As	mg/l	IS 3025 (Part 2) : 2004	0.01	0.05	BDL(DL:0.005)
40	Total Chromium as Cr	mg/l	IS 3025 (Part 2) : 2004	0.05	No Relaxation	BDL(DL:0.01)
41	Bromoform	mg/l	APHA (23rd Edition) 6232 B: 2017	0.1	No Relaxation	BDL(DL:0.01)
42	Dibromochloromethane	mg/l	APHA (23rd Edition) 6232 B: 2017	0.1	No Relaxation	BDL(DL:0.01)
43	Bromodichloromethane	mg/l	APHA (23rd Edition) 6232 B: 2017	0.06	No Relaxation	BDL(DL:0.01)
44	Chloroform	mg/l	APHA (23rd Edition) 6232 B: 2017	0.2	No Relaxation	BDL(DL:0.01)
45	Alachlor	micro gm/l	USEPA 525.2	Not specified	20	BDL(DL:0.02)
46	Atrazine	micro gm/l	USEPA 8141A: 2007	Not specified	2.0	BDL(DL:0.02)
47	Aldrin	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	0.03	BDL(DL:0.01)
48	Dieldrin	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	0.03	BDL(DL:0.01)
49	Alpha- HCH	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	0.01	BDL(DL:0.01)
50	Beta- HCH	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	0.04	BDL(DL:0.01)
51	Butachlor	micro gm/l	USEPA 8141A: 2007	Not specified	125	BDL(DL:0.02)
52	Chlorlopyrfos	micro gm/l	USEPA 8141 A	Not specified	30	BDL(DL:0.02)
53	Delta-HCH	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	0.04	BDL(DL:0.01)
54	2,4-Dichlorophenoxyacetic acid	micro gm/l	USEPA 515: 1981	Not specified	30	BDL(DL:0.01)
55	o,p DDT	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	1.0	BDL(DL:0.01)

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MSK TESTING • INSPECTION

Report No. : MSKGL/FD/2023-24/001160 **Sample No. :** MSKGL/FD/2023-24/05/00307

ANALYSIS RESULT (As per DW (IS:10500-2012))

Chemical

Sl No.	Test Parameters	Unit	Test Method	Desirable Limit	Permissible Limit	Result
56	p,p DDT	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	1.0	BDL(DL:0.01)
57	o,p DDE	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	1.0	BDL(DL:0.01)
58	p,p DDE	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	1.0	BDL(DL:0.01)
59	o,p DDD	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	1.0	BDL(DL:0.01)
60	p,p DDD	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	1.0	BDL(DL:0.01)
61	Alpha-Endosulfan	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	0.4	BDL(DL:0.01)
62	Beta-Endosulfan	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	0.4	BDL(DL:0.01)
63	Endosulfan Sulphate	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	0.4	BDL(DL:0.01)
64	Ethion	micro gm/l	US EPA 8141A: 2007	Not specified	3.0	BDL(DL:0.02)
65	Gama-HCH (Lindane)	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	2.0	BDL(DL:0.01)
66	Isoproturon	micro gm/l	USEPA 532: 2000	Not specified	9	BDL(DL:0.02)
67	Malathion	micro gm/l	USEPA 8141A: 2007	Not specified	190	BDL(DL:0.02)
68	Methyl Parathion	micro gm/l	USEPA 8141A: 2007	Not specified	0.3	BDL(DL:0.02)
69	Monocrotophos	micro gm/l	USEPA 8141A: 2007	Not specified	1.0	BDL(DL:0.02)
70	Phorate	micro gm/l	USEPA 8141A: 2007	Not specified	2.0	BDL(DL:0.02)

Micro Biology

Sl No.	Test Parameters	Unit	Test Method	Desirable Limit	Permissible Limit	Result
71	E. coli	/100ml	IS 15185:2016	NA	Not Detectable	Not Detected
72	Total coliform	/100ml	IS 15185:2016	NA	Not Detectable	Not Detected

DL : Detection Limit BDL : Below Detection Limit

Opinion :

----------END OF REPORT----------

Report Verified By

For Mitra S. K. Private Limited

Authorised Signatory

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MSK TESTING • INSPECTION

Scan for Portal

TEST REPORT

Report No. : MSKGL/FD/2023-24/001161
Date : 03/07/2023
Sample No. : MSKGL/FD/2023-24/05/00308
Drawn/Submitted on : 18/05/2023
Customer Ref No & Date Wed, Feb 15, 7:03/PM, Date - 01/05/2023

We hereby certify that the following sample Drawn by us has been analyzed with the following results:

1. Description of sample (As declared by customer)	Jamnagar GW-03
2. Sample Mark (if any, given by the customer)	MSKGDM/ED/W9
3. Date of sampling	15/05/2023
4. Place of sampling	Navanagna village.
5. Environmental conditions during sampling	Ambient Temperature : 31
6. Sampling Plan & Procedures used	IS:10500-2012

Report No. : MSKGL/FD/2023-24/001161 **Sample No. :** MSKGL/FD/2023-24/05/00308

ANALYSIS RESULT (As per DW (IS:10500-2012))

Physical

Sl No.	Test Parameters	Unit	Test Method	Desirable Limit	Permissible Limit	Result
1	Colour	Hazen	3025 (Part 4)-1983; Rflm:2002	5	15	BDL(DL:1.0)
2	Odour	None	3025 (Part 5)-1983; Rflm:2002	Agreeable	Agreeable	AGREEABLE
3	pH	at 25 Deg C	IS 3025 (Part 11)-1984 Rflm: 2012	6.5-8.5	No Relaxation	7.58
4	Taste	None	IS 3025 (Part 8)- 1983 Rflm: 2012	Agreeable	Agreeable	AGREEABLE
5	Turbidity	N.T.U.	3025 (Part 10)-1984; Rflm:2002	1	5	BDL(DL:1.0\)
6	Total Dissolved Solids	mg/l	IS 3025 (Part 16) : 1984	500	2000	630

Chemical

Sl No.	Test Parameters	Unit	Test Method	Desirable Limit	Permissible Limit	Result
7	Aluminium as Al	mg/l	IS 3025 (Part 2) : 2004	0.03	0.2	BDL(DL:0.01)
8	Ammonia (as total ammonia-N)	mg/l	IS 3025 (Part 34): 1988	0.5	No Relaxation	BDL(DL:0.1)
9	Anionic Detergents (as MBAS)	mg/l	IS 13428 (ANNEX K): 2005	0.2	1.0	BDL(DL:0.05)
10	Barium as Ba	mg/l	IS 3025 (Part 2) : 2004	0.7	No relaxation	BDL(DL:0.1)
11	Boron as B	mg/l	IS 3025 (Part 2) : 2004	0.5	1.0	BDL(DL:0.25)
12	Calcium as Ca	mg/l	IS 3025 (Part 40) : 1991	75	200	31.36
13	Chloramines	mg/l	IS 3025 (Part 26) : 1986	4.0	No Relaxation	BDL(DL:0.1)
14	Chloride as Cl	mg/l	IS 3025 (Part 32) : 1988	250	1000	313.6

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MSK TESTING • INSPECTION

Report No. : MSKGL/FD/2023-24/001161 **Sample No. :** MSKGL/FD/2023-24/05/00308

ANALYSIS RESULT (As per DW (IS:10500-2012))

Chemical						
Sl No.	Test Parameters	Unit	Test Method	Desirable Limit	Permissible Limit	Result
15	Copper as Cu	mg/l	IS 3025 (Part 2) : 2004	0.05	1.5	BDL(DL:0.02)
16	Fluoride as F	mg/l	IS 3025 (Part 60) : 2008	1.0	1.5	0.36
17	Residual Free Chlorine	mg/l	IS 3025 (Part 26) : 1986	0.2	1.0	BDL(DL:0.1)
18	Iron as Fe	mg/l	IS 3025 (Part 53): 2003	0.3	No Relaxation	BDL(DL:0.05)
19	Magnesium as Mg	mg/l	IS 3025 (Part 46) : 1994	30	100	9.41
20	Manganese as Mn	mg/l	IS 3025 (Part 2) : 2004	0.1	0.3	BDL(DL:0.02)
21	Mineral Oil	mg/l	IS 3025 (Part 39) : 1991	0.5	No Relaxation	BDL(DL:0.5)
22	Nitrate as NO3	mg/l	IS 3025 (Part 34) : 1988	45	No Relaxation	1.12
23	Phenolic Compounds as C6H5OH	mg/l	IS 3025 (Part 43) : 1992	0.001	0.002	BDL(DL:0.001)
24	Selenium as Se	mg/l	IS 3025 (Part 2) : 2004	0.01	No Relaxation	BDL(DL:0.005)
25	Silver as Ag	mg/l	IS 3025 (Part 2) : 2004	0.1	No Relaxation	BDL(DL:0.005)
26	Sulphate as SO4	mg/l	IS 3025 (Part 24) : 1986	200	400	5.66
27	Sulphide as H2S	mg/l	IS 3025 (Part 29) : 1986	0.05	No Relaxation	BDL(DL:0.02)
28	Total Alkalinity as CaCO3	mg/l	IS 3025 (Part 23) : 1986	200	600	81.6
29	Total Hardness as CaCO3	mg/l	IS 3025 (Part 21) : 2009	200	600	117.60
30	Zinc as Zn	mg/l	IS 3025 (Part 2) : 2004	5	15	BDL(DL:0.02)
31	Cadmium as Cd	mg/l	IS 3025 (Part 2) : 2004	0.003	No Relaxation	BDL(DL:0.001)
32	Cyanide as CN	mg/l	IS 3025 (Part 27) : 1986	0.05	No Relaxation	BDL(DL:0.01)
33	Lead as Pb	mg/l	IS 3025 (Part 2) : 2004	0.01	No Relaxation	BDL(DL:0.005)
34	Mercury as Hg	mg/l	IS 3025 (Part 48) : 1994	0.001	No Relaxation	BDL(DL:0.0002)
35	Molybdenum as Mo	mg/l	IS 3025 (Part 2) : 2004	0.07	No Relaxation	BDL(DL:0.05)
36	Nickel (as Ni)	mg/l	IS 3025 (Part 2) : 2004	0.02	No Relaxation	BDL(DL:0.01)
37	Polychlorinated biphenyls (PCB)	mg/l	USEPA 8082: 2007	0.0005	No Relaxation	BDL(DL:0.0005)
38	Polynuclear Aromatic Hydrocarbons (PAH)	mg/l	APHA (23rd Edition) 6440C: 2017	0.0001	No Relaxation	BDL(DL:0.0001)
39	Arsenic as As	mg/l	IS 3025 (Part 2) : 2004	0.01	0.05	BDL(DL:0.005)
40	Total Chromium as Cr	mg/l	IS 3025 (Part 2) : 2004	0.05	No Relaxation	BDL(DL:0.01)
41	Bromoform	mg/l	APHA (23rd Edition) 6232 B: 2017	0.1	No Relaxation	BDL(DL:0.01)
42	Dibromochloromethane	mg/l	APHA (23rd Edition) 6232 B: 2017	0.1	No Relaxation	BDL(DL:0.01)
43	Bromodichloromethane	mg/l	APHA (23rd Edition) 6232 B: 2017	0.06	No Relaxation	BDL(DL:0.01)
44	Chloroform	mg/l	APHA (23rd Edition) 6232 B: 2017	0.2	No Relaxation	BDL(DL:0.01)
45	Alachlor	micro gm/l	USEPA 525.2	Not specified	20	BDL(DL:0.02)
46	Atrazine	micro gm/l	USEPA 8141A: 2007	Not specified	2.0	BDL(DL:0.02)
47	Aldrin	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	0.03	BDL(DL:0.01)
48	Dieldrin	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	0.03	BDL(DL:0.01)
49	Alpha- HCH	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	0.01	BDL(DL:0.01)
50	Beta- HCH	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	0.04	BDL(DL:0.01)
51	Butachlor	micro gm/l	USEPA 8141A: 2007	Not specified	125	BDL(DL:0.02)
52	Chloriopyrifos	micro gm/l	USEPA 8141 A	Not specified	30	BDL(DL:0.02)
53	Delta-HCH	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	0.04	BDL(DL:0.01)
54	2,4-Dichlorophenoxyacetic acid	micro gm/l	USEPA 515: 1981	Not specified	30	BDL(DL:0.01)
55	o,p DDT	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	1.0	BDL(DL:0.01)

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MSK TESTING • INSPECTION

Report No. : MSKGL/FD/2023-24/001161 **Sample No. :** MSKGL/FD/2023-24/05/00308

ANALYSIS RESULT (As per DW (IS:10500-2012))

Chemical

Sl No.	Test Parameters	Unit	Test Method	Desirable Limit	Permissible Limit	Result
56	p,p DDT	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	1.0	BDL(DL:0.01)
57	o,p DDE	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	1.0	BDL(DL:0.01)
58	p,p DDE	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	1.0	BDL(DL:0.01)
59	o,p DDD	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	1.0	BDL(DL:0.01)
60	p,p DDD	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	1.0	BDL(DL:0.01)
61	Alpha-Endosulfan	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	0.4	BDL(DL:0.01)
62	Beta-Endosulfan	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	0.4	BDL(DL:0.01)
63	Endosulfan Sulphate	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	0.4	BDL(DL:0.01)
64	Ethion	micro gm/l	US EPA 8141A: 2007	Not specified	3.0	BDL(DL:0.02)
65	Gama-HCH (Lindane)	micro gm/l	AOAC (21st edition), 990.06: 2019	Not specified	2.0	BDL(DL:0.01)
66	Isoproturon	micro gm/l	USEPA 532: 2000	Not specified	9	BDL(DL:0.02)
67	Malathion	micro gm/l	USEPA 8141A: 2007	Not specified	190	BDL(DL:0.02)
68	Methyl Parathion	micro gm/l	USEPA 8141A: 2007	Not specified	0.3	BDL(DL:0.02)
69	Monocrotophos	micro gm/l	USEPA 8141A: 2007	Not specified	1.0	BDL(DL:0.02)
70	Phorate	micro gm/l	USEPA 8141A: 2007	Not specified	2.0	BDL(DL:0.02)

Micro Biology

Sl No.	Test Parameters	Unit	Test Method	Desirable Limit	Permissible Limit	Result
71	E. coli	/100ml	IS 15185:2016	NA	Not Detectable	Not Detected
72	Total coliform	/100ml	IS 15185:2016	NA	Not Detectable	Not Detected

DL : Detection Limit BDL : Below Detection Limit

Opinion :

----------END OF REPORT----------

Report Verified By

For Mitra S. K. Private Limited

Authorised Signatory

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MSK TESTING • INSPECTION

TEST REPORT

Report No. : MSKGL/ED/2023-24/000211
Date : 03/07/2023
Sample No. : MSKGL/ED/2023-24/05/01102
Drawn/Submitted on : 18/05/2023
Reference No. & Date : Wed, Feb 15, 7:03/PM, Date - 01/05/2023

We hereby certify that the following sample drawn by us / submitted by the customer has been analyzed with the following results:

1. Description of sample (As declared by customer)	Jamnagar SW-01
2. Sample Mark (if any, given by the customer)	MSKGDM/ED/W7
3. Date of sampling	16/05/2023
4. Place of sampling	Behind the plang premises.
5. Environmental conditions during sampling	Ambient Temperature : 31
6. Sampling Plan & Procedures used	APHA (23rd Edition)

Report No. : MSKGL/ED/2023-24/000211 **Sample No. :** MSKGL/ED/2023-24/05/01102

ANALYSIS RESULT

Chemical

Sl No.	Test Parameters	Unit	Test Method	Desirable Limit	Permissible	Result
1	Colour	Hazen	APHA (23rd Edition) 2120B : 2017			<5.0
2	pH value	None	APHA (23rd Edition) 4500 -H-B : 2017			7.51 at 25 deg C
3	Turbidity	N.T.U.	APHA (23rd Edition) 2130B : 2017			18
4	Total Dissolved Solids (as TDS)	mg/l	APHA (23rd Edition) 2540C : 2017			816
5	Calcium (as Ca)	mg/l	APHA (23rd Edition) 3500 Ca B,2017 (O)			64
6	Chloride (as Cl)	mg/l	APHA (23rd Edition) 4500 -Cl B : 2017			198
7	Copper (as Cu)	mg/l	APHA (23rd Edition) 3120 B : 2017			<0.02
8	Fluoride (as F)	mg/l	APHA (23rd Edition) 4500 -F- C/D: 2017			0.29
9	Iron (as Fe)	mg/l	APHA (23rd Edition) 3500 Fe B : 2017			0.15
10	Magnesium (as Mg)	mg/l	APHA (23rd Edition) 3500 Mg B,2017 (O)			41
11	Manganese (as Mn)	mg/l	APHA (23rd Edition) 3120 B : 2017			<0.02
12	Nitrate (as NO3)	mg/l	APHA (23rd Edition) 4500 - NO3 - E : 2017			48
13	Phenolic Compounds (as C6H5OH)	mg/l	APHA (23rd Edition) 5530C : 2017			<0.001
14	Sulphate (as SO4)	mg/l	APHA (23rd Edition) 4500 - SO42- E : 2017			38
15	Alkalinity (as CaCO3)	mg/l	APHA (23rd Edition) 2320B 2017 (O)			355
16	Total Hardness (as CaCO3)	mg/l	APHA (23rd Edition) , 2340 C : 2017			332

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MSK TESTING • INSPECTION

Report No. : MSKGL/ED/2023-24/000211 **Sample No. :** MSKGL/ED/2023-24/05/01102

ANALYSIS RESULT

Chemical

Sl No.	Test Parameters	Unit	Test Method	Desirable Limit	Permissible	Result
17	Cadmium (as Cd)	mg/l	APHA (23rd Edition)3120B 2017_(O)			<0.001
18	Lead (as Pb)	mg/l	APHA (23rd Edition) 3120 B : 2017			<0.005
19	Mercury (as Hg)	mg/l	IS 3025 (Part 48): 1994			<0.001
20	Nickel (as Ni)	mg/l	APHA (23rd Edition) 3120 B : 2017			<0.02
21	Arsenic(as As)	mg/l	APHA (23rd Edition)3120B 2017 (ICP OES)_(O)			<0.005
22	Zinc (as Zn)	mg/l	APHA (23rd Edition) 3120 B : 2017			<0.02
23	Cobalt (as Co)	mg/l	APHA (23rd Edition)3120B 2017 (ICP OES)_(O)			<0.05
24	Total Suspended Solid (as TSS)	mg/l	APHA (23rd Edition) 2540D : 2017			28
25	Temperature	Deg C	APHA 23rd EDITION,2550 B_(O)			25
26	Conductivity	us/cm	APHA (23rd Edition) 2510B: 2017			1320
27	Biochemical Oxygen Demand (as BOD)	mg/l	APHA (23rd Edition) 5210B : 2017			3.6
28	Chemical Oxygen Demand (COD)	mg/l	APHA (23rd Edition) 5220B : 2017			16
29	Oil and Grease	mg/l	APHA (23rd Edition) 5520B : 2017			<5.0
30	Salinity	None	APHA (23rd Edition)2520B, 2017_(O)			0.79 in respect to KCl equivalent salinity 35.
31	Phosphate (as PO4)	mg/l	APHA (23rd Edition) 4500- P D, 2017_(O)			3.6
32	DO	mg/l	APHA 23rd Ed. 2017-4500-O-C/G_(O)			6.2
33	Chromium as Cr	mg/l	APHA (23rd Edition)3120B 2017 (ICP OES)_(O)			<0.01

Micro Biology

Sl No.	Test Parameters	Unit	Test Method	Desirable Limit	Permissible	Result
34	Faecal coliform	MPN/100ml	APHA 23rd Edition 9221 E_(O)			33
35	Total coliform	MPN/100ml	APHA 23rd Edition 9221 B_(O)			170

DL : Detection Limit ***BDL : Below Detection Limit***

Opinion :

Report Verified By

For Mitra S. K. Private Limited

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MSK TESTING • INSPECTION

TEST REPORT

Report No. : MSKGL/ED/2023-24/000220
Date : 03/07/2023
Sample No. : MSKGL/ED/2023-24/05/01103
Drawn/Submitted on : 18/05/2023
Reference No. & Date : Wed, Feb 15, 7:03/PM, Date - 01/05/2023

We hereby certify that the following sample drawn by us / submitted by the customer has been analyzed with the following results:

1. Description of sample (As declared by customer)	Jamnagar SW-02
2. Sample Mark (if any, given by the customer)	MSKGDM/ED/W8
3. Date of sampling	16/05/2023
4. Place of sampling	Metropolitan Area
5. Environmental conditions during sampling	Ambient Temperature : 31
6. Sampling Plan & Procedures used	APHA (23rd Edition)

Report No. : MSKGL/ED/2023-24/000220 **Sample No. :** MSKGL/ED/2023-24/05/01103

ANALYSIS RESULT

Chemical

Sl No.	Test Parameters	Unit	Test Method	Desirable Limit	Permissible	Result
1	Colour	Hazen	APHA (23rd Edition) 2120B : 2017			<5.0
2	pH value	None	APHA (23rd Edition) 4500 -H-B : 2017			7.59 at 25 deg C
3	Turbidity	N.T.U.	APHA (23rd Edition) 2130B : 2017			30
4	Total Dissolved Solids (as TDS)	mg/l	APHA (23rd Edition) 2540C : 2017			850
5	Calcium (as Ca)	mg/l	APHA (23rd Edition) 3500 Ca B,2017 (O)			63
6	Chloride (as Cl)	mg/l	APHA (23rd Edition) 4500 -Cl B : 2017			224
7	Copper (as Cu)	mg/l	APHA (23rd Edition) 3120 B : 2017			<0.02
8	Fluoride (as F)	mg/l	APHA (23rd Edition) 4500 -F- C/D: 2017			0.31
9	Iron (as Fe)	mg/l	APHA (23rd Edition) 3500 Fe B : 2017			0.65
10	Magnesium (as Mg)	mg/l	APHA (23rd Edition) 3500 Mg B,2017 (O)			35
11	Manganese (as Mn)	mg/l	APHA (23rd Edition) 3120 B : 2017			<0.02
12	Nitrate (as NO3)	mg/l	APHA (23rd Edition) 4500 - NO3 - E : 2017			71
13	Phenolic Compounds (as C6H5OH)	mg/l	APHA (23rd Edition) 5530C : 2017			<0.001
14	Sulphate (as SO4)	mg/l	APHA (23rd Edition) 4500 - SO42- E : 2017			60
15	Alkalinity (as CaCO3)	mg/l	APHA (23rd Edition) 2320B 2017 (O)			290
16	Total Hardness (as CaCO3)	mg/l	APHA (23rd Edition) , 2340 C : 2017			300

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Mitra S. K. Private Limited

MSK TESTING • INSPECTION

Report No. : MSKGL/ED/2023-24/000220 **Sample No. :** MSKGL/ED/2023-24/05/01103

ANALYSIS RESULT

Chemical						
Sl No.	**Test Parameters**	**Unit**	**Test Method**	**Desirable Limit**	**Permissible**	**Result**
17	Cadmium (as Cd)	mg/l	APHA (23rd Edition)3120B 2017_(O)			<0.001
18	Lead (as Pb)	mg/l	APHA (23rd Edition) 3120 B : 2017			<0.005
19	Mercury (as Hg)	mg/l	IS 3025 (Part 48): 1994			<0.001
20	Nickel (as Nl)	mg/l	APHA (23rd Edition) 3120 B : 2017			<0.02
21	Arsenic(as As)	mg/l	APHA (23rd Edition)3120B 2017 (ICP OES)_(O)			<0.005
22	Zinc (as Zn)	mg/l	APHA (23rd Edition) 3120 B : 2017			<0.02
23	Cobalt (as Co)	mg/l	APHA (23rd Edition)3120B 2017 (ICP OES)_(O)			<0.05
24	Total Suspended Solid (as TSS)	mg/l	APHA (23rd Edition) 2540D : 2017			38
25	Temperature	Deg C	APHA 23rd EDITION,2550 B_(O)			25
26	Conductivity	us/cm	APHA (23rd Edition) 2510B: 2017			1340
27	Biochemical Oxygen Demand (as BOD)	mg/l	APHA (23rd Edition) 5210B : 2017			6.9
28	Chemical Oxygen Demand (COD)	mg/l	APHA (23rd Edition) 5220B : 2017			28
29	Oil and Grease	mg/l	APHA (23rd Edition) 5520B : 2017			<5.0
30	Salinity	None	APHA (23rd Edition)2520B, 2017_(O)			0.80 In respect to KCl equivalent salinity 35.
31	Phosphate (as PO4)	mg/l	APHA (23rd Edition) 4500- P D, 2017_(O)			2.0
32	DO	mg/l	APHA 23rd Ed. 2017-4500-O-C/G_(O)			6.0
33	Chromium as Cr	mg/l	APHA (23rd Edition)3120B 2017 (ICP OES)_(O)			<0.01

Micro Biology						
Sl No.	**Test Parameters**	**Unit**	**Test Method**	**Desirable Limit**	**Permissible**	**Result**
34	Faecal coliform	MPN/100ml	APHA 23rd Edition 9221 E_(O)			<1.8
35	Total coliform	MPN/100ml	APHA 23rd Edition 9221 B_(O)			<1.8

DL : Detection Limit BDL : Below Detection Limit

Opinion :

Report Verified By

For Mitra S. K. Private Limited

Authorised Signatory

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MSK TESTING • INSPECTION

TEST REPORT

Report No. : MSKGL/ED/2023-24/000221
Date : 03/07/2023
Sample No. : MSKGL/ED/2023-24/05/01104
Drawn/Submitted on : 18/05/2023
Reference No. & Date : Wed, Feb 15, 7:03/PM, Date - 01/05/2023

We hereby certify that the following sample drawn by us / submitted by the customer has been analyzed with the following results:

1. Description of sample (As declared by customer)	Jamnagar SW-03
2. Sample Mark (if any, given by the customer)	MSKGDM/ED/W9
3. Date of sampling	16/05/2023
4. Place of sampling	Near, Ashapura temple
5. Environmental conditions during sampling	Ambient Temperature : 31
6. Sampling Plan & Procedures used	APHA (23rd Ediition)

Report No. : MSKGL/ED/2023-24/000221 **Sample No. :** MSKGL/ED/2023-24/05/01104

ANALYSIS RESULT

Chemical

Sl No.	Test Parameters	Unit	Test Method	Desirable Limit	Permissible	Result
1	Colour	Hazen	APHA (23rd Edition) 2120B : 2017			<5.0
2	pH value	None	APHA (23rd Edition) 4500 -H-B : 2017			8.49 at 25 deg C
3	Turbidity	N.T.U.	APHA (23rd Edition) 2130B : 2017			38
4	Total Dissolved Solids (as TDS)	mg/l	APHA (23rd Edition) 2540C : 2017			7432
5	Calcium (as Ca)	mg/l	APHA (23rd Edition) 3500 Ca B,2017 (O)			23
6	Chloride (as Cl)	mg/l	APHA (23rd Edition) 4500 -Cl B : 2017			4050
7	Copper (as Cu)	mg/l	APHA (23rd Edition) 3120 B : 2017			<0.02
8	Fluoride (as F)	mg/l	APHA (23rd Edition) 4500 -F-C/D: 2017			0.28
9	Iron (as Fe)	mg/l	APHA (23rd Edition) 3500 Fe B : 2017			1.5
10	Magnesium (as Mg)	mg/l	APHA (23rd Edition) 3500 Mg B,2017 (O)			179
11	Manganese (as Mn)	mg/l	APHA (23rd Edition) 3120 B : 2017			<0.02
12	Nitrate (as NO3)	mg/l	APHA (23rd Edition) 4500 - NO3 - E : 2017			9.6
13	Phenolic Compounds (as C6H5OH)	mg/l	APHA (23rd Edition) 5530C : 2017			<0.001
14	Sulphate (as SO4)	mg/l	APHA (23rd Edition) 4500 - SO42- E : 2017			205
15	Alkalinity (as CaCO3)	mg/l	APHA (23rd Edition) 2320B 2017 (O)			528
16	Total Hardness (as CaCO3)	mg/l	APHA (23rd Edition) , 2340 C : 2017			802

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Mitra S. K. Private Limited

MSK TESTING • INSPECTION

Report No. : MSKGL/ED/2023-24/000221 **Sample No. :** MSKGL/ED/2023-24/05/01104

ANALYSIS RESULT

Chemical						
Sl No.	**Test Parameters**	**Unit**	**Test Method**	**Desirable Limit**	**Permissible**	**Result**
17	Cadmium (as Cd)	mg/l	APHA (23rd Edition)3120B 2017_(O)			<0.001
18	Lead (as Pb)	mg/l	APHA (23rd Edition) 3120 B : 2017			<0.005
19	Mercury (as Hg)	mg/l	IS 3025 (Part 48): 1994			<0.001
20	Nickel (as Ni)	mg/l	APHA (23rd Edition) 3120 B : 2017			<0.02
21	Arsenic(as As)	mg/l	APHA (23rd Edition)3120B 2017 (ICP OES) (O)			<0.005
22	Zinc (as Zn)	mg/l	APHA (23rd Edition) 3120 B : 2017			<0.02
23	Cobalt (as Co)	mg/l	APHA (23rd Edition)3120B 2017 (ICP OES) (O)			<0.05
24	Total Suspended Solid (as TSS)	mg/l	APHA (23rd Edition) 2540D : 2017			50
25	Temperature	Deg C	APHA 23rd EDITION,2550 B_(O)			25
26	Conductivity	us/cm	APHA (23rd Edition) 2510B: 2017			12170
27	Biochemical Oxygen Demand (as BOD)	mg/l	APHA (23rd Edition) 5210B : 2017			40
28	Chemical Oxygen Demand (COD)	mg/l	APHA (23rd Edition) 5220B : 2017			152
29	Oil and Grease	mg/l	APHA (23rd Edition) 5520B : 2017			<5.0
30	Salinity	None	APHA (23rd Edition)2520B, 2017_(O)			8.34 In respect to KCl equivalent salinity 35.
31	Phosphate (as PO4)	mg/l	APHA (23rd Edition) 4500- P D, 2017_(O)			0.31
32	DO	mg/l	APHA 23rd Ed. 2017-4500-O-C/G_(O)			5.8
33	Chromium as Cr	mg/l	APHA (23rd Edition)3120B 2017 (ICP OES) (O)			<0.01

Micro Biology						
Sl No.	**Test Parameters**	**Unit**	**Test Method**	**Desirable Limit**	**Permissible**	**Result**
34	Faecal coliform	MPN/100ml	APHA 23rd Edition 9221 E_(O)			<1.8
35	Total coliform	MPN/100ml	APHA 23rd Edition 9221 B_(O)			14

DL : Detection Limit BDL : Below Detection Limit

Opinion :

Report Verified By

For Mitra S. K. Private Limited

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APPENDIX 18: 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	African Comb Duck	*Sarkidiornis melanotos*	R	Least Concern	Schedule IV
2	Alexandrine Parakeet	*Palaeornis eupatria*	R	Near Threatened	Schedule IV
3	Amur Falcon	*Falco amurensis*	M	Least Concern	Schedule IV
4	Ashy Drongo	*Dicrurus leucophaeus*	M	Least Concern	Schedule IV
5	Ashy Prinia	*Prinia socialis*	R	Least Concern	Schedule IV
6	Ashy-crowned Sparrow-lark	*Eremopterix griseus*	R	Least Concern	Schedule IV
7	Asian Brown Flycatcher	*Muscicapa dauurica*	M	Least Concern	Schedule IV
8	Asian Desert Warbler	*Sylvia nana*	M	Least Concern	Schedule IV
9	Asian Dowitcher	*Limnodromus semipalmatus*	M	Near Threatened	Schedule IV
10	Asian Green Bee-eater	*Merops orientalis*	R	Least Concern	Schedule IV
11	Asian Houbara	*Chlamydotis macqueenii*	M	Vulnerable	Not Listed
12	Asian Koel	*Eudynamys scolopaceus*	R	Least Concern	Schedule IV
13	Asian Openbill	*Anastomus oscitans*	R	Least Concern	Schedule IV
14	Asian Palm-swift	*Cypsiurus balasiensis*	R	Least Concern	Schedule IV
15	Asian Plain Martin	*Riparia chinensis*	R	Least Concern	Not Listed
16	Asian Woollyneck	*Ciconia episcopus*	R	Near Threatened	Schedule IV
17	Baillon's Crake	*Zapornia pusilla*	M	Least Concern	Schedule IV
18	Bank Myna	*Acridotheres ginginianus*	R	Least Concern	Schedule IV
19	Bar-headed Goose	*Anser indicus*	M	Least Concern	Schedule IV
20	Barn Swallow	*Hirundo rustica*	M	Least Concern	Not Listed
21	Barred Buttonquail	*Turnix suscitator*	R	Least Concern	Schedule IV
22	Bar-tailed Godwit	*Limosa lapponica*	M	Near Threatened	Schedule IV
23	Baya Weaver	*Ploceus philippinus*	R	Least Concern	Schedule IV
24	Bay-backed Shrike	*Lanius vittatus*	R	Least Concern	Not Listed
25	Black Drongo	*Dicrurus macrocercus*	R	Least Concern	Schedule IV
26	Black Kite	*Milvus migrans*	R	Least Concern	Schedule II
27	Black Redstart	*Phoenicurus ochruros*	M	Least Concern	Schedule IV
28	Black Stork	*Ciconia nigra*	M	Least Concern	Schedule IV
29	Black Tern	*Chlidonias niger*	M	Least Concern	Schedule IV
30	Black-breasted Weaver	*Ploceus benghalensis*	R	Least Concern	Schedule IV
31	Black-crowned Night-heron	*Nycticorax Nycticorax*	R	Least Concern	Schedule IV
32	Black-headed Bunting	*Emberiza melanocephala*	M	Least Concern	Schedule IV
33	Black-headed Cuckooshrike	*Lalage melanoptera*	R	Least Concern	Schedule IV
34	Black-headed Gull	*Chroicocephalus ridibundus*	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
35	Black-headed Ibis	*Threskiornis melanocephalus*	R	Near Threatened	Schedule IV
36	Black-naped Monarch	*Hypothymis azurea*	R	Least Concern	Schedule IV
37	Black-necked grebe	*Podiceps nigricollis*	M	Least Concern	Schedule IV
38	Black-necked Stork	*Ephippiorhynchus asiaticus*	R	Near Threatened	Schedule IV
39	Black-tailed Godwit	*Limosa limosa*	M	Near Threatened	Schedule IV
40	Black-winged Kite	*Elanus caeruleus*	R	Least Concern	Schedule II
41	Black-winged Stilt	*Himantopus himantopus*	R	Least Concern	Schedule IV
42	Blue Rock-Thrush	*Monticola solitarius*	M	Least Concern	Schedule IV
43	Blue-cheeked Bee-eater	*Merops persicus*	R	Least Concern	Not Listed
44	Blue-tailed Bee-eater	*Merops philippinus*	M	Least Concern	Schedule IV
45	Bluethroat	*Cyanecula svecica*	M	Least Concern	Schedule IV
46	Blyth's Pipit	*Anthus godlewskii*	M	Least Concern	Schedule IV
47	Blyth's Reed Warbler	*Acrocephalus dumetorum*	M	Least Concern	Schedule IV
48	Bonelli's Eagle	*Aquila fasciata*	R	Least Concern	Schedule I
49	Booted Eagle	*Hieraaetus pennatus*	M	Least Concern	Schedule I
50	Booted Warbler	*Iduna caligata*	M	Least Concern	Schedule IV
51	Brahminy Kite	*Haliastur indus*	R	Least Concern	Schedule I
52	Brahminy Starling	*Sturnia pagodarum*	R	Least Concern	Schedule IV
53	Broad-billed Sandpiper	*Calidris falcinellus*	M	Least Concern	Schedule IV
54	Bronze-winged Jacana	*Metopidius indicus*	R	Least Concern	Schedule IV
55	Brown Crake	*Zapornia akool*	R	Least Concern	Schedule IV
56	Brown Rockchat	*Oenanthe fusca*	R	Least Concern	Schedule IV
57	Brown Shrike	*Lanius cristatus*	M	Least Concern	Not Listed
58	Brown-breasted Flycatcher	*Muscicapa muttui*	M	Least Concern	Schedule IV
59	Brown-headed Gull	*Larus brunnicephalus*	M	Least Concern	Schedule IV
60	Caspian Plover	*Charadrius asiaticus*	M	Least Concern	Schedule IV
61	Caspian Tern	*Hydroprogne caspia*	M	Least Concern	Schedule IV
62	Cattle Egret	*Bubulcus ibis*	R	Least Concern	Schedule IV
63	Chestnut-bellied Sandgrouse	*Pterocles exustus*	R	Least Concern	Schedule IV
64	Chestnut-shouldered Bush-sparrow	*Gymnoris xanthocollis*	R	Least Concern	Schedule IV
65	Chestnut-tailed Starling	*Sturnia malabarica*	M	Least Concern	Schedule IV
66	Cinnamon Bittern	*Ixobrychus cinnamomeus*	R	Least Concern	Schedule IV
67	Citrine Wagtail	*Motacilla citreola*	M	Least Concern	Schedule IV
68	Clamorous Reed Warbler	*Acrocephalus stentoreus*	R	Least Concern	Schedule IV
69	Collared Pratincole	*Glareola pratincola*	R	Least Concern	Not Listed
70	Collared Sand Martin	*Riparia riparia*	M	Least Concern	Not Listed

S.N.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
71	Common Babbler	*Argya caudata*	R	Least Concern	Schedule IV
72	Common Chiffchaff	*Phylloscopus collybita*	M	Least Concern	Schedule IV
73	Common Coot	*Fulica atra*	M	Least Concern	Schedule IV
74	Common Crane	*Grus grus*	M	Least Concern	Schedule IV
75	Common Cuckoo	*Cuculus canorus*	R	Least Concern	Schedule IV
76	Common Greenshank	*Tringa nebularia*	M	Least Concern	Schedule IV
77	Common Gull-billed Tern	*Gelochelidon nilotica*	M	Least Concern	Schedule IV
78	Common Hawk-cuckoo	*Hierococcyx varius*	R	Least Concern	Schedule IV
79	Common Hoopoe	*Upupa epops*	R	Least Concern	Not Listed
80	Common Iora	*Aegithina tiphia*	R	Least Concern	Schedule IV
81	Common Kestrel	*Falco tinnunculus*	M	Least Concern	Schedule IV
82	Common Kingfisher	*Alcedo atthis*	R	Least Concern	Schedule IV
83	Common Moorhen	*Gallinula chloropus*	R	Least Concern	Schedule IV
84	Common Myna	*Acridotheres tristis*	R	Least Concern	Schedule IV
85	Common Pochard	*Aythya ferina*	M	Vulnerable	Schedule IV
86	Common Quail	*Coturnix coturnix*	M	Least Concern	Schedule IV
87	Common Redshank	*Tringa totanus*	M	Least Concern	Schedule IV
88	Common Ringed Plover	*Charadrius hiaticula*	M	Least Concern	Schedule IV
89	Common Rosefinch	*Carpodacus erythrinus*	M	Least Concern	Schedule IV
90	Common Sandpiper	*Actitis hypoleucos*	M	Least Concern	Schedule IV
91	Common Shelduck	*Tadorna tadorna*	M	Least Concern	Schedule IV
92	Common Snipe	*Gallinago gallinago*	M	Least Concern	Schedule IV
93	Common Tailorbird	*Orthotomus sutorius*	R	Least Concern	Schedule IV
94	Common Teal	*Anas crecca*	M	Least Concern	Schedule IV
95	Common Tern	*Sterna hirundo*	M	Least Concern	Schedule IV
96	Common Woodshrike	*Tephrodornis pondicerianus*	R	Least Concern	Schedule IV
97	Coppersmith Barbet	*Psilopogon haemacephalus*	R	Least Concern	Schedule IV
98	Cotton Pygmy-goose	*Nettapus coromandelianus*	R	Least Concern	Schedule IV
99	Crab-Plover	*Dromas ardeola*	M	Least Concern	Not Listed
100	Crested Lark	*Galerida cristata*	R	Least Concern	Schedule IV
101	Crested Serpent-Eagle	*Spilornis cheela*	M	Least Concern	Schedule I
102	Curlew Sandpiper	*Calidris ferruginea*	M	Near Threatened	Schedule IV
103	Dalmatian Pelican	*Pelecanus crispus*	M	Near Threatened	Schedule IV
104	Delicate Prinia	*Prinia lepida*	--	Not Assessed	Not Listed
105	Demoiselle Crane	*Grus virgo*	M	Least Concern	Schedule IV
106	Desert Wheatear	*Oenanthe deserti*	M	Least Concern	Schedule IV
107	Dunlin	*Calidris alpina*	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
108	Dusky Crag-Martin	*Ptyonoprogne concolor*	R	Least Concern	Not Listed
109	Eastern Orphean Warbler	*Sylvia crassirostris*	M	Least Concern	Schedule IV
110	Eurasian Buzzard	*Buteo buteo*	M	Least Concern	Schedule I
111	Eurasian Collared-Dove	*Streptopelia decaocto*	R	Least Concern	Schedule IV
112	Eurasian Curlew	*Numenius arquata*	M	Near Threatened	Schedule IV
113	Eurasian Hobby	*Falco subbuteo*	M	Least Concern	Schedule IV
114	Eurasian Oystercatcher	*Haematopus ostralegus*	M	Near Threatened	Schedule IV
115	Eurasian Sparrowhawk	*Accipiter nisus*	M	Least Concern	Schedule I
116	Eurasian Spoonbill	*Platalea leucorodia*	R	Least Concern	Schedule I
117	Eurasian Wigeon	*Mareca penelope*	M	Least Concern	Schedule IV
118	Eurasian Wryneck	*Jynx torquilla*	M	Least Concern	Schedule IV
119	European Roller	*Coracias garrulus*	M	Least Concern	Schedule IV
120	Falcated Duck	*Mareca falcata*	M	Near Threatened	Schedule IV
121	Ferruginous Duck	*Aythya nyroca*	M	Near Threatened	Schedule IV
122	Forest Wagtail	*Dendronanthus indicus*	M	Least Concern	Schedule IV
123	Gadwall	*Mareca strepera*	M	Least Concern	Schedule IV
124	Garganey	*Spatula querquedula*	M	Least Concern	Schedule IV
125	Glossy Ibis	*Plegadis falcinellus*	M	Least Concern	Schedule IV
126	Great Cormorant	*Phalacrocorax carbo*	R	Least Concern	Schedule IV
127	Great Crested Grebe	*Podiceps cristatus*	R	Least Concern	Schedule IV
128	Great Egret	*Ardea alba*	R	Least Concern	Schedule IV
129	Great Grey Shrike	*Lanius excubitor*	R	Least Concern	Not Listed
130	Great Knot	*Calidris tenuirostris*	M	Endangered	Schedule IV
131	Great Thick-Knee	*Esacus recurvirostris*	R	Near Threatened	Schedule IV
132	Great White Pelican	*Pelecanus onocrotalus*	R	Least Concern	Schedule IV
133	Greater Coucal	*Centropus sinensis*	R	Least Concern	Schedule IV
134	Greater Flamingo	*Phoenicopterus roseus*	R	Least Concern	Schedule IV
135	Greater Painted snipe	*Rostratula benghalensis*	R	Least Concern	Not Listed
136	Greater Sand-Plover	*Charadrius leschenaultii*	M	Least Concern	Schedule IV
137	Greater Short-toed Lark	*Calandrella brachydactyla*	M	Least Concern	Schedule IV
138	Greater Spotted Eagle	*Clanga clanga*	M	Vulnerable	Schedule I
139	Green Sandpiper	*Tringa ochropus*	M	Least Concern	Schedule IV
140	Green Warbler	*Phylloscopus nitidus*	M	Least Concern	Schedule IV
141	Greenish Warbler	*Phylloscopus trochiloides*	M	Least Concern	Schedule IV
142	Grey Francolin	*Francolinus pondicerianus*	R	Least Concern	Schedule IV
143	Grey Heron	*Ardea cinerea*	R	Least Concern	Schedule IV
144	Grey Plover	*Pluvialis squatarola*	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
145	Grey Wagtail	*Motacilla cinerea*	M	Least Concern	Schedule IV
146	Grey-bellied Cuckoo	*Cacomantis passerinus*	R	Least Concern	Schedule IV
147	Grey-breasted Prinia	*Prinia hodgsonii*	R	Least Concern	Schedule IV
148	Grey-headed Canary-flycatcher	*Culicicapa ceylonensis*	M	Least Concern	Schedule IV
149	Greylag Goose	*Anser anser*	M	Least Concern	Schedule IV
150	Grey-necked Bunting	*Emberiza buchanani*	M	Least Concern	Schedule IV
151	House Crow	*Corvus splendens*	R	Least Concern	Schedule V
152	House Sparrow	*Passer domesticus*	R	Least Concern	Schedule IV
153	Hume's Leaf-warbler	*Phylloscopus humei*	M	Least Concern	Schedule IV
154	Hypocolius	*Hypocolius ampelinus*	M	Least Concern	Not Listed
155	Indian Bushlark	*Mirafra erythroptera*	R	Least Concern	Schedule IV
156	Indian Cormorant	*Phalacrocorax fuscicollis*	R	Least Concern	Schedule IV
157	Indian Courser	*Cursorius coromandelicus*	R	Least Concern	Schedule IV
158	Indian Golden Oriole	*Oriolus kundoo*	M	Least Concern	Schedule IV
159	Indian Grey Hornbill	*Ocyceros birostris*	R	Least Concern	Schedule I
160	Indian Nightjar	*Caprimulgus asiaticus*	R	Least Concern	Schedule IV
161	Indian Paradise-flycatcher	*Terpsiphone paradisi*	M	Least Concern	Schedule IV
162	Indian Peafowl	*Pavo cristatus*	R	Least Concern	Schedule I
163	Indian Pond Heron	*Ardeola grayii*	R	Least Concern	Schedule IV
164	Indian Robin	*Saxicoloides fulicata*	R	Least Concern	Schedule IV
165	Indian Roller	*Coracias benghalensis*	R	Least Concern	Schedule IV
166	Indian Scops-owl	*Otus bakkamoena*	R	Least Concern	Schedule IV
167	Indian Silverbill	*Euodice malabarica*	R	Least Concern	Schedule IV
168	Indian Skimmer	*Rynchops albicollis*	R	Endangered	Not Listed
169	Indian Spot-billed Duck	*Anas poecilorhyncha*	R	Least Concern	Schedule IV
170	Indian Spotted Eagle	*Clanga hastata*	R	Vulnerable	Not Listed
171	Indian Thick-knee	*Burhinus indicus*	R	Least Concern	Not Listed
172	Indian White-eye	*Zosterops palpebrosus*	R	Least Concern	Schedule IV
173	Intermediate Egret	*Ardea intermedia*	R	Least Concern	Schedule IV
174	Isabelline Shrike	*Lanius isabellinus*	M	Least Concern	Not Listed
175	Isabelline Wheatear	*Oenanthe isabellina*	M	Least Concern	Schedule IV
176	Jack Snipe	*Lymnocryptes minimus*	M	Least Concern	Schedule IV
177	Jungle Babbler	*Turdoides striatus*	R	Least Concern	Schedule IV
178	Jungle Prinia	*Prinia sylvatica*	R	Least Concern	Schedule IV
179	Kentish Plover	*Charadrius alexandrinus*	M	Least Concern	Schedule IV
180	Large Grey Babbler	*Argya malcolmi*	R	Least Concern	Schedule IV
181	Large-billed Crow	*Corvus macrorhynchos*	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
182	Laughing Dove	*Streptopelia senegalensis*	R	Least Concern	Schedule IV
183	Lesser Black-backed Gull	*Larus fuscus*	M	Least Concern	Schedule IV
184	Lesser Crested Tern	*Thalasseus bengalensis*	M	Least Concern	Schedule IV
185	Lesser Flamingo	*Phoeniconaias minor*	R	Near Threatened	Schedule IV
186	Lesser Sand-Plover	*Charadrius mongolus*	M	Least Concern	Schedule IV
187	Lesser Whistling-duck	*Dendrocygna javanica*	R	Least Concern	Schedule IV
188	Lesser Whitethroat	*Sylvia curruca*	M	Least Concern	Schedule IV
189	Little Cormorant	*Microcarbo niger*	R	Least Concern	Schedule IV
190	Little Crake	*Zapornia parva*	M	Least Concern	Schedule IV
191	Little Egret	*Egretta garzetta*	R	Least Concern	Schedule IV
192	Little Grebe	*Tachybaptus ruficollis*	R	Least Concern	Schedule IV
193	Little Pratincole	*Glareola lactea*	R	Least Concern	Not Listed
194	Little Ringed Plover	*Charadrius dubius*	R	Least Concern	Schedule IV
195	Little Stint	*Calidris minuta*	M	Least Concern	Schedule IV
196	Little Swift	*Apus affinis*	R	Least Concern	Not Listed
197	Little Tern	*Sternula albifrons*	R	Least Concern	Schedule IV
198	Long-billed Pipit	*Anthus similis*	M	Least Concern	Schedule IV
199	Long-legged Buzzard	*Buteo rufinus*	M	Least Concern	Schedule I
200	Long-tailed Shrike	*Lanius schach*	R	Least Concern	Not Listed
201	Mallard	*Anas platyrhynchos*	M	Least Concern	Schedule IV
202	Marsh Sandpiper	*Tringa stagnatilis*	M	Least Concern	Schedule IV
203	Montagu's Harrier	*Circus pygargus*	M	Least Concern	Schedule I
204	Moustached Warbler	*Acrocephalus melanopogon*	M	Least Concern	Schedule IV
205	Mute Swan	*Cygnus olor*	M	Least Concern	Schedule IV
206	Namaqua Dove	*Oena capensis*	M	Least Concern	Not Listed
207	Northern Pintail	*Anas acuta*	M	Least Concern	Schedule IV
208	Northern Shoveler	*Spatula clypeata*	M	Least Concern	Schedule IV
209	Oriental Darter	*Anhinga melanogaster*	R	Near Threatened	Schedule IV
210	Oriental Honey-buzzard	*Pernis ptilorhynchus*	R	Least Concern	Schedule II
211	Oriental Magpie-Robin	*Copsychus saularis*	R	Least Concern	Schedule IV
212	Oriental Skylark	*Alauda gulgula*	R	Least Concern	Schedule IV
213	Osprey	*Pandion haliaetus*	M	Least Concern	Schedule I
214	Pacific Golden-Plover	*Pluvialis fulva*	M	Least Concern	Schedule IV
215	Paddyfield Pipit	*Anthus rufulus*	R	Least Concern	Schedule IV
216	Paddyfield Warbler	*Acrocephalus agricola*	M	Least Concern	Schedule IV
217	Painted Francolin	*Francolinus pictus*	R	Least Concern	Schedule IV
218	Painted Sandgrouse	*Pterocles 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
219	Painted Stork	*Mycteria leucocephala*	R	Near Threatened	Schedule IV
220	Pale Sand Martin	*Riparia diluta*	M	Least Concern	Not Listed
221	Pallas's Gull	*Larus ichthyaetus*	M	Least Concern	Schedule IV
222	Pallid Harrier	*Circus macrourus*	M	Near Threatened	Schedule I
223	Pallid Scops-Owl	*Otus brucei*	M	Least Concern	Schedule IV
224	Peregrine Falcon	*Falco peregrinus*	R	Least Concern	Schedule I
225	Pheasant-tailed Jacana	*Hydrophasianus chirurgus*	R	Least Concern	Schedule IV
226	Pied Avocet	*Recurvirostra avosetta*	M	Least Concern	Schedule IV
227	Pied Bushchat	*Saxicola caprata*	R	Least Concern	Schedule IV
228	Jacobin Cuckoo	*Clamator jacobinus*	R	Least Concern	Schedule IV
229	Pied Kingfisher	*Ceryle rudis*	R	Least Concern	Schedule IV
230	Pintail Snipe	*Gallinago stenura*	M	Least Concern	Schedule IV
231	Plain Prinia	*Prinia inornata*	R	Least Concern	Schedule IV
232	Plum-headed Parakeet	*Psittacula cyanocephala*	R	Least Concern	Schedule IV
233	Pomarine Jaeger	*Stercorarius pomarinus*	M	Least Concern	Not Listed
234	Purple Heron	*Ardea purpurea*	R	Least Concern	Schedule IV
235	Purple Sunbird	*Nectarinia asiatica*	R	Least Concern	Schedule IV
236	Purple Swamphen	*Porphyrio porphyrio*	R	Least Concern	Schedule IV
237	Rain Quail	*Coturnix coromandelica*	R	Least Concern	Schedule IV
238	Red Avadavat	*Amandava amandava*	R	Least Concern	Schedule IV
239	Red Collared-Dove	*Streptopelia tranquebarica*	R	Least Concern	Schedule IV
240	Red Knot	*Calidris canutus*	M	Near Threatened	Schedule IV
241	Red-backed Shrike	*Lanius collurio*	M	Least Concern	Not Listed
242	Red-breasted Flycatcher	*Ficedula parva*	M	Least Concern	Schedule IV
243	Red-crested Pochard	*Netta rufina*	M	Least Concern	Schedule IV
244	Red-headed Bunting	*Emberiza bruniceps*	M	Least Concern	Schedule IV
245	Red-naped Ibis	*Pseudibis papillosa*	R	Least Concern	Schedule IV
246	Red-necked Falcon	*Falco ruficollis*	M	Least Concern	Schedule I
247	Red-necked Phalarope	*Phalaropus lobatus*	M	Least Concern	Not Listed
248	Red-rumped Swallow	*Cecropis daurica*	R	Least Concern	Schedule IV
249	Red-tailed Shrike	*Lanius phoenicuroides*	M	Least Concern	Not Listed
250	Red-throated Flycatcher	*Ficedula albicilla*	M	Least Concern	Schedule IV
251	Red-vented Bulbul	*Pycnonotus cafer*	R	Least Concern	Schedule IV
252	Red-wattled Lapwing	*Vanellus indicus*	R	Least Concern	Schedule IV
253	Richard's Pipit	*Anthus richardi*	M	Least Concern	Schedule IV
254	River Tern	*Sterna aurantia*	R	Vulnerable	Schedule IV
255	Rock Bush-Quail	*Perdicula argoondah*	R	Least Concern	Schedule IV

S.N.	Common English Name	Binomial Scientific Name	Migrant (M) / Resident (R)	IUCN Red List - Categories	Wildlife (Protection) Act - Schedules
256	Rock Dove	*Columba livia*	R	Least Concern	Schedule IV
257	Rose-ringed Parakeet	*Psittacula krameri*	R	Least Concern	Schedule IV
258	Rosy Starling	*Pastor roseus*	M	Least Concern	Schedule IV
259	Ruddy Shelduck	*Tadorna ferruginea*	M	Least Concern	Schedule IV
260	Ruddy Turnstone	*Arenaria interpres*	M	Least Concern	Schedule IV
261	Ruff	*Calidris pugnax*	M	Least Concern	Schedule IV
262	Rufous Treepie	*Dendrocitta vagabunda*	R	Least Concern	Schedule IV
263	Rufous-fronted Prinia	*Prinia buchanani*	R	Least Concern	Schedule IV
264	Rufous-tailed Lark	*Ammomanes phoenicura*	R	Least Concern	Schedule IV
265	Sand Lark	*Alaudala raytal*	R	Least Concern	Schedule IV
266	Sanderling	*Calidris alba*	M	Least Concern	Schedule IV
267	Sandwich Tern	*Thalasseus sandvicensis*	M	Least Concern	Schedule IV
268	Sarus Crane	*Antigone antigone*	R	Vulnerable	Schedule IV
269	Saunders's Tern	*Sternula saundersi*	M	Least Concern	Schedule IV
270	Scaly-breasted Munia	*Lonchura punctulata*	R	Least Concern	Schedule IV
271	Shikra	*Accipiter badius*	R	Least Concern	Schedule I
272	Short-eared Owl	*Asio flammeus*	M	Least Concern	Schedule IV
273	Short-toed Snake-Eagle	*Circaetus gallicus*	R	Least Concern	Schedule I
274	Siberian Stonechat	*Saxicola maurus*	M	Not Listed	Schedule IV
275	Sirkeer Malkoha	*Taccocua leschenaultii*	R	Least Concern	Schedule IV
276	Slender-billed Gull	*Larus genei*	R	Least Concern	Schedule IV
277	Small Minivet	*Pericrocotus cinnamomeus*	R	Least Concern	Schedule IV
278	Spotted Crake	*Porzana porzana*	M	Least Concern	Schedule IV
279	Spotted Flycatcher	*Muscicapa striata*	M	Least Concern	Schedule IV
280	Spotted Owlet	*Athene brama*	R	Least Concern	Schedule IV
281	Spotted Redshank	*Tringa erythropus*	M	Least Concern	Schedule IV
282	Steppe Eagle	*Aquila nipalensis*	M	Endangered	Schedule I
283	Streaked Weaver	*Ploceus manyar*	R	Least Concern	Schedule IV
284	Streak-throated Swallow	*Petrochelidon fluvicola*	R	Least Concern	Schedule IV
285	Striated Heron	*Butorides striata*	M	Least Concern	Schedule IV
286	Striolated Bunting	*Emberiza striolata*	R	Least Concern	Schedule IV
287	Sulphur-bellied Warbler	*Phylloscopus griseolus*	M	Least Concern	Not Listed
288	Sykes's Lark	*Galerida deva*	R	Least Concern	Schedule IV
289	Sykes's Nightjar	*Caprimulgus mahrattensis*	M	Least Concern	Schedule IV
290	Sykes's Warbler	*Iduna rama*	M	Least Concern	Not Listed
291	Tawny Pipit	*Anthus campestris*	M	Least Concern	Schedule IV
292	Temminck's Stint	*Calidris temminckii*	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
293	Terek Sandpiper	*Xenus cinereus*	M	Least Concern	Schedule IV
294	Tickell's Blue Flycatcher	*Cyornis tickelliae*	R	Least Concern	Schedule IV
295	Tree Pipit	*Anthus trivialis*	M	Least Concern	Schedule IV
296	Tufted Duck	*Aythya fuligula*	M	Least Concern	Schedule IV
297	Ultramarine Flycatcher	*Ficedula superciliaris*	M	Least Concern	Schedule IV
298	Variable Wheatear	*Oenanthe picata*	M	Least Concern	Schedule IV
299	Western Crowned Leaf-warbler	*Phylloscopus occipitalis*	M	Least Concern	Schedule IV
300	Western Marsh-Harrier	*Circus aeruginosus*	M	Least Concern	Schedule I
301	Western Reef-Egret	*Egretta gularis*	R	Least Concern	Schedule IV
302	Western Water Rail	*Rallus aquaticus*	M	Least Concern	Schedule IV
303	Western Yellow Wagtail	*Motacilla flava*	M	Least Concern	Schedule IV
304	Whimbrel	*Numenius phaeopus*	M	Least Concern	Schedule IV
305	Whiskered Tern	*Chlidonias hybrida*	R	Least Concern	Schedule IV
306	White stork	*Ciconia ciconia*	M	Least Concern	Schedule IV
307	White Wagtail	*Motacilla alba*	M	Least Concern	Schedule IV
308	White-bellied Drongo	*Dicrurus caerulescens*	R	Least Concern	Schedule IV
309	White-breasted Kingfisher	*Halcyon smyrnensis*	R	Least Concern	Schedule IV
310	White-breasted Waterhen	*Amaurornis phoenicurus*	R	Least Concern	Schedule IV
311	White-browed Fantail	*Rhipidura aureola*	R	Least Concern	Schedule IV
312	White-browed Wagtail	*Motacilla maderaspatensis*	R	Least Concern	Schedule IV
313	White-eared Bulbul	*Pycnonotus leucotis*	R	Least Concern	Schedule IV
314	White-eyed Buzzard	*Butastur teesa*	R	Least Concern	Schedule I
315	White-tailed Iora	*Marshall's Iora*	R	Least Concern	Schedule IV
316	White-tailed Lapwing	*Vanellus leucurus*	M	Least Concern	Schedule IV
317	White-Winged Tern	*Chlidonias leucopterus*	M	Least Concern	Schedule IV
318	Wire-tailed Swallow	*Hirundo smithii*	R	Least Concern	Not Listed
319	Wood Sandpiper	*Tringa glareola*	M	Least Concern	Schedule IV
320	Yellow Bittern	*Ixobrychus sinensis*	R	Least Concern	Schedule IV
321	Yellow-crowned Woodpecker	*Leiopicus mahrattensis*	R	Least Concern	Schedule IV
322	Yellow-eyed Babbler	*Chrysomma sinense*	R	Least Concern	Schedule IV
323	Yellow-footed Green-Pigeon	*Treron phoenicopterus*	R	Least Concern	Schedule IV
324	Yellow-wattled Lapwing	*Vanellus malabaricus*	R	Least Concern	Schedule IV
325	Zitting Cisticola	*Cisticola juncidis*	R	Least Concern	Schedule IV

APPENDIX 19: STATUS OF PERMITS

S. No	Applicable Policies and Regulations	Institution Responsible	Applicability/Coverage	Recommendation
Project – Waste to energy plant				
1.	The Environmental (Protection) Act 1986; EIA Notification 2006	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 7.5 MW and MSW is being used as fuel for the boiler, therefore, environmental clearance is not applicable to the project	Nil
2.	Consent to Operate (CTO) under the air (Prevention and control of pollution) Act 1981 (the Air Act 1981) the water (Prevention and control of pollution) Act, 1974 (the Water Act, 1974)	Gujarat Pollution Control Board	*Applicable* The project has received Consolidated Consent and Authorization (CCA) under Air Act, 1981, Water Act 1974 and Hazardous and other waste (Management & Transboundary Movement Rules) 2016 dated 23.06.2022 valid till 03.04.2027. According to the condition of the CCA under Air Act 1981, the stack height of the ~38 TPH boiler should be 45 m. However, based on review of documents such as stack emission monitoring report and details of boiler shared by Client, the stack height of the boiler has been reported to be 40m, which is non-compliance to the condition of the CCA. Though, the project has received NOC from Ministry of Defence dated 11.03.2020 for stack height of 40 m, however, the stack height of the WTE plant remains non-compliant to the CTE. Based on discussion with GWJPL, it is understood that GWJPL has made a request to GPCB to amend the height of boiler from 45 m to 40 m Additionally, as per the General Condition of the CCA, the project is required to conduct environmental audit annually and submit environmental statement pertaining to previous year to GPCB by 30th September every year. Since the Project is operational since November 2021 and the CCA has been obtained on 23.06.2022, the project was required to share their first environmental statement on 30th September 2022. However, as reported by project team, the project will submit its first environment statement to CPCB by September 2023 which is non-compliance to the General Conditions of the CCA	• GWJPL should ensure that the CCA is amended with stack height of 40 m in line with the application shared to GPCB for amendment of CCA and NOC received from Ministry of Defence on stack height of boiler • GWJPL should conduct environmental audit annually and submit environmental statement pertaining to previous year to GPCB by 30th September every year in compliance to the CCA. GWJPL should ensure to file its first environmental statement by 30th September 2023.

S. No	Applicable Policies and Regulations	Institution Responsible	Applicability/Coverage	Recommendation
3.	Hazardous and other waste (Management & Transboundary Movement Rules) 2016 as amended		*Applicable* The project has received Consolidated Consent and Authorization (CCA) under Air Act, 1981, Water Act 1974 and Hazardous and other waste (Management & Transboundary Movement Rules) 2016 dated 23.06.2022 valid till 03.04.2027. As per the conditions under and Hazardous and other waste (Management & Transboundary Movement Rules) 2016, the project is required to display online data outside the main factory gate with regard to quantity and nature of hazardous chemicals being handled in the plant including wastewater and air emission and solid hazardous waste generated within the factory premises. However, the same was not observed to be displayed at the project entry gate or any other designated area during site visit in March 2023. However, GWJPL has displayed the above details outside the main factory gate since July 2023, therefore it is compliant to the conditions of the CCA. Additionally, as reported by site team during site visit in March 2023, the hazardous waste had been stored at site for more than one year which was a noncompliance to the hazardous waste rules, 2016.Although, GWJPL has identified authorised hazardous waste recycler i.e., M/s Saurashtra Enviro Projects Private Limited[99] and M/s Aztec recycling Hub Private Limited[100] for disposal of hazardous waste. Current Status: GWJPL disposed its hazardous waste to Aztec recycling hub private limited as per the vendor's scope of work on 29.04.2023. The hazardous waste manifest was shared by GWJPL for review.	Nil
4.	NOC for Ground water Abstraction	Central Groundwater Authority	*Applicable* GWJPL has obtained No Objection Certificate (NOC) from CGWA on 14.09.2022 valid up to 13.09.2025. 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, it was observed that project is abstracting 7.5 KLD water from the borewell for domestic purpose only which is in compliance to the NOC obtained.	Nil

[99] For disposal of spent ion exchange resins and sludge as per CCA

[100] For waste recycling service for the following

- Hazardous waste management Cat.33.1 for Decontamination of Drums and Barrels under License No - WH – 42637
- Hazardous waste management Cat.5.1 for Refining of used oil under License no – AWH-11974
- Waste recovery service under certification no - WH-42637

S. No	Applicable Policies and Regulations	Institution Responsible	Applicability/Coverage	Recommendation
5.	Permission for procuring treated water from JMC STP	Solid Waste Management Department, Jamnagar Municipal Corporation	*Applicable* GWJPL has obtained No Objection Certificate from JMC dated 15.01.2019 to procure 1 MLD secondary treated water from 70 MLD STP located 60 m (aerial distance) from the project boundary for meeting water requirement for industrial purpose. GWJPL has also obtained permission to lay underground pipeline of length 324 m connecting the STP to the Project's pump house. In addition to the above, GWJPL has also obtained permission from JMC dated 19.09.2022 to return excess STP water (if any) for further treatment back to the STP during project lifecycle.	Nil
6.	Boiler Certificate under Boilers Act, 1923	Gujarat Boiler Inspection Department	*Applicable* GWJPL has obtained boiler certificate as per Form IV under Boilers Act, 1923 from Gujarat Boiler Inspection Department dated 04.10.2022 valid up to 03.10.2023 to be worked at a Maximum Pressure of 51.00 kg/cm^2(g).	Nil
7.	Fire NOC	Fire and Emergency Services, Jamnagar Municipal Corporation	*Applicable* GWJPL has received fire NOC from Chief Fire Officer of Fire and Emergency Services, Jamnagar Municipal Corporation dated 17.04.2022 after review of the fire equipment installed within the project premises. Based on review of documents, it is understood that GWJPL has shared proposal for firefighting scheme with Chief Fire Officer, JMC dated 02.05.2019 describing fire hydrant system to be installed at the project premises. Based on review of the proposal and subsequent verification by Fire Brigade Officer on 26.03.2021, Final Fire NOC was granted on 31.03.2021. The fire NOC was renewed on 17.04.2022. According to the notification of Directorate of State Fire Prevention Service, Government of Gujarat dated 12.01.2022, the validity of all new fire safety certificates issued after 12.01.2022 shall be considered to be for 3 years and the validity of renewal fire safety certificates shall be considered for 2 years. Based on the above notification, the validity of GWJPL's fire NOC is for 2 years from the date of issue.	Nil
8.	Forest Clearance under The Forest (Conservation) Act, 1980 Wildlife Clearance under the Wildlife (Protection)Act, 1972		*Not Applicable* Since there are no protected areas such as national parks, wildlife sanctuaries, biosphere reserved within 5 km of the project area and only eco sensitive zone (ESZ) of marine national park is falling 5 km away from project, therefore forest clearance and wildlife clearance is not applicable to the project.	Nil
9.	Factories license as per the Section 6 of the Factories Act, 1948	Directorate Industrial Safety and	Applicable	Nil

S. No	Applicable Policies and Regulations	Institution Responsible	Applicability/Coverage	Recommendation
		Health, Gujarat State	GWJPL has obtained the factories license vide the license number – 43805 dated 22.03.2021 As per the license, the maximum number of workers to be employed on any days during the year is 250. The Project is in the compliance with the requirement of maximum number of workers (refer to section 2.13 for more details on number of workers employed at the Project).	
10.	Principle Employers' Registration as per the section 7 of the Contract Labour (Regulation and Abolition) Act, 1970	Assistant Labour Commissioner Office	Applicable GWJPL has obtained the principal employer license with the registration number JMN/2019/CLRA/4. Upon reviewing the principal labour license, it has been found that only two (2) contractors out of the total four (4) appointed contactor at the Project are included in the license: 1. J.G. Services and 2. Aditya Security Services. However, the other two (2) contractor, namely M/s Vijay Singh and M/s Aditya Enterprises, have not been included in the license. However, to rectify the non-compliance, after the site visit of service provider, GWJPL has submitted the application to update the principal labour license	GWJPL shall follow up with appropriate department to timely issue the updated license.
11.	Contract Labour License under the Contract Labour (Regulation & Abolition) Act 1970 And	Assistant Labour Commissioner Office	Applicable for J.G. Services J.G. services have obtained the contract labour license with the license number CLRA/License/CLRA/JMN/2022/CLL/35 dated 09.01.2023 Not Applicable for M/s Aditya Security Services, M/s Vijay Singh, and M/s Aditya Enterprises The number of personnel employed by each above-mentioned contractor are below 20. Therefore, as per the section 4 of the Act, the contractor labour license is not applicable on above mentioned contractors.	Nil
12.	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	Office of the licensing officer, Government of India	Not Applicable As per the consultation with workers, the appointed contractual workers do not fall under the definition of Inter-state migrant workmen[101] provided by Section 2(e) of the Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1979.	Nil

[101] 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

S. No	Applicable Policies and Regulations	Institution Responsible	Applicability/Coverage	Recommendation
	Conditions Of Service) Act, 1979			
13.	The Child Labour (Prohibition and Regulation) Amendment Act, 2016	Labour Commissioner Office	Applicable The project has not employed any child labour, as observed through consultations with workers and 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 such practise to ensure ongoing compliance with applicable laws and regulations related to labour and child protection.	Nil
14.	The Bonded Labour System (Abolition) Act, 1976	Labour commissioner Office	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.	
15.	The Minimum Wages Act, 1948	Labour commissioner office	Applicable	

<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>It has been confirmed through consultation and a review of the wage register that all workers at the project are receiving wages equivalent to the minimum wages prescribed by the Gujarat state notification[102].
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</td><td>Earthmover's driver</td><td>18,000/month and 692.3/day</td><td>Skilled</td><td>474</td></tr>
<tr><td>Workers</td><td>Worker involved in waste handling</td><td>10,000/month and 384.6/day</td><td>Unskilled</td><td>363</td></tr>
</table></td><td></td></tr>
<tr><td>16.</td><td>Registration under the Private security Agencies (Regulation) Act, 2005</td><td>Department of Police</td><td>Applicable
The PSARA license (15101811/Jamnagar) obtained by M/s Aditya Security Services for providing security at the plant and the license is valid till 06.10.2025.</td><td>Nil</td></tr>
<tr><td>17.</td><td>Registration under the Employees' Provident Funds and Miscellaneous Provisions Act, 1952</td><td>Employees' Provident Fund Organisation</td><td>Applicable
The project has appointed four (4) contractors, the details of applicability and status of registration of each contractor is provided below:
<table>
<tr><th>Contractor/Project SPV</th><th>Applicability</th><th>Status</th></tr>
<tr><td>JG Services</td><td>The Act is applicable on the contractor</td><td>Obtained the registration and the establishment code of the contractor is GJAHD0052506000</td></tr>
</table></td><td>GWJPL shall ensure that all the employed workers shall receive benefits as per the Employees' Provident Funds and Miscellaneous Provisions Act, 1952.</td></tr>
</table>

[102] https://col.gujarat.gov.in/circular.htm (Accessed on July 28, 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></td><td></td><td></td><td>
<table>
<tr><td>Aditya Security Services</td><td>The Act is applicable on the contractor</td><td>Obtained the registration and the establishment code of the contractor is GJRAJ1044637000</td></tr>
<tr><td>Vijay Singh</td><td>The contractor has employed seven (7) workers, thus, per the section 1(3) of the Act, the registration is not applicable on the contractor</td><td>Not Applicable</td></tr>
<tr><td>Aditya Enterprises</td><td>The contractor has employed six (6) workers, thus, per the section 1(3) of the Act, the registration is not applicable on the contractor</td><td>Not Applicable</td></tr>
</table>
</td><td></td></tr>
<tr><td>18.</td><td>Registration under the Employees' State Insurance Act, 1948</td><td>Employees' State Insurance Corporation</td><td>Applicable
The project has appointed four (4) contractors, the details of applicability and status of registration of each contractor is provided below:
<table>
<tr><th>Contractor</th><th>Applicability</th><th>Status</th></tr>
<tr><td>JG Services</td><td>The Act is applicable on the contractor</td><td>Obtained the registration and the employer code of the contractor is 37001048050001099</td></tr>
</table>
</td><td>GWJPL shall ensure that M/s Vijay Singh and M/s Aditya Enterprises shall obtained the registration under the Employees' State Insurance Act, 1948.</td></tr>
</table>

S. No	Applicable Policies and Regulations	Institution Responsible	Applicability/Coverage			Recommendation
			Aditya Security Services	The Act is applicable on the contractor	Obtained the registration and the employer code of the contractor is 7001301610001099	
			Aditya Enterprises	The Act is applicable on the Contractor	The contractor has obtained the registration vide registration number 37001496730001099. The registration has been obtained after the site visit of service provider	

APPENDIX 20: CEMS DATA

Industry Dashboard	
Industry Name	Goodwatts Wte Jamnagar Pvt Ltd
Category	Others
Address	Rameshwar Nagar
Station Name	Horiba
Emission	CEMS
From	05-Jun-2023 00:00:00
To	06-Jul-2023 23:59:59
Interval	30 Minutes

Scan Timestamp	CO (mg/Nm3)	CO2 (%)	HCL (mg/Nm3)	NOX (mg/Nm3)	O2 (%)	Pressure (mmWC)	SO2 (mg/Nm3)	SPM (mg/Nm3)	TEMP (Deg.C)	Operator Remarks
05-Jun-2023 06:00:00	6.34	7.52	100.12	78.4	11.8	3.17	18.04	14.08	119.31	Boiler in lightup
05-Jun-2023 07:00:00	6.9	8.4	21.68	79.54	10.91	2.1	26.35	7.09	123.05	Connectivity issue resolve
05-Jun-2023 07:30:00	7.8	10.05	28.12	79.28	9.55	1.75	30.93	5.19	124.62	
05-Jun-2023 08:00:00	7.31	8.92	30.06	79.89	10.59	2.08	27.31	7.92	126.97	

05-Jun-2023 08:30:00	7.72	9.71	36.38	83.52	9.77	2.27	32.2	7.6	136.31
05-Jun-2023 09:00:00	7.88	9.59	31.72	79.2	10.07	2.19	30.19	9.48	136.96
05-Jun-2023 09:30:00	8.12	9.99	32.23	86.85	9.83	1.86	31.3	9.11	138.17
05-Jun-2023 10:00:00	8.91	11.12	34.87	90.11	8.65	1.56	35.31	9.15	141.73
05-Jun-2023 10:30:00	9.1	11.25	33.42	88.51	8.45	1.07	38.44	11.95	147.49
05-Jun-2023 11:00:00	9.19	11.24	31.8	85.01	8.54	1.13	41.26	12.2	149.81
05-Jun-2023 11:30:00	8.01	9.76	26.61	95.21	9.89	0.74	26.59	12.42	148.9
05-Jun-2023 12:00:00	8.3	9.92	30.27	94.75	9.88	1.05	26.74	16.03	148.55
05-Jun-2023 12:30:00	9.09	10.93	29.18	95.57	8.97	1.01	34.71	19.75	146.61
05-Jun-2023 13:00:00	9.37	11.53	29.76	101.44	8.45	0.99	34.44	21.04	147.03
05-Jun-2023 13:30:00	8.75	10.81	36.24	89.6	8.9	0.73	39.27	23.99	147.31
05-Jun-2023 14:00:00	9.63	11.87	36.66	87.5	8.15	0.72	43.8	25.66	145.42
05-Jun-2023 14:30:00	9.2	11.23	27.53	92.35	8.76	0.73	33.06	23.82	145.14
05-Jun-2023 15:00:00	8.97	11.14	29.1	81.78	8.62	1.1	32.68	22.45	144.61

05-Jun-2023 15:30:00	9.1	11.2	40.25	79.55	8.51	0.75	41.09	24.97	148.54
05-Jun-2023 16:00:00	8.47	10.33	39.21	79.79	9.32	1.9	41.14	23.83	150.02
05-Jun-2023 16:30:00	9.26	11.28	31.43	100.51	8.62	1.29	36.31	24.85	150.31
05-Jun-2023 17:00:00	8.42	10.17	30.64	95.15	9.5	1.09	34.15	23.61	150.28
05-Jun-2023 17:30:00	8.35	10.02	30.4	94.59	9.72	1.58	28.95	24.37	150.41
05-Jun-2023 18:00:00	8.49	9.84	27.29	89.97	10.12	1.21	31.56	28.04	148.38
05-Jun-2023 18:30:00	8.25	9.82	31.69	89.31	9.78	1.21	33.08	30.47	149.7
05-Jun-2023 19:00:00	9.08	11.15	33.01	89.92	8.71	1.03	62.19	27	148.29
05-Jun-2023 19:30:00	8.48	10.35	31.32	78.89	9.36	1.05	42.54	27.4	149.36
05-Jun-2023 20:00:00	8.97	11.1	31.43	81	8.58	1.17	38.14	25.28	147.21
05-Jun-2023 20:30:00	9.22	11.28	35.42	74.3	8.34	1.07	44.87	25.32	147.27
05-Jun-2023 21:00:00	8.5	10.35	40.83	75.18	9.14	1.3	47.14	26.88	148.1
05-Jun-2023 21:30:00	8.47	10.32	36.54	78.6	9.14	1.22	43.55	24.9	147.13
05-Jun-2023 22:00:00	8.37	10.14	39.47	77.91	9.3	1.64	43.73	25.87	147.04

05-Jun-2023 22:30:00	8.96	10.97	40.46	87.5	8.38	1.48	54.3	25.97	147.1
05-Jun-2023 23:00:00	7.34	9	35.42	77.39	10.28	2.19	34.74	25.49	145.39
05-Jun-2023 23:30:00	8.7	10.79	34.18	90.25	8.6	1.99	43.85	26.69	145.43
06-Jun-2023 00:00:00	8.67	10.55	38.75	81.5	8.85	1.97	47.26	28.75	147.76
06-Jun-2023 00:30:00	8.21	10.01	36.27	73.25	9.39	1.78	42	30.61	147.22
06-Jun-2023 01:00:00	9.08	11.24	39.9	80.87	8.16	1.41	56.14	33.63	145.61
06-Jun-2023 01:30:00	8.03	9.81	40.13	76.31	9.5	1.73	50.2	35.21	143.28
06-Jun-2023 02:00:00	6.91	7.79	38.15	76.99	11.49	1.92	34.44	26.43	141.3
06-Jun-2023 02:30:00	6.87	7.9	33.84	77.78	11.48	1.91	24.11	24.97	142.05
06-Jun-2023 03:00:00	8.51	10.52	41.74	82.77	8.78	1.86	53.71	27.59	142.59
06-Jun-2023 03:30:00	7.7	9.19	33.68	74.47	10.16	2.06	36.86	28.12	144.83
06-Jun-2023 04:00:00	7.66	9.38	24.27	72.76	10.34	1.84	21.13	25.76	141.89
06-Jun-2023 04:30:00	8.02	9.8	28.29	74.85	9.69	2.03	29.4	29.62	143.59
06-Jun-2023 05:00:00	8.29	10.33	39.56	73.33	8.93	1.87	43.45	30.34	144.24

06-Jun-2023 05:30:00	8.11	9.72	40.19	74.37	9.52	2.17	50.62	35.8	145.6
06-Jun-2023 06:00:00	7.71	9.45	35.91	79.96	9.75	2.13	35.47	36.36	143.8
06-Jun-2023 06:30:00	7.87	9.58	27.83	76	9.8	2.06	30.84	38.27	144.29
06-Jun-2023 07:00:00	7.46	9.01	22.08	70.15	10.29	1.9	22.5	41.68	143.86
06-Jun-2023 07:30:00	8.2	9.99	27.76	82.7	9.5	1.83	27.53	47.02	143.16
06-Jun-2023 08:00:00	8.8	10.97	30.03	92.56	8.7	1.84	31.08	43.76	143.77
06-Jun-2023 08:30:00	8.82	10.96	32.01	89.51	8.58	1.46	37.97	41.73	145.22
06-Jun-2023 09:00:00	9.14	11.28	36.46	83.64	8.21	1.68	46.48	39.48	147.06
06-Jun-2023 09:30:00	8.91	10.89	33.31	77.01	8.56	1.37	43.51	36.61	149.08
06-Jun-2023 10:00:00	10.03	12.32	38.34	75.19	7.32	1.27	53.29	32.94	150.37
06-Jun-2023 10:30:00	8.95	10.93	40.94	73.56	8.53	1.58	45.44	35.15	152.05
06-Jun-2023 11:00:00	9.98	12.22	40.86	73.07	7.43	0.43	87.42	31.88	151.64
06-Jun-2023 11:30:00	9.24	11.35	37.3	71.62	8.26	0.28	61.22	28.32	145.83
06-Jun-2023 12:00:00	7.97	9.91	37.58	80.56	9.47	0.27	42.39	29.28	143.14

06-Jun-2023 12:30:00	8.22	10.35	37.39	81.85	9.02	0.62	42.65	26.16	141.74
06-Jun-2023 13:00:00	8.61	10.69	38.11	89.39	8.73	0.77	48.62	27.35	141.98
06-Jun-2023 13:30:00	8.31	10.17	37.23	85.75	9.19	0.72	47.53	29.05	141.49
06-Jun-2023 14:00:00	8.47	10.61	33.07	89.01	8.86	0.63	42.24	26.47	141.04
06-Jun-2023 14:30:00	8.4	10.49	38.4	78.66	8.93	0.22	40.22	23.67	143.24
06-Jun-2023 15:00:00	8.95	11.12	37.53	75.24	8.35	0.46	47.71	22.76	144.74
06-Jun-2023 15:30:00	8.82	11.04	38.16	76.57	8.47	0.71	46.49	25.95	142.51
06-Jun-2023 16:00:00	7.68	9.35	35.37	78.61	10.05	0.56	36.42	23.26	142.5
06-Jun-2023 16:30:00	7.82	9.71	30.47	79.25	9.8	0.28	29	23.1	141.49
06-Jun-2023 17:00:00	8.44	10.47	26.17	93.79	9.38	0.53	26.39	24.18	142.58
06-Jun-2023 17:30:00	8.54	10.67	28.93	84.31	9.04	0.95	29.33	25.07	142.79
06-Jun-2023 18:00:00	8.63	10.77	30.55	85.25	8.84	1.19	33.98	23.61	142.57
06-Jun-2023 18:30:00	8.62	10.49	30.56	87.13	9.1	1.13	41.8	26.16	143.66
06-Jun-2023 19:00:00	8.59	10.62	28.77	82.11	8.9	0.91	40.09	23.56	143.4

06-Jun-2023 19:30:00	8.33	10.27	23.57	78.61	9.27	0.77	30.04	27.94	141.09
06-Jun-2023 20:00:00	8.55	10.45	24.54	76.84	9.11	1.18	35.06	25.97	141.47
06-Jun-2023 20:30:00	8.33	10.28	27.67	86.18	9.19	1.32	35.75	28.4	141.48
06-Jun-2023 21:00:00	8.32	10.34	36.81	81.43	8.95	1.83	46.53	35.72	142.67
06-Jun-2023 21:30:00	8.65	10.66	33.59	76.38	8.86	1.82	40.14	42.73	143.64
06-Jun-2023 22:00:00	8.66	10.58	38.34	78.36	8.89	1.64	45.9	35.19	143.71
06-Jun-2023 22:30:00	8.85	10.99	38.62	83.78	8.45	1.9	50.99	26.81	143.67
06-Jun-2023 23:00:00	9.29	11.54	46.03	77.87	7.81	1.55	67.97	32.07	145.92
06-Jun-2023 23:30:00	8.25	10.24	43.57	82.1	9.04	2.17	51.66	30.99	146.2
07-Jun-2023 00:00:00	8.64	10.74	40.98	87	8.6	2.18	53.14	41.44	145.31
07-Jun-2023 00:30:00	8.52	10.51	44.39	75.61	8.81	2.32	52.89	31.84	146.21
07-Jun-2023 01:00:00	8.98	11.13	43.6	82.49	8.24	1.99	53.85	28.74	146.44
07-Jun-2023 01:30:00	8.42	10.4	50.66	75.55	8.75	2.24	58.82	29.14	146.25
07-Jun-2023 02:00:00	8.97	10.98	37.96	75.13	8.57	2.25	56.74	28.44	144.78

07-Jun-2023 02:30:00	8.54	10.39	43.96	78.39	9	2.08	58.47	25.52	146.12
07-Jun-2023 05:30:00	7.08	8.55	27.97	124.48	11.38	1.67	24.46	49.18	146.18
07-Jun-2023 06:00:00	8.1	9.73	10.79	84.9	10.06	1.69	23.92	28.08	145.13
07-Jun-2023 06:30:00	8.47	10.18	16.71	79.99	9.24	2.18	43.4	27.49	146.66
07-Jun-2023 07:00:00	8.5	10.46	9.56	87.41	8.83	2.24	25.13	29.8	146.7
07-Jun-2023 07:30:00	7.93	9.6	10.29	81.4	9.7	1.39	24.67	32.11	147.01
07-Jun-2023 08:00:00	8.69	10.66	9.01	87.52	8.85	1.7	30.59	31.74	145.97
07-Jun-2023 08:30:00	9.02	11.03	10.56	84.71	8.49	1.51	33.81	30.93	147.99
07-Jun-2023 09:00:00	8.83	10.69	17.92	69.11	8.7	1.52	45.83	34.2	149.34
07-Jun-2023 09:30:00	8.94	10.89	21.7	79.83	8.52	1.52	40.29	37.62	151.03
07-Jun-2023 10:00:00	9.32	11.32	23.61	80.23	8.24	1.44	41.85	36.37	152.32
07-Jun-2023 10:30:00	9.07	11.06	27.85	88.34	8.49	1.92	39.75	28.83	151.42
07-Jun-2023 11:00:00	9.22	11.28	24.23	86.85	8.28	1.65	37.88	30.19	150.79
07-Jun-2023 11:30:00	8.91	10.86	16.9	83.24	8.73	0.81	44.39	45.81	151.23

07-Jun-2023 12:00:00	8.01	9.6	14.61	84.84	9.86	0.37	26.33	50.01	150.79
10-Jun-2023 09:00:00	7.04	8.64	22.44	81.12	10.68	2.79	17.32	7.24	138.18
10-Jun-2023 09:30:00	7.38	9	17.67	85.2	10.34	2.96	20.48	9.53	141.96
10-Jun-2023 10:00:00	7.3	8.84	25.46	78.7	10.41	3.5	25.41	9.89	142.92
10-Jun-2023 10:30:00	6.82	8.13	22.77	82.49	11.14	3.06	20.3	8.52	143.61
10-Jun-2023 11:00:00	7.66	9.47	24.47	77.82	10.02	2.87	21.61	5.22	143.6
10-Jun-2023 11:30:00	7.53	9.21	19.61	82.95	10.24	2.02	20.44	4.78	144.15
10-Jun-2023 12:00:00	7.86	9.56	23.36	74.52	9.95	2.16	20.84	4.84	145.15
10-Jun-2023 12:30:00	7.43	9.01	27.04	76.17	10.28	1.73	24.98	6.99	146.35
10-Jun-2023 13:00:00	7.46	9.12	26.29	74.47	10.21	0.76	24.44	5.71	146.39
10-Jun-2023 13:30:00	7.27	8.58	34.1	84.01	10.71	0.98	27.83	5.14	144.53
10-Jun-2023 15:00:00	6.54	7.08	20.8	76.75	11.86	0.75	33.88	10.67	139.97
10-Jun-2023 15:30:00	8.08	10.17	35.32	70.99	9	1.16	48.01	7.24	140.08
10-Jun-2023 16:00:00	7.62	9.55	40.97	81.87	9.54	3.07	43.21	5.58	143.08

10-Jun-2023 16:30:00	6.86	8.72	25.05	85.86	10.22	-0.57	17.84	1.77	123.85
10-Jun-2023 18:00:00	6.23	7.4	14.86	73.52	11.52	2.82	25.4	8.58	128.04
10-Jun-2023 18:30:00	7.26	9.17	26.49	67.21	10.1	3.55	35.79	7.53	132.61
10-Jun-2023 19:00:00	6.59	8.07	33.18	68.12	10.95	3.43	30.5	9.79	136.99
10-Jun-2023 19:30:00	6.96	8.54	20.55	64.68	10.61	2.78	26.87	6.34	137.03
10-Jun-2023 20:00:00	6.57	8.06	26.59	65.34	10.96	2.63	24.35	6.96	136.28
10-Jun-2023 20:30:00	6.67	8.19	13.44	71.9	10.86	2.48	19.28	8.09	135.69
10-Jun-2023 21:00:00	6.91	8.43	29.87	73.48	10.68	2.37	27.29	6.49	136.27
10-Jun-2023 21:30:00	6.64	8.25	26.97	72.49	10.71	2.51	28.68	6.88	136.32
10-Jun-2023 22:00:00	7	8.72	28.87	77.39	10.33	2.56	36.13	5.41	136.93
10-Jun-2023 22:30:00	6.83	8.44	22.12	77.36	10.43	2.44	39.88	8.14	138.33
10-Jun-2023 23:00:00	6.76	8.39	26.22	75.54	10.47	2.18	38.42	7.75	139.16
10-Jun-2023 23:30:00	6.62	8.12	38.52	70.35	10.68	2.37	41.15	6.45	139.23
11-Jun-2023 00:00:00	7	8.66	34.84	67.93	10.22	2.2	42.99	6.32	139.41

11-Jun-2023 00:30:00	7.17	8.94	39.32	69.4	10.01	2.23	45.14	5.69	138.98
11-Jun-2023 01:00:00	7.01	8.71	38.34	74.29	10.25	2.66	43.25	5.41	139.86
11-Jun-2023 01:30:00	6.43	7.68	34.04	76.32	11.2	3.2	32.76	6.98	141.17
11-Jun-2023 02:00:00	7.2	8.7	17.23	76.24	10.22	3.23	37.44	7.66	141.44
11-Jun-2023 02:30:00	6.62	8.13	34.19	77.18	10.71	2.74	41.66	5.6	141.01
11-Jun-2023 03:00:00	7.05	8.61	38.28	81.53	10.38	2.78	47.85	5.82	139.75
11-Jun-2023 03:30:00	6.78	7.95	37	74.44	10.97	2.76	43.09	6.39	140.02
11-Jun-2023 04:00:00	7.16	8.8	40.22	70.6	10.09	2.95	52.78	5.34	140.79
11-Jun-2023 04:30:00	7.3	8.79	36.87	74.93	10	2.63	57.94	6.08	140.79
11-Jun-2023 05:00:00	7.06	8.53	21.03	79.82	10.23	2.63	44.47	7.77	141.87
11-Jun-2023 05:30:00	7.12	8.81	40.51	74.69	10	2.06	52.42	4.24	141.3
11-Jun-2023 06:00:00	7	8.6	45.92	73.12	10.16	2.62	51.39	5.68	141.5
11-Jun-2023 06:30:00	7.25	9.11	38.44	65.56	9.7	2.51	42.77	5.26	141.9
11-Jun-2023 07:00:00	7.31	9.1	34.99	69.59	9.69	2.24	39.9	5.71	143.61

11-Jun-2023 07:30:00	6.57	7.42	39.14	75.12	11.44	2.17	37.77	5.18	144.12
11-Jun-2023 08:00:00	7.06	8.66	31.51	81.04	10.26	2.15	29.82	5.73	140.99
11-Jun-2023 08:30:00	7.24	9.06	33.71	76.75	9.91	2.25	32.57	5.51	141.68
11-Jun-2023 09:00:00	7.16	8.92	28.34	76.19	10.07	2.66	30.5	6.45	141.56
11-Jun-2023 09:30:00	6.91	8.56	32.23	76.7	10.49	3.17	24.09	5.64	140.44
11-Jun-2023 10:00:00	7.25	9.13	22.8	82.9	10	3.27	23.22	6.01	139.45
11-Jun-2023 10:30:00	8.09	10.14	29.92	71.26	9.04	2.81	42.11	6.51	141.21
11-Jun-2023 11:00:00	7.5	9.45	23.05	74.26	9.61	4.12	31.77	6.4	141.42
11-Jun-2023 11:30:00	7.38	9.19	11.98	66.59	9.84	4.28	27.44	9.44	140.65
11-Jun-2023 12:00:00	7.75	9.53	13.57	68.45	9.57	4.62	41.14	14.92	138.48
11-Jun-2023 12:30:00	7.11	8.66	27.96	74.83	10.49	4.36	33.23	7.83	135.89
11-Jun-2023 13:00:00	7.19	8.91	25.41	76.49	10.27	4.33	30.29	7.76	136.75
11-Jun-2023 13:30:00	7.12	8.7	20.24	78.25	10.46	4.21	31.9	9.57	134.63
11-Jun-2023 14:00:00	6.74	8.5	25.98	71.63	10.52	3.92	24.94	3.42	130.06

11-Jun-2023 14:30:00	7.22	9.26	21.19	70.12	9.87	4.09	24.78	4.47	129.41
11-Jun-2023 15:00:00	7.71	9.8	26.14	69.23	9.37	4.29	34.34	5.05	134.35
11-Jun-2023 15:30:00	7.4	9.38	33.43	68.75	9.69	4.42	32.42	4.37	135.08
11-Jun-2023 16:00:00	7.38	9.33	10.55	67.61	9.63	3.9	22.98	5.87	136.91
11-Jun-2023 16:30:00	7.76	9.71	31.72	66.9	9.21	3.74	40.84	5.32	142.72
11-Jun-2023 17:00:00	7.65	9.62	30.66	60.38	9.21	3.31	46.39	9.93	139.58
11-Jun-2023 17:30:00	7.74	9.72	28.32	65.14	9.25	4.3	37.34	9.47	138
11-Jun-2023 18:00:00	7.68	9.64	33.15	66.44	9.44	4.5	36.06	4.17	136.45
11-Jun-2023 18:30:00	7.42	9.29	37.07	72.09	9.77	4.68	36.33	3.82	135.97
11-Jun-2023 19:00:00	6.79	8.33	25.9	78.35	10.73	4.48	24.59	4.17	133.85
11-Jun-2023 20:00:00	6.25	7.19	24.51	73.85	11.72	3.7	22.43	4.44	130
11-Jun-2023 21:30:00	6.07	6.95	24.56	71.27	11.97	2.82	22.49	4.05	130.84
11-Jun-2023 22:00:00	5.97	6.93	12.14	78.74	11.89	2.93	19.61	8.22	131.58
11-Jun-2023 22:30:00	6.61	7.99	29.86	76.4	10.97	2.43	34.01	7.5	131.53

11-Jun-2023 23:00:00	6.78	8.27	13.41	75.83	10.83	2.56	26.31	8.72	131.87
11-Jun-2023 23:30:00	7.01	8.69	17.93	83.67	10.45	2.43	32.45	6.24	133.13
12-Jun-2023 00:00:00	7.29	9.2	25.34	79.36	9.84	2.58	31.88	6.56	133.41
12-Jun-2023 00:30:00	6.88	8.43	25.75	77.73	10.54	2.5	22.91	7.79	135.81
12-Jun-2023 01:00:00	6.5	7.94	24.52	76.55	10.9	2.25	24.76	5.81	135.79
12-Jun-2023 01:30:00	7.01	8.55	20.1	78.9	10.33	2.48	33.6	5.44	134.73
12-Jun-2023 02:00:00	6.88	8.52	28.94	75.16	10.2	2.47	39.42	4.3	136.12
12-Jun-2023 02:30:00	6.76	8.21	31.29	77.77	10.6	3.46	34.58	5.27	136.06
12-Jun-2023 03:00:00	7.1	8.95	23.8	71.67	9.73	2.33	43.73	5.7	137.36
12-Jun-2023 03:30:00	6.72	8.39	32.29	77.49	10.27	2.25	40.99	6.76	138.3
12-Jun-2023 04:00:00	6.58	7.98	42.97	79.61	10.69	2.65	42.23	6.97	138.61
12-Jun-2023 04:30:00	7.46	9.04	29.76	83.71	9.95	2.78	44.85	8.68	138.12
12-Jun-2023 05:00:00	7.17	8.92	37.8	79.32	9.94	2.72	47.65	8.69	138.41
12-Jun-2023 05:30:00	7.56	9.22	19.29	80.79	9.73	2.57	46.36	10.4	139.8

12-Jun-2023 06:00:00	7.04	8.55	28.31	73.35	10.35	2.26	41.19	8.76	139.99	
12-Jun-2023 06:30:00	6.9	8.47	40.39	75.45	10.37	2.18	48.66	7.56	138.8	
12-Jun-2023 07:00:00	7.16	8.83	38.03	73.04	10.12	3.1	40.7	6.53	137.79	
12-Jun-2023 07:30:00	7.29	9.09	37.99	72.69	9.87	3.43	41.63	6.57	138.18	
12-Jun-2023 08:00:00	7.01	8.6	34.93	74.47	10.33	2.92	38.86	6.47	138.59	
12-Jun-2023 08:30:00	7.15	8.87	30.64	80.71	10.07	3.8	36.23	5.62	138.76	
12-Jun-2023 09:00:00	6.73	8.08	31.04	80.12	10.99	4.55	53.97	6.66	138.36	
12-Jun-2023 09:30:00	6.33	7.1	27.93	81.26	11.96	4.99	40.14	6.05	136.05	
12-Jun-2023 10:00:00	7.34	9.22	26.29	80.17	9.94	4.07	34.52	8.01	136.32	
13-Jun-2023 12:30:00	7.33	9.27	1.11	62.41	10.37	6.02	5.97	7.01	130.01	Sample Solenoid issue resolve
13-Jun-2023 13:00:00	6.95	8.58	11.58	67.21	10.78	6.14	17.78	6.98	130.29	
13-Jun-2023 13:30:00	7.39	9.05	29.1	71.06	10.22	3.93	35.62	4.32	129.93	
13-Jun-2023 14:00:00	7.1	8.91	26.07	73.39	10.54	3.66	24.82	3.76	127.59	
13-Jun-2023 14:30:00	6.98	8.63	26.91	82.98	10.68	3.2	27.05	3.51	127.27	

13-Jun-2023 15:00:00	6.6	8	27.26	71.29	11.22	3.81	22.35	4.09	127.24
13-Jun-2023 15:30:00	6.95	8.68	42.41	67.87	10.52	4.88	39.17	3.41	130.82
13-Jun-2023 16:00:00	6.23	7.2	43.83	77.48	11.77	4.55	35.73	4.19	130.83
13-Jun-2023 22:00:00	6.69	8.43	27.98	75.55	10.54	2.98	40.93	4.35	129.83Connectivity issue resolve
13-Jun-2023 22:30:00	8.06	10.31	33.89	68.68	8.97	2.81	45.52	4.55	131.96
13-Jun-2023 23:00:00	8.12	10.22	35.24	64.72	9.02	2.42	43.16	3.86	135.26
13-Jun-2023 23:30:00	8.09	10.1	39.3	72.53	9.19	2.63	61.23	3.99	136.25
14-Jun-2023 00:00:00	6.42	7.39	33.94	79.15	11.77	2.62	32.75	6.27	133.27
14-Jun-2023 00:30:00	7.5	9.49	11.56	83.13	9.79	2.56	35.39	7	130.85
14-Jun-2023 01:00:00	7.48	9.56	6.41	92.73	9.7	2.76	32.34	5.8	131.73
14-Jun-2023 01:30:00	7.53	9.44	8.7	74.67	9.84	2.92	37.81	4.46	134.41
14-Jun-2023 02:00:00	7.85	9.81	6.41	70.23	9.51	2.82	42.2	4.19	134.95
14-Jun-2023 02:30:00	8.18	10.14	16.16	70.69	9.27	2.87	47.14	3.35	136.85
14-Jun-2023 03:00:00	8.45	10.51	32.64	69.87	8.94	2.83	53.75	2.92	136.81

14-Jun-2023 03:30:00	8.88	11.16	28.65	77.52	8.35	2.68	50.54	2.28	134.3
14-Jun-2023 04:00:00	6.85	7.82	24.98	80.44	11.54	2.67	31.74	4.55	131.55
14-Jun-2023 04:30:00	7.61	9.44	13.14	85.55	9.89	2.98	27.59	3.53	134.38
14-Jun-2023 05:00:00	7.74	9.58	25.13	90.22	9.77	2.97	38.67	3.45	136.6
14-Jun-2023 05:30:00	8.01	9.48	18.16	80.48	9.89	3.12	40.39	3.71	136.94
14-Jun-2023 06:00:00	7.89	9.74	11.07	81.58	9.71	2.86	27.51	3.58	137.98
14-Jun-2023 06:30:00	7.64	9.07	17.11	87.33	10.41	3.09	25.96	2.82	137.85
14-Jun-2023 07:00:00	6.81	8.25	24.02	81.89	11.01	2.97	21.35	2.57	136.67
14-Jun-2023 07:30:00	7.47	9.3	25.08	84.25	10.14	2.93	23.91	2.35	136.67
14-Jun-2023 08:00:00	7.3	8.92	25.6	79.9	10.46	3.43	23.02	2.18	137.24
14-Jun-2023 08:30:00	8.44	10.64	31.03	63.91	8.81	3.74	38.29	2.02	137.42
14-Jun-2023 09:00:00	8.68	10.91	36.69	70.35	8.54	5.72	43.62	2	138.34
14-Jun-2023 09:30:00	8.49	10.73	32.26	52.38	8.74	5.49	37.37	3.44	137.51
14-Jun-2023 10:00:00	9.13	11.48	39.35	68.71	8.03	4.47	53.61	3.47	139.01

14-Jun-2023 10:30:00	8.54	10.63	42.67	67.16	8.76	4.84	55.79	4.52	139.81
14-Jun-2023 11:00:00	8.39	10.5	47.17	71.44	8.8	5.06	55.35	6.14	138.63
14-Jun-2023 11:30:00	7.64	9.55	30.52	72.51	9.75	4.98	37.57	8.23	136.55
14-Jun-2023 12:00:00	7.35	9.1	27.98	77.2	10.14	5.23	35.09	4.41	135.49
14-Jun-2023 12:30:00	7.5	9.32	21.13	68.44	10.03	4.83	28.46	2.81	135.41
14-Jun-2023 13:00:00	8.34	10.49	25.06	70.26	9.01	5.13	42.13	2.73	138.16
14-Jun-2023 13:30:00	8.25	10.34	30.42	68.28	9.03	4.34	41.83	2.86	138.62
14-Jun-2023 14:00:00	7.57	9.37	28.75	70.84	9.88	4.54	34.55	2.61	138.42
14-Jun-2023 14:30:00	7.87	9.92	20.47	77.23	9.46	4.13	33.15	2.56	137.89
14-Jun-2023 15:00:00	8.14	10.17	16.53	73.5	9.22	3.79	38.39	2.89	138.71
14-Jun-2023 15:30:00	7.96	9.97	12.87	71.66	9.44	4.99	34.33	3.04	137.2
14-Jun-2023 16:00:00	8	10.09	20.13	70.97	9.35	5.2	39.99	4.78	134.11
14-Jun-2023 16:30:00	7.65	9.61	33.72	76.97	9.83	3.56	37.46	4.86	133.28
14-Jun-2023 17:00:00	7.54	9.57	34.79	78.32	9.79	3.9	37	4.72	133.96

14-Jun-2023 17:30:00	7.43	9.43	25.24	80.03	9.84	4.08	34.71	5.17	134.47	
14-Jun-2023 18:00:00	8.02	10.15	16.66	73.16	9.34	4.27	35.49	2.29	136.03	
14-Jun-2023 18:30:00	7.89	9.93	15.28	81.14	9.49	3.46	34.21	2.96	135.69	
14-Jun-2023 19:00:00	8.07	10.17	13.17	78.22	9.24	3.29	39.29	5.25	136.32	
14-Jun-2023 19:30:00	7.1	8.76	12.49	73.06	10.55	5.58	28.95	3.72	131.61	
14-Jun-2023 20:00:00	7.39	9.33	10.36	73.96	10.01	3.48	24.84	4.56	130.3	
14-Jun-2023 20:30:00	6.78	8.35	11.78	74.93	10.91	2.92	18.28	4.75	131.57	
14-Jun-2023 21:00:00	8.18	10.42	22.47	67.08	9.09	2.59	30.94	3.12	132.55	
14-Jun-2023 21:30:00	7.16	8.59	29.98	73.19	10.78	2.85	29.26	3.64	131.72	
14-Jun-2023 22:00:00	7.69	9.77	28.7	70.96	9.62	2.97	29.3	3.56	132.68	
14-Jun-2023 22:30:00	8.07	10.12	23.77	71.94	9.3	2.87	40.26	3.42	134.78	
14-Jun-2023 23:00:00	8.19	10.47	20.92	84.9	8.86	2.05	37.01	2.03	132.36	
19-Jun-2023 17:00:00	7.66	9.98	36.6	71.64	9.6	0.65	30.33	5.21	126.37	Issue resolve
19-Jun-2023 17:30:00	7.57	9.17	37.48	77.3	10.42	0.95	37.39	7.83	126.16	

19-Jun-2023 18:30:00	8.42	10.97	44.09	73.67	8.52	0.67	48.92	7.72	125.18
19-Jun-2023 19:00:00	8.35	10.86	45.78	76.37	8.51	0.97	52.99	6.06	127.26HT tube line cleaning
19-Jun-2023 19:30:00	8.33	10.76	51.09	73.21	8.52	1.35	58.65	6.24	130.26HT tube line cleaning
19-Jun-2023 20:00:00	8.58	10.97	51.22	71.17	8.39	1.38	58.99	6.16	132.26HT tube line cleaning
19-Jun-2023 20:30:00	8.77	11.31	53.51	65	8.02	0.92	59.89	4.68	133.05HT tube line cleaning
19-Jun-2023 21:00:00	6.78	7.76	43.47	80.87	11.24	0.39	38.47	2.61	124.67HT tube line cleaning
19-Jun-2023 22:00:00	6.46	7.79	37.03	71.73	11.44	1.78	25.87	6.48	122.92
19-Jun-2023 23:30:00	7.46	9.64	31.01	75.62	9.53	2.02	38.73	5.41	121.07
20-Jun-2023 00:00:00	7.92	10.19	39.09	65.55	9.22	1.83	45.53	5.43	126.31
20-Jun-2023 03:00:00	7.48	9.84	16.71	61.88	9.4	1.97	38.81	7.31	110.82
20-Jun-2023 03:30:00	7.16	9.36	33.03	68.97	10.01	2.09	34.74	5.09	113.88
20-Jun-2023 05:30:00	6.58	8.48	23.26	63.54	10.71	1.74	25.1	4.86	120.13
20-Jun-2023 06:00:00	8.21	10.5	36.09	74.34	9.18	1.56	46.07	5.64	124.5
20-Jun-2023 07:30:00	7.59	9.66	41.04	65.38	9.58	1.34	52.33	3.6	122.35

20-Jun-2023 08:00:00	8.66	11.33	45.75	72.37	7.94	1.04	58.89	1.93	125.27HT tube line cleaning
20-Jun-2023 08:30:00	8.56	11.19	50.88	66.15	8.05	0.75	66.39	1.45	127.52HT tube line cleaning
20-Jun-2023 09:00:00	7.87	10.16	50.76	72.69	9.07	0.76	54.69	5.35	129.91HT tube line cleaning
20-Jun-2023 09:30:00	8.58	11.07	55.51	69.55	8.13	0.97	64.42	5.16	133.51HT tube line cleaning
20-Jun-2023 10:00:00	8.09	10.31	47.69	64.02	8.9	0.63	60.85	4.6	134.84HT tube line cleaning
20-Jun-2023 10:30:00	8.11	10.5	35.95	64.14	8.74	0.42	51.75	4.99	135.04HT tube line cleaning
20-Jun-2023 12:30:00	7.36	9.09	36.22	65.88	10.03	0.23	44.93	8.18	138.26Connectivity issue resolve
20-Jun-2023 13:00:00	8.1	10.16	31.93	77.05	9.28	0.46	42.07	13.95	138.35
20-Jun-2023 13:30:00	7.61	9.39	26.91	75.87	10	0.24	32.15	16.24	137.3
20-Jun-2023 14:00:00	9.4	11.94	33.06	66.79	7.65	0.17	64.99	13.04	138.29
20-Jun-2023 14:30:00	9.38	11.85	34.65	68.99	7.9	0.13	59.52	10.5	139.95
20-Jun-2023 15:00:00	9.65	12.22	29.96	73.62	7.59	-0.05	53.57	9.12	140.01
20-Jun-2023 15:30:00	9.98	12.67	29.49	75.09	7.08	-0.01	66.12	10.03	140.42
20-Jun-2023 16:00:00	9.05	11.47	28.15	71.89	8.17	0.35	53.86	9.77	138.61

20-Jun-2023 16:30:00	8.85	11.22	28.45	79.24	8.37	0.09	49.14	15.24	136.31
20-Jun-2023 17:00:00	8.69	11.04	29.59	78.75	8.56	0.34	42.35	14.22	135.37
20-Jun-2023 17:30:00	8.79	11.2	27.84	79.22	8.45	0.37	38.37	15.08	135.45
20-Jun-2023 18:00:00	8.79	11.13	28.26	81.73	8.42	0.67	44.08	15.44	135.69
20-Jun-2023 18:30:00	9.28	11.82	30.65	68.89	7.67	0.57	55.73	13.77	135.47
20-Jun-2023 19:00:00	9.12	11.67	35.99	69.47	7.79	0.61	55.32	22.46	134.86
20-Jun-2023 19:30:00	9	11.55	35.84	73.59	7.92	0.85	57.55	20.52	133.71
20-Jun-2023 20:00:00	8.24	10.56	36.65	77.41	8.81	1.11	47.63	17.54	135.2
20-Jun-2023 20:30:00	8.4	10.66	33.15	78.4	8.78	1.3	45.76	18.74	135.24
20-Jun-2023 21:00:00	8.72	10.97	30.94	76.75	8.63	1.44	48.92	18.85	135.63
20-Jun-2023 21:30:00	8.1	10.28	30.11	84.12	9.15	1.45	38.67	16.35	135.87
20-Jun-2023 22:00:00	8.49	10.74	30.6	85.52	8.64	1.3	43.28	16.7	135.84
20-Jun-2023 22:30:00	8.37	10.68	34.28	79.37	8.73	1.47	46.15	18.61	135.86
20-Jun-2023 23:00:00	8.32	10.4	37.84	80.19	8.87	1.39	49.01	19.62	136.7

20-Jun-2023 23:30:00	7.79	9.78	35.56	78.15	9.38	1.37	42.34	19.03	136.38
21-Jun-2023 00:00:00	8.7	10.99	35.96	79.16	8.42	1.53	52.43	9.31	136.4
21-Jun-2023 00:30:00	8.45	10.63	32.59	81.82	8.71	1.45	46.34	9.94	136.9
21-Jun-2023 01:00:00	8.63	10.96	34.77	81.29	8.22	1.32	53.17	9.08	137.33
21-Jun-2023 01:30:00	8.54	10.72	42.11	75.98	8.5	1.29	54.92	8.86	137.88
21-Jun-2023 02:00:00	8.33	10.48	40.09	78.92	8.7	1.57	50.98	8.53	138.27
21-Jun-2023 02:30:00	8.49	10.65	39.3	78.4	8.6	1.45	54.93	12.03	138.19
21-Jun-2023 03:00:00	7.97	10.14	41.11	79.4	9	1.55	48.99	12.7	136.89
21-Jun-2023 03:30:00	8.48	10.73	39.43	73.89	8.52	1.64	63.2	12.49	137.49
21-Jun-2023 04:00:00	8.38	10.53	40.01	83.15	8.65	1.72	55.02	14.05	138.51
21-Jun-2023 04:30:00	8.3	10.55	38.74	75.8	8.66	1.62	56.85	17.16	138.77
21-Jun-2023 05:00:00	8.56	10.8	25.1	76.56	8.39	1.7	59.91	17.86	138.54
21-Jun-2023 05:30:00	8.48	10.8	40.73	81.35	8.31	1.45	63	14.1	138.85
21-Jun-2023 06:00:00	8.26	10.29	41.65	79.07	8.89	1.47	61.81	17.15	138.4

21-Jun-2023 06:30:00	8.43	10.67	27.74	76.79	8.61	1.4	61.34	18.79	137.88
21-Jun-2023 07:00:00	8.14	10.24	38.45	83.19	8.88	1.73	61.51	20.52	138.84
21-Jun-2023 07:30:00	8.47	10.54	32.06	73.9	8.87	1.58	55.07	22.45	137.73
21-Jun-2023 08:00:00	8.24	10.47	21.75	76.9	8.7	1.55	51.26	22.76	138.27
21-Jun-2023 08:30:00	8.19	10.42	28.29	73.52	8.83	1.43	52.14	23.68	138.19
21-Jun-2023 09:00:00	8.41	10.52	26.74	77.31	8.89	1.45	39.62	8.32	137.64
21-Jun-2023 09:30:00	8.26	10.35	26.7	82.17	9.15	1.29	29.35	7.81	138.9
21-Jun-2023 10:00:00	8.09	10.13	27.55	77.05	9.34	0.54	33.96	7.59	137.3
21-Jun-2023 10:30:00	8.57	10.72	30.19	79.95	8.86	0.84	40.4	6.09	139.77
21-Jun-2023 11:00:00	7.93	9.63	31.69	80.32	9.94	0.9	37.5	6.92	139.61
21-Jun-2023 11:30:00	9.41	11.79	33.51	71.64	7.89	0.41	75	6.74	140.35
21-Jun-2023 12:00:00	8.6	10.71	30.59	78.18	8.83	0.39	52.8	5.44	140.06
21-Jun-2023 12:30:00	8.67	10.84	26.71	80.83	8.68	0.42	56.68	5.94	138.04
21-Jun-2023 13:00:00	9.38	11.9	31.36	78.16	7.58	0.18	64.93	4.94	137.65

21-Jun-2023 13:30:00	9.21	11.64	32.01	73.46	8	0.16	59.41	3.89	135.57
21-Jun-2023 14:00:00	9.4	11.95	35.16	75.93	7.71	0.43	67.73	4.03	135.05
21-Jun-2023 14:30:00	9.22	11.69	37.54	71.35	7.78	0.49	69.72	4.28	134.85
21-Jun-2023 15:00:00	8.26	10.42	35.67	82.86	8.88	0.6	53.99	3.52	135.98
21-Jun-2023 15:30:00	8.78	11.07	32.28	86.63	8.3	0.59	54.57	4.04	136.43
21-Jun-2023 16:00:00	8.71	11.02	17.19	86.71	8.3	0.34	48.27	5.03	136.82
21-Jun-2023 16:30:00	8.49	10.7	20.01	80.11	8.45	0.22	55.6	5.31	138.17
21-Jun-2023 17:00:00	8.77	11.1	15.04	84.38	8.11	0.41	68.77	5.12	137.94
21-Jun-2023 17:30:00	8.42	10.66	27.51	79.86	8.49	0.24	63.27	3.88	136.54
21-Jun-2023 18:00:00	8.43	10.59	29.33	72.5	8.76	0.11	61.75	4.78	134.17
21-Jun-2023 18:30:00	8.57	10.87	33.77	75.42	8.49	0.53	58.78	4.88	135.32
21-Jun-2023 19:00:00	8.63	10.96	32.4	74.2	8.36	0.31	57.29	2.76	135.59
21-Jun-2023 19:30:00	8.59	10.91	37.36	72.83	8.25	0.64	64.34	4.06	136.27
21-Jun-2023 20:00:00	8.23	10.41	37.41	73.42	8.64	0.75	68.44	5.05	137.15

21-Jun-2023 20:30:00	7.74	9.7	27.87	78.71	9.46	0.83	48.57	4.27	135.64
21-Jun-2023 21:00:00	8.61	10.91	19.12	85.18	8.27	1.21	54.45	4.6	135.97
21-Jun-2023 21:30:00	8.24	10.36	25.17	83.12	8.81	1.16	50.79	4.06	136.74
21-Jun-2023 22:00:00	8.27	10.41	33.89	83.21	8.9	1.53	50.27	3.84	137.18
21-Jun-2023 22:30:00	8.51	10.69	34.6	85.08	8.69	1.38	53.11	4.36	136.89
21-Jun-2023 23:00:00	8.31	10.34	41.69	79.83	8.85	1.57	62.29	3.89	138.23
21-Jun-2023 23:30:00	8.34	10.48	36.14	85.09	8.79	1.53	52.94	4.26	138.08
22-Jun-2023 00:00:00	8.25	10.28	40.81	85.4	8.84	1.4	60.84	5.29	138.09
22-Jun-2023 00:30:00	8.55	10.71	35.78	75.21	8.57	1.32	54.91	6.94	138.29
22-Jun-2023 01:00:00	8.78	11.04	34.6	80.91	8.3	1.32	55.91	3.88	138.77
22-Jun-2023 01:30:00	8.6	10.74	41.87	75.64	8.5	1.36	65.47	4.39	139.04
22-Jun-2023 02:00:00	8.38	10.43	31.23	75.27	9.04	1.4	38.92	5.15	139.1
22-Jun-2023 02:30:00	8.39	10.56	31.55	77.44	8.8	1.31	41.91	5.05	138.57
22-Jun-2023 03:00:00	8.5	10.61	27.76	69.08	8.8	1.59	42.44	4.72	139.02

22-Jun-2023 03:30:00	8.05	10.01	19.38	73.35	9.15	1.55	44.98	5.05	139.09
22-Jun-2023 04:00:00	8.65	10.77	16.95	74.37	8.62	1.49	42.61	4.62	139.73
22-Jun-2023 04:30:00	8.54	10.69	17.39	77.58	8.76	1.47	42.5	4.71	139.72
22-Jun-2023 05:00:00	8.42	10.47	19.34	78.79	8.93	1.5	38.26	4.47	139.26
22-Jun-2023 05:30:00	8.43	10.55	30.13	83.75	8.66	1.59	49.57	4.48	140.1
22-Jun-2023 06:00:00	8.81	10.95	33.52	82.51	8.39	1.84	55.54	4.5	140.83
22-Jun-2023 06:30:00	8.93	11.12	34.69	85.71	8.31	1.88	54.86	4.67	141.5
22-Jun-2023 07:00:00	8.52	10.64	36.78	78.09	8.78	1.73	57.08	4.71	141.4
22-Jun-2023 07:30:00	8.98	11.21	20.71	77.82	8.14	1.6	48.25	6.4	141.05
22-Jun-2023 08:00:00	8.58	10.64	24.99	76.17	8.72	1.48	46.66	6.84	140.89
22-Jun-2023 08:30:00	8.69	10.86	30.57	88.03	8.59	1.6	51.79	7.93	140.45
22-Jun-2023 09:00:00	8.69	10.9	30.14	72.72	8.55	1.36	50.69	8.5	139.99
22-Jun-2023 09:30:00	8.71	10.92	27.03	80.01	8.51	0.77	41.6	5.17	138.48
22-Jun-2023 10:00:00	8.86	11.07	28.88	76.57	8.5	0.74	43.91	4.58	139.98

22-Jun-2023 10:30:00	9.14	11.37	36.34	83.65	8.08	0.34	48.77	4.34	141.84
22-Jun-2023 11:00:00	8.61	10.67	35.61	86.91	8.75	1.3	46.08	4.39	143.23
22-Jun-2023 11:30:00	9.39	11.56	23.49	75.85	8.06	0.55	49.5	5.74	143.5
22-Jun-2023 12:00:00	9.32	11.52	18.15	78.46	8.17	0.09	40.01	5.6	144.71
22-Jun-2023 12:30:00	9.54	11.77	30.66	78.09	7.93	0.48	51.99	4.68	145.5
22-Jun-2023 13:00:00	8.57	10.5	29.54	87.63	9.07	0.28	42.27	3.98	144.36
22-Jun-2023 13:30:00	7.9	9.61	28.76	79.89	9.69	0.05	36.26	4.87	143.05
22-Jun-2023 14:00:00	7.58	9.23	27.37	82.98	10.05	-0.16	31.63	5.25	141.64
22-Jun-2023 14:30:00	7.98	9.55	24.5	73.91	9.89	0.28	31.91	5.6	139.81
22-Jun-2023 15:00:00	9.26	11.6	16.18	76.97	7.98	-0.12	42.27	5.48	141.19
22-Jun-2023 15:30:00	8.98	11.08	25.54	75.84	8.44	-0.37	43.06	4.71	142.04
22-Jun-2023 16:00:00	9.16	11.22	34.82	72.57	8.15	-0.09	59.47	4.89	144.88
22-Jun-2023 16:30:00	9.21	11.44	41.86	72.05	7.78	0.03	61.77	3.45	145.81
22-Jun-2023 17:00:00	9.83	12.24	43.6	62.64	7.02	0.32	104.31	4.58	145.6

22-Jun-2023 17:30:00	9.17	11.42	42.93	61.35	7.83	0.01	87.94	4.62	144.71
22-Jun-2023 18:00:00	9.54	11.91	27.75	75.28	7.33	0.27	63.72	6.44	143.23
22-Jun-2023 18:30:00	8.26	10.3	29.44	76.66	8.87	0.33	49.35	4.61	141.33
22-Jun-2023 19:00:00	8.26	10.37	27.69	72	8.77	0.34	53.49	4.6	138.5
22-Jun-2023 19:30:00	8.94	11.2	40.46	69.34	7.98	0.24	68.56	3.01	139.23
22-Jun-2023 20:00:00	8.5	10.62	42.12	76.96	8.48	0.34	61.61	3.17	139.46
22-Jun-2023 20:30:00	9.11	11.48	38.56	75.6	7.79	0.41	64.31	3.9	139.23
22-Jun-2023 21:00:00	9.44	11.92	43.72	83.35	7.34	0.43	73.51	3.41	139.07
22-Jun-2023 21:30:00	9.99	12.58	23.5	62.61	6.87	0.53	76.66	4.4	138.84
22-Jun-2023 22:00:00	8.56	10.72	16.75	77.85	8.59	1.15	46.56	4.36	138.84
22-Jun-2023 22:30:00	9.12	11.4	18.79	70.81	7.9	1.2	58.47	4.52	140.35
22-Jun-2023 23:00:00	8.75	10.78	19.09	78.72	8.59	1.15	53.21	3.71	141.69
22-Jun-2023 23:30:00	9.2	11.45	19.35	69.17	7.91	1.4	59.3	4.14	141.71
23-Jun-2023 00:00:00	8.38	10.39	22.57	81.49	8.84	1.58	49.92	3.71	141.73

23-Jun-2023 00:30:00	8.78	10.89	10.81	82.68	8.52	1.47	44.73	3.9	141.12
23-Jun-2023 01:00:00	9.57	11.97	9.68	77.58	7.49	1.22	56.26	4.53	141.31
23-Jun-2023 01:30:00	10.78	13.53	13	63.02	6.03	1.06	67.91	5.39	139.7
23-Jun-2023 02:00:00	9.34	11.69	29.58	75.48	7.76	1.37	80.88	4.47	137.92
23-Jun-2023 02:30:00	8.68	10.93	29.86	84.23	8.46	1.5	48.29	4.85	139.45
23-Jun-2023 03:00:00	9.4	11.78	31.67	72.67	7.65	1.49	54.41	4.54	141.52
23-Jun-2023 03:30:00	9.46	11.81	32	74.85	7.7	1.52	53.69	4.44	142.28
23-Jun-2023 04:00:00	9.51	11.87	34.28	72.04	7.67	1.38	68.15	4.28	142.73
23-Jun-2023 04:30:00	8.99	11.11	35.39	72.14	8.33	1.58	54.97	7.59	141.62
23-Jun-2023 05:00:00	8.79	11.01	29.94	82.9	8.46	1.62	43.58	4.8	141.2
23-Jun-2023 05:30:00	9.08	11.36	35.67	83.53	8.04	1.66	57.44	4.52	141.36
23-Jun-2023 06:00:00	7.88	9.89	36.31	88.8	9.39	1.64	43.38	5.95	139.76
23-Jun-2023 06:30:00	8.61	10.77	33.11	96.95	8.7	1.69	46.37	7.61	140.68
23-Jun-2023 07:00:00	8.94	11.18	37.65	90.5	8.2	1.54	56.4	6.15	141.68

23-Jun-2023 07:30:00	7.73	9.54	31.22	89.24	9.83	1.69	37.23	6.63	141.69
23-Jun-2023 08:00:00	9.04	11.24	31.74	101.12	8.4	1.52	48.37	6.32	141.41
23-Jun-2023 08:30:00	9.07	11.25	30.08	86.55	8.28	1.59	48.6	5.15	141.48
23-Jun-2023 09:00:00	8.56	10.73	27.28	80.77	8.76	1.55	40.59	5.87	140.05
23-Jun-2023 09:30:00	8.98	11.21	30.93	81.81	8.26	1.11	44.53	5.32	141.69
23-Jun-2023 10:00:00	8.58	10.69	31.15	82.65	8.71	0.93	41.08	4.14	142.33
23-Jun-2023 10:30:00	8.84	10.95	32.83	84.17	8.6	1.01	44.05	4.52	143.39
23-Jun-2023 11:00:00	8.2	10.14	29.99	73.73	9.3	1.38	42.96	3.39	142.55
23-Jun-2023 11:30:00	8.18	10.27	24.27	67.39	9.3	1.15	47.06	7.28	139.4
23-Jun-2023 12:00:00	9.05	11.51	24.2	61.81	8.13	0.45	69.61	6.12	136.01
23-Jun-2023 12:30:00	8.43	10.76	26.06	64.12	8.73	0.46	51.26	5.79	133.92
23-Jun-2023 13:00:00	8.93	11.36	30.26	73.44	8.21	0.53	53.86	3.81	135.96
23-Jun-2023 13:30:00	8.94	11.24	29.89	66.47	8.28	-0.05	44.12	3.75	139.43
23-Jun-2023 14:00:00	7.32	8.82	25.61	77.23	10.75	0.19	30.51	7.28	135.13

23-Jun-2023 14:30:00	7.99	10.17	3.85	69.41	9.24	-0.28	30.32	10.17	132.58
23-Jun-2023 15:00:00	7.8	9.89	6.2	76.57	9.55	-0.44	30.11	11.6	131.82
23-Jun-2023 15:30:00	9.12	11.55	24.34	73.69	8.15	-0.37	50.6	5.77	136.47
23-Jun-2023 16:00:00	8.53	10.84	22.52	62.59	8.68	0.09	47.57	6.14	134.8
23-Jun-2023 16:30:00	9.2	11.56	27.73	66.82	8.2	-0.06	45.24	3.64	137.35
23-Jun-2023 17:00:00	9.62	12.13	26.8	70.7	7.6	0.05	71.53	4.76	139.71
23-Jun-2023 17:30:00	8.71	11.02	26.07	73.8	8.57	-0.28	47.22	4.27	136.43
23-Jun-2023 18:00:00	8.68	10.83	23.33	75.5	8.88	-0.09	39.36	4.16	136.29
23-Jun-2023 18:30:00	8.96	11.35	21.72	70.74	8.29	-0.12	33.04	3.87	135.81
23-Jun-2023 19:00:00	8.7	11.03	23.48	73.22	8.58	0.4	37.46	4.44	137.19
23-Jun-2023 19:30:00	8.48	10.73	10.14	69.15	8.8	0.27	40.66	7.17	135.4
24-Jun-2023 04:30:00	7.08	9.26	22.25	75.4	9.93	1.7	28.29	3.36	120.08
24-Jun-2023 05:00:00	7.16	9.32	24.05	75.59	9.85	1.54	32.53	3.01	123.51
24-Jun-2023 05:30:00	7.83	10.11	29.53	76.94	9.13	1.39	41.46	3.05	127.96

24-Jun-2023 06:00:00	8.14	10.47	33.99	74.68	8.79	1.26	46.42	3.01	131.59
24-Jun-2023 06:30:00	7.27	9.19	14.15	79.75	9.95	1.36	34.05	4.22	133.68
24-Jun-2023 07:00:00	7.28	9.26	11.41	74.68	9.95	1.45	26.12	4.44	135.09
24-Jun-2023 07:30:00	9.21	11.62	21.61	73.57	7.95	1.28	42.97	4.76	137.74
24-Jun-2023 08:00:00	9.08	11.49	23.54	76.64	7.98	1	32.52	4.54	138.39
24-Jun-2023 08:30:00	8.9	11.26	23.81	70.12	8.23	1.05	33.65	4.42	137.99
24-Jun-2023 09:00:00	7.74	9.67	23.72	79.85	9.74	0.82	25.22	2.51	139.11
24-Jun-2023 09:30:00	7.53	9.42	24.27	78.17	9.94	0.81	22.96	1.97	139.78
24-Jun-2023 10:00:00	8.38	10.53	27.05	83.87	8.9	0.65	31.41	2.07	140.79
24-Jun-2023 10:30:00	9.06	11.37	32.21	82.79	8.13	0.65	46.1	2.37	142.18
24-Jun-2023 11:00:00	9.34	11.71	31.16	79.46	7.91	0.11	61.46	2.09	141.56
24-Jun-2023 11:30:00	8.1	9.9	25.77	80.72	9.59	-0.02	35.68	2.7	139.61
24-Jun-2023 13:00:00	8.29	10.66	22.31	82.6	8.83	-0.09	33.34	2.6	131.96
24-Jun-2023 13:30:00	8.54	10.9	22.37	78.57	8.62	-0.1	34.09	2.55	134.27

24-Jun-2023 14:00:00	9.17	11.72	26.41	82.22	7.83	-0.47	43.26	2.97	134.23
24-Jun-2023 14:30:00	8.28	10.64	23.16	75	8.81	-0.37	31.08	3.1	131.92
24-Jun-2023 15:00:00	8.16	10.38	23.05	77.08	9.06	-0.68	29.65	3.42	135.85
24-Jun-2023 15:30:00	8.44	10.71	27.79	76.24	8.78	-0.7	36.5	3.47	136.77
24-Jun-2023 16:00:00	7.03	8.81	23.13	75.23	10.46	-0.92	21.01	4.23	136.94
24-Jun-2023 16:30:00	8.76	11.15	25.63	76.76	8.29	-1.01	38.81	4.89	135.78
24-Jun-2023 17:00:00	7.95	9.94	26.15	67.94	9.38	-1	31.8	5.14	136.35
24-Jun-2023 17:30:00	8.68	11.11	29.3	79.95	8.24	-0.89	46.19	3.85	133.92
24-Jun-2023 18:00:00	8.28	10.5	31.26	69.82	8.83	-1.01	48.16	3.96	133.52
24-Jun-2023 18:30:00	9.05	11.56	30.05	76.44	7.94	-0.68	37.09	2.7	135.23
24-Jun-2023 19:00:00	8.24	10.39	26.58	71.88	8.99	-1.13	40.22	2.31	134.15
24-Jun-2023 19:30:00	7.04	8.82	9.43	77.85	10.39	-0.47	14.05	2.98	136.08
24-Jun-2023 20:00:00	7.19	9.04	10.78	77.42	10.17	0.03	18.85	3.17	137.92
24-Jun-2023 22:30:00	6.35	7.43	0.59	80.73	11.65	0.62	6.67	6	129.83

24-Jun-2023 23:00:00	6.08	7.01	6.7	87.91	11.95	0.78	11.86	9.05	130.7
24-Jun-2023 23:30:00	7.8	9.8	14.19	85.87	9.44	0.9	24.92	6.59	134.97
25-Jun-2023 00:00:00	9.64	12.17	20.79	75.32	7.44	0.85	60.39	6.76	137.14
25-Jun-2023 00:30:00	9.47	11.9	25.46	70.93	7.7	1.12	60.03	7.02	140.58
25-Jun-2023 01:00:00	9.59	11.98	30.53	70.68	7.55	1.31	48.57	7.64	143.09
25-Jun-2023 01:30:00	9.24	11.52	28.87	78.82	8.05	0.84	49.78	7.34	143.86
25-Jun-2023 02:00:00	9.18	11.46	29.49	86.23	8	1.2	46.35	8.1	144.08
25-Jun-2023 02:30:00	8.93	11.08	32.21	81	8.45	1.29	50.38	9.09	145.1
25-Jun-2023 03:00:00	9.62	11.95	29.71	87.86	7.58	1.29	49.3	8.32	144.67
25-Jun-2023 03:30:00	9.62	12	32.42	79.92	7.42	1.25	52.04	9.13	146.03
25-Jun-2023 04:00:00	8.92	11.13	24.48	85.64	8.5	1.52	35.8	9.22	144.29
25-Jun-2023 04:30:00	9.24	11.55	25.53	84.98	8.13	1.47	54.76	10.59	144.02
25-Jun-2023 05:00:00	9.43	11.74	26.65	87.49	7.88	1.3	40.9	8.02	144.15
25-Jun-2023 05:30:00	9.21	11.4	25.19	80.12	8.34	1.36	47.62	3.84	143.77

25-Jun-2023 06:00:00	9.33	11.61	27.47	81.3	7.84	1.43	39.41	4.87	144.59
25-Jun-2023 06:30:00	9.54	11.91	26.65	74.93	7.55	1.46	45.52	5.28	144.54
25-Jun-2023 07:00:00	8.56	10.53	27.81	82.11	8.74	1.43	43.49	4.21	145
25-Jun-2023 07:30:00	8.06	10	30.9	88.19	9.17	1.47	41.43	2.34	144.4
25-Jun-2023 08:00:00	7.87	9.74	32.67	79.92	9.49	1.1	34.47	3.52	143.88
25-Jun-2023 08:30:00	10.15	12.6	31.82	82.18	7.05	1.36	55.17	4.22	144.57
25-Jun-2023 09:00:00	8.94	10.98	30.91	71.32	8.54	0.63	48.95	5.55	145.66
25-Jun-2023 09:30:00	9.24	11.52	28.87	83.45	8.02	0.52	39.77	3.51	145.59
25-Jun-2023 10:00:00	8.83	11	14.44	87.74	8.52	0.09	28.83	3.8	146
25-Jun-2023 10:30:00	9.2	11.41	16.12	85.58	8.09	0.67	34.19	3.92	146.83
25-Jun-2023 11:00:00	8.48	10.5	18.09	85.03	8.93	0.23	49.12	4.71	146.78
25-Jun-2023 11:30:00	10.02	12.48	17.76	79.78	7.36	0.2	55.89	4.45	143.72
25-Jun-2023 12:00:00	9.72	12.14	25.05	79.58	7.47	0.2	62.5	3.64	142.59
25-Jun-2023 12:30:00	9.56	11.97	27.31	66.39	7.65	0.15	54.66	3.14	142.01

25-Jun-2023 13:00:00	9.95	12.52	26.52	78.34	7.14	-0.41	56.72	2.83	140.06
25-Jun-2023 13:30:00	9.73	12.22	29.6	70.11	7.47	-0.52	52.12	2.52	140.51
25-Jun-2023 14:00:00	9.26	11.71	27.45	80.25	7.94	-0.66	39.43	2.74	140.25
25-Jun-2023 14:30:00	8.82	11.12	27.54	77.64	8.4	-0.39	42.11	2.92	139.91
25-Jun-2023 15:00:00	8.99	11.41	27.29	72.4	7.96	-0.12	44.96	3.29	139.67
25-Jun-2023 15:30:00	9.88	12.47	31.45	65.64	6.98	-0.27	61.58	2.15	139.58
25-Jun-2023 16:00:00	9.75	12.3	31.32	64.58	7.17	-0.1	57.06	3.17	140.29
25-Jun-2023 16:30:00	8.23	10.37	27.37	73.89	8.82	0.6	38.54	3.22	143.45
25-Jun-2023 18:00:00	8.24	10.54	26.56	71.39	8.93	1.47	35.89	3.42	133.05
25-Jun-2023 18:30:00	6.91	8.61	19.08	61.69	10.73	1.32	15.68	4.37	131.88
25-Jun-2023 19:00:00	9.48	12.3	23.54	75.17	7.37	1.57	41.62	5.89	129.14
25-Jun-2023 19:30:00	8.78	11.35	28.06	71.82	8.12	1.37	42.77	4.62	129.97
25-Jun-2023 20:30:00	8.69	11.2	26.85	74.61	8.37	1.42	39.16	5.62	129.61
25-Jun-2023 21:00:00	9.33	11.87	26.33	70.91	7.73	1.46	61.91	5	133.49

25-Jun-2023 21:30:00	8.48	10.85	26.39	75.49	8.53	1.53	39.25	5.22	134.28
25-Jun-2023 22:00:00	8.53	10.88	25.77	73.98	8.57	1.39	43.41	5.8	135.88
25-Jun-2023 22:30:00	9.45	11.95	31.18	78.39	7.66	1.49	61.05	5.63	136.71
25-Jun-2023 23:00:00	9.37	11.73	27.37	74.26	8.02	1.48	47.93	5.82	139.04
25-Jun-2023 23:30:00	8.48	10.65	24.2	78.51	8.95	1.47	34.71	6.04	139.77
26-Jun-2023 00:00:00	8.51	10.66	27.07	76.68	8.88	1.48	44.09	5.3	139.23
26-Jun-2023 00:30:00	8.72	10.98	30.38	86.66	8.43	1.5	59.43	6.49	139.66
26-Jun-2023 01:00:00	7.74	9.63	29.57	76.37	9.66	1.45	43.39	4.91	138.56
26-Jun-2023 01:30:00	9.25	11.59	28.3	81.66	7.92	1.55	50.33	5.53	139.67
26-Jun-2023 02:00:00	7.92	9.74	22.72	83.26	9.58	1.68	33.37	6.91	140.02
26-Jun-2023 02:30:00	8.89	11.18	25.9	80.43	8.18	1.65	40.5	7.28	140.64
26-Jun-2023 03:00:00	9.57	12	25.69	80.57	7.44	1.69	42.99	6.56	142.15
26-Jun-2023 03:30:00	9.89	12.46	29.68	72.51	7.08	1.4	54.92	6.67	143.07
26-Jun-2023 04:00:00	10.26	13.01	28.91	64.01	6.62	1.25	74.22	9.9	141.01

26-Jun-2023 04:30:00	9.66	12.2	32.05	66.37	7.3	1.35	62.1	6.89	140.87
26-Jun-2023 05:00:00	9.27	11.62	32.4	79.34	7.96	1.47	58.17	5.02	141.1
26-Jun-2023 05:30:00	10.37	13.05	32.25	62.52	6.58	1.26	74.32	5.49	142.38
26-Jun-2023 06:00:00	10.14	12.71	30	67.37	6.82	1.17	64.99	5.62	143.28
26-Jun-2023 06:30:00	9.63	12.07	28.19	71.99	7.28	1.14	58.03	7.36	143.05
26-Jun-2023 07:00:00	9.51	11.97	37.35	67.12	7.39	1.15	57.86	7.19	141.66
26-Jun-2023 07:30:00	8.64	10.85	31.89	73.44	8.46	1.19	38.93	8.67	141.69
26-Jun-2023 08:00:00	8.4	10.64	32.44	66.16	8.63	1.39	38.75	8.78	140.87
26-Jun-2023 08:30:00	8.85	11.21	31.38	57.52	8.24	1.3	39.91	10.42	140.44
26-Jun-2023 09:00:00	8.07	9.95	22.94	60.77	9.48	1.28	27.61	11.36	141.62
26-Jun-2023 09:30:00	8.48	10.56	14.06	65.99	8.86	1.32	25.46	12.45	142.17
26-Jun-2023 10:00:00	8.68	10.85	22.65	67.46	8.66	1.34	39.69	11.82	141.24
26-Jun-2023 10:30:00	9.23	11.58	30.89	67.44	7.93	1.33	55.95	13.53	141.89
26-Jun-2023 11:00:00	9.55	11.98	30.73	66.4	7.61	1.23	70.75	12.72	141.33

26-Jun-2023 11:30:00	8.26	10.43	27.35	70.11	9.04	1.18	43.79	11.98	137.94
26-Jun-2023 12:00:00	6.96	8.62	21.96	65.82	10.78	1.08	22.41	11.34	134.98
26-Jun-2023 13:00:00	6.45	7.66	18.95	65.89	11.75	1.22	12.76	11.7	127.96
26-Jun-2023 13:30:00	7.75	9.67	25.7	83.5	9.56	1.16	34.3	11.5	133.84
26-Jun-2023 14:00:00	7.65	9.59	29.36	79.84	9.54	1.26	36.87	12.13	139.27
26-Jun-2023 14:30:00	7.87	9.87	26.96	80.93	9.42	1.13	31.2	11.54	137.9
26-Jun-2023 15:00:00	9.02	11.49	24.5	62.55	8.04	0.22	38.59	13.06	138.45
26-Jun-2023 15:30:00	10.12	12.98	25.1	63.07	6.66	-2.05	49.81	11.48	138.23
26-Jun-2023 16:00:00	9.82	12.31	27.03	69.55	7.24	-1.38	59.6	10.03	139.76
26-Jun-2023 16:30:00	9.55	12.08	28.83	75.57	7.41	0.69	49.5	3.43	141.66
26-Jun-2023 17:00:00	8.45	10.62	27.38	76.76	8.79	1.16	37.68	3.22	141.03
26-Jun-2023 17:30:00	8.43	10.59	25.86	65.21	8.86	1.53	33.22	3.64	141.84
26-Jun-2023 18:00:00	8.19	10.19	26.32	74.59	9.22	1.27	30.49	3.89	141.66
26-Jun-2023 18:30:00	7.49	9.27	24.94	72.04	10.05	1.09	22.01	3.98	139.96

26-Jun-2023 19:00:00	8.53	10.64	29.39	60.06	8.85	1.14	35.99	5.6	141.01
26-Jun-2023 19:30:00	9.53	11.78	30.04	58.56	7.83	1.08	38.86	7.13	145.17
26-Jun-2023 20:00:00	7.92	9.66	25.89	64.46	9.68	1.12	27.86	7.19	147.51
26-Jun-2023 20:30:00	7.3	8.45	23.7	77.22	10.76	1.11	24.92	7.7	142.54
26-Jun-2023 21:00:00	6.87	8.23	21.95	75.49	10.98	1.2	19.03	8.94	137.5
26-Jun-2023 21:30:00	8.46	10.52	26.02	71.28	8.93	1.17	38.04	11.05	138.97
26-Jun-2023 22:00:00	7.94	9.72	26.74	71.15	9.68	1.12	36.14	11.32	140.41
26-Jun-2023 23:00:00	10.05	12.78	27.29	75.91	7.05	1.2	51.29	5.56	134.75
26-Jun-2023 23:30:00	10.39	13.02	29.67	65.74	6.63	1.12	62.72	4.59	140.82
27-Jun-2023 00:00:00	10.25	12.8	31.64	62.14	6.82	1.18	65.27	4.21	143.82
27-Jun-2023 00:30:00	9.55	11.76	33.67	70.72	7.75	1.13	55.13	5.02	144.55
27-Jun-2023 01:00:00	10.13	12.67	29.84	65.98	7.09	1.13	48.68	5.45	143.73
27-Jun-2023 01:30:00	10.65	13.26	33.59	69.87	6.39	1.18	76.9	6.78	142.91
27-Jun-2023 02:00:00	9.13	11.5	32.23	68.74	7.88	1.29	53.03	4.03	140.14

27-Jun-2023 02:30:00	7.15	8.88	26.48	74.33	10.2	1.22	26.01	8.39	137.84
27-Jun-2023 03:00:00	7.99	9.99	28.22	72.16	9.17	1.28	32.97	9.79	137.56
27-Jun-2023 03:30:00	10.4	13.19	32.25	62.88	6.39	1.25	69.75	10.79	140.92
27-Jun-2023 04:00:00	9.29	11.67	28.94	76.51	7.88	1.27	56.57	9.14	140.66
27-Jun-2023 04:30:00	10.03	12.68	33.13	65.71	6.75	1.15	78.08	6.98	142.19
27-Jun-2023 05:00:00	10.49	13.08	39.27	69.39	6.36	1.19	84.74	7.78	144.61
27-Jun-2023 05:30:00	10.41	12.9	35.72	70.27	6.74	1.1	69.4	8.17	144.72
27-Jun-2023 06:00:00	9.4	11.5	36.63	82.6	7.91	1.15	60.92	8.98	144.78
27-Jun-2023 06:30:00	9.82	12.2	29.55	70.9	7.28	1.14	62.9	9.82	144.83
27-Jun-2023 07:00:00	9.71	12.03	23.78	65.14	7.38	1.16	71.15	11.19	144.74
27-Jun-2023 07:30:00	9.38	11.57	30.3	65.18	7.91	1.21	60.38	11.32	145.53
27-Jun-2023 08:00:00	9.84	12.18	33.52	67.89	7.33	1.18	56.88	11.55	145.92
27-Jun-2023 08:30:00	8.15	9.91	25.89	65.48	9.47	1.17	26.9	11.28	144.54
27-Jun-2023 09:00:00	10.1	12.54	22.79	68.19	7.19	0.87	44.59	12.07	145.04

27-Jun-2023 09:30:00	9.27	11.38	27.66	70.92	8.1	0.69	41.02	11.51	146.06
27-Jun-2023 10:00:00	9.13	11.27	31.63	60.95	8.05	1.06	43.28	11.54	145.71
27-Jun-2023 10:30:00	9.03	11.12	33.44	67.48	8.26	0.81	43.13	11.92	145.83
27-Jun-2023 11:00:00	10.41	12.84	35.71	67.07	6.67	1.06	61.1	13.77	147.16
27-Jun-2023 11:30:00	8.37	10.23	20.03	72.03	9.03	1.24	32.22	14.78	142.2
27-Jun-2023 12:00:00	9.22	11.47	29.16	73.49	7.89	1.45	45.27	12.9	141.46
27-Jun-2023 12:30:00	8.7	10.89	26.37	68.63	8.27	1.62	38.38	12.92	139.92
27-Jun-2023 13:00:00	10.38	13.05	31.86	70.78	6.34	1.36	59.2	13.13	140.58
27-Jun-2023 13:30:00	8.61	10.69	34.41	74.82	8.49	1.06	42.31	12.91	141.72
27-Jun-2023 14:00:00	9.74	12.13	33.2	74.25	7.24	0.46	43.13	12.68	142.65
27-Jun-2023 14:30:00	9.41	11.69	34.68	73.68	7.74	0.24	44.85	11.65	143.32
27-Jun-2023 15:00:00	8.63	10.71	29.88	72.65	8.89	-0.71	48.72	12.6	143.1
27-Jun-2023 15:30:00	8.34	10.34	28.46	75.08	9.03	-0.38	37.16	13.37	142.53
27-Jun-2023 16:00:00	7.58	9.35	27.53	72.48	9.86	-0.13	26.71	8.18	144.48

27-Jun-2023 16:30:00	8.63	10.64	31.43	68.71	8.68	0.11	66.97	8.45	144.54
27-Jun-2023 17:00:00	9.09	11.25	33.56	69.14	8.13	0.23	55	9.5	144.54
27-Jun-2023 17:30:00	8.4	10.36	29.64	73.32	9.04	0.33	38.36	10.67	144.6
27-Jun-2023 18:00:00	7.58	9.24	25.4	73.26	10.02	0.79	30.29	11.04	143.73
27-Jun-2023 18:30:00	8.97	11.13	28.37	66.95	8.37	0.53	49.48	11.47	144.26
27-Jun-2023 19:00:00	6.78	8.08	24.55	74.44	11.03	0.68	23.16	12.25	143.48
27-Jun-2023 19:30:00	9.09	11.31	25.6	61.98	8.24	0.64	45.09	13.82	143.27
27-Jun-2023 20:00:00	9.34	11.55	26.64	64.42	8.03	1.21	46.79	16.04	144.76
27-Jun-2023 20:30:00	10.23	12.58	30.27	58.79	7.12	1.19	91.85	19.91	146.95
27-Jun-2023 21:00:00	9.84	12.12	31.4	69.26	7.46	1.16	53.2	21.21	147.21
27-Jun-2023 21:30:00	9.41	11.55	25.35	61.71	8.11	1.12	70.93	20.86	147.09
27-Jun-2023 22:00:00	8.89	10.96	26.3	69.5	8.67	1.08	39.37	22.45	146.2
27-Jun-2023 22:30:00	6.79	7.91	23.53	69.68	11.3	1.03	16.83	22.56	144.22
27-Jun-2023 23:00:00	8.77	10.73	29.28	63.72	8.66	1.09	36.48	22.41	143.43

27-Jun-2023 23:30:00	10.44	12.8	35.6	61.88	6.9	0.74	64.57	23.41	147.2
28-Jun-2023 00:00:00	9.96	12.22	34.05	71.3	7.45	0.98	48.52	25.69	147.63
28-Jun-2023 00:30:00	10.59	13.03	33.13	64.6	6.65	1.22	57.61	28.03	148.06
28-Jun-2023 01:00:00	10.43	12.89	28.98	59.19	6.76	1.17	44.64	26.89	148.37
28-Jun-2023 01:30:00	10.4	12.76	27.23	69.78	6.87	1.17	45.87	23.31	148.37
28-Jun-2023 02:00:00	8.46	10.4	20.64	60.6	9.03	1.13	27.25	29.44	145.71
28-Jun-2023 02:30:00	6.73	7.64	16.25	74.71	11.57	1.28	13.31	23.5	143.68
28-Jun-2023 03:00:00	6.6	7.2	15.42	75.3	11.98	1.28	10.84	25.57	141.72
28-Jun-2023 03:30:00	7.33	9.01	17.96	76.57	10.24	1.15	14.28	15.36	141.47
28-Jun-2023 04:30:00	7.91	9.75	22.71	75.88	9.59	0.92	22.97	15.75	139.03
28-Jun-2023 06:30:00	6.66	7.78	15.97	81.28	11.7	0.71	12.05	24.47	128.27
28-Jun-2023 07:00:00	6.13	7.11	16.77	76.66	11.95	1.42	18.32	22.8	116.11
28-Jun-2023 08:30:00	6.47	8.47	16.06	77.73	10.48	1.41	16.26	21.64	114.86
28-Jun-2023 09:00:00	8.36	11	24.69	73.88	8.27	0.93	32.42	23.71	121.02

28-Jun-2023 09:30:00	6.42	7.2	21.56	81.26	11.78	0.07	19.91	35.27	125.16
28-Jun-2023 10:30:00	6.69	8.11	1.73	75.46	11.07	-0.53	12.42	51.83	125.18
28-Jun-2023 11:00:00	8.26	10.45	11.49	80.79	8.86	-0.34	27	43.35	133.92
28-Jun-2023 11:30:00	7.41	9.09	15.72	84.11	10.07	0.06	23.96	38.66	138.02
28-Jun-2023 12:00:00	8.27	10.27	17.34	79.99	8.97	0.26	41.43	25.47	140.34
28-Jun-2023 12:30:00	9.11	11.45	23.05	77.3	7.82	0.33	50.71	25.62	140.61
28-Jun-2023 13:00:00	9.03	11.41	27.8	83.94	7.94	0.15	49.92	20.22	138.38
28-Jun-2023 16:00:00	6.63	8.18	19.93	78.85	10.96	-0.81	20.25	25.88	130.33
28-Jun-2023 16:30:00	8.47	10.77	22.39	85.7	8.71	-0.91	35.61	27.85	132.82
28-Jun-2023 17:00:00	7.67	9.66	23.28	80.83	9.63	0.06	28.42	26.7	135.02
28-Jun-2023 17:30:00	7.78	9.82	21.98	78.4	9.36	0.93	28.61	34.18	135.98
28-Jun-2023 18:00:00	8.99	11.32	27.91	76.47	8.03	1.19	43.87	26.58	138.83
28-Jun-2023 18:30:00	9.11	11.41	30.25	66.79	7.93	0.91	43.59	24.56	140.48
28-Jun-2023 19:00:00	8.94	11.19	30.11	68.83	8.08	0.5	43.6	26.35	141.24

28-Jun-2023 19:30:00	8.66	10.68	17.63	73.62	8.64	0.76	40.37	38.62	142.14
28-Jun-2023 20:00:00	7.71	9.46	22.56	84.37	9.77	0.82	25.85	32.27	142.39
28-Jun-2023 20:30:00	8.6	10.69	20.94	72.42	8.74	0.57	31.36	27.79	141.54
28-Jun-2023 21:00:00	9.61	12	28.35	90.07	7.59	0.79	50.63	29.98	143.28
28-Jun-2023 21:30:00	8.94	11.06	30.53	81.17	8.5	0.67	38.93	32.88	143.14
28-Jun-2023 22:00:00	7.78	9.06	28.38	91.29	10.22	0.61	35.78	42.8	143.36
28-Jun-2023 22:30:00	8.89	11.12	30.29	85.16	8.18	0.58	38.24	33.91	142.14
28-Jun-2023 23:00:00	10.65	13.29	35.59	85.42	6.43	0.24	62.43	28.41	143.76
28-Jun-2023 23:30:00	9.94	12.38	34.08	94.85	7.27	0.46	53.66	39.83	145.32
29-Jun-2023 00:30:00	8.69	10.72	27.29	88.68	8.87	0.43	36	39	140.49
29-Jun-2023 01:00:00	7.89	9.58	18.84	87.5	9.65	0.46	28.78	52.43	140.56
29-Jun-2023 01:30:00	9.7	12.11	30.65	81.45	7.44	0.44	51.5	32	143.94
29-Jun-2023 02:00:00	8.9	10.97	28.37	91.28	8.56	0.59	40.35	51.96	144.81
29-Jun-2023 02:30:00	9.47	11.76	32.72	91.06	7.84	0.53	48.45	52.98	145.17

29-Jun-2023 03:00:00	10.15	12.55	37.42	91.01	7.18	0.27	66.9	50.78	145.7
29-Jun-2023 03:30:00	7.73	9.55	33.52	82.54	9.59	-0.22	35.84	50.87	144.69
29-Jun-2023 04:00:00	7.41	9.14	30.91	84.68	9.97	0	33.48	54.37	143.14
29-Jun-2023 04:30:00	9.06	11.26	31.61	81.17	8.35	-0.09	43.95	58.3	143.15
29-Jun-2023 05:00:00	8.48	10.47	34.16	79.46	8.91	0.21	46.46	62.8	144.04
29-Jun-2023 05:30:00	7.37	8.71	32.67	87.06	10.39	0.16	33.32	51.76	142.26
29-Jun-2023 06:00:00	8.46	10.28	33.49	82.08	9.1	0.02	49	47.99	142.89
29-Jun-2023 06:30:00	9.31	11.58	30.76	77.6	7.96	0.36	42.79	32.05	144.42
29-Jun-2023 07:00:00	9.26	11.49	31	68.9	8.06	0.57	44.96	42.85	145.97
29-Jun-2023 07:30:00	8.36	10.36	27.02	69.29	9.22	0.35	31.25	46.62	144.44
29-Jun-2023 08:00:00	7.5	8.65	27.1	83.09	10.68	-0.25	30.25	31.22	144.42
29-Jun-2023 08:30:00	8.45	10.29	30	71.65	9.07	0.24	39.46	33.86	143.95
29-Jun-2023 09:00:00	9.45	11.72	32.87	76.59	7.86	-0.39	51.97	35.34	145.64
29-Jun-2023 09:30:00	8.52	10.54	22.07	78.77	8.93	-1.08	32.08	42.38	146.52

29-Jun-2023 10:00:00	9.22	11.36	28.79	81.68	8.16	-1.02	42.04	37.13	147.89
29-Jun-2023 10:30:00	8.67	10.71	26.94	80.24	8.74	-1.27	31.83	39.47	148.51
29-Jun-2023 12:00:00	10.24	12.8	26.23	74.02	7	-0.91	51.05	11.83	142.13
29-Jun-2023 12:30:00	10.74	13.31	29.19	79.5	6.58	-1.5	54.39	10.75	146.34
29-Jun-2023 13:00:00	11.63	14.25	29.13	81.02	5.51	-0.91	59.43	11.77	150.97
29-Jun-2023 13:30:00	10.61	12.99	30.72	73.04	6.68	-0.08	45.88	10.68	151.35
29-Jun-2023 14:00:00	8.72	9.87	30.04	57.62	9.53	-0.45	35.01	13.42	151.41Gas Analyzer HT line observed choking
03-Jul-2023 00:00:00	-	-	-	-	-	-	-	-	-Plant Stop
03-Jul-2023 00:30:00	-	-	-	-	-	-	-	-	-
03-Jul-2023 01:00:00	-	-	-	-	-	-	-	-	-
03-Jul-2023 01:30:00	-	-	-	-	-	-	-	-	-
03-Jul-2023 02:00:00	-	-	-	-	-	-	-	-	-
03-Jul-2023 02:30:00	-	-	-	-	-	-	-	-	-
03-Jul-2023 03:00:00	-	-	-	-	-	-	-	-	-

03-Jul-2023 03:30:00	-	-	-	-	-	-	-	-	-
03-Jul-2023 04:00:00	-	-	-	-	-	-	-	-	-
03-Jul-2023 04:30:00	-	-	-	-	-	-	-	-	-
03-Jul-2023 05:00:00	-	-	-	-	-	-	-	-	-
03-Jul-2023 05:30:00	-	-	-	-	-	-	-	-	-
03-Jul-2023 06:00:00	-	-	-	-	-	-	-	-	-
03-Jul-2023 06:30:00	-	-	-	-	-	-	-	-	-
03-Jul-2023 07:00:00	-	-	-	-	-	-	-	-	-
03-Jul-2023 07:30:00	-	-	-	-	-	-	-	-	-
03-Jul-2023 08:00:00	-	-	-	-	-	-	-	-	-
03-Jul-2023 08:30:00	-	-	-	-	-	-	-	-	-
03-Jul-2023 09:00:00	-	-	-	-	-	-	-	-	-
03-Jul-2023 09:30:00	-	-	-	-	-	-	-	-	-
03-Jul-2023 10:00:00	-	-	-	-	-	-	-	-	-

03-Jul-2023 10:30:00	-	-	-	-	-	-	-	-	-Gas Analyzer HT line observed choking
03-Jul-2023 11:00:00	0	0	0	0	0	0	0	0	0Work continue for resolving issue
04-Jul-2023 00:00:00	6.5	7.73	15.3	59.51	11.66	1.59	4.44	24.3	130.56
04-Jul-2023 00:30:00	6.58	7.59	20.59	71.06	11.68	1.57	7.88	23.1	133.83
04-Jul-2023 01:00:00	7.31	8.99	21.29	66.36	10.49	1.29	10.71	22.46	136.75
04-Jul-2023 01:30:00	7.36	9.23	22.82	68.61	10.18	0.62	14.03	21.84	139.13
04-Jul-2023 02:00:00	7.87	9.73	23.16	70.2	9.83	1.09	17.37	23.35	141.72
04-Jul-2023 02:30:00	7.61	9.25	24.08	65.45	10.09	1.36	16.36	21.91	142.68
04-Jul-2023 03:00:00	8.52	10.63	27.52	63.18	8.83	1.25	28.89	19.16	144.52
04-Jul-2023 03:30:00	6.98	8.31	23.04	63.98	10.95	1.34	16.61	19.39	144.9
04-Jul-2023 04:00:00	7.5	9.11	48.71	27.8	10.68	1.3	7.05	28.68	143.51
04-Jul-2023 04:30:00	6.39	8.46	38.89	18.94	8.33	1.64	4.99	38.89	142.46
04-Jul-2023 05:00:00	6.21	8.39	41.38	14.16	8.4	1.6	5.28	27.14	141.58
04-Jul-2023 05:30:00	5.72	7.22	35.58	13.42	8.56	1.59	5.46	25.18	139.97

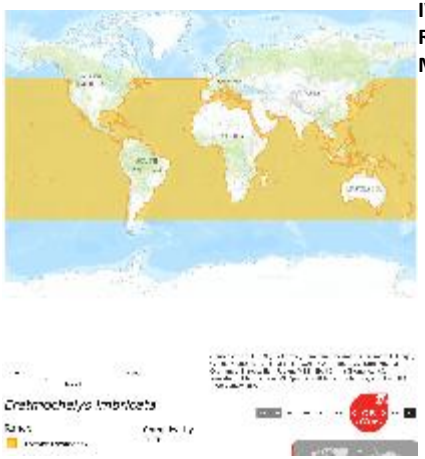
04-Jul-2023 06:00:00	5.86	7.26	38.74	13.05	10.51	1.4	4.99	21.36	140.59
04-Jul-2023 06:30:00	6.74	8.22	42.57	12.51	9.58	1.34	4.99	24.33	139.91
04-Jul-2023 07:00:00	6.71	8.21	28.14	10.99	8.57	1.26	5.02	22.86	140.06
04-Jul-2023 07:30:00	7.61	9.18	34.45	11.21	8.58	1.23	5.09	25.92	137.4
04-Jul-2023 08:00:00	7.44	9.13	25.81	11.09	8.65	1.13	5.25	19.61	134.13
04-Jul-2023 08:30:00	7.53	9.16	30.6	10.51	8.62	1.2	4.33	18.19	135.76
04-Jul-2023 09:00:00	7.67	9.2	27.28	9.57	8.57	1.13	4.99	28.44	139.13
04-Jul-2023 09:30:00	7.71	9.21	30.1	9.11	10.57	0.59	4.93	25.42	140.84
04-Jul-2023 10:00:00	6.44	8.13	24.78	9.92	8.68	0.64	4.97	22.71	135.75
04-Jul-2023 10:30:00	5.1	7.03	8.27	7.17	8.78	0.7	5.02	23.24	125.3
04-Jul-2023 11:00:00	5.42	7.58	2.68	12.42	9.21	0.75	5.37	18.44	119.15
04-Jul-2023 11:30:00	6.92	8.9	16.6	22.94	11	0.76	7.97	31.08	125.04
04-Jul-2023 12:00:00	6.58	8.77	13	10.12	11.97	0.76	2.68	27.9	135.12
04-Jul-2023 12:30:00	7.19	9.25	16.87	3.69	10.53	0.65	1.42	29.51	135.83

04-Jul-2023 13:00:00	7.11	9.13	16.87	2.54	10.66	0.75	1.25	29.12	139.94
04-Jul-2023 13:30:00	7.08	9.09	22.14	2.08	8.69	0.66	0.88	30.43	142.18
04-Jul-2023 14:00:00	6.1	8.12	31.83	1.87	8.67	0.88	1.18	31.99	143.17
04-Jul-2023 14:30:00	6.1	8.12	25.66	1.7	7.68	0.45	1.21	27.95	144.17
04-Jul-2023 15:00:00	6.15	8.2	15.56	2.09	7.6	0.86	1.25	26.76	142.24
04-Jul-2023 15:30:00	6.39	8.55	22.72	51.41	6.74	0.88	9.78	27.28	140.32
04-Jul-2023 16:00:00	7.56	9.2	26.61	68.1	5.97	0.76	19.4	7.87	142.86
04-Jul-2023 16:30:00	9.52	11.98	30.02	77.37	7.7	0.59	3.31	15.42	143.86
04-Jul-2023 17:00:00	9.49	11.65	32.24	71.14	7.95	0.38	4.87	16.73	147.28
04-Jul-2023 17:30:00	9.21	11.22	32.67	81.92	8.27	0.75	4.08	15.05	149.54
04-Jul-2023 18:00:00	9.33	11.14	32.56	56.53	8.27	0.66	7.78	18.34	151.15
04-Jul-2023 18:30:00	8.74	10.55	30.57	66.33	8.93	0.78	7.75	17.44	149.88
04-Jul-2023 19:00:00	6.87	7.83	48.66	54.13	11.37	0.94	9.03	32.28	149.26
04-Jul-2023 19:30:00	8.07	10.34	36.38	13.79	10.43	1.01	7.63	35.37	143.37

04-Jul-2023 20:00:00	7.94	9.31	22.05	11.48	10.48	1.28	6.24	43.32	137.12
04-Jul-2023 20:30:00	8.83	10.27	34.04	9.72	11.5	1.31	7.11	38.99	134.44
04-Jul-2023 21:00:00	8.67	10.22	10.24	10.25	8.57	1.33	4.93	36.11	133.17
04-Jul-2023 21:30:00	6.59	8.19	19.43	9.06	8.59	1.12	5.14	35.67	132.39
04-Jul-2023 22:00:00	8.49	9.16	31.96	8.59	8.61	1.16	6.2	33.2	134.66
04-Jul-2023 22:30:00	8.39	10.11	10.55	8.67	8.65	1.28	5.12	29.7	133.51
04-Jul-2023 23:00:00	7.52	9.21	14.93	9.29	8.55	0.83	5.01	22.25	136.21
04-Jul-2023 23:30:00	8.2	10.67	12.31	21.97	10.27	1.19	8.83	28.52	137.64
05-Jul-2023 00:00:00	8.3	10.46	33.68	69.17	9	1.15	40.57	22.7	137.34
05-Jul-2023 00:30:00	8.35	10.46	36.61	69.38	8.84	1.27	42.6	22.04	138.52
05-Jul-2023 01:00:00	8.58	10.87	32.66	73	8.61	1.42	36.61	23.48	136.46
05-Jul-2023 01:30:00	9.15	11.47	37.95	68.89	7.85	1.45	56.26	21.37	138.99
98 Percentile	**10.3858**	**12.8958**	**45.7674**	**91.9048**	**11.6916**	**4.767**	**71.0576**	**46.2798**	**150.2974**

APPENDIX 21: CRITICAL HABITAT SCREENING

Appendix 21: Critical Habitat Screening

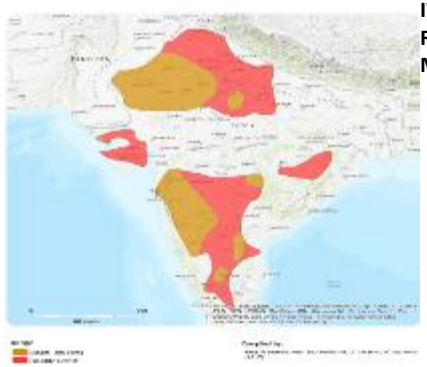
S.N.	Common English Name (Binomial Scientific Name) Distribution Map	IUCN[1] Categories IWP[2] Schedules Endemicity Migratory Status	CHA Criteria	Screening Argument	Screened In or Out
Herpetofauna					
1	Hawksbill Turtle (*Eretmochelys imbricata*)  https://www.iucnredlist.org/species/8005/12881238	**IUCN:** 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)[3]. 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[4]. 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[5, 6]. The species has also not been reported from the surroundings of Jamnagar area[7].	Screened Out
2	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	Screened Out

[1] IUCN RedList - Online Version 2023-1
[2] Indian Wildlife (Protection) Act. 1972
[3] https://www.seaturtlesofindia.org/about/species/hawksbill/#:~:text=In%20India%2C%20hawksbills%20are%20found,to%20reach%20the%20nesting%20beach).
[4] 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.
[5] https://www.seaturtlesofindia.org/about/distribution/gujarat/
[6] https://www.researchgate.net/publication/237308904_The_status_of_sea_turtle_populations_on_the_Gujarat_coast_of_India
[7] https://www.inaturalist.org/observations?iconic_taxa=Amphibia,Reptilia&lat=22.486977569578578&lng=70.06248615708378&place_id=any&radius=25.85506205566563&subview=map

	 https://www.iucnredlist.org/species/220353080/220353155			are highly migratory and they undertake complex movements and migrations through geographically disparate habitats. [8] In India, Green Turtles are found in Andaman Island, Gujarat, Lakshwadeep Island, Nicobar Island.[9] Their movements within the marine environment are less understood but it is believed that green turtles inhabit coastal waters of over 140 countries[10] It has been hypothesized that hatchlings begin an oceanic phase[11], perhaps floating passively in major current systems (gyres) that serve as open-ocean developmental grounds.[12] 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.[13] Upon attaining sexual maturity green turtles commence breeding migrations between foraging grounds and nesting areas that are undertaken every few years.[14] The species distribution map includes all the coasts of the country (India). As per the available secondary information, the species has been reported from the Gujarat state[15]; however, no record of the species is available from the surroundings of Jamnagar area[16].	
3	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[17] 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[18] 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[19]. 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	Screened Out

[8] 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.
[9] https://www.seaturtlesofindia.org/about/species/green/
[10] 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.

[11] Carr, A. 1987. New perspectives on the pelagic stage of sea turtle development. Conservation Biology 1: 103.
[12] Carr, A. and Meylan, A.B. 1980. Evidence of passive migration of green turtle hatchlings in Sargassum. Copeia 1980: 366-368
[13] 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.
[14] Hirth, H.F. 1997. Synopsis of the biological data on the green turtle, Chelonia mydas (Linnaeus 1758).
[15] https://www.seaturtlesofindia.org/about/distribution/gujarat/
[16]https://www.inaturalist.org/observations?iconic_taxa=Amphibia,Reptilia&nelat=22.527178923956743&nelng=70.11308670080975&place_id=any&subview=map&swlat=22.451047613759712&swlng=69.98125076330975
[17] www.iucnredlist.org/species/pdf/2930943
[18] 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.
[19] 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.

	 https://www.iucnredlist.org/species/39618/2930943			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.[20] 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, no records are available from the surroundings of Jamnagar area[21].	
Birds					
4	Great Indian Bustard (*Ardeotis nigriceps*) 	**IUCN:** Critically Endangered **IWP:** Schedule I **Restricted range:** Yes **Migratory:** No	1 a, c	Great Indian Bustard inhabits arid and semi-arid grasslands with scattered short scrub, bushes and low intensity cultivation in flat or gently undulating terrain. These birds congregate in traditional less disturbed grassland patches to breed during mid-summer and monsoon[22] Great Indian Bustard has been extirpated from 90% of its former range and is now principally confined to Rajasthan. In 2014 a survey of the Thar Desert, Rajasthan, estimated the species was present at a density of 0.61 ± 0.36 individuals/100 km^2. Smaller populations (likely to be considerably fewer than 15-20 birds[23]) are present in Gujarat, Maharashtra, Andhra Pradesh, and Karnataka states of India. In India, their population is confined mostly to Rajasthan and Gujarat. Small population occur in Maharashtra, Karnataka and Andhra Pradesh[24].	Screened Out

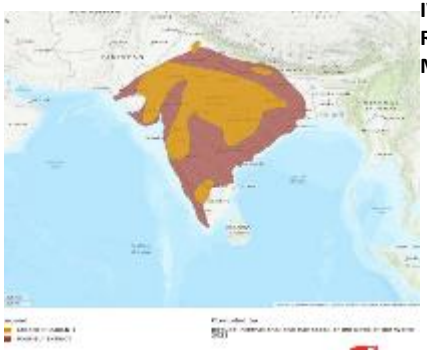
[20] https://wildlifesos.org/anti-poaching/introducing-the-indian-softshell-turtle/

[21] https://www.inaturalist.org/observations?iconic_taxa=Amphibia,Reptilia&nelat=22.660651531893684&nelng=70.60729187759638&place_id=any&subview=map&swlat=22.34092753776227&swlng=69.63362854751826

[22] Dutta, S., Bhardwaj, G.S., Bhardwaj, D.K. and Jhala, Y.V. 2014. Status of Great Indian Bustard and Associated Wildlife in Thar. Wildlife Institute of India, Dehradun and Rajasthan Forest Department, Jaipur.

[23] Patil, P. 2011. Joint meeting to discuss conservation of Great Indian Bustard sanctuary. Protected Area Update 17(3): 13.

[24] https://www.wwfindia.org/about_wwf/priority_species/threatened_species/great_indian_bustard/#:~:text=Habitat%20and%20distribution&text=Its%20stronghold%20was%20once%20the,Maharashtra%2C%20Karnataka%20and%20Andhra%20Pradesh.

	https://www.iucnredlist.org/species/22691932/134188105			Historically the species was present throughout the Kachchh and Saurashtra, but now only restricted in the Kutch Bustard Wildlife Sanctuary and Chhari Dhand[25], and there are no recent records of the species from the Jamnagar and surrounding area[26, 27].	
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[28]. 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)[29]. 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)[30], but the Jamnagar and surrounding area comes under the area where the species has been possibly extinct i.e. not recorded since long time[31, 32].	Screened Out
6	Lesser Florican (*Sypheotides indicus*)	**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[33]. 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)[34]. 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	Screened Out

[25] 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

[26] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=114

[27] https://ebird.org/species/indbus1

[28] BirdLife International. 2021. Gyps indicus. The IUCN Red List of Threatened Species 2021: e.T22729731A204672586

[29] Collar, N., Chen, H. and Crosby, M. 2001. Threatened Birds of Asia: the BirdLife International Red Data Book. BirdLife International, Cambridge, UK.

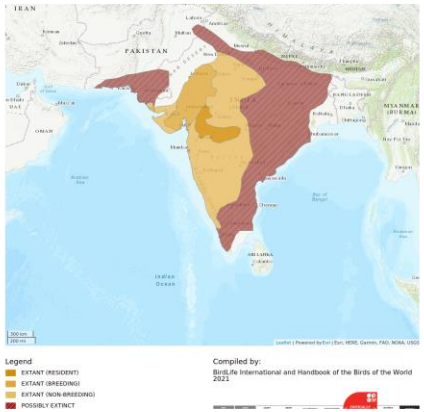
[30] Rahmani, A.R., Islam, M.Z. and Kasambe, R.M. (2016) Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated). Bombay Natural History Society, Indian Bird Conservation Network, Royal Society for the Protection of Birds and BirdLife International (U.K.).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

[31] https://ebird.org/region/IN-GJ-JA

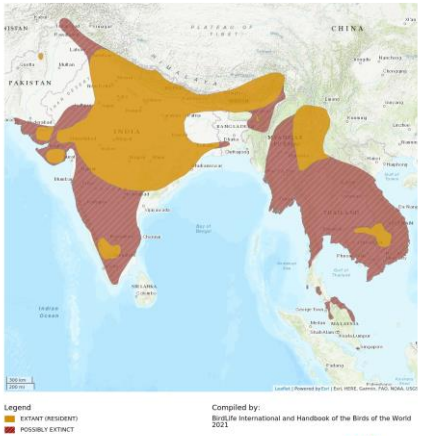
[32] https://www.inaturalist.org/observations?place_id=32154&subview=map&view=species&iconic_taxa=Aves

[33] BirdLife International. 2021. Sypheotides indicus. The IUCN Red List of Threatened Species 2021: e.T22692024A199959007

[34] 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.

	 https://www.iucnredlist.org/species/22692024/199959007			believed to be a high level of site fidelity among males[35]. 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) [36], 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 Jamnagar and the available secondary data[37, 38] also indicates unlikelihood of this species in Jamnagar and surrounding area.	
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[39]. 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[40] Although the species distribution map includes few of the coasts of the country (India), however as per the available secondary information, the species has been reported from the Gujarat state and not from the surroundings of Jamnagar area[41] 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 &	Screened Out

[35] 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.
[36] 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
[37] https://ebird.org/region/IN-GJ-JA
[38] https://www.inaturalist.org/observations?place_id=32154&subview=map&view=species&iconic_taxa=Aves
[39] 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.
[40] BirdLife International. 2021. Sarcogyps calvus. The IUCN Red List of Threatened Species 2021: e.T22695254A205031246
[41] https://ebird.org/region/IN-GJ-JA

	 https://www.iucnredlist.org/species/22695254/205031246			Nanda Island and Nikol-Samadhiyala-Malan Wetlands Complex[42]. In Saurashtra region, the species has stray records from Junagarh, Gir Somnath, Amreli and Bhavnagar districts[43]; however, there is no record of the species from the Jamnagar and surrounding area and this area also comes under the area where the species has been possibly extinct i.e. not recorded since long time[44, 45].	
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[46], 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[47], 30 at Great Rann of Kutch in November 2008 and 2012[48]. Sociable lapwing uses dry wastelands, cultivated, ploughed and stubble fields[49]. It winters in Sudan, Eritrea, Israel, Arabian Peninsula, Pakistan and India, possibly also in Iraq and Iran[50]. As per the Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated Edition - 2016) [51], 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 Saurashtra region. The	Screened Out

[42] 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

[43] https://ebird.org/species/rehvul1

[44]https://ebird.org/region/IN-GJ-JA

[45]https://www.inaturalist.org/observations?place_id=32154&subview=map&view=species&iconic_taxa=Aves

[46] Kamp, J.; Koshkin, M. A.; Sheldon, R. D. 2010. Historic breeding of Sociable Lapwing (Vanellus gregarius) in Xinjiang. Chinese Birds 1(1): 70-73.

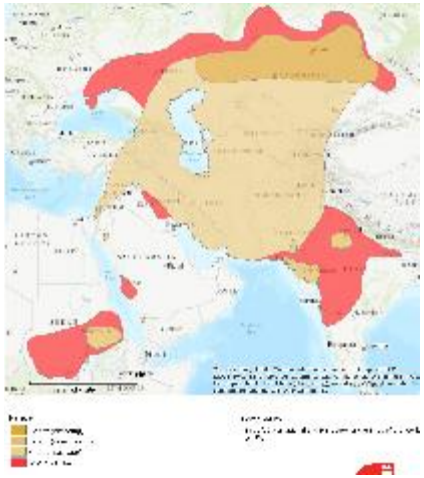
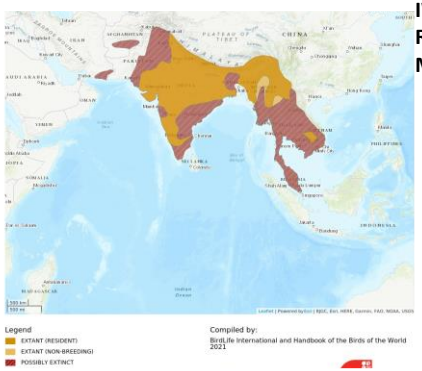
[47] Deomurari, A. 2007. Western India: Gujarat Kutch Birding and Wildlife Tour, November 2007.

[48] Sheldon, R. 2013. The Sociable Lapwing - Interim short report to the BirdLife International Preventing Extinctions Programme. BirdLife International Preventing Extinctions Programme.

[49] https://www.iucnredlist.org/species/22694053/155545788#habitat-ecology

[50] https://birdsoftheworld.org/bow/species/soclap1/cur/introduction?login

[51] 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/22694053/155545788			available secondary data[52, 53] also indicates unlikelihood of this species in Jamnagar and surrounding area.	
9	White-rumped Vulture (*Gyps bengalensis*)  https://www.iucnredlist.org/species/22695194/204618615	**IUCN:** Critically Endangered **IWP:** Schedule I **Restricted range:** No **Migratory:** No	1 a, c	White-rumped Vulture occurs mostly in plains and less frequently in hilly regions where it utilises light woodland, villages, cities, and open areas. It feeds on carrion, both putrid and fresh. While feeding considerable aggregations can form, and regular communal roost sites are used. It is social and usually found in conspecific flocks. It breeds in colonies in tall trees (e.g. in Himanchal Pradesh it is restricted to pine forest/plantations) [54], often near human habitation[55]. White-rumped Vulture occurs in Pakistan, India, Bangladesh, Nepal, Bhutan, Myanmar, Thailand, Laos, Cambodia and southern Viet Nam, and may be extinct in southern China and Malaysia. 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[56]. 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

[52] https://ebird.org/map/soclap1?bmo=1&emo=12&byr=1900&eyr=2024&env.minX=69.725&env.minY=21.698&env.maxX=70.663&env.maxY=22.937&gp=true
[53] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=4858
[54] Thakur, M. L. 2015. Breeding ecology and distribution of Whiterumped Vultures (Gyps bengalensis) in Himachal Pradesh, India. J. Raptor Research 49(2): 183-191.
[55] BirdLife International. 2021. Gyps bengalensis. The IUCN Red List of Threatened Species 2021: e.T22695194A204618615
[56] Prakash, V., Galligan, T. H., Chakraborty, S. S., Dave, R., Kulkarni, M. D., Prakash, N., Shringarpure, R. N., Ranade, S. P. and Green, R. E. 2019. Recent changes in populations of Critically Endangered Gyps vultures in India. Bird Conservation International 29: 55-70.

				As per the Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated Edition - 2016) [57], the species is reported from Banni Grassland & 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. All the above-mentioned areas are away from the Jamnagar and the available secondary data[58, 59] also indicates unlikelihood of this species in Jamnagar and surrounding area.	
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[60]. 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) [61], 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. Although the species was historically reported from the Khijadia Bird Sanctuary, however the absence of its record in the surroundings of Jamnagar since long time[62, 63] indicates the unlikelihood of this species in EAAA.	Screened Out

[57] 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

[58] https://ebird.org/map/whrvul1?neg=true&env.minX=57.88833488522253&env.minY=17.446114905442876&env.maxX=80.38833488522253&env.maxY=26.501126414758176&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

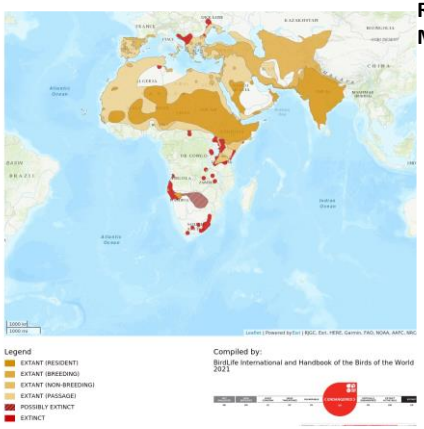
[59] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=5368

[60] https://www.iucnredlist.org/species/22694711/207933556

[61] 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

[62] https://ebird.org/map/blbter1?neg=true&env.minX=67.05476902304451&env.minY=21.294613062865974&env.maxX=72.67976902304451&env.maxY=23.554035066445092&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

[63] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=4461

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[64]. 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[65, 66, 67]. 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[68]. 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 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 Jamnagar[70], however based on available secondary information extracted from eBird Database[71] (which reports a single individual from the Khijadiya Bird Sanctuary[72]), it is less likely to meet the threshold i.e. 186-540 (≥1 percent of the global population[73]) for the EAAA.	Screened Out
12	Greater Adjutant (*Leptoptilos dubius*)	**IUCN:** Endangered **IWP:** Schedule I **Restricted range:** No **Migratory:** No	1 a, c	This species was previously widespread and common across much of South and continental South-East Asia but declined dramatically during the first half of the 20th century. It is	Screened Out

[64] BirdLife International. 2021. Neophron percnopterus. The IUCN Red List of Threatened Species 2021: e.T22695180A205187871

[65] 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.

[66] 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.

[67] 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).

[68] 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.

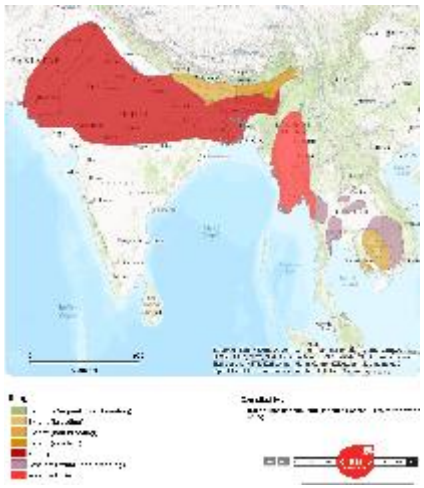
[69] Rahmani, A.R., Islam, M.Z. and Kasambe, R.M. (2016) Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated). Bombay Natural History Society, Indian Bird Conservation Network, Royal Society for the Protection of Birds and BirdLife International (U.K.).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

[70] https://ebird.org/region/IN-GJ-JA

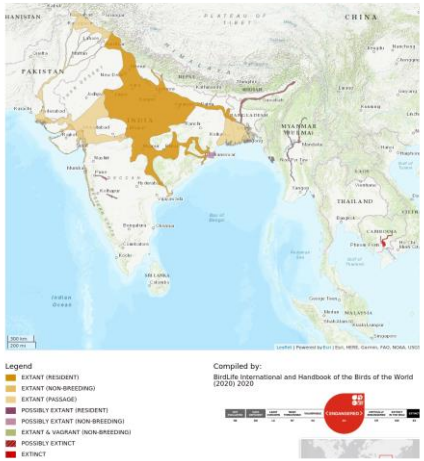
[71] https://ebird.org/map/egyvul1?neg=true&env.minX=69.67622496309086&env.minY=22.290717223309603&env.maxX=70.37934996309086&env.maxY=22.573153639948384&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

[72] https://ebird.org/view/checklist/S154601698

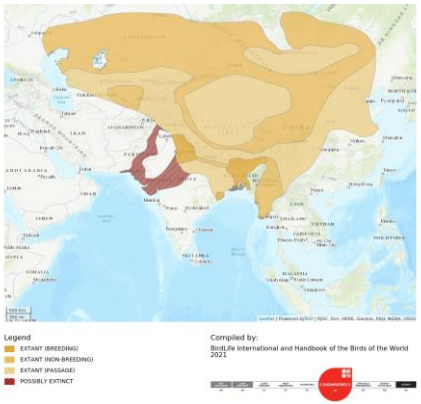
[73] https://www.iucnredlist.org/species/22696027/203868747#population

	 https://www.iucnredlist.org/species/22697721/93633471			known to breed in Assam (at least 650-800 birds, or more)[74] and Bihar (more than 350 birds)[75], India, and at the Tonle Sap lake (ca.150 pairs)[76], Cambodia. The total population is estimated to number 800-1,200 mature individuals, roughly equivalent to 1,200-1,800 individuals in total. This is based on estimates of 650-800 birds in Assam, India, and 150-200 birds in Cambodia, as well as at least 156 birds in Bihar state, India, which may have dispersed from the Assam population[77]. It inhabits wetlands, nesting in tall trees with closed canopies and bamboo clumps around nesting trees, and historically on cliffs. Breeding is thought to coincide with the dry season (October-April/May) in order to take advantage of abundant prey as water levels recede[78]. As per the Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated Edition - 2016) [79], there is no record of the species from Gujarat. The available secondary data[80, 81] also supports the unlikelihood of this species in the EAAA.	
13	Indian Skimmer (*Rynchops albicollis*)	**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[82]. The recent population decline has been accompanied by a range contraction and there are no recent confirmed breeding records from Pakistan or Myanmar[83]. 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[84], ca. 100-300 from Yamuna &	Screened In

[74] Choudhury, A. 2000. The birds of Assam. Gibbon Books and WWF-India, Guwahati, India.
[75] Choudhury, A. 2008. Counting large gatherings of globally threatened Greater Adjutant Leptoptilos dubius. Indian Birds 4(4): 133-135.
[76] Visal, S. and Mahood, S. 2015. Wildlife monitoring at Prek Toal Ramsar site, Tonle Sap Great Lake 2013 and 2014. Wildlife Conservation Society, Cambodia Program, Phnom Penh.
[77] BirdLife International. 2016. Leptoptilos dubius. The IUCN Red List of Threatened Species 2016: e.T22697721A93633471
[78] Singha, H.; Goswami, S. K.; Phukan, R.; Talukdar, B. K. 2006. Rehabilitation of captive-reared Greater Adjutants Leptoptilos dubius in Assam. Journal of the Bombay Natural History Society 103(2-3): 315-320.
[79] 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
[80] https://ebird.org/region/IN-GJ-JA
[81] https://www.inaturalist.org/observations?place_id=32154&subview=map&view=species&iconic_taxa=Aves
[82] 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.
[83] BirdLife International. 2020. Rynchops albicollis. The IUCN Red List of Threatened Species 2020: e.T22694268A178970109.
[84] eBird. 2020. eBird: An online database of bird distribution and abundance [web application]. Ithaca, NY, USA Available at: http://www.ebird.org

	 https://www.iucnredlist.org/species/22694268/178970109				Ganges rivers[85], while on the east coast between 200 - 400 have been recorded at Satkosia on the River Mahanadi in Odisha[86] and around 120 at Coringa Wildlife Sanctuary and Kakinada in Andhra Pradesh[87]. 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[88, 89, 90]. The Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated Edition - 2016)[91], 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. Undoubtedly the species has a presence in the surroundings of Jamnagar[92, 93], however based on available secondary information extracted from eBird Database[94] (which reports maximum 350 individuals from the Khijadiya Bird Sanctuary[95]), it is likely to meet the threshold i.e. 24-29 (≥1 percent of the global population[96]) for the EAAA.	
14	Pallas's Fish-eagle (*Haliaeetus leucoryphus*)	**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	Screened Out

[85] 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.
[86] 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.
[87] Wetlands International South Asia. 2020. Asian Waterbird Census: Results for Coordinated January Counts for India 2006-2015. Wetlands International New Delhi, India.
[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] 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.
[90] 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.
[91] 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
[92] https://ebird.org/region/IN-GJ-JA
[93] https://www.inaturalist.org/observations?place_id=32154&subview=map&view=species&iconic_taxa=Aves
[94] https://ebird.org/map/indski1?neg=true&env.minX=68.54149326511494&env.minY=21.822308052821807&env.maxX=71.35399326511494&env.maxY=22.952393293955367&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[95] https://ebird.org/checklist/S142507968
[96] https://www.iucnredlist.org/species/22696027/203868747#population

	 https://www.iucnredlist.org/species/22695130/199521572			numbers in Bhutan, dispersing north of the Himalayas to Kazakhstan, Russia and Mongolia in its non-breeding season (May to September)[97]. 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[98]. 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[99] and in Bangladesh it returns to nest sites in late August[100]. Although the species was historically reported from Khijadia Bird Sanctuary and Nalsarovar Wildlife Sanctuary[101]; however, the species has not been reported from Gujrat since long time[102, 103].	
15	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, 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	Screened Out

[97] BirdLife International. 2021. Haliaeetus leucoryphus. The IUCN Red List of Threatened Species 2021: e.T22695130A199521572

[98] 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.

[99] BirdLife International. 2001. Threatened birds of Asia: the BirdLife International Red Data Book. BirdLife International, Cambridge, U.K.

[100] Sourav, M.S.H., Ahmed, B. & Thompson, P. 2011. Pallas's Fish Eagle Haliaeetus leucoryphus in Bangladesh. BirdingASIA 16: 101-105.

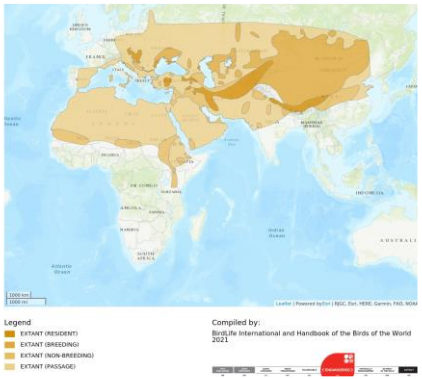
[101] Rahmani, A.R., Islam, M.Z. and Kasambe, R.M. (2016) Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated). Bombay Natural History Society, Indian Bird Conservation Network, Royal Society for the Protection of Birds and BirdLife International (U.K.).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

[102] https://ebird.org/map/pafeag1?neg=true&env.minX=68.69190612420695&env.minY=21.984009323191206&env.maxX=71.50440612420695&env.maxY=23.112781661797623&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

[103] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=5312

[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.

	 https://www.iucnredlist.org/species/22696495/204182473			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 Jamnagar area and the available secondary data[107, 108] also supports the unlikelihood of this species in the EAAA.	
16	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]. Undoubtedly the species has a presence in the surroundings of Jamnagar[113], however based on available secondary information extracted from eBird Database[114] (which reports	Screened Out

[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=58.938673787510844&env.minY=18.67141536387653&env.maxX=81.43867378751085&env.maxY=27.64867577168789&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.

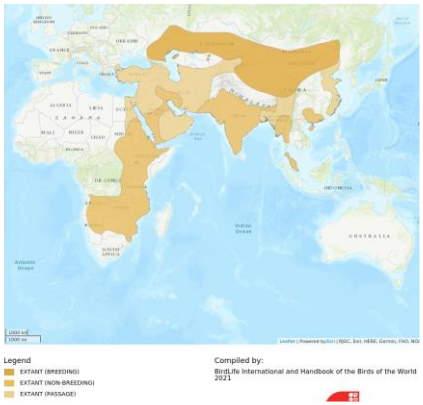
[110] Karyakin, I. V., Zinevich L. S., Schepetov D. M., Sorokina S.Y. 2016. Population Structure of the Steppe Eagle Range and Preliminary Data on the Population Genetic Diversity and Status of Subspecies. Raptors Conservation 32: 67-88.

[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.

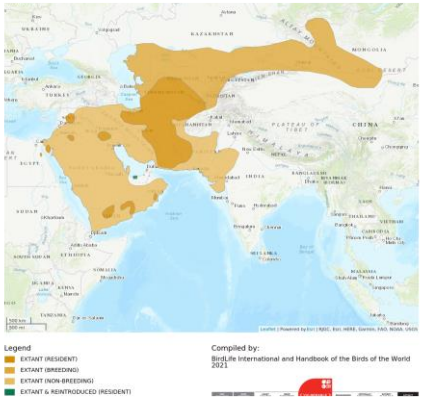
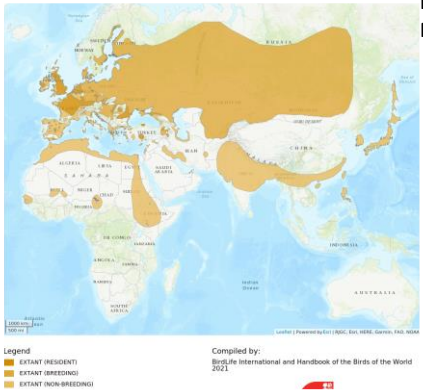
[112] BirdLife International. 2021. Aquila nipalensis. The IUCN Red List of Threatened Species 2021: e.T22696038A205452572

[113] https://ebird.org/barchart?r=IN-GJ-JA&yr=all&m=

[114] https://ebird.org/map/steeag1?neg=true&env.minX=69.86643981933594&env.minY=22.415340029007158&env.maxX=70.21800231933594&env.maxY=22.556503387694413&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/22696038/205452572			maximum 4 individuals from the Khijadiya Bird Sanctuary[115]), it is less likely to meet the threshold i.e. 370 (≥1 percent of the global population) for the EAAA.	
17	Asian Houbara (*Chlamydotis macqueenii*)	**IUCN:** Vulnerable **IWP:** Schedule I **Restricted range:** No **Migratory:** Yes	3a	Asian Houbara extends from Egypt east of the Nile, through Israel, Palestine, Jordan, Syria, Saudi Arabia, Yemen, Oman, U.A.E., Bahrain, Qatar, Iraq, Kuwait, Iran, Afghanistan, Pakistan, India, Turkmenistan, Uzbekistan, Tajikistan, Kyrgyzstan, Kazakhstan and Mongolia to China [116]. This species inhabits open, arid and sparsely vegetated steppe and semi-desert[117,118]. It favours scattered shrubby vegetation, typically comprising xerophytic or halophytic plants[119]. The distribution map of the species covers majorly Gujrat and Rajasthan states of India. In Gujrat[120], it has historical records from Banni Grassland and Chhari Dhand, Bhal Area, Naliya Grassland (Wildlife Kutch Bustard Sanctuary), Velavadar National, Wild Ass Wildlife Sanctuary & Nanda Island, and Gosabara (Mokarsar) Wetland Complex. All the above mentioned IBAs are away from the Jamnagar area. The species was last time reported from the Jamnagar area in 2009[121], after that there is no record of the species is available for the Jamnagar area[122, 123], which supports the unlikelihood of this species in Jamnagar area.	Screened Out

[115] https://ebird.org/checklist/S123851452
[116] BirdLife International. 2021. Chlamydotis macqueenii. The IUCN Red List of Threatened Species 2021: e.T22733562A205364424
[117] Launay, F.; Roshier, D.; Loughland, R.; Aspinall, S. J. 1997. Habitat use by houbara bustard (*Chlamydotis undulata macqueenii*) in arid shrubland in the United Arab Emirates. Journal of Arid Environments 35(1): 111–121.
[118] Mian, A. 2003. On biology of houbara bustard (*Chlamydotis macqueenii*) in Balochistan, Pakistan: animal populations sharing habitat. Pakistan Journal of Biological Science 6(14): 1282-1295.
[119] Collar, N. J. 1996. Otididae (Bustards). In: del Hoyo, J.; Elliott, A.; Sargatal, J. (ed.), Handbook of the birds of the world, pp. 240-273. Lynx Edicions, Barcelona, Spain.
[120] 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
[121] https://ebird.org/hotspot/L3916588
[122] https://ebird.org/map/macbus1?neg=true&env.minX=64.62466807157317&env.minY=19.609260908319474&env.maxX=75.87466807157317&env.maxY=24.14454245287082&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://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=144471

	 https://www.iucnredlist.org/species/22733562/205364424				
18	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[124]. 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[125]. 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[126]. Sometimes it also breeds on saline, brackish and soda lakes and occasionally even in sheltered coastal bays[127]. Undoubtedly the species has a presence in the surroundings of Jamnagar[128], however based on available secondary information extracted from eBird Database[129] (which reports maximum 3741 individuals from the Khijadiya Bird Sanctuary), it is less likely to meet the threshold i.e. 11,400-11,800 (≥1 percent of the global population[130]) for the EAAA.	Screened Out

[124] 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.

[125] https://www.iucnredlist.org/species/22680358/205288455#population

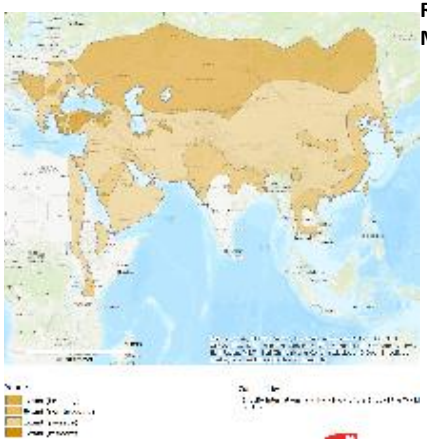
[126] BirdLife International. 2021. Aythya ferina. The IUCN Red List of Threatened Species 2021: e.T22680358A205288455

[127] Kear, J. 2005. Ducks, geese and swans volume 2: species accounts (Cairina to Mergus). Oxford University Press, Oxford, U.K.

[128] https://ebird.org/barchart?r=IN-GJ-JA&yr=all&m=

[129] https://ebird.org/map/compoc?neg=true&env.minX=69.66819455015631&env.minY=22.361188725966464&env.maxX=70.37131955015631&env.maxY=22.643481666625686&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

[130] https://www.iucnredlist.org/species/22696027/203868747#population

	https://www.iucnredlist.org/species/22680358/205288455				
19	Eastern Imperial Eagle (*Aquila heliaca*)  https://www.iucnredlist.org/species/22696048/155464885	**IUCN:** Vulnerable **IWP:** Schedule I **Restricted range:** No **Migratory:** Yes	3a	Eastern Imperial Eagle breeds in Austria, Azerbaijan, Bulgaria, China, Czech Republic, Macedonia, Georgia, Greece, Hungary, Kazakhstan, Russia, Mongolia, Serbia, Slovakia, Turkey and Ukraine[131]. On passage and in winter, birds are found in the Middle East, east Africa south to Tanzania, the Arabian Peninsula, Indian Subcontinent and south as well as East Asia (Thailand to Korea)[132]. This is a lowland species that has been pushed to higher altitudes by persecution and habitat loss in Europe. It breeds in forests up to 1,000 m and also in steppe and agricultural areas with large trees, and nowadays also on electricity pylons. In the Caucasus region, it occurs in steppe, lowland and riverine forests and semi-deserts[133]. Banni Grassland and Chhari Dhand, Bhal Area, Flamingo City, Gir National Park and Wildlife Sanctuary, Kaj Lake (Pipalava Bhandharo), Khijadia Bird Sanctuary, Nalsarovar Wildlife Sanctuary, Naliya Grassland (Wildlife Kutch Bustard Sanctuary), Salt Pans of Bhavnagar, Velavadar National Park, and Wild Ass Wildlife Sanctuary & Nanda Island are the possible habitats for this migratory raptor in Gujarat[134]. Undoubtedly the species has a presence in the surroundings of Jamnagar, however based on available secondary information extracted from eBird Database[135] (which reports a single individual from the Jamnagar area[136]), it is less likely to meet the threshold i.e. 25-100 (≥1 percent of the global population[137]) for the EAAA.	Screened Out
20	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[138]; and potentially in tiny numbers in Pakistan and north-west India[139]. 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	Screened Out

[131] Horváth, M.; Béres, I.; Juhász, T.; Kleszó, A.; Kovács, A.; Isfendiyaroglu S.; Tavares, J. 2014. Population surveys of Eastern Imperial Eagles in Anatolia between 2009 and 2013. Proceedings from VII. International Conference on the Conservation of the Eastern Imperial Eagle, 2-5 October 2013, Bratislava, Slovakia. Slovak Raptor Journal 8: 63-64.

[132] BirdLife International. 2019. Aquila heliaca (amended version of 2017 assessment). The IUCN Red List of Threatened Species 2019: e.T22696048A155464885

[133] BirdLife International. 2019. Aquila heliaca (amended version of 2017 assessment). The IUCN Red List of Threatened Species 2019: e.T22696048A155464885

[134] 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

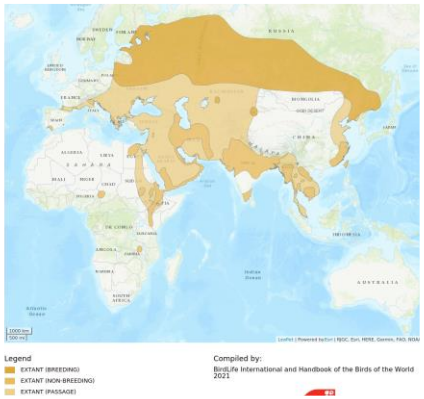
[135] https://ebird.org/map/impeag1?neg=true&env.minX=67.78873057157317&env.minY=21.622458694207154&env.maxX=73.41373057157317&env.maxY=23.876551891464445&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

[136] https://ebird.org/checklist/S115319860

[137] https://www.iucnredlist.org/species/22696048/155464885#population

[138] Meyburg, B.-U.; Haraszthy, L.; Strazds, M.; Schäffer, N. 1999. European species action plan for Greater Spotted Eagle (Aquila clanga).

[139] BirdLife International. 2001. Threatened birds of Asia: the BirdLife International Red Data Book. BirdLife International, Cambridge, U.K.

	 https://www.iucnredlist.org/species/22696027/203868747			lagoons and water courses[140]. It feeds on unretrieved quarry, small mammals, waterbirds, frogs and snakes, hunting over swamps, and wet meadows[141]. The Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated Edition - 2016)[142], 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, 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 Jamnagar, however based on available secondary information extracted from eBird Database[143] (which reports maximum 3 individuals from the Khijadiya Bird Sanctuary[144]), it is less likely to meet the threshold i.e. 39-100 (≥1 percent of the global population[145]) for the EAAA.	
21	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[146]. 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[147]. The population size is preliminarily suspected to fall into the band 10,000-19,999 mature individuals[148]. 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[149]. It may also occur on mountain valleys close to water	Screened Out

[140] 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.

[141] Lõhmus A, Väli Ü. 2001. Interbreeding of the Greater Aquila clanga and Lesser Spotted Eagle A. pomarina. Acta Ornithoecologica 4: 377–384.

[142] 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

[143] https://ebird.org/map/grseag1?neg=true&env.minX=67.78873057157317&env.minY=21.622458694207154&env.maxX=73.41373057157317&env.maxY=23.876551891464445&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

[144] https://ebird.org/checklist/S160390116

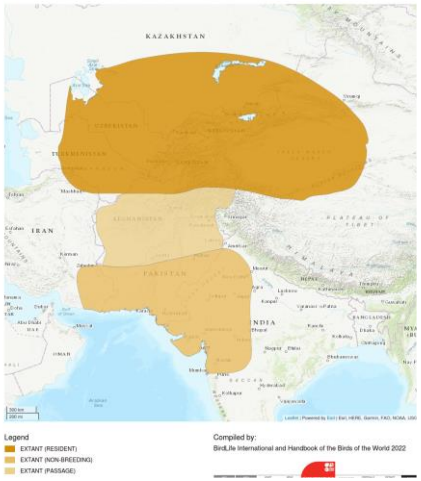
[145] https://www.iucnredlist.org/species/22696027/203868747#population

[146] BirdLife International. 2001. Threatened birds of Asia: the BirdLife International Red Data Book. BirdLife International, Cambridge, U.K.

[147] BirdLife International. 2022. Columba eversmanni. The IUCN Red List of Threatened Species 2022: e.T22690097A217014626

[148] 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.

[149] BirdLife International. 2022. Columba eversmanni. The IUCN Red List of Threatened Species 2022:e.T22690097A217014626

	 https://www.iucnredlist.org/species/22690097/217014626			sources[150]. 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[151]. Last time, the species was recorded from Little Rann of Kachchh in 2005[152], after that there is no record of this migratory species from the Gujarat state [153, 154, 155].	
22	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[156]. 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.	Screened Out

[150] 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.

[151] BirdLife International. 2022. Columba eversmanni. The IUCN Red List of Threatened Species 2022:e.T22690097A217014626

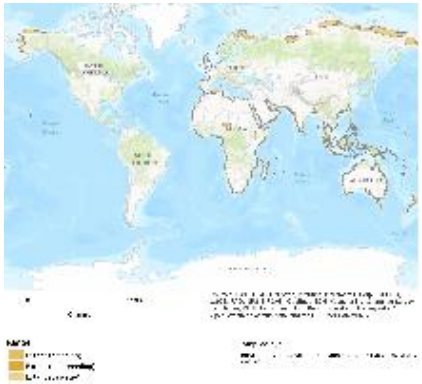
[152] https://ebird.org/hotspot/L3315807

[153] 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

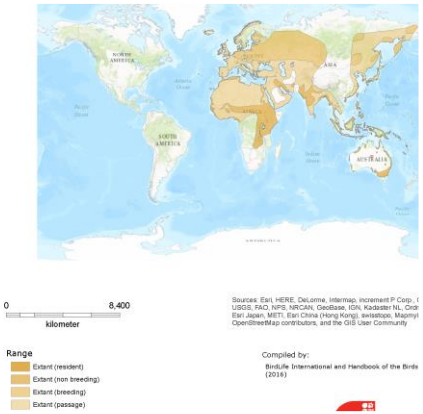
[154] https://ebird.org/map/pabpig1?neg=true&env.minX=68.93208043728741&env.minY=22.06850727071084&env.maxX=71.74458043728741&env.maxY=23.196590010623925&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

[155] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=3015

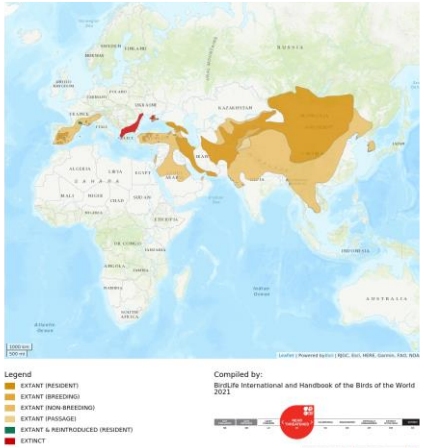
[156] https://www.iucnredlist.org/species/22693158/111221714#population

	 https://www.iucnredlist.org/species/22693158/111221714			It winter in intertidal areas along muddy coastlines, estuaries, inlets, mangrove-fringed lagoons and sheltered bays with tidal mudflats or sandbars[157]. Undoubtedly the species has a presence in the surroundings of Jamnagar[158, 159], however based on available secondary information extracted from eBird Database[160](which reports maximum 600 individuals from Sachana Beach[161] followed by 432 individuals Khijadiya Bird Sanctuary[162]), it is less likely to meet the threshold i.e. 10,990-11,490 (≥1 percent of the global population) for the EAAA.	
23	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[163]. The global population is estimated at 614,000-809,000 individuals[164]. 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[165].	Screened Out

[157] BirdLife International. 2017. Limosa lapponica. The IUCN Red List of Threatened Species 2017: e.T22693158A111221714
[158] https://ebird.org/barchart?r=IN-GJ-JA&yr=all&m=
[159] https://www.inaturalist.org/observations?place_id=32154&subview=map&view=species&iconic_taxa=Aves
[160] https://ebird.org/map/batgod?neg=true&env.minX=69.6834487915039&env.minY=22.347742514441588&env.maxX=70.3865737915039&env.maxY=22.63006286369832&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[161] https://ebird.org/checklist/S94038686
[162] https://ebird.org/india/checklist/S78820083
[163] 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.
[164] https://www.iucnredlist.org/species/22693150/111611637#population
[165] BirdLife International. 2017. Limosa limosa. The IUCN Red List of Threatened Species 2017: e.T22693150A111611637

	 https://www.iucnredlist.org/species/22693150/111611637			Undoubtedly the species has a presence in the surroundings of Jamnagar[166, 167], however based on available secondary information extracted from eBird Database[168](which reports maximum 1200 individuals from Khijadiya Bird Sanctuary[169]), it is less likely to meet the threshold i.e. 6,140-8,090 (≥1 percent of the global population) for the EAAA.	
24	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[170], Mongolia and mainland China, with a small reintroduced population in France[171, 172]. 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[173]. 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[174]. The population in Korea has been estimated at c.50-10,000 wintering individuals[175].	Screened Out

[166] https://ebird.org/barchart?r=IN-GJ-JA&yr=all&m=
[167] https://www.inaturalist.org/observations?place_id=32154&subview=map&view=species&iconic_taxa=Aves
[168] 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
[169] https://ebird.org/checklist/S46637300
[170] BirdLife International. 2021. Aegypius monachus. The IUCN Red List of Threatened Species 2021: e.T22695231A154915043
[171] 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.
[172] Heredia, B.; Yarar, M.; Parr, S. J. 1997. A baseline survey of Cinereous Vultures Aegypius monachus in Western Turkey.
[173] BirdLife International. 2021. Aegypius monachus. The IUCN Red List of Threatened Species 2021: e.T22695231A154915043
[174] BirdLife International. 2021. Aegypius monachus. The IUCN Red List of Threatened Species 2021: e.T22695231A154915043
[175] Brazil, M. 2009. Birds of East Asia: eastern China, Taiwan, Korea, Japan, eastern Russia. Christopher Helm, London.

	 https://www.iucnredlist.org/species/22695231/154915043			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[176]. 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 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)[177], 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 Jamnagar and the available secondary data[178, 179] also indicates unlikelihood of this species in Jamnagar and surrounding area.	
25	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[180, 181]. 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[182], 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[183]. However, the total global population (mature individuals) has been estimated as 11400-13400[184].	Screened In

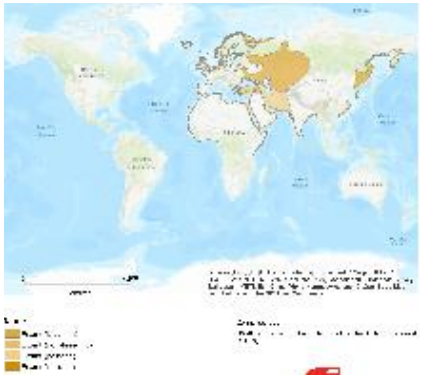
[176] Thiollay, J.-M. 1994. Family Accipitridae (Hawks and Eagles). In: del Hoyo, J.; Elliott, A.; Sargatal, J. (ed.), Handbook of the birds of the world, pp. 52-205. Lynx Edicions, Barcelona, Spain.
[177] Rahmani, A.R., Islam, M.Z. and Kasambe, R.M. (2016) Important Bird and Biodiversity Areas in India: 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
[178] https://ebird.org/map/cinvul1?neg=true&env.minX=59.27471492461777&env.minY=19.05366498639926&env.maxX=81.77471492461777&env.maxY=28.005905832244554&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[179] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=5382
[180] 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.
[181] BirdLife International. 2015. European Red List of Birds. Office for Official Publications of the European Communities, Luxembourg.
[182] 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.
[183] BirdLife International. 2018. Pelecanus crispus (amended version of 2017 assessment). The IUCN Red List of Threatened Species 2018: e.T22697599A122838534
[184] https://www.iucnredlist.org/species/22697599/122838534#population

	 https://www.iucnredlist.org/species/22697599/122838534			It occurs mainly at inland, freshwater wetlands but also at coastal lagoons, river deltas & estuaries[185, 186, 187, 188], small islands in freshwater lakes[189] or in dense aquatic vegetation[190], and often in hilly terrain[191]. On migration, large lakes form important stop-over sites[192]. It typically winters on *Jheels* and lagoons in India, and ice-free lakes in Europe[193]. It sometimes fishes inshore along sheltered coasts[194]. 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[195]. Undoubtedly the species has a presence in the surroundings of Jamnagar[196, 197], however based on available secondary information extracted from eBird Database[198](which reports maximum 270 individuals from Khijadiya Bird Sanctuary [199]), it is likely to meet the threshold i.e. 114-134 (≥1 percent of the global population) for the EAAA.	
26	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[200].	Screened Out

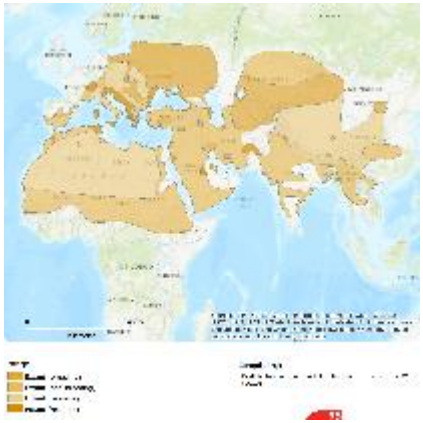
[185] del Hoyo, J., Elliot, A. and Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[186] Peja, N.; Sarigul, G.; Siki, M.; Crivelli, A. J. 1996. The Dalmatian Pelican, Pelecanus crispus, nesting in Mediterranean lagoons in Albania and Turkey. Colonial Waterbirds 19: 184-189.
[187] Crivelli, A. J.; Catsadorakis, G.; Hatzilacou, D.; Nazirides, T. 1997. Pelicanus crispus Dalmatian Pelican. Birds of the Western Palearctic Update 1(3): 149-153.
[188] 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.
[189] 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.
[190] 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.
[191] Nelson, J. B. 2005. Pelicans, cormorants and their relatives. Pelecanidae, Sulidae, Phalacrocoracidae, Anhingidae, Fregatidae, Phaethontidae. Oxford University Press, Oxford, U.K.
[192] Nelson, J. B. 2005. Pelicans, cormorants and their relatives. Pelecanidae, Sulidae, Phalacrocoracidae, Anhingidae, Fregatidae, Phaethontidae. Oxford University Press, Oxford, U.K.
[193] 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.
[194] 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.
[195] 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
[196] https://ebird.org/barchart?r=IN-GJ-JA&yr=all&m=
[197] https://www.inaturalist.org/observations?place_id=32154&subview=map&view=species&iconic_taxa=Aves
[198] https://ebird.org/map/dalpel1?neg=true&env.minX=69.89245778104588&env.minY=22.49979043058466&env.maxX=70.24402028104588&env.maxY=22.64086755618928&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[199] https://ebird.org/australia/checklist/S16631082
[200] BirdLife International. 2017. Numenius arquata. The IUCN Red List of Threatened Species 2017: e.T22693190A117917038

	 https://www.iucnredlist.org/species/22693190/117917038			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[201]. 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[202], and non-intensive farmland in river valleys[203]. During the winter the species frequents inland lakes & rivers, muddy coasts, bays & estuaries, wet grassland & arable fields[204], tidal mudflats & sandflats[205], rocky & sandy beaches with many pools, muddy shores of coastal lagoons, mangroves, saltmarshes[206, 207], and coastal meadows & pasture[208]. 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[209]. Undoubtedly the species has a presence in the surroundings of Jamnagar[210, 211], however based on available secondary information extracted from eBird Database[212](which reports maximum 275 individuals from the Sachana area[213] followed by 265 individuals from Viphapar area[214]), it is less likely to meet the threshold i.e. 8,350-13,100 (≥1 percent of the global population) for the EAAA.	
27	Eurasian Oystercatcher (*Haematopus ostralegus*)	**IUCN:** Near Threatened **IWP:** Schedule II	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,	Screened Out

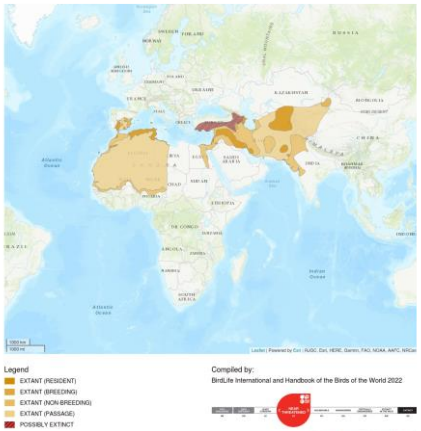
[201] BirdLife International. 2015. European Red List of Birds. Office for Official Publications of the European Communities, Luxembourg.
[202] del Hoyo, J., Elliott, A., and Sargatal, J. 1996. Handbook of the Birds of the World, vol. 3: Hoatzin to Auks. Lynx Edicions, Barcelona, Spain.
[203] Hayman, P.; Marchant, J.; Prater, A. J. 1986. Shorebirds. Croom Helm, London.
[204] 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.
[205] Snow, D.W. and Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[206] Johnsgard, P. A. 1981. The plovers, sandpipers and snipes of the world. University of Nebraska Press, Lincoln, U.S.A. and London.
[207] Snow, D.W. and Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[208] 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.
[209] 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
[210] https://ebird.org/barchart?r=IN-GJ-JA&yr=all&m=
[211] https://www.inaturalist.org/observations?place_id=32154&subview=map&view=species&iconic_taxa=Aves
[212] https://ebird.org/map/eurcur?neg=true&env.minX=69.62869908047495&env.minY=22.407905829350742&env.maxX=70.33182408047493&env.maxY=22.690103421955463&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[213] https://ebird.org/india/checklist/S78555561
[214] https://ebird.org/checklist/S157126186

	 https://www.iucnredlist.org/species/22693613/154998347	**Restricted range:** No **Migratory:** Yes		Caspian and Aral Seas, and east to western Siberia, and winters on coasts from East Africa through Arabia to India[215]. 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 *Haematopus ostralegus osculans* (5,000-10,000)[216]. 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[217, 218]. Outside of the breeding season the species is chiefly coastal, frequenting estuarine mudflats, saltmarshes & sandy & rocky shores[219]. Undoubtedly the species has a presence in the surroundings of Jamnagar[220, 221], however based on available secondary information extracted from eBird Database[222](which reports maximum 150 individuals from the Sachana area[223]), it is less likely to meet the threshold i.e. 9,250-10,300 (≥1 percent of the global population) for the EAAA.	
28	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[224, 225]. 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[226]. The species shows a strong preference for fresh standing water and is very rarely found on flowing streams or rivers[227]. It requires shallow water 30-100 cm deep close to littoral	Screened Out

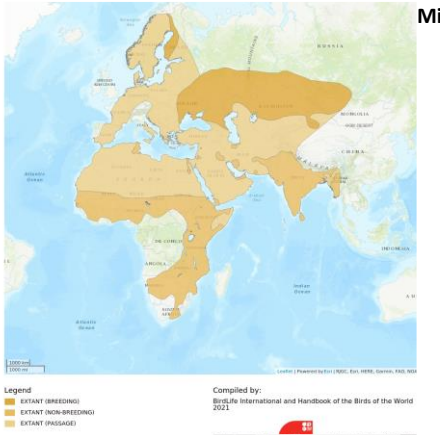
[215] BirdLife International. 2019. Haematopus ostralegus. The IUCN Red List of Threatened Species 2019: e.T22693613A154998347
[216] Wetlands International. 2019. Waterbird Population Estimates. Available at: wpe.wetlands.org.
[217] Hayman, P.; Marchant, J.; Prater, A. J. 1986. Shorebirds. Croom Helm, London.
[218] del Hoyo, J.; Elliott, A.; Sargatal, J. 1996. Handbook of the Birds of the World, vol. 3: Hoatzin to Auks. Lynx Edicions, Barcelona, Spain.
[219] del Hoyo, J.; Elliott, A.; Sargatal, J. 1996. Handbook of the Birds of the World, vol. 3: Hoatzin to Auks. Lynx Edicions, Barcelona, Spain.
[220] https://ebird.org/barchart?r=IN-GJ-JA&yr=all&m=
[221] https://www.inaturalist.org/observations?place_id=32154&subview=map&view=species&iconic_taxa=Aves
[222] https://ebird.org/map/euroys1?neg=true&env.minX=69.18846511840822&env.minY=22.30029360858508&env.maxX=70.59471511840822&env.maxY=22.864549716482408&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[223] https://ebird.org/checklist/S162529231
[224] Callaghan, D. A. 1999. European Union Species Action Plan: Ferruginous Duck (Althea nervosa). Council of Europe Publishing, Strasbourg.
[225] Vinicombe, K. E. 2000. Identification of Ferruginous Duck and its status in Britain and Ireland. British Birds 93: 4-21.
[226] https://www.iucnredlist.org/species/22680373/152620862#population
[227] 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/22680373/152620862			vegetation for feeding and generally avoids large open areas[228, 229, 230]. It is also found on shallow mudflats, possibly as a result of more accessible and abundant invertebrate food sources in this habitat[231]. Indeed, the species has a presence in the surroundings of Jamnagar[232, 233], however based on available secondary information extracted from eBird Database[234] (which reports maximum 18 individuals from Khijadiya Bird Sanctuary[235]), it is less likely to meet the threshold i.e. 1,800–2,400 (≥1 percent of the global population) for the EAAA.	
29	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)[236, 237]; Israel, Jordan, Syria, wintering south to Egypt) and western and southern Asia (Azerbaijan, Armenia, Russia (where it is on the verge of extinction) [238]; Turkmenistan, Uzbekistan, Tajikistan, Kazakhstan, Iraq, Iran, Afghanistan, Pakistan, India and extreme northwest China, wintering in Iran, Pakistan and north-west India[239].	Screened Out

[228] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[229] Scott, D. A.; Rose, P. M. 1996. Atlas of Anatidae populations in Africa and western Eurasia. Wetlands International, Wageningen, Netherlands.
[230] Kear, J. 2005. Ducks, geese and swans volume 2: species accounts (Cairina to Mergus). Oxford University Press, Oxford, U.K.
[231] BirdLife International. 2019. Aythya nyroca. The IUCN Red List of Threatened Species 2019: e.T22680373A152620862
[232] https://ebird.org/barchart?r=IN-GJ-JA&yr=all&m=
[233] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=7055
[234] https://ebird.org/map/ferduc?neg=true&env.minX=-19.972212536909137&env.minY=-15.876114866185985&env.maxX=160.02778746309085&env.maxY=52.64350136429397&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[235] https://ebird.org/checklist/S156842652
[236] Boyla, K.A., Sinav, L. and Dizdaroğlu D.E. 2019. Turkey Breeding Bird Atlas. WWF-Turkey, Wildlife Conservation Foundation, İstanbul.
[237] 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.
[238] Van Impe, J. 2013. Esquisse de l'avifaune de la Sibérie Occidentale: une revue bibliographique. Alauda 81(4): 269-296.
[239] 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.

	 https://www.iucnredlist.org/species/22680339/205917761			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[240]. It is adapted to temporary, unpredictable, Mediterranean-type wetlands[241, 242]; and breeds in fairly dry, steppe-like areas on shallow freshwater, brackish or alkaline ponds with well vegetated shorelines, rich emergent and submergent vegetation[243, 244, 245]; delta marshes where receding waters leave behind large areas of shallow water with abundant sedges and bulrushes[246]; slow rivers and saline coastal lagoons, & man-made wetlands including fish-rearing ponds, small reservoirs and sewage farms[247, 248]. 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[249]. Banni Grassland and Chhari Dhand, and Nalsarovar Wildlife Sanctuary are the possible habitats for this migratory species in Gujarat[250]. Both the above mentioned IBAs are away from the Jamnagar area and the available secondary data[251, 252] also supports the unlikelihood of this species in the EAAA.	
30	Pallid Harrier (*Circus macrourus*)	**IUCN:** Near Threatened **IWP:** Schedule I **Restricted range:** No	3a	Pallid Harrier breeds primarily in the steppes of Asiatic Russia, Kazakhstan and north-west China. Small populations breed in Azerbaijan, Romania, Turkey and Ukraine, however recent survey data suggest that these populations have almost disappeared[253]. A minority winter in	Screened Out

[240] Wetlands International. 2022. Waterbird Populations Portal. Available at: wpp.wetlands.org.
[241] 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.
[242] 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.
[243] Green, A. J. 1993. The status and conservation of the Marbled Teal Marmaronetta angustirostris. International Waterfowl and Wetlands Research Bureau, Slimbridge, U.K.
[244] Kear, J. 2005. Ducks, geese and swans volume 2: species accounts (Cairina to Mergus). Oxford University Press, Oxford, U.K.
[245] 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.
[246] Johnsgard, P.A. 1978. Ducks, geese and swans of the World. University of Nebraska Press, Lincoln and London.
[247] Green, A. J. 1993. The status and conservation of the Marbled Teal Marmaronetta angustirostris. International Waterfowl and Wetlands Research Bureau, Slimbridge, U.K.
[248] BirdLife International. 2022. Marmaronetta angustirostris. The IUCN Red List of Threatened Species 2022: e.T22680339A205917761
[249] 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.
[250] 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
[251] https://ebird.org/map/martea1?neg=true&env.minX=67.40442207752098&env.minY=21.372533692932727&env.maxX=73.02942207752098&env.maxY=23.630695707649686&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[252] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=7139
[253] 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.

	 https://www.iucnredlist.org/species/22695396/201209093	**Migratory:** Yes		south-east and central Europe, north Africa and the Middle East but most migrate to the Afrotropics and the Indian subcontinent[254, 255]. The global population is estimated at 9,000-15,000 pairs[256], equating to 18,000-30,000 mature individuals. 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[257, 258]. The species has also been found to breed in agricultural areas, at least when agriculture is nonintensive[259]. A minority of the population breeds in the boreal forest and forest tundra zones, north of its main breeding range[260], where it nests in clearings and other open areas[261]. The species is migratory, with most birds wintering in sub-Saharan Africa or south-east Asia. During winter it prefer mosaics of forest/ shrubland and grassland and, to a lesser extent, and agricultural land[262]. Definitely, the species has a presence in the surroundings of Jamnagar[263], however based on available secondary information extracted from eBird Database[264] (which reports maximum 3 individuals from Khijadiya Bird Sanctuary[265]), it is less likely to meet the threshold i.e. 180-300 (≥1 percent of the global population) for the EAAA.	
31	Black Stork (*Ciconia nigra*)	**IUCN:** Least Concern **IWP:** Schedule II **Restricted range:** No **Migratory:** Yes	3a	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[266]. The global population is estimated to number c.24,000-44,000 individuals[267].	Screened Out

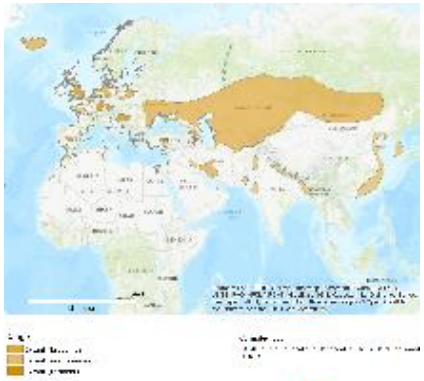
[254] Thiollay, J.-M. 1994. Family Accipitridae (Hawks and Eagles). In: del Hoyo, J.; Elliott, A.; Sargatal, J. (ed.), Handbook of the birds of the world, pp. 52-205. Lynx Edicions, Barcelona, Spain.
[255] Corso A. & Cardelli C. 2004. The migration of Pallid Harrier across the central Mediterranean with particular reference to the Strait of Messina. British Birds 97: 238-246.
[256] Galushin, V.; Clarke, R.; Davygora, A. 2003. International Action Plan for the Pallid Harrier (Circus macrourus).
[257] Snow, D.W. and Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[258] Galushin, V.; Clarke, R.; Davygora, A. 2003. International Action Plan for the Pallid Harrier (Circus macrourus).
[259] 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.
[260] Kuznetsov, A. V. 1994. Birds of prey of the Kostroma lowland. In: Kurochkin, E.N. (ed.), Modern ornithology, pp. 86-93. Nauka, Moscow.
[261] Galushin, V.; Clarke, R.; Davygora, A. 2003. International Action Plan for the Pallid Harrier (Circus macrourus).
[262] 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.
[263] https://ebird.org/barchart?r=IN-GJ-JA&yr=all&m=
[264] https://ebird.org/map/palhar1?neg=true&env.minX=-19.972212536909176&env.minY=-15.876114866186022&env.maxX=160.02778746309082&env.maxY=52.64350136429397&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[265] https://ebird.org/checklist/S156842652
[266] BirdLife International. 2017. Ciconia nigra. The IUCN Red List of Threatened Species 2017: e.T22697669A111747857
[267] BirdLife International. 2017. Ciconia nigra. The IUCN Red List of Threatened Species 2017: e.T22697669A111747857

	 https://www.iucnredlist.org/species/22697669/111747857			The species inhabits old, undisturbed, open forests - from sea-level up to mountainous regions (e.g. 2,000-2,500 m in altitude)[268, 269, 270]. It forages in shallow streams, pools, marshes, occasionally grasslands[271], swampy patches[272], damp meadows[273], flood-plains, pools in dry riverbeds[274], especially where there are stands of reeds or long grass[275]. Undoubtedly the species has a presence in the surroundings of Jamnagar, however based on available secondary information extracted from eBird Database[276, 277] (which reports maximum 4 individuals from the Khijadiya Bird Sanctuary[278]), it is less likely to meet the threshold i.e. 20-25 (≥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[279].	Screened Out

[268] Hancock, J. A.; Kushlan, J. A.; Kahl, M. P. 1992. Storks, ibises and spoonbills of the world. Academic Press, London.
[269] 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.
[270] Snow, D.W. and Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[271] 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.
[272] Snow, D.W. and Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[273] Hancock, J. A.; Kushlan, J. A.; Kahl, M. P. 1992. Storks, ibises and spoonbills of the world. Academic Press, London.
[274] 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.
[275] Brown, L.H., Urban, E.K. and Newman, K. 1982. The Birds of Africa, Volume I. Academic Press, London.
[276] https://ebird.org/barchart?r=IN-GJ-JA&yr=all&m=
[277] https://ebird.org/map/blasto1?neg=true&env.minX=67.40442207752098&env.minY=21.372533692932727&env.maxX=73.02942207752098&env.maxY=23.630695707649686&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[278] https://ebird.org/checklist/S162529231
[279] https://www.iucnredlist.org/species/22692146/86219168#population

	 https://www.iucnredlist.org/species/22692146/86219168			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[280]. Definitely, the species has a presence in the surroundings of Jamnagar[281, 282], however based on available secondary information extracted from eBird Database[283] (which reports maximum 1250 individuals from Khijadiya Bird Sanctuary[284]), 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 Shelduck (*Tadorna tadorna*)	**IUCN:** Least Concern **IWP:** Schedule II **Restricted range:** No **Migratory:** Yes	3a	Common Shelduck is largely resident in westernmost Europe and breeds in temperate Euro-Siberia. Most populations migrate to subtropical areas during winter. The global population is estimated to number 625,000-750,000 individuals (Wetlands International 2015). This roughly equates to 415,000-500,000 mature individuals. The European population is estimated at 50,800-68,900 pairs, which equates to 102,000-138,000 mature individuals[285]. The species shows a preference for saline habitats and frequents mudflats and muddy or sandy estuaries in coastal regions, and occurs inland on saline and brackish lakes in steppe or semi-desert[286, 287]. Asiatic populations also occupy freshwater rivers or marshes and other populations utilise freshwater habitats on migration[288, 289]. The Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated Edition - 2016)[290], reports the presence of the species in Salt Pans of	Screened Out

[280] BirdLife International. 2016. Grus grus. The IUCN Red List of Threatened Species 2016: e.T22692146A86219168
[281] https://ebird.org/barchart?r=IN-GJ-JA&yr=all&m=
[282] https://www.inaturalist.org/observations?place_id=32154&subview=map&view=species&iconic_taxa=Aves
[283] https://ebird.org/map/comcra?neg=true&env.minX=69.89330673217775&env.minY=22.454821727634865&env.maxX=70.24486923217775&env.maxY=22.59594480929902&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[284] https://ebird.org/checklist/S122689455
[285] BirdLife International. 2015. European Red List of Birds. Office for Official Publications of the European Communities, Luxembourg.
[286] Madge, S.; Burn, H. 1988. Wildfowl. Christopher Helm, London.
[287] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[288] 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.
[289] Kear, J. 2005. Ducks, geese and swans volume 1: general chapters; species accounts (Anhima to Salvadorina). Oxford University Press, Oxford, U.K.
[290] 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/22680024/154560262			Bhavnagar, Gujarat. Only a single record of the species was reported in 2015 from Khijadiya Bird Sanctuary, after that no observation was made around the Jamnagar area[291]. Exclusion of EAAA from the global distribution map and absence of any recent record, supports the unlikelihood of this species in 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[292]. The global population is estimated at c. 2,800,000 mature individuals[293, 294]. The European population is estimated at 557,000-915,000 pairs, which equates to 1,110,000-1,830,000 mature individuals[295]. Its habitats include Forest, Shrubland, Wetlands (inland), Marine Intertidal, Marine Coastal/Supratidal, Artificial/Terrestrial, Artificial/Aquatic & Marine[296]. Definitely, the species has a presence in the surroundings of Jamnagar[297, 298], however based on available secondary information extracted from eBird Database[299] (which reports maximum 1950 individuals from Khijadiya Bird Sanctuary[300]), it is less likely to meet the threshold i.e. 28,000 (≥1 percent of the global population) for the EAAA.	Screened Out

[291] https://ebird.org/checklist/S96383987
[292] BirdLife International. 2020. Anas crecca. The IUCN Red List of Threatened Species 2020: e.T22680321A181692388
[293] Partners in Flight. 2019. Avian Conservation Assessment Database, version 2019. Available at: http://pif.birdconservancy.org/ACAD.
[294] Wetlands International. 2020. Waterbird Population Estimates. Available at: wpe.wetlands.org.
[295] BirdLife International. 2015. European Red List of Birds. Office for Official Publications of the European Communities, Luxembourg.
[296] BirdLife International. 2020. Anas crecca. The IUCN Red List of Threatened Species 2020: e.T22680321A181692388
[297] https://ebird.org/barchart?r=IN-GJ-JA&yr=all&m=
[298] https://www.inaturalist.org/observations?place_id=32154&subview=map&view=species&iconic_taxa=Aves
[299] https://ebird.org/map/gnwtea?neg=true&env.minX=69.93888092041016&env.minY=22.5357360470627&env.maxX=70.29044342041016&env.maxY=22.676776375408302&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[300] https://ebird.org/checklist/S160843581

		 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)[301]. The global population is estimated to number c. 230,000-261,000 individuals[302]. 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[303, 304, 305, 306]. In India a wider range of habitat types are used, including marshes, freshwater lakes, rivers[307], cultivated fields and rice stubble[308], sandy riverbeds, the flat and open margins of seasonal pans and farm ponds[309], and hot desert (if water is readily available) [310, 311].	Screened In

[301] https://birdcount.in/migration-map/demcra1/
[302] Wetlands International. 2015. Waterbird Population Estimates. Available at: wpe.wetlands.org.
[303] Johnsgard, P. A. 1983. Cranes of the world. Croom Helm, London.
[304] Ellis, D.H., Gee, G.F. and Mirande, C.M. 1996. Cranes: their biology, husbandary, and conservation. Gazelle Books, Lancaster, U.K.
[305] del Hoyo, J.; Elliott, A.; Sargatal, J. 1996. Handbook of the Birds of the World, vol. 3: Hoatzin to Auks. Lynx Edicions, Barcelona, Spain.
[306] 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.
[307] Urban, E.K.; Fry, C.H.; Keith, S. 1986. The Birds of Africa, Volume II. Academic Press, London.
[308] del Hoyo, J.; Elliott, A.; Sargatal, J. 1996. Handbook of the Birds of the World, vol. 3: Hoatzin to Auks. Lynx Edicions, Barcelona, Spain.
[309] Johnsgard, P. A. 1983. Cranes of the world. Croom Helm, London.
[310] Ellis, D.H., Gee, G.F. and Mirande, C.M. 1996. Cranes: their biology, husbandary, and conservation. Gazelle Books, Lancaster, U.K.
[311] 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[312]. Indeed, the species has a presence in the surroundings of Jamnagar[313], however based on available secondary information extracted from eBird Database[314] (which reports maximum 4000 individuals from Khijadiya Bird Sanctuary[315] in 2022), it is 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[316]. This species breeds in lowland freshwater marshes, slow-flowing large rivers[317] and shallow lakes and lagoons with ample submerged, floating and emerging vegetation[318]. 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 [319, 320].	Screened Out

[312] 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

[313] https://ebird.org/barchart?r=IN-GJ-JA&yr=all&m=

[314] https://ebird.org/map/demcra1?neg=true&env.minX=69.71900776846557&env.minY=22.38171481789806&env.maxX=70.42213276846557&env.maxY=22.663965888526235&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

[315] https://ebird.org/checklist/S105524552

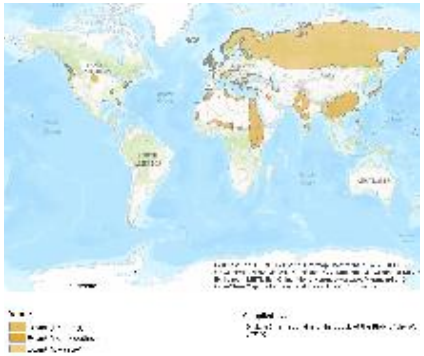
[316] Wetlands International. 2015. Waterbird Population Estimates. Available at: wpe.wetlands.org.

[317] Kretchmar, A. V. 1994. Eurasian wigeon (Anas penelope) in north-eastern Asia. Zoologichesky Zhurnal 73(5): 68-79.

[318] Kear, J. 2005. Ducks, geese and swans volume 2: species accounts (Cairina to Mergus). Oxford University Press, Oxford, U.K.

[319] 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.

[320] 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[321]. Indeed, the species has a presence in the surroundings of Jamnagar[322, 323], however based on available secondary information extracted from eBird Database[324] (which reports maximum 7000 individuals from Khijadiya Bird Sanctuary[325]), 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[326]. 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[327]. It may also be found on permanent, shallow, slightly alkaline marshes, as well as on oxbow lakes, channels, reservoirs, and gravel-pits[328]. Although the Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated Edition - 2016)[329] reports the species from Salt Pans of Bhavnagar. However, the species has been reported throughout the state (Gujarat)[330].	Screened Out

[321] 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

[322] https://ebird.org/barchart?r=IN-GJ-JA&yr=all&m=

[323] https://www.inaturalist.org/observations?place_id=32154&subview=map&view=species&iconic_taxa=Aves

[324] https://ebird.org/map/eurwig?neg=true&env.minX=69.74286043342697&env.minY=22.425281712904344&env.maxX=70.44598543342697&env.maxY=22.707443794184663&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

[325] https://ebird.org/india/checklist/S63753809

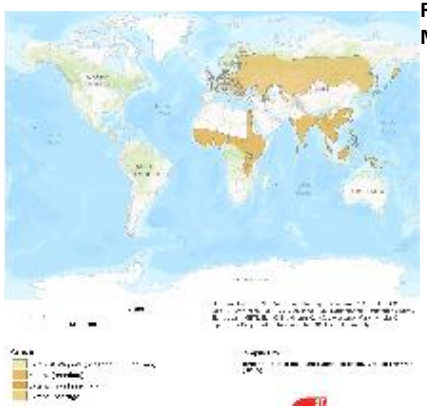
[326] Wetlands International. 2015. Waterbird Population Estimates. Available at: wpe.wetlands.org.

[327] Kear, J. 2005. Ducks, geese and swans volume 2: species accounts (Cairina to Mergus). Oxford University Press, Oxford, U.K.

[328] BirdLife International. 2016. Mareca strepera. The IUCN Red List of Threatened Species 2016: e.T22680149A86020572

[329] 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

[330] 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

	 https://www.iucnredlist.org/species/22680149/86020572			Indeed, the species has a presence in the surroundings of Jamnagar[331, 332], however based on available secondary information extracted from eBird Database[333] (which reports maximum 6000 individuals from Khijadiya Bird Sanctuary[334]), 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*)  https://www.iucnredlist.org/species/22680313/86016410	**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[335]. The global population is estimated to number c. 2,600,000-2,800,000 individuals[336]. 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 (Cramp and Simmons 1977, Johnsgard 1978, de Hoyo. 1992, Green 1998, Schricke 2001). During nonbreeding season the species shows a preference for large freshwater or occasionally brackish lakes, again with abundant floating, emergent and fringing vegetation (Kear 2005b), also shallow flood plains, shallow dams, pans and sewage ponds (in South Africa) (Hockey et al. 2005). The species also frequents coastal saltmarshes and lagoons on passage (de Hoyo. 1992) and may spend the day resting on marine inshore waters when migrating (Madge and Burn 1988).	Screened Out

[331] https://ebird.org/barchart?r=IN-GJ-JA&yr=all&m=

[332] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=558439

[333] https://ebird.org/map/gadwal?neg=true&env.minX=69.72912752327072&env.minY=22.48194709818253&env.maxX=70.43225252327072&env.maxY=22.763993191922605&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

[334] https://ebird.org/india/checklist/S63753809

[335] https://indianbirds.thedynamicnature.com/2015/03/garganey-spatula-querquedula.html#google_vignette

[336] Wetlands International. 2015. Waterbird Population Estimates. Available at: wpe.wetlands.org.

				Although the Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated Edition - 2016)[337] reports the species from Salt Pans of Bhavnagar. However, the species has been reported throughout the state (Gujarat)[338]. Indeed, the species has a presence in the surroundings of Jamnagar[339], however based on available secondary information extracted from eBird Database[340] (which reports maximum 250 individuals from Vibhapar area[341] followed by 151 individuals from Khijadiya Bird Sanctuary[342]), it is less likely to meet the threshold i.e. 26,000-28,000 (≥1 percent of the global population) for the EAAA.	
39	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[343]. 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 entering alkaline or saline lakes[344, 345]. It nests and roosts nests in large dense colonies on sandbanks, mudflats, islands or boggy, open shores[346, 347]. 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[348].	Screened Out

[337] 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

[338] 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

[339] https://ebird.org/barchart?r=IN-GJ-JA&yr=all&m=

[340] https://ebird.org/map/gargan?neg=true&env.minX=69.71347045898436&env.minY=22.514805408698596&env.maxX=70.41659545898436&env.maxY=22.796784119263318&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024

[341] https://ebird.org/india/checklist/S75319850

[342] https://ebird.org/checklist/S156796792

[343] https://www.iucnredlist.org/species/22697360/155527405#population

[344] 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.

[345] BirdLife International. 2019. Phoenicopterus roseus (amended version of 2018 assessment). The IUCN Red List of Threatened Species 2019: e.T22697360A155527405

[346] Brown, L.H.; Urban, E.K.; Newman, K. 1982. The Birds of Africa, Volume I. Academic Press, London.

[347] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.

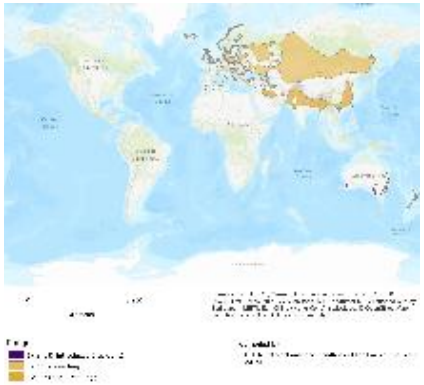
[348] Rahmani, A.R., Islam, M.Z. and Kasambe, R.M. (2016) Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated). Bombay Natural History Society, Indian Bird Conservation Network, Royal Society for the Protection of Birds and BirdLife International (U.K.).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

	 https://www.iucnredlist.org/species/22697360/155527405			Indeed, the species has a presence in the surroundings of Jamnagar[349, 350], however based on available secondary information extracted from eBird Database[351] (which reports maximum 2000 individuals from Khijadiya Bird Sanctuary[352]), it is less likely to meet the threshold i.e. 5,500-6,800 (≥1 percent of the global population) for the EAAA.	
40	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[353]. The European breeding population is estimated at 280,000-331,000 pairs, which equates to 560,000-662,000 mature individuals[354]. In East Asia, the population across South Korea, Japan and China are thought to number 231,000-283,000 individuals[355]. 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[356, 357, 358]. 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[359]. The species winters	Screened Out

[349] https://ebird.org/barchart?r=IN-GJ-JA&yr=all&m=
[350] https://www.inaturalist.org/observations?place_id=32154&subview=map&view=species&iconic_taxa=Aves
[351] https://ebird.org/map/grefla3?neg=true&env.minX=69.93937683105467&env.minY=22.581925689880602&env.maxX=70.29093933105467&env.maxY=22.722918652864035&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[352] https://ebird.org/india/checklist/S28957247
[353] https://doi.org/10.2305%2FIUCN.UK.2016-3.RLTS.T22679881A85980652.en
[354] BirdLife International. 2021. European Red List of Birds. Publications Office of the European Union, Luxembourg.
[355] 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.
[356] Johnsgard, P.A. 1978. Ducks, geese and swans of the World. University of Nebraska Press, Lincoln and London.
[357] 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.
[358] Snow, D.W. and Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[359] 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/22679881/213839615			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) [360, 361, 362, 363, 364]. Exclusion of Jamnagar and surrounding area from its global distribution map[365] and absence of any record of the species in the same area[366, 367], supports the unlikelihood of this species in the EAAA.	
41	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[368]. During the breeding season the species inhabits wetlands surrounded by fringing vegetation in open grassland[369], sedge or heather moorland[370], arctic tundra, steppe or semi-desert from	Screened Out

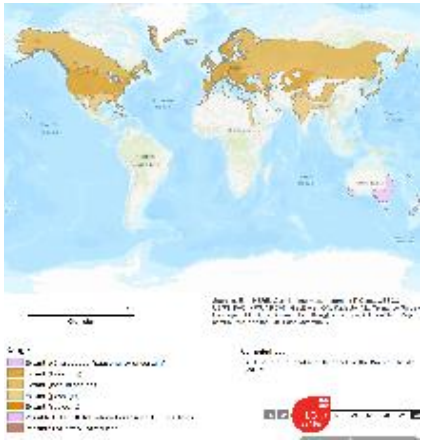
[360] Johnsgard, P.A. 1978. Ducks, geese and swans of the World. University of Nebraska Press, Lincoln and London.
[361] Madge, S.; Burn, H. 1988. Wildfowl. Christopher Helm, London.
[362] del Hoyo, J., Elliot, A. and Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[363] Scott, D. A.; Rose, P. M. 1996. Atlas of Anatidae populations in Africa and western Eurasia. Wetlands International, Wageningen, Netherlands.
[364] Kear, J. 2005. Ducks, geese and swans volume 1: general chapters; species accounts (Anhima to Salvadorina). Oxford University Press, Oxford, U.K.
[365] https://www.iucnredlist.org/species/22679881/213839615
[366] https://ebird.org/map/gwfgoo?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
[367] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=7019
[368] Wetlands International. 2015. Waterbird Population Estimates. Available at: wpe.wetlands.org.
[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. 1978. Ducks, geese and swans of the World. University of Nebraska Press, Lincoln and London.

	 https://www.iucnredlist.org/species/22679889/131907747			sea-level up to 2,300 m[371]. In the winter the species inhabits lowland farmland in open country, swamps, lakes, reservoirs, coastal lagoons, and estuaries[372, 373]. Indeed, the species has a presence in the surroundings of Jamnagar[374, 375], however based on available secondary information extracted from eBird Database[376] (which reports maximum 135 individuals from Vibhapar area[377] followed by 122 individuals from Khijadiya Bird Sanctuary[378]), it is less likely to meet the threshold i.e. 10,000-11,000 (≥1 percent of the global population) for the EAAA.	
42	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[379]. 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[380, 381].	Screened Out

[371] Snow, D.W.; 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] Madge, S.; Burn, H. 1988. Wildfowl. Christopher Helm, London.
[374] https://ebird.org/barchart?r=IN-GJ-JA&yr=all&m=
[375] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=7018
[376] https://ebird.org/map/gragoo?neg=true&env.minX=69.29115459270794&env.minY=22.24946118836616&env.maxX=70.69740459270794&env.maxY=22.81392485290627&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[377] https://ebird.org/india/checklist/S80565165
[378] https://ebird.org/checklist/S122863718
[379] BirdLife International. 2018. Phoeniconaias minor. The IUCN Red List of Threatened Species 2018: e.T22697369A129912906
[380] McCulloch, G.; Irvine, K. 2004. Breeding of Greater and Lesser Flamingos at Sua Pan, Botswana, 1998-2001. Ostrich 75: 236-242.
[381] BirdLife International. 2018. Phoeniconaias minor. The IUCN Red List of Threatened Species 2018: e.T22697369A129912906

	 https://www.iucnredlist.org/species/22697369/129912906			Indeed, the species has a presence in the surroundings of Jamnagar[382, 383], however based on available secondary information extracted from eBird Database[384] (which reports maximum 3000 individuals from Khijadiya Bird Sanctuary[385]), it is less likely to meet the threshold i.e. 22,200-32,400 (≥1 percent of the global population) for the EAAA.	
43	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[386]. The global population is estimated to number > c. 19,000,000 individuals[387], while the European population is estimated at 2,850,000-4,610,000 pairs[388]. Habitats commonly frequented include flooded swampy woodlands, seasonal flood lands[389], wet grassy swamps and meadows, oxbow lakes[390], open waters with mudflats, banks or spits, irrigation networks, reservoirs, ornamental waters[391, 392], canals and sewage farms[393].	Screened Out

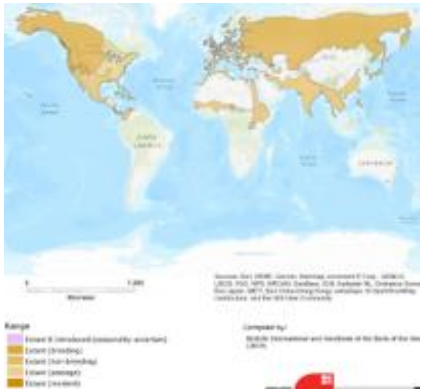
[382] https://ebird.org/barchart?r=IN-GJ-JA&yr=all&m=
[383] https://www.inaturalist.org/observations?place_id=32154&subview=map&view=species&iconic_taxa=Aves
[384] https://ebird.org/map/lesfla1?neg=true&env.minX=69.17423479046673&env.minY=22.26778211679387&env.maxX=70.58048479046673&env.maxY=22.832171025033947&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[385] https://ebird.org/checklist/S46637300
[386] https://indianbirds.thedynamicnature.com/2015/03/mallard-anas-platyrhynchos.html
[387] Wetlands International. 2015. Waterbird Population Estimates. Available at: wpe.wetlands.org.
[388] BirdLife International. 2015. European Red List of Birds. Office for Official Publications of the European Communities, Luxembourg.
[389] Snow, D.W.; Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[390] 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.
[391] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[392] Scott, D. A.; Rose, P. M. 1996. Atlas of Anatidae populations in Africa and western Eurasia. Wetlands International, Wageningen, Netherlands.
[393] 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[394] where water is shallow, fairly sheltered and within site of land i.e. brackish lagoons, brackish estuaries and bays[395, 396]. Undoubtedly the species has a presence in the surroundings of Jamnagar[397, 398], however based on available secondary information extracted from eBird Database[399] (which reports maximum 11 individuals from Lakhota Lake[400] followed by 10 individuals from Khijadiya Bird Sanctuary[401]), it is less likely to meet the threshold i.e. 1,90,000 (≥1 percent of the global population) for the EAAA.	
44	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[402]; while the European population is estimated at 210,000-269,000 pairs[403]. 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 vegetation	Screened Out

[394] Madge, S.; Burn, H. 1988. Wildfowl. Christopher Helm, London.
[395] Snow, D.W.; Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[396] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[397] https://ebird.org/barchart?r=IN-GJ-JA&yr=all&m=
[398] https://www.inaturalist.org/observations?place_id=32154&subview=map&view=species&iconic_taxa=Aves
[399] https://ebird.org/map/mallar3?neg=true&env.minX=69.25800554241985&env.minY=22.250335184944593&env.maxX=70.66425554241985&env.maxY=22.81479528455182&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[400] https://ebird.org/checklist/S51705608
[401] https://ebird.org/checklist/S101399157
[402] Wetlands International. 2006. Waterbird Population Estimates – Fourth Edition. Wageningen, The Netherlands.
[403] BirdLife International. 2015. European Red List of Birds. Office for Official Publications of the European Communities, Luxembourg.

	 https://www.iucnredlist.org/species/22680301/153882797			and wetlands interspersed with brushy thickets or copses[404, 405, 406, 407, 408, 409]. 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[410, 411, 412, 413, 414, 415, 416]. 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)[417]. Undoubtedly the species has a presence in the surroundings of Jamnagar[418, 419], however based on available secondary information extracted from eBird Database[420] (which reports maximum 7000 individuals from Khijadiya Bird Sanctuary[421]), it is less likely to meet the threshold i.e. 71,000-72,000 (≥1 percent of the global population) for the EAAA.	
45	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

[404] Johnsgard, P.A. 1978. Ducks, geese and swans of the World. University of Nebraska Press, Lincoln and London.
[405] Madge, S.; Burn, H. 1988. Wildfowl. Christopher Helm, London.
[406] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[407] Snow, D.W.; Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[408] 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.
[409] Kear, J. 2005. Ducks, geese and swans volume 2: species accounts (Cairina to Mergus). Oxford University Press, Oxford, U.K.
[410] Johnsgard, P.A. 1978. Ducks, geese and swans of the World. University of Nebraska Press, Lincoln and London.
[411] Brown, L.H.; Urban, E.K.; Newman, K. 1982. The Birds of Africa, Volume I. Academic Press, London.
[412] Madge, S.; Burn, H. 1988. Wildfowl. Christopher Helm, London.
[413] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[414] Scott, D. A.; Rose, P. M. 1996. Atlas of Anatidae populations in Africa and western Eurasia. Wetlands International, Wageningen, Netherlands.
[415] 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.
[416] Snow, D.W.; Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[417] 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
[418] https://ebird.org/barchart?r=IN-GJ-JA&yr=all&m=
[419] https://www.inaturalist.org/observations?place_id=32154&subview=map&view=species&iconic_taxa=Aves
[420] https://ebird.org/map/norpin?neg=true&env.minX=69.86888975132993&env.minY=22.363173126909842&env.maxX=70.22045225132993&env.maxY=22.504389600715992&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/india/checklist/S63753809



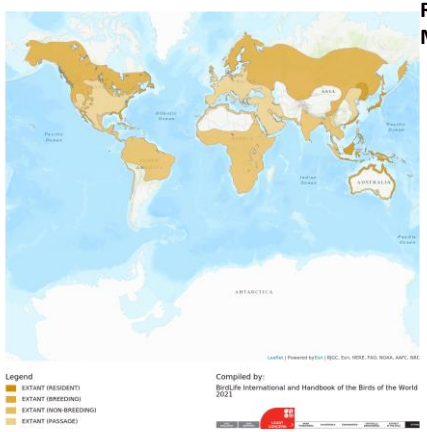
https://www.iucnredlist.org/species/22680247/153875944

The global population is estimated to number 6,500,000-7,000,000 individuals[422]; while the European population is estimated at 170,000-233,000 pairs[423].

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)[424, 425, 426, 427], oxbow lakes, channels and swamps[428, 429, 430, 431, 432, 433], artificial waters bordered by lush grassland such as sewage farms, rice-fields and fish ponds[434, 435, 436]. 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)[437, 438, 439, 440, 441].

Undoubtedly the species has a presence in the surroundings of Jamnagar[442, 443], however based on available secondary information extracted from eBird Database[444] (which reports maximum 3540 individuals from Khijadiya Bird Sanctuary[445]), it is less likely to meet the threshold i.e. 65,000-70,000 (≥1 percent of the global population) for the EAAA.

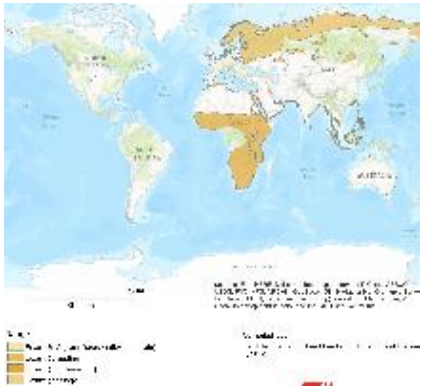
[422] Wetlands International. 2015. Waterbird Population Estimates. Available at: wpe.wetlands.org.
[423] BirdLife International. 2015. European Red List of Birds. Office for Official Publications of the European Communities, Luxembourg.
[424] Johnsgard, P.A. 1978. Ducks, geese and swans of the World. University of Nebraska Press, Lincoln and London.
[425] Brown, L.H.; Urban, E.K.; Newman, K. 1982. The Birds of Africa, Volume I. Academic Press, London.
[426] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[427] Snow, D.W.; Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[428] Johnsgard, P.A. 1978. Ducks, geese and swans of the World. University of Nebraska Press, Lincoln and London.
[429] Brown, L.H.; Urban, E.K.; Newman, K. 1982. The Birds of Africa, Volume I. Academic Press, London.
[430] 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.
[431] Madge, S.; Burn, H. 1988. Wildfowl. Christopher Helm, London.
[432] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[433] Kear, J. 2005. Ducks, geese and swans volume 2: species accounts (Cairina to Mergus). Oxford University Press, Oxford, U.K.
[434] Snow, D.W.; Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[435] Kear, J. 2005. Ducks, geese and swans volume 2: species accounts (Cairina to Mergus). Oxford University Press, Oxford, U.K.
[436] 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.
[437] Johnsgard, P.A. 1978. Ducks, geese and swans of the World. University of Nebraska Press, Lincoln and London.
[438] Madge, S.; Burn, H. 1988. Wildfowl. Christopher Helm, London.
[439] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[440] Snow, D.W.; Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[441] Kear, J. 2005. Ducks, geese and swans volume 2: species accounts (Cairina to Mergus). Oxford University Press, Oxford, U.K.
[442] https://ebird.org/barchart?r=IN-GJ-JA&yr=all&m=
[443] https://www.inaturalist.org/observations?place_id=32154&subview=map&view=species&iconic_taxa=Aves
[444] https://ebird.org/map/norsho?neg=true&env.minX=69.71283218592544&env.minY=22.514805408698596&env.maxX=70.41595718592544&env.maxY=22.796784119263318&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[445] https://ebird.org/india/checklist/S63753809

46	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[446]. 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[447]. 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[448]. It inhabits the areas around shallow waters, being sufficiently tolerant of human settlement to persist in suburban and sometimes urban environments[449]. Due to the presence of suitable habitats in the surroundings of Jamnagar, and historical records of the species from the same area, there is a likelihood of the presence of this migratory species in the EAAA. Undoubtedly the species has a presence in the surroundings of Jamnagar, however based on available secondary information extracted from eBird Database[450] (which reports maximum 3 individuals from the Ranjitsagar Dam[451]), it is less likely to meet the threshold i.e. 96-136 (≥1 percent of the global population) for the EAAA.	Screened Out
47	Red-crested Pochard (*Netta rufina*)	**IUCN:** Least Concern **IWP:** Schedule IV **Restricted range:** No **Migratory:** Yes	3a	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[452, 453].	Screened Out

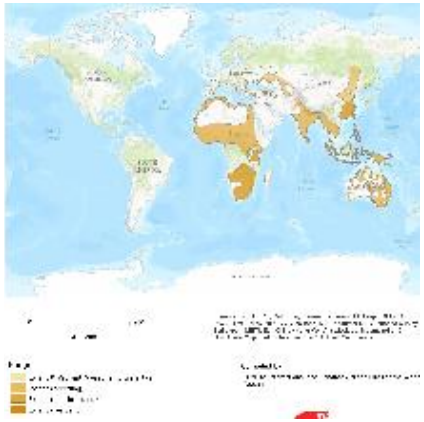
[446] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4650845
[447] https://archive.org/details/audubonsocietyfi0000bull/page/469
[448] BirdLife International. 2021. Pandion haliaetus. The IUCN Red List of Threatened Species 2021: e.T22694938A206628879
[449] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[450] https://ebird.org/barchart?r=IN-GJ-JA&yr=all&m=
[451] https://ebird.org/checklist/S132920534
[452] Wetlands International. 2015. Waterbird Population Estimates. Available at: wpe.wetlands.org.
[453] https://www.iucnredlist.org/species/22680348/86012189

	 https://www.iucnredlist.org/species/22680348/86012189			The species inhabits inland deep fresh or brackish[454] reed-fringed lakes, rivers, or saline and alkaline lagoons[455] in open country[456], also occurring (less often) on estuaries, river deltas and other sheltered coastal habitats[457] on passage[458] or during the winter[459]. Undoubtedly the species has a presence in the surroundings of Jamnagar, however based on available secondary information extracted from eBird Database[460] (which reports maximum 8 individuals from the Khijadiya Bird Sanctuary[461]), it is less likely to meet the threshold i.e. 4200-6000 (≥1 percent of the global population) for the EAAA.	
48	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[462]. 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[463, 464].	Screened Out

[454] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[455] Kear, J. 2005. Ducks, geese and swans volume 2: species accounts (Cairina to Mergus). Oxford University Press, Oxford, U.K.
[456] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[457] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[458] Madge, S.; Burn, H. 1988. Wildfowl. Christopher Helm, London.
[459] Scott, D. A.; Rose, P. M. 1996. Atlas of Anatidae populations in Africa and western Eurasia. Wetlands International, Wageningen, Netherlands.
[460] https://ebird.org/map/recpoc?neg=true&env.minX=64.59115570663336&env.minY=20.363170841897603&env.maxX=75.84115570663334&env.maxY=24.874479633896616&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/hotspot/L23958760
[462] https://www.thainationalparks.com/species/ruff
[463] BirdLife International. 2015. European Red List of Birds. Office for Official Publications of the European Communities, Luxembourg.
[464] https://www.iucnredlist.org/species/22693468/86591264

	 https://www.iucnredlist.org/species/22693468/86591264			The species inhabits tundra habitats from the coast to the Arctic treeline[465, 466] during the breeding season, requiring adjacent foraging, lekking and nesting areas[467]. 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[468, 469, 470, 471]. 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[472, 473]. The species rarely utilises intertidal habitats[474] but may frequent tidal mudflats and lagoons in India[475]. Indeed, the species has a presence in the surroundings of Jamnagar, however based on available secondary information extracted from eBird Database[476] (which reports maximum 1264 individuals from the Vibhapar[477] and 985 individuals from the Dhinchada Lake, Jamnagar in during 2021[478]), it is less likely to meet the threshold i.e. 15,940-99,400 (≥1 percent of the global population) for the EAAA.	
49	Whiskered Tern (*Chlidonias hybrida*)	**IUCN:** Least Concern **IWP:** Schedule IV **Restricted range:** No **Migratory:** Yes	3a	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[479]. The global population is estimated to number c. 300,000-1,500,000 individuals[480, 481]. 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	Screened Out

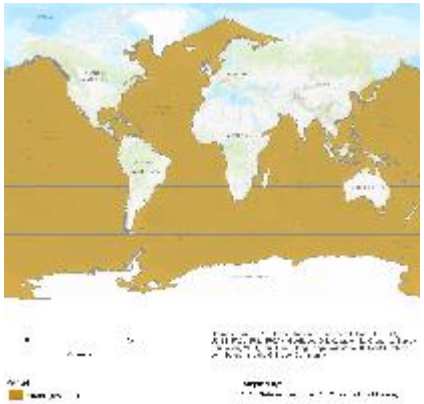
[465] Johnsgard, P. A. 1981. The plovers, sandpipers and snipes of the world. University of Nebraska Press, Lincoln, U.S.A. and London.
[466] del Hoyo, J., Elliott, A., and Sargatal, J. 1996. Handbook of the Birds of the World, vol. 3: Hoatzin to Auks. Lynx Edicions, Barcelona, Spain.
[467] del Hoyo, J., Elliott, A., and Sargatal, J. 1996. Handbook of the Birds of the World, vol. 3: Hoatzin to Auks. Lynx Edicions, Barcelona, Spain.
[468] Johnsgard, P. A. 1981. The plovers, sandpipers and snipes of the world. University of Nebraska Press, Lincoln, U.S.A. and London.
[469] Hayman, P.; Marchant, J.; Prater, A. J. 1986. Shorebirds. Croom Helm, London.
[470] 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.
[471] Snow, D.W.; Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[472] Hayman, P.; Marchant, J.; Prater, A. J. 1986. Shorebirds. Croom Helm, London.
[473] 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.
[474] Hayman, P.; Marchant, J.; Prater, A. J. 1986. Shorebirds. Croom Helm, London.
[475] 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.
[476] https://ebird.org/map/ruff?neg=true&env.minX=70.11500549316406&env.minY=22.515846985048455&env.maxX=70.20289611816406&env.maxY=22.551125697000476&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[477] https://ebird.org/india/checklist/S80565165
[478] https://ebird.org/india/checklist/S78704103
[479] https://indianbirds.in/pdfs/IB_17_1_Ranade_WhiskeredTern.pdf
[480] Wetlands International. 2015. Waterbird Population Estimates. Available at: wpe.wetlands.org.
[481] https://www.iucnredlist.org/species/22694764/111750380

	 https://www.iucnredlist.org/species/22694764/111750380			cattle or horses[482]. 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-fields[483, 484]. It also occurs along the coast on estuaries, coastal lagoons, creeks in mangrove swamps[485] and tidal mudflats[486]. Definitely, the species has a presence in the surroundings of Jamnagar, however based on available secondary information extracted from eBird Database[487] (which reports maximum 684 individuals from the Khijadiya Bird Sanctuary in 2021[488], 562 individuals from the Vibhapar in during 2020[489], 485 individuals from the Khijadiya Bird Sanctuary in 2024[490] and 457 individuals from the Lakhota Lake in 2021[491]), it is less likely to meet the threshold i.e. 3,000-15,000 (≥1 percent of the global population) for the EAAA.	
50	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[492]. The global population size is estimated at 700,000-704,000 individuals[493, 494]. 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	Screened Out

[482] Richards, A. 1990. Seabirds of the northern hemisphere. Dragon's World Ltd, Limpsfield, U.K.
[483] 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.
[484] 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.
[485] Snow, D.W.; Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[486] 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.
[487] https://ebird.org/map/whiter2?neg=true&env.minX=69.9831063314934&env.minY=22.44932894180824&env.maxX=70.1588875814934&env.maxY=22.51991130279965&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[488] https://ebird.org/india/checklist/S78820083
[489] https://ebird.org/india/checklist/S74069020
[490] https://ebird.org/checklist/S160103362
[491] https://ebird.org/india/checklist/S82349999
[492] https://animalia.bio/white-stork
[493] Wetlands International. 2015. Waterbird Population Estimates. Available at: wpe.wetlands.org.
[494] https://www.iucnredlist.org/species/22697691/86248677

	 https://www.iucnredlist.org/species/22697691/86248677				are scattered trees for roosting[495, 496, 497]. During the winter the species shows a preference for drier habitats such as grasslands, steppe, savanna and cultivated fields, often gathering near lakes, ponds, pools, slow-flowing streams, ditches or rivers[498, 499]. Bhal Area and Velavadar National Park are the possible habitats for this migratory species in Gujarat[500]. Definitely, the species has a presence in the surroundings of Jamnagar, however based on available secondary information extracted from eBird Database[501] (which reports only solitary observations from the Khijadiya Bird Sanctuary[502], Saltpans on INS Valsura[503] and Vibhapar[504]), it is unlikely to meet the threshold i.e. 7,000-7,040 (≥1 percent of the global population) for the EAAA.	
Mammals						
51	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.		Screened Out

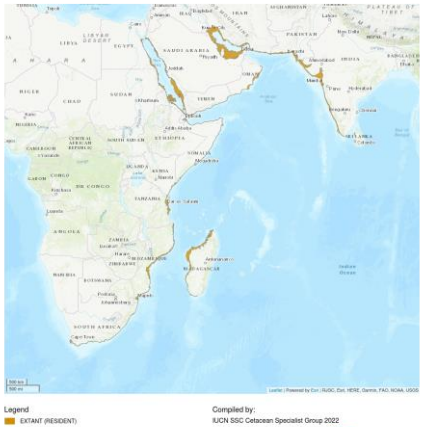
[495] Hancock, J. A.; Kushlan, J. A.; Kahl, M. P. 1992. Storks, ibises and spoonbills of the world. Academic Press, London.
[496] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[497] Snow, D.W.; Perrins, C.M. 1998. The Birds of the Western Palearctic, Volume 1: Non-Passerines. Oxford University Press, Oxford.
[498] Hancock, J. A.; Kushlan, J. A.; Kahl, M. P. 1992. Storks, ibises and spoonbills of the world. Academic Press, London.
[499] del Hoyo, J.; Elliot, A.; Sargatal, J. 1992. Handbook of the Birds of the World, vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona, Spain.
[500] 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
[501] https://ebird.org/map/whisto1?neg=true&env.minX=69.92137145996094&env.minY=22.457637254512434&env.maxX=70.27293395996094&env.maxY=22.598757461377332&zh=true&gp=true&ev=Z&excludeExX=false&excludeExAll=false&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2024
[502] https://ebird.org/hotspot/L2136331
[503] https://ebird.org/hotspot/L3517377
[504] https://ebird.org/hotspot/L3794727

	 https://www.iucnredlist.org/species/2477/156923585			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[505, 506, 507, 508]. The global population of the species ranges from 5000 to 15000; however, no abundance estimation for the Northern Indian Ocean are available[509]. In the Indian Ocean, blue whales are only documented from the highly productive northern part[510]. No recognized information about the presence of the species in Gujarat cost was available[511]. 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[512]. In Apr. 2018, an observation was also made about 112 km away from the Dwarka cost[513]. All the above-mentioned records are away from the EAAA and no record of the species is available from the EAAA[514].	
52	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[515]. 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[516].	Screened Out

[505] 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.
[506] 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.
[507] 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.
[508] 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 Ocean. Journal of Cetacean Research and Management 12(2): 203-218.
[509] https://www.iucnredlist.org/species/2477/156923585#population
[510] https://www.currentscience.ac.in/Volumes/120/03/0470.pdf
[511] https://arabianseawhalenetwork.org/wp-content/uploads/2017/09/sc_66b_sh_34_baleen-whale-records-from-arabian-sea-coast-of-india.pdf
[512] https://timesofindia.indiatimes.com/city/ahmedabad/30-feet-blue-whale-rescued-off-una-coast/articleshow/60785894.cms
[513] https://www.currentscience.ac.in/Volumes/120/03/0470.pdf
[514] https://www.inaturalist.org/observations?iconic_taxa=Mammalia&lat=22.486977569578578&lng=70.06248615708378&place_id=any&radius=25.85506205566563&subview=map&view=species
[515] 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
[516] https://www.wwfindia.org/about_wwf/priority_species/threatened_species/indian_pangolin/

	 https://www.iucnredlist.org/species/12761/123583998			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 the Khijadia Wildlife Sanctuary[517]; Marine National Park & Marine Wildlife Sanctuary[518], and has also not been recorded from the Project's EAAA[519].	
53	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[520]. 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[521]. 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[522]. 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[523].	Screened Out

[517] http://moef.gov.in/wp-content/uploads/2017/06/khijadia.pdf
[518] http://moef.gov.in/wp-content/uploads/2017/06/S.O.%202561%20%5B22.08.2013%5D%20Final%20ESZ%20Notification%20on%20Marine%20National%20and%20Marine%20Sanctuary%2C%20Gujarat.pdf
[519] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=43362
[520] 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.
[521] 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.
[522] 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.
[523] 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[524]. Recently the species was reported only from Dwarka in 2014, 2019, & 2023[525]. After 2001-02, the species has not been reported from the coasts of Jamnagar[526].	
Other Aquatic Fauna					
54	Coral Sp. (*Parasimplastrea sheppardi*)	**IUCN:** Endangered **IWP:** Not Available **Restricted range:** No **Migratory:** No	1 a	In the Indo-West Pacific, this species is found in the northwest Indian Ocean and Arabian/Iranian Gulf. This species is found in the Rodrigues[527] and Mauritius[528]. No species-specific population information available for this species[529]. This species occurs in marginal reef environments, mainly the Arabian region. This species is found on subtidal rock and rocky reefs, on the back and fore slope of the reef, and in lagoons. This species is found to 20 m. Although the global distribution of the species includes the coasts of western Gujarat, the absence of historical records[530, 531] from the Jamnagar area suggests that its occurrence in the EAAA is less probable.	Screened Out

[524] 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.
[525] https://www.marinemammals.in/database/sightings-and-strandings/
[526] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=469961
[527] Fenner, D., Clark, T.H., Turner, J.R., and Chapman, B. 2004. A checklist of the corals of the island state of Rodrigues, Mauritius. Journal of Natural History 38: 3091-3102.
[528] Pillay, R. M., H. Terashima, A. Venkatasami, and H. Uchida. 2002. Field guide to corals of Mauritius. AFRC and JICA.
[529] DeVantier, L., Hodgson, G., Huang, D., Johan, O., Licuanan, A., Obura, D., Sheppard, C., Syahrir, M. & Turak, E. 2008. Parasimplastrea sheppardi. The IUCN Red List of Threatened Species 2008: e.T133692A3867187.
[530] https://www.researchgate.net/profile/Benjamin-Jones-11/publication/337166759_Section_6_Seagrass_Ecosystems_Marine_Biodiversity_of_Myeik_Archipelago_Survey_Results_2013-2017_and_Conservation_Recommendations/links/5dc95a1f92851c8180440ac4/Section-6-Seagrass-Ecosystems-Marine-Biodiversity-of-Myeik-Archipelago-Survey-Results-2013-2017-and-Conservation-Recommendations.pdf
[531] https://www.gbif.org/species/2260108

https://www.iucnredlist.org/species/133692/3867187

55	Pineapple Sea Cucumber (*Thelenota ananas*)	**IUCN:** Endangered **IWP:** Not Available **Restricted range:** No **Migratory:** No	1 a	Pineapple Sea Cucumber is widely distributed throughout the Indo-Pacific, excluding Hawaii. ItScreened occurs in Australia, Bangladesh, Brunei Darussalam, Cambodia, China, Cocos (Keeling) Islands, Out 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[532, 533]. No species-specific population information available for this species. This species is found along slopes and passes within reef zones[534] and along outer reef flats[535] to depths of 35 m, but is more common in waters from 10-20 m.

[532] Conand, C., Gamboa, R. & Purcell, S. (2013). Thelenota ananas. The IUCN Red List of Threatened Species 2013: e.T180481A1636021.
[533] 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.
[534] Skewes, T., Haywood, M., Pitchern, R. and Willan, R . 2004. Holothurians. National Oceans Office, Hobart, Australia.
[535] 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.

	 https://www.iucnredlist.org/species/180481/1636021			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[536, 537, 538]. Thus the presence of this species in the EAAA is unlikely. ssss	
56	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[539, 540, 541]. It inhabits nearshore estuarine (juveniles and pupping females) and offshore marine (adults) waters. Observed in depths of >100 m[542]. 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[543]. 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	Screened Out

[536] 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]
[537] https://www.gbif.org/species/4343232
[538] https://core.ac.uk/download/pdf/33013177.pdf
[539] D'Anastasi, B.R., Simpfendorfer, C.A. and van Herwerden, L. 2013. Anoxypristis cuspidata (errata version published in 2019.
[540] Harrison, L.R. and Dulvy, N.K. 2014. Sawfish: A Global Strategy for Conservation. IUCN Species Survival Commission's Shark Specialist Group, Vancouver, Canada.
[541] Last, P., White, W., de Carvalho, M., Séret, B., Stehmann, M. and Naylor, G. 2016. Rays of the World. CSIRO Publishing, Clayton.
[542] https://www.sawfishconservationsociety.org/narrow-sawfish
[543] https://www.iucnredlist.org/species/39389/58304073#population

				tropical and subtropical regions with warm water temperatures, these areas serve as prime environments for the Narrow Sawfish[544, 545]. Observer data on Indian landings of Narrow Sawfish between 1989–2011 reported considerable catch from Okha, Gujarat on the Arabian Sea coast[546]. Currently the species distribution is restricted to the coasts of Orissa, Tamil Nadu, Travancore and Mumbai[547] and no record has been reported from the coasts of Jamnagar.	
57	Pondicherry Shark (*Carcharhinus hemiodon*)  https://www.iucnredlist.org/species/39369/221513674	**IUCN:** Critically Endangered **IWP:** Schedule I **Restricted range:** No **Migratory:** No	1 a	The Pondicherry Shark historically inhabited the Arabian Sea to the South China Sea but was rarely sighted, with only a few recorded individuals in the Indo-West Pacific, including Oman, Pakistan, India, Borneo, and Java. Museum collections hold fewer than twenty specimens, collected before 1960. Reports from Sri Lanka remain unverified, and recent sightings, such as those mentioned in De Silva (2014), are deemed inaccurate[548]. Population status of the Pondicherry Shark is concerning. Intensive and largely unregulated coastal fisheries have likely driven historical population reduction in this species. Fisheries across its range have experienced increased demand for sharks since the 1970s due to growing coastal human population densities, leading to an increasing fishing effort in traditional shark fisheries in many areas, and international trade in shark products, including the fin trade[549], [550]. Pondicherry Shark historically preferred inshore continental and insular shelves, with a depth range of 10 to 150 meters. It's worth noting that there are unverified reports of this species entering rivers[551]. The Pondicherry Shark is typically found in coastal waters. It tends to inhabit areas with soft-bottomed substrates, including sandy or muddy bottoms. These habitats provide suitable conditions for the shark's feeding and breeding behaviors[552],[553]. The species has been reportedly declining across various locations, with historic records predating 1960. Ongoing fish market surveys in the Gulf and Sea of Oman, as well as	Screened Out

[544] 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.
[545] 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.
[546] Harrison, L.R. and Dulvy, N.K. 2014. Sawfish: A Global Strategy for Conservation. IUCN Species Survival Commission's Shark Specialist Group, Vancouver, Canada.
[547] https://indiabiodiversity.org/species/show/231641
[548] Garrick, J.A.F. 1985. Additions to a revision of the shark genus Carcharhinus: synonymy of Aprionodon and Hypoprion, and description of a new species of Carcharhinus. NOAA Tech. Rep., Nat. Mar. Fish. Serv. (34), 14 fig., 4 tab. Cited record from Guyana.
[549] Henderson, A.C., McIlwain, J.L., Al-Oufi, H.S. and Al-Sheili, S. 2007. The Sultanate of Oman shark fishery: Species composition, seasonality and diversity. Fisheries Research 86: 159-168.
[550] Jabado, R.W., Al Ghais, S.M., Hamza, W., Shivji, M.S. and Henderson, A.C. 2015. Shark diversity in the Arabian/Persian Gulf higher than previously thought: insights based on species composition of shark landings in the United Arab Emirates. Marine Biodiversity 45(4): 719–731.
[551] Garrick, J.A.F. 1985. Additions to a revision of the shark genus Carcharhinus: synonymy of Aprionodon and Hypoprion, and description of a new species of Carcharhinus. NOAA Tech. Rep., Nat. Mar. Fish. Serv. (34), 14 fig., 4 tab. Cited record from Guyana.
[552] Compagno, L.J.V., Dando, M. & Fowler, S. (2005). Sharks of the World. Princeton University Press.
[553]Dharmadi, et al. (2017). First record of the Pondicherry shark, Carcharhinus hemiodon (Chondrichthyes: Carcharhinidae), from eastern Indonesia. Marine Biodiversity Records, 10(1), 1-5. doi:10.1186/s41200-017-0114-7.

			extensive landing site surveys across India, have failed to locate any further records of the Pondicherry Shark[554], [555], [556]. As the species has been displayed as "possibly extant" in IUCN portal for throughout the Indian coast[557] and has not been reported from the surroundings of Jamnagar[558, 559]; its presence in the project's EAAA is unlikely.	
58	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[560],[561]. 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[562], [563]. 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	Screened Out

[554] Akhi Dharmadi, et al. (2017). First record of the Pondicherry shark, Carcharhinus hemiodon (Chondrichthyes: Carcharhinidae), from eastern Indonesia. Marine Biodiversity Records, 10(1), 1-5. doi:10.1186/s41200-017-0114-7 lesh, K.V., Bineesh, K.K., Gopalakrishnan, A., Jena, J.K., Basheer, V.S. and Pillai, N.G.K. 2014. Checklist of Chondrichthyans in Indian waters. Journal of the Marine Biological Association of India 56(1): 109- 120.

[555] Kumar, R.R., Venu, S., Akhilesh, K.V., Bineesh, K.K. and Rajan, P.T. 2018. First report of four deep-sea chondrichthyans (Elasmobranchii and Holocephali) from Andaman waters, India with an updated checklist from the region. Acta Ichthyologica et Piscatoria 48(3): 289–301.

[556] Tyabji, Z., Jabado, R.W. and Sutaria, D. 2018. New records of sharks (Elasmobranchii) from the Andaman and Nicobar Archipelago in India with notes on current checklists. Biodiversity Data Journal 6: e28593.

[557] https://www.iucnredlist.org/species/39369/221513674

[558] https://www.gbif.org/species/2418111

[559] https://indiabiodiversity.org/species/show/231887

[560] Last, P.R. and Stevens, J.D. 2009. Sharks and Rays of Australia. Second Edition. CSIRO Publishing, Collingwood.

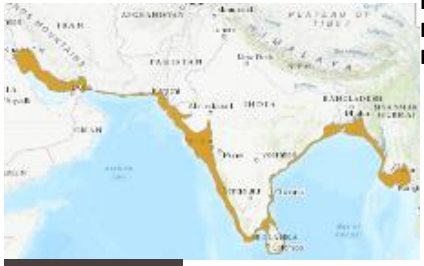
[561] Ebert, D.A., Fowler, S. and Compagno, L. 2013. Sharks of the World. Wild Nature Press, Plymouth.

[562] 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.

[563] 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.

			strong affinity for open ocean environments, particularly in tropical and subtropical regions[564], [565],[566]. The species has not been reported from the coasts of Gujarat specifically around the Jamnagar area[567], [568], thus its presence in the project's EAAA is less likely.	
59	Sand Tiger Shark (*Carcharias taurus*)  https://www.iucnredlist.org/species/3854/2876505	**IUCN:** Critically Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	The species has a circumglobal distribution, meaning it occurs in all oceans except for the eastern Pacific. Its range includes the Indian Ocean (western and eastern), Mediterranean and Black Sea, Atlantic Ocean (western central, northwest, southeast, and southwest), and Pacific Ocean (northwest, southwest, and western central). The shark can be found in numerous countries across the globe, including but not limited to Australia, South Africa, United States, Japan, Italy, India, and Spain[569], [570], [571], [572], [573]. The global population status of the Sand Tiger Shark is currently decreasing. The species is facing significant threats such as overfishing, habitat loss. Due to its low biological productivity and vulnerability to fishing pressure, the Sand Tiger Shark is experiencing a decline in its population, with numbers decreasing globally[574]. The Sand Tiger Shark prefers marine habitats, specifically neritic and deep benthic environments. It is known to occupy tropical and temperate seas on the continental shelf at depths ranging from 0 to 232 meters, with a particular preference for shallow waters within	Screened Out

[564] 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.
[565] 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.
[566] 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.
[567] https://indiabiodiversity.org/species/show/231901
[568] https://www.gbif.org/species/2418052
[569] White, W.T., Last, P.R., Stevens, J.D., Yearsley, G.K., Fahmi and Dharmadi. 2006. Economically Important Sharks and Rays of Indonesia. Australian Centre for International Agricultural Research, Canberra, Australia.
[570] Ebert, D.A., Fowler, S. and Compagno, L. 2013. Sharks of the World. A Fully Illustrated Guide. Wild Nature Press, Plymouth, United Kingdom.
[571] White W.T., Baje, L., Sabub, B., Appleyard, S.A., Pogonoski, J.J. and Mana, R.R. 2017. Sharks and Rays of Papua New Guinea. ACIAR Monograph No. 189. Australian Centre for International Agricultural Research, Canberra.
[572] Psomadakis, P.N., Htun Thein, Russell, B.C. and Mya Than Tun. 2019. Field identification guide to the living marine resources of Myanmar. FAO Species Identification Guide for Fishery Purposes. FAO and MOALI, Rome.
[573] 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.
[574] The IUCN Red List of Threatened Species. Version 2023-1. (https://www.iucnredlist.org/species/3854/2876505)

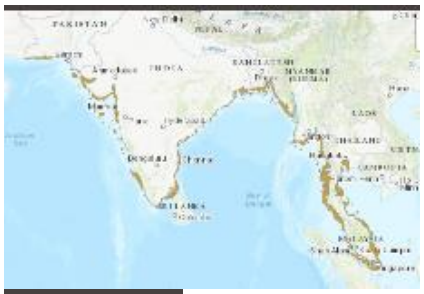
				the depth range of 15 to 25 meters[575]. It occurs mainly in shallow waters of 15–25 m depth and aggregates in or near underwater caves, gullies, and rocky and coral reefs[576], [577], [578], [579]. Specific data on local status in Gujarat about the species is lacking. However, given the general declining population trend of this species globally due to factors such as overfishing and habitat loss. The species has not been reported from the coasts of Gujarat specifically around the Jamnagar area[580], [581], thus its presence in the project's EAAA is less likely.	
60	Sharpnose Guitarfish (*Glaucostegus granulatus*)  https://www.iucnredlist.org/species/60166/215829219	**IUCN:** Critically Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	The Sharpnose Guitarfish (Glaucostegus granulatus) is moderately widespread in the northern Indian Ocean, spanning from the Arabian/Persian Gulf to Myanmar[582]. However, it is absent from Bahrain and Qatar, and in the United Arab Emirates, it may only occur in the Gulf of Oman[583]. Despite being previously mapped in the Andaman and Nicobar Islands, recent surveys indicate its absence there[584]. The global population status of the Sharpnose Guitarfish (Glaucostegus granulatus) 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%. The Sharpnose Guitarfish occurs from close inshore (including the intertidal zone) to depths of 120 m on the continental shelf [582]. Maximum size is 229 cm total length (TL). Reproduction is lecithotrophic viviparous with litter sizes of 6–18 pups[585], size at birth is ~39 cm TL. Generation length is estimated as 15 years [586] .	Screened Out

[575] Ebert, D.A., Fowler, S. and Compagno, L. 2013. Sharks of the World. A Fully Illustrated Guide. Wild Nature Press, Plymouth, United Kingdom.
[576] Otway, N.M. and Parker P.C. 2000. The biology, ecology, distribution, abundance and identification of marine protected areas for the conservation of threatened grey nurse sharks in south east Australian waters. NSW Fisheries Final Report Series 19. Office of Conservation, New South Wales, Australia.
[577] Pollard, D.A., Lincoln Smith, M.P. and Smith, A.K. 1996. The biology and conservation states of the grey nurse shark (Carcharias taurus Rafinesque 1810) in New South Wales, Australia. Aquatic Conservation. Marine and Freshwater Ecosystems 6: 1–20.

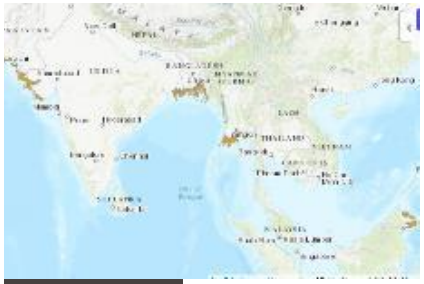
[579] Ebert, D.A., Fowler, S. and Compagno, L. 2013. Sharks of the World. A Fully Illustrated Guide. Wild Nature Press, Plymouth, United Kingdom.
[580] https://indiabiodiversity.org/species/show/231924
[581] https://www.gbif.org/species/2420766
[582]Last, P., White, W., de Carvalho, M., Séret, B., Stehmann, M. and Naylor, G. 2016b. Rays of the World. CSIRO Publishing, Clayton.
[583] 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.
[584] 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.
[585] 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.
[586] 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.

				In Gujarat has been reported from Veraval, and Dwarka[587], [588], [589]. However, no observation has been recorded around the Jamnagar area, thus its presence in the project's EAAA is less likely.	
61	Halavi Guitarfish (*Glaucostegus halavi*)  https://www.iucnredlist.org/species/161408/124479984	**IUCN:** Critically Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	The Halavi Guitarfish is endemic to the Arabian Sea and its adjacent waters in the Western Indian Ocean, where it occurs in coastal waters of the Red Sea and the Gulf of Aden, the Arabian Sea from Kenya and Yemen to northern India (Gujarat), including the southern Arabian/Persian Gulf[590]. The global population of the Halavi Guitarfish (*Glaucostegus halavi*) has experienced severe declines, with an estimated reduction exceeding 80% over the last three generations, spanning approximately 30 years. Fishing pressure across its range, particularly in the Indo-West Pacific, has contributed to this decline. Various historical accounts and contemporary datasets from Iran, Pakistan, India, and Indonesia demonstrate significant reductions in landings and catch rates, indicative of population depletion. The Halavi Guitarfish occurs from close inshore to depths of at least 100 m on the continental shelf. Maximum size is 187 cm total length (TL); males and females mature at ~83 cm TL[590],[591]. Reproduction is lecithotrophic viviparous with litter sizes of up to 10 pups; size at birth is ~29 cm TL . Generation length is estimated as 10 years[592]. Although it is common landing in fishing nets in India and Pakistan[593]; however, no record of the species is available from the coasts of Gujarat[594], [595]. Thus, its presence in the project's EAAA is less likely.	Screened Out
62	Widenose Guitarfish (*Glaucostegus obtusus*)	**IUCN:** Critically Endangered **IWP:** Schedule I **Restricted range:** No **Migratory:** No		The Widenose Guitarfish is moderately widespread in the northern Indian Ocean from Pakistan to the Gulf of Thailand[596]. The global population status of the Widenose Guitarfish (Glaucostegus obtusus) 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	Screened Out

[587] 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.
[588] https://www.gbif.org/species/2418915
[589] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=101483
[590] Last, P., White, W., de Carvalho, M., Séret, B., Stehmann, M. and Naylor, G. 2016b. Rays of the World. CSIRO Publishing, Clayton.
[591] Moore, A.B.M. and Peirce, R. 2013. Composition of elasmobranch landings in Bahrain. African Journal of Marine Science 35: 593–596.
[592] Gohar, H.A.F. and Mazhar, F.M. 1964. The elasmobranchs of the north-western Red Sea. Publications of the Marine Biological Station Al-Ghardaqa (Red Sea) 13: 1–144.
[593] ICAR-CMFRI, 2022. India Non-Detriment Finding (NDF) for bowmouth guitarfish Rhina ancylostoma in the Indian Ocean. CMFRI Marine Fisheries Policy Series No:22. ICARCentral Marine Fisheries Research Institute, Kochi. 50 pp.
[594] https://www.gbif.org/species/2418919
[595] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=101484
[596] Last, P., White, W., de Carvalho, M., Séret, B., Stehmann, M. and Naylor, G. 2016b. Rays of the World. CSIRO Publishing, Clayton.

	 https://www.iucnredlist.org/species/60170/207283191		range, particularly in the Indo-West Pacific, has contributed to this decline, leading to an estimated reduction exceeding 80%[597]. The Widenose Guitarfish 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.[598] Although it is common landing in fishing nets in western coasts of India[599]; however, their records are restricted from the coasts of Kerala to Goa[600] and no record of the species is available from the coasts of Gujarat[601]. Thus, its presence in the project's EAAA is less likely.	
63	Ganges Shark (*Glyphis gangeticus*)	**IUCN:** Critically Endangered **IWP:** Schedule I **Restricted range:** No **Migratory:** No	The Ganges Shark has a patchy distribution across the Indo-West Pacific[602]. Records suggest its presence in the lower Ganges River Basin, West Bengal, India, extending eastward to at least the Bangladesh-Myanmar border[603], [604], [605]. It has been reported in Pakistan, particularly in the Karachi area, and in Sabah, Borneo, with historical records from Indonesia and Myanmar[606], [607]. However, its historical distribution remains difficult to ascertain, and there is no suitable habitat for the species west of the Indus River[608]. Declines in shark catches suggest population depletion, with possible local extinctions in some areas like Myanmar. Intensive and unregulated fishing, along with habitat threats, have driven a population reduction of over 80% in the past 54 years. Global estimates indicate very few mature individuals, with less than 250 individuals overall. Each	Screened Out

[597] Kyne, P.M. & Jabado, R.W. 2021. Glaucostegus obtusus (amended version of 2019 assessment). The IUCN Red List of Threatened Species 2021: e.T60170A207283191.
[598] Last, P., White, W., de Carvalho, M., Séret, B., Stehmann, M. and Naylor, G. 2016b. Rays of the World. CSIRO Publishing, Clayton.
[599] 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.
[600] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=623881
[601] https://www.gbif.org/species/9341842
[602] Li, C., Corrigan, S., Yang, L., Straube, N., Harris, M., Hofreiter, M., White, W.T. and Naylor, G.J.P. 2015. DNA capture reveals transoceanic gene flow in endangered river sharks. Proceedings of the National Academy of Sciences of the United States of America 112(43): 13302–13307.
[603] Ebert, D.A., Fowler, S. and Compagno, L. 2013. Sharks of the World. A Fully Illustrated Guide. Wild Nature Press, Plymouth, United Kingdom.
[604] Chowdhury, G.W., Akash, M. and Haque, A.B. 2017. Status of the Ganges River Shark Glyphis gangeticus (Müller & Henle, 1839). Dhaka University Journal of Biological Sciences 26: 111–116.
[605] Haque, A.B. and Das S.A. 2019. New records of the Critically Endangered Ganges shark Glyphis gangeticus in Bangladeshi waters: urgent monitoring needed. Endangered Species Research 40: 65 73.
[606] Compagno, L.J.V. 1984. FAO species catalogue. Vol. 4. Sharks of the world. An annotated and illustrated catalogue of shark species known to date. Part 1. Hexanchiformes to Lamniformes. FAO, Rome.
[607] Compagno, L.J.V., White, W.T. and Cavanagh, R.D. 2010. Glyphis fowlerae sp. nov., a new species of river shark (Carcharhiniformes; Carcharhinidae) from northeastern Borneo. In: Last, P.R., White, W.T. and Pognoski, J.J. (eds), Descriptions of new sharks and rays from Borneo, pp. 29–44. CSIRO Marine and Atmospheric Research Paper No. 032, Hobart.
[608] 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.

	 https://www.iucnredlist.org/species/169473392/124398647			subpopulation likely harbors fewer than 50 mature adults. Ongoing declines are expected due to continued fishing pressure and habitat degradation[609]. The Ganges Shark (Glyphis gangeticus) prefers riverine and coastal habitats, especially in the Ganges River Basin and adjacent areas. It inhabits tidal river systems, estuaries, and coastal waters[610]. Juvenile and subadult Glyphis species generally occur in rivers while adults are generally coastal and marine[611], [612], [613]. The status of the Ganges Shark in Gujarat is likely to be rare[614], [615]. The available secondary data also support the absence of this species from the Gujarat state[616], [617], [618]. Thus, its presence in the project's EAAA is unlikely.	
64	Tentacled Butterfly Ray (*Gymnura tentaculata*)	**IUCN:** Critically Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	The Tentacled Butterfly Ray was reported as widespread in the Northern Indian Ocean[619]. The species has been recorded with certainty from Iran, Pakistan, and India. Most Indian records are from the west coast, with the only specimen from outside the Arabian Sea being from Odisha in the Bay of Bengal. The known contemporary range is restricted to Iran (eastern Gulf, Strait of Hormuz, Gulf of Oman, encompassing the coast from the border between Hormozgan and Bushehr Provinces to the Iran/Pakistan border[620]. Extensive surveys in India and Pakistan since the 1970s have failed to record the species, indicating severe declines. The only contemporary records are from Iran, where the species represents a significant portion of ray bycatch[621]. With documented declines in rays and	Screened Out

[609] Rigby, C.L., Derrick, D., Dulvy, N.K., Grant, I & Jabado, R.W. 2021. Glyphis gangeticus. The IUCN Red List of Threatened Species 2021: e.T169473392A124398647.
[610] Compagno, L.J.V., White, W.T. and Cavanagh, R.D. 2010. Glyphis fowlerae sp. nov., a new species of river shark (Carcharhiniformes; Carcharhinidae) from northeastern Borneo. In: Last, P.R., White, W.T. and Pognoski, J.J. (eds), Descriptions of new sharks and rays from Borneo, pp. 29–44. CSIRO Marine and Atmospheric Research Paper No. 032, Hobart.
[611] Li, C., Corrigan, S., Yang, L., Straube, N., Harris, M., Hofreiter, M., White, W.T. and Naylor, G.J.P. 2015. DNA capture reveals transoceanic gene flow in endangered river sharks. Proceedings of the National Academy of Sciences of the United States of America 112(43): 13302–13307.
[612] Dwyer, R.G., Campbell, H.A., Cramp, R.L., Burke, C.L., Micheli-Campbell, M.A., Pillans, R.D., Lyon, B.J. and Franklin, C.E. 2020. Niche partitioning between river shark species is driven by seasonal fluctuations in environmental salinity. Functional Ecology 34(10): 2170–2185.
[613] Grant, M.I., Kyne, P.M., Simpfendorfer, C.A., White, W.T. and Chin, A. 2019. Categorising use patterns of non-marine environments by elasmobranchs and a review of their extinction risk. Reviews in Fish Biology and Fisheries 29: 689–710.
[614] Akhilesh, K.V., Bineesh, K.K., Gopalakrishnan, A., Jena, J.K., Basheer, V.S. and Pillai, N.G.K. 2014. Checklist of Chondrichthyans in Indian waters. Journal of the Marine Biological Association of India 56(1): 109- 120.
[615] Raje, S.G., Thakurdas, Sundaram, S. and Raje, R.K. 2015. Fishery and some aspects of biology of major species of sharks from Mumbai waters. Journal of Indian Fisheries Association 42: 69–79.
[616] https://www.gbif.org/species/5215563
[617] https://indiabiodiversity.org/species/show/232349
[618] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=101508
[619] Last, P., White, W., de Carvalho, M., Séret, B., Stehmann, M. and Naylor, G. 2016. Rays of the World. CSIRO Publishing, Clayton.
[620] Jabado, R.W., Rezaie-Atagholipour, M. & Kyne, P.M. 2021. Gymnura tentaculata. The IUCN Red List of Threatened Species 2021: e.T161516A124498408.
[621] Rezaie-Atagholipour, M., Jabado, R. W., Askari Hesni, M., Owfi, F., Rastegar Pouyani, E., & Ebert, D. A. (2023). Redescription of the critically endangered tentacled butterfly ray, Gymnura tentaculata (Valenciennes in Müller & Henle, 1841)(Myliobatiformes: Gymnuridae) from Iranian waters. Marine Biodiversity, 53(1), 6.

	 https://www.iucnredlist.org/species/161516/124498408			intense fishing pressure across its range, the population is inferred to have undergone a reduction of over 80% in the last 30 years. The current population trend is decreasing[622]. The Tentacled Butterfly Ray is found from close inshore to a depth of 87 meters[623]. As the species has been displayed as "possibly extant" in IUCN portal for throughout the Indian coast[624] and has not been reported from the surroundings of Jamnagar[625, 626]; its presence in the project's EAAA is unlikely.	
65	Pakistan Whipray (*Maculabatis arabica*) 	**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.[627] 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.[628] Although the species distribution map includes the western coast of India, however as per the available secondary information[629], [630], the species has been reported near the coast of Pingleshwar, Bhuj, Gujarat, but not from the surroundings of Jamnagar area. Thus, its presence in the project's EAAA is less likely.	Screened Out

[622] Jabado, R.W., Rezaie-Atagholipour, M. & Kyne, P.M. 2021. Gymnura tentaculata. The IUCN Red List of Threatened Species 2021: e.T161516A124498408.
[623] Last, P., White, W., de Carvalho, M., Séret, B., Stehmann, M. and Naylor, G. 2016. Rays of the World. CSIRO Publishing, Clayton.
[624] https://www.iucnredlist.org/species/161516/124498408
[625] https://indiabiodiversity.org/species/show/232449
[626] https://www.gbif.org/species/5216238
[627] 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.
[628] 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.
[629] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=623859
[630] https://www.gbif.org/species/9125247

	https://www.iucnredlist.org/species/107604987/109922508				
66	Largetooth Sawfish (*Pristis pristis*)  https://www.iucnredlist.org/species/18584848/58336780	**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[631], [632], [633], the species has not been reported from the surroundings of Jamnagar area. Thus, its presence in the project's EAAA is less likely.	Screened Out
67	Green Sawfish (*Pristis zijsron*) 	**IUCN:** Critically Endangered **IWP:** Schedule I **Restricted range:** No **Migratory:** No	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 of Aden, the Persian/Arabian Gulf, Gulf of Oman, and Arabian Sea.[634] 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 [635] [636] 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.[637]	Screened Out

[631] https://www.gbif.org/species/5216276
[632] https://indiabiodiversity.org/species/show/233205
[633] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=110381
[634] Harrison, L.R. and Dulvy, N.K. 2014. Sawfish: A Global Strategy for Conservation. IUCN Species Survival Commission's Shark Specialist Group, Vancouver, Canada.
[635] 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.
[636] 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.
[637] 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.

	https://www.iucnredlist.org/species/39393/58304631			Although the species distribution map includes few of the coasts of the country (India), however as per the available secondary information, the species has been reported from the Gujarat state and not from the surroundings of Jamnagar area.[638] As the species has been displayed as "possibly extant" in IUCN portal for throughout the Indian coast[639] and has also not been reported from the coasts of Gujarat (specifically surroundings of Jamnagar)[640, 641, 642]; its presence in the project's EAAA is unlikely.	
68	Bowmouth Guitarfish (*Rhina ancylostoma*)  https://www.iucnredlist.org/species/41848/124421912	**IUCN:** Critically Endangered **IWP:** Schedule-I **Restricted range:** No **Migratory:** No	1 a	The Bowmouth Guitarfish is distributed in the Indo-West Pacific from South Africa through the Western Indian Ocean, the Arabian Sea, Southeast Asia, and extending north to Japan, south to Australia (where it is wide-ranging across the north of the continent), and east to New Caledonia[643] They are seen close to the seabeds, mainly over sandy or muddy substrates, and also around coral reefs. These guitarfish primarily feed on crustaceans and mollusks they find on the ocean floor and in the sediment.[644] Globally, wedgefishes are subject to intense fishing pressure on their coastal and shelf habitats that is unregulated across the majority of their distributions. Wedgefishes are captured in industrial, artisanal, and subsistence fisheries with multiple fishing gears, including gillnet, trawl, hook and line, trap, and seine net and are generally retained for their meat and fins[645] Although the species distribution map includes the entire Indian coasts, however as per the available secondary information[646], [647], the species has been reported from the Gujarat state as well as from the surroundings of Jamnagar area. Thus, its presence in the project's EAAA is less likely.	Screened Out

[638] https://www.inaturalist.org/observations?iconic_taxa=Amphibia,Actinopterygii&nelat=22.570645404412222&nelng=70.19873780044794&place_id=any&subview=map&swlat=22.396805552009074&swlng=69.9268261793542

[639] https://www.iucnredlist.org/species/39393/58304631

[640] https://www.gbif.org/species/5216288

[641] https://indiabiodiversity.org/species/show/233208

[642] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=110382

[643] Last, P.R. and Stevens, J.D. 2009. Sharks and Rays of Australia. Second Edition. CSIRO Publishing, Collingwood.

[644] Purushottama, G. B., Thakurdas, Tandel, S. S., Mhatre, V. D. and Singh, V. V. 2018. Records of rare elasmobranchs and their biological observation from the north-eastern Arabian Sea, off Mumbai. Indian J. Mar. Sci., 47(8): 1566-1573.

[645] Bonfil, R. and Abdallah, M. 2004. Field identification guide to the sharks and rays of the Red Sea and Gulf of Aden. FAO Species Identification Guide for Fishery Purposes. FAO, Rome.

[646] https://www.gbif.org/species/5963013

[647] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=1303415

69	Bengal Guitarfish (*Rhinobatos annandalei*)  https://www.iucnredlist.org/species/161478/124492224	**IUCN:** Critically Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	The Bengal Guitarfish is a small (to 95 cm total length) guitarfish that is seen in Bangladesh, India, Iran, Islamic Republic of; Oman; Pakistan; Sri Lanka; United Arab Emirates. The western boundary of this species distribution is uncertain due to confusion with the Spotted Guitarfish. Globally, guitarfishes are subject to intense fishing pressure on their coastal and shelf habitats that is unregulated across the majority of their distributions. Guitarfishes are captured in industrial, artisanal, and subsistence fisheries with multiple fishing gears, including gillnet, trawl, hook and line, trap, and seine net and are generally retained for their meat, with only the fins of the largest individuals generally retained[648] Although the species distribution map includes the entire coast of India, however as per the available secondary information[649], [650], the species has been reported near the coast of Pithalpur, Bhavnagar; Somnath; and Porbandar in Gujarat, but not from the surroundings of Jamnagar area. Thus, its presence in the project's EAAA is less likely.	Screened out
70	Smoothback Guitarfish (*Rhinobatos lionotus*)	**IUCN:** Critically Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	The Smoothback Guitarfish occurs in the northern Indian Ocean from India to Myanmar, including Sri Lanka, and Bangladesh[651]. No species-specific population data is available. The species resides on the inner continental shelf upto 73 m depth[652]. The species was historically abundant along both east and west coasts of India. On the west coast, the population declined by more than 90% and surveys of fisheries landing sites have not recorded any individuals since 2008[653]. Although the global distribution map of the species includes the entire coast of India, however as per the available secondary information[654], [655], the species has been reported near the eastern coast of India, while no record is available from the western coast including Gujarat State, as well as surroundings of Jamnagar area. Thus, its presence in the project's EAAA is less likely.	Screened out

[648] Moore, A.B.M. 2017. Are guitarfishes the next sawfishes? Extinction risk and an urgent call for conservation action. Endangered Species Research 34: 75–88.
[649] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=111661
[650] https://www.gbif.org/species/2419014
[651] https://www.iucnredlist.org/species/161677/124526883
[652] 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.
[653] Dulvy, N.K., Bineesh, K.K., Derrick, D., Fernando, D., Haque, A.B., Maung, A. & VanderWright, W.J. 2021. Rhinobatos lionotus. The IUCN Red List of Threatened Species 2021: e.T161677A124526883
[654] https://www.gbif.org/species/2419003
[655] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=111671

	 https://www.iucnredlist.org/species/161677/124526883				
71	Bottlenose Wedgefish (*Rhynchobatus australiae*)  https://www.iucnredlist.org/species/41853/68643043	**IUCN:** Critically Endangered **IWP:** Schedule-I **Restricted range:** No **Migratory:** No	1 a	The Bottlenose Wedgefish is widespread in the Indo-West Pacific from Mozambique through the Western Indian Ocean, the Arabian Sea, Southeast Asia, and extending north to Taiwan, south to Australia (where it is wide-ranging across the north of the continent), and east to the Solomon Islands[656]. It inhabits inshore waters to depths of at least 60 m on the continental shelves, specifically enclosed bays, estuaries, and also coral reefs[657], [658]. Although the global distribution map of the species includes the entire coast of India, however as per the available secondary information[659], [660], the species has not been reported from the coast of Gujarat State, specifically from the surroundings of Jamnagar area. Thus, its presence in the project's EAAA is less likely.	Screened Out

[656] Last, P., White, W., de Carvalho, M., Séret, B., Stehmann, M. and Naylor, G. 2016. Rays of the World. CSIRO Publishing, Clayton.
[657] Last, P., White, W., de Carvalho, M., Séret, B., Stehmann, M. and Naylor, G. 2016. Rays of the World. CSIRO Publishing, Clayton.
[658] https://www.cms.int/en/species/rhynchobatus-australiae
[659] https://www.gbif.org/species/2418942
[660] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=111775

72	Smoothnose Wedgefish (*Rhynchobatus laevis*)  https://www.iucnredlist.org/species/41854/124422344	**IUCN:** Critically Endangered **IWP:** Schedule I **Restricted range:** No **Migratory:** No	1 a	The Smoothnose Wedgefish is found in countries like Bahrain, Bangladesh, China, India, Iran, Islamic Republic of; Iraq; Japan; Kuwait; Oman; Pakistan; Qatar, Saudi Arabia, Sri Lanka, Taiwan, Province of China and United Arab Emirates. They occur from close inshore to depths of at least 60 m on the continental shelf and has a preference for shallow bays and river mouths[661]. They feed mostly on benthic invertebrates and reproduces by lecithotrophic viviparity. These species are threatened by habitat loss and overfishing[662]. There is a high level of fisheries resource use and increasing fishing pressure across the range of the Smoothnose Wedgefish, and demersal coastal fisheries resources have been severely depleted in significant areas of the Indo-West Pacific, including India and Southeast Asia[663]. The species distribution map includes the entire coast of India. As per the available secondary information[664], [665], the species has been reported near the coast of Somnath; and Porbandar in Gujarat, but not from the surroundings of Jamnagar area. Thus, its presence in the project's EAAA is less likely.	Screened Out
73	Scalloped Hammerhead (*Sphyrna lewini*)  https://www.iucnredlist.org/species/39385/2918526	**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[666], 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)[667]. 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[668].	Screened Out

[661] Last, P., White, W., de Carvalho, M., Séret, B., Stehmann, M. and Naylor, G. 2016. Rays of the World. CSIRO Publishing, Clayton.

[662] Kyne, P.M.; Jabado, R.W. (2019). "Rhynchobatus laevis". IUCN Red List of Threatened Species. 2019

[663] Stobutzki, I.C., Silvestre, G.T., Abu Talib, A., Krongprom, A., Supongpan, M., Khemakorn, P., Armada, N.and Garces, L.R. 2006. Decline of demersal coastal fisheries resources in three developing Asian countries. Fisheries Research 78: 130–142.

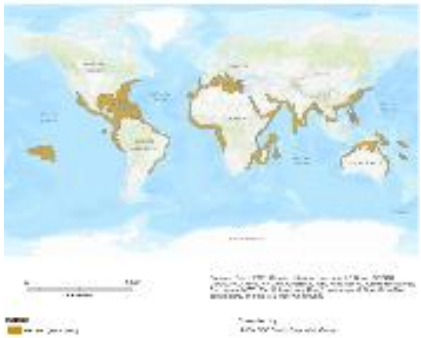
[664] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=111777

[665] https://www.gbif.org/species/2418939

[666] https://marinesanctuary.org/blog/scalloped-hammerhead-shark/

[667] http://www.fishbase.org/Summary/SpeciesSummary.php?id=912

[668] https://www.iucnredlist.org/species/39385/2918526#population

				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[669]. The species distribution map includes the entire coast of India. As per the available secondary information[670], [671], the species has been reported near the coast of Somnath; and Porbandar in Gujarat, but not from the surroundings of Jamnagar area. Thus, its presence in the project's EAAA is less likely.	
74	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). [672]The Great Hammerhead ranges worldwide throughout tropical and warm temperate seas[673] 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[674] They are seen in tropical and subtropical coastal waters, near continental shelves, coral reefs and in deep waters.[675] Great hammerheads are, however, vulnerable to overfishing[676] Although the global distribution map of the species includes the entire coast of India, however as per the available secondary information[677], [678], the species has not been reported from the coast of Gujarat State, specifically from the surroundings of Jamnagar area. Thus, its presence in the project's EAAA is less likely.	Screened Out

[669] 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.
[670] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=111777
[671] https://www.gbif.org/species/2418939
[672] https://oceana.org/marine-life/great-hammerhead-shark/
[673] Last, P.R. and Stevens, J.D. 2009. Sharks and Rays of Australia. CSIRO Publishing, Collingwood
[674] Ebert, D.A., Fowler, S. and Compagno, L. 2013. Sharks of the World. A Fully Illustrated Guide. Wild Nature Press, Plymouth, United Kingdom.
[675]
[676] https://oceana.org/marine-life/great-hammerhead-shark/
[677] https://www.gbif.org/species/2418792
[678] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=56766

75	Longhead Eagle Ray (*Aetobatus flagellum*)  https://www.iucnredlist.org/species/169243577/124440562	**IUCN:** Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	The Longhead Eagle Ray has a patchy distribution in the Eastern and Western Indian Oceans and Western Central Pacific from the Arabian/Persian Gulf to Myanmar and in the waters surrounding Borneo down to the Java Sea[679][680] The longhead eagle ray displays a strong association to estuary habitats with brackish waters in tropical and subtropical coasts. Longhead eagle ray's preference for inshore coastal habitats make it highly vulnerable to be caught as bycatch due to the increasingly high fishing pressure in these areas.[681] The species distribution map includes the entire coast of India. As per the available secondary information[682], [683], the species has been reported near the coast of Somnath in Gujarat, but not from the surroundings of Jamnagar area. Thus, its presence in the project's EAAA is less likely.	Screened Out
76	Ocellate Eagle Ray (*Aetomylaeus milvus*)	**IUCN:** Endangered **IWP:** Schedule II **Restricted range:** No **Migratory:** No	1 a	The Ocellate Eagle Ray is distributed from Indo-Pacific: East Africa, including the Red Sea to Hawaiian Islands and French Polynesia[684]. 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[685].	Screened Out

[679] Last, P.R., White, W.T., Caira, J.N., Dharmadi, Fahmi, Jensen, K., Lim, A.P.K., Manjaji-Matsumoto, B.M., Naylor, G.J.P., Pogonoski, J.J., Stevens, J.D., Yearsley, G.K. 2010. Sharks and Rays of Borneo. CSIRO Marine and Atmospheric Research, Collingwood.

[680] Last, P., White, W., de Carvalho, M., Séret, B., Stehmann, M. and Naylor, G. 2016. Rays of the World. CSIRO Publishing, Clayton

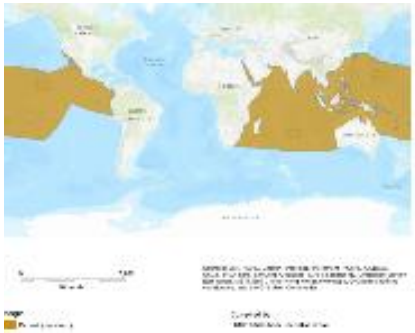
[681] https://www.edgeofexistence.org/species/longhead-eagle-ray/

[682] https://www.gbif.org/species/2419243

[683] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=93462

[684] https://www.fishbase.se/summary/12600

[685] https://www.iucnredlist.org/species/104023514/109922492

	 https://www.iucnredlist.org/species/104023514/109922492			Although the global distribution map of the species includes the entire coast of India, however as per the available secondary information[686], [687], the species has not been reported from the coast of Gujarat State, specifically from the surroundings of Jamnagar area. Thus, its presence in the project's EAAA is less likely.	
77	Pelagic Thresher (*Alopias pelagicus*) 	**IUCN:** Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	The 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.[688] 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[689] The species distribution map includes the entire coast of India. As per the available secondary information[690], [691], the species has been reported near the coast of Dwarka in	Screened Out

[686] https://www.gbif.org/species/2419264
[687] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=607462
[688] 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.
[689] https://www.iucnredlist.org/species/161597/68607857

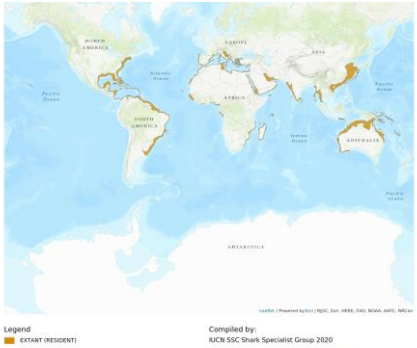
[690] https://www.gbif.org/species/2420809
[691] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=68050

	https://www.iucnredlist.org/species/161597/68607857			Gujarat, but not from the surroundings of Jamnagar area. Thus, its presence in the project's EAAA is less likely.	
78	Dusky Meagre (*Argyrosomus japonicus*)  https://www.iucnredlist.org/species/16924357/124440562	**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[692, 693, 694]. 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[695]. This species has not recently been reported from India and fisheries data are not available[696]. The species distribution map includes the entire coast of India. As per the available secondary information[697], [698], the species has not been reported from the coasts of India, as well as from the surroundings of Jamnagar area. Thus, its presence in the project's EAAA is unlikely.	Screened Out
79	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[699]. 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)[700]. There have been no dedicated surveys or population estimates for this species.	Screened Out

[692] 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.
[693] 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.
[694] 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.
[695] Fennessy, S. 2020. Argyrosomus japonicus. The IUCN Red List of Threatened Species 2020: e.T49145403A49234015
[696] Fennessy, S. 2020. Argyrosomus japonicus. The IUCN Red List of Threatened Species 2020: e.T49145403A49234015
[697] https://www.gbif.org/species/5212440
[698] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=203918
[699] 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).
[700] 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.

	 https://www.iucnredlist.org/species/70680197/68612632			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[701]. The species distribution map includes the entire coast of India. As per the available secondary information[702], [703], the species has been reported near the Gulf of Kutch[704], but not from the surroundings of Jamnagar area. Thus, its presence in the project's EAAA is less likely.	
80	Sandbar Shark (*Carcharhinus plumbeus*)	**IUCN:** Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	Sandbar Shark has a circumglobal distribution in tropical and warm-temperate waters[705], [706]. Across the regions, the Sandbar Shark is estimated and suspected to have declined by 50–79% over the past three generation lengths (60–78 years) due to fishing pressure[707]. The Sandbar Shark is demersal and pelagic in tropical and temperate seas on the continental shelf from close inshore to a depth of 280 m[708], [709]. It occurs in shallow waters associated with bays, estuaries and harbours and offshore on oceanic banks[710]. The species distribution map includes the entire coast of India. As per the available secondary information[711], [712], the species has not been reported from the coasts of India, as	Screened Out

[701] 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.
[702] https://www.gbif.org/species/2418172
[703] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=96753
[704] https://www.gbif.org/occurrence/90122440
[705] https://www.fishbase.se/FieldGuide/FieldGuideSummary.php?genusname=Carcharhinus&speciesname=plumbeus&c_code=458
[706] Rigby, C.L., Derrick, D., Dicken, M., Harry, A.V., Pacoureau, N. & Simpfendorfer, C. 2021. Carcharhinus plumbeus. The IUCN Red List of Threatened Species 2021: e.T3853A2874370
[707] Rigby, C.L., Derrick, D., Dicken, M., Harry, A.V., Pacoureau, N. & Simpfendorfer, C. 2021. Carcharhinus plumbeus. The IUCN Red List of Threatened Species 2021: e.T3853A2874370
[708] Ebert, D.A., Fowler, S. and Compagno, L. 2013. Sharks of the World. A Fully Illustrated Guide. Wild Nature Press, Plymouth, United Kingdom.
[709] 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.
[710] Ebert, D.A., Fowler, S. and Compagno, L. 2013. Sharks of the World. A Fully Illustrated Guide. Wild Nature Press, Plymouth, United Kingdom.
[711] https://www.gbif.org/species/2418009
[712] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=53583

	 https://www.iucnredlist.org/species/3853/2874370			well as from the surroundings of Jamnagar area. Thus, its presence in the project's EAAA is unlikely.	
81	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[713]. 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[714]. 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[715]. The species distribution map includes the entire coast of India. As per the available secondary information[716], [717], the species has not been reported in the coasts of Gujarat, as well as from the surroundings of Jamnagar area. Thus, its presence in the project's EAAA is unlikely.	Screened Out

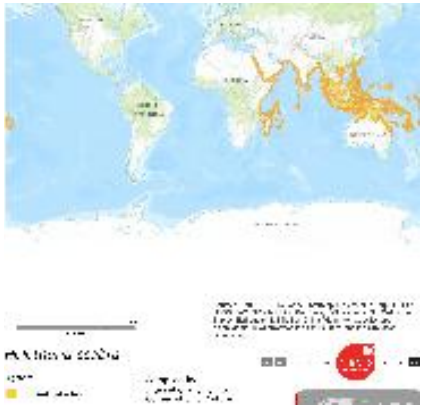
[713] Last, P.R. and Stevens, J.D. 2009. Sharks and Rays of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia.
[714] Dulvy, N.K., Fowler, S.L., Musick, J.A., Cavanagh, R.D., Kyne, P.M., Harrison, L.R., Carlson, J.K., Davidson, L.N.K., Fordham, S.V., Francis, M.P., Pollock, C.M., Simpfendorfer, 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.
[715] Smart, J.J. & Simpfendorfer, C. 2016. Eusphyra blochii. The IUCN Red List of Threatened Species 2016: e.T41810A68623209
[716] https://www.gbif.org/species/2418825
[717] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=48066

	https://www.iucnredlist.org/species/41810/68623209				
82	Coach Whipray (*Himantura uarnak*)  https://www.iucnredlist.org/species/201098826/124528737	**IUCN:** Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	Coach Whipray is widespread in the Indo-Pacific in the Eastern and Western Indian and Western Central Pacific Oceans from South Africa to the Philippines[718]. The species is a Lessepsian immigrant, having entered the Mediterranean Sea from the Red Sea through the Suez Canal and is present in Egypt and Israel and may extend north to Syria[719], [720], [721]. There is no population trend estimate for this species. Despite the lack of species-specific trend data, reconstructed landings data from 1950–2014 are available on combined whipray species from fisheries within the Malaysian and Indonesian Exclusive Economic Zones (EEZ)[722]. It occurs in inshore waters from the surface to a depth of 50 m, although it prefers shallow waters (including estuarine waters and sometimes into freshwater) and is often located in intertidal lagoons, reef flats, and reef faces[723]. The species distribution map includes the entire coast of India. As per the available secondary information[724], [725], the species has been reported from the coasts of Somnath and Dwarka, but not from the surroundings of Jamnagar area. Thus, its presence in the project's EAAA is less likely.	Screened Out
83	Black Teatfish (*Holothuria nobilis*)	**IUCN:** Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	Black Teatfish only occurs in the Indian Ocean[726] and does not occur in the Western Central Pacific[727] or in Asia[728]. It is present in the Africa and Indian Ocean region[729], and is found in	Screened Out

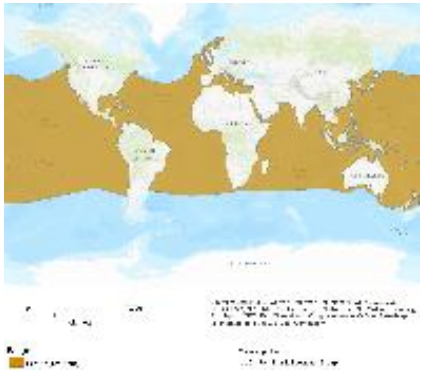
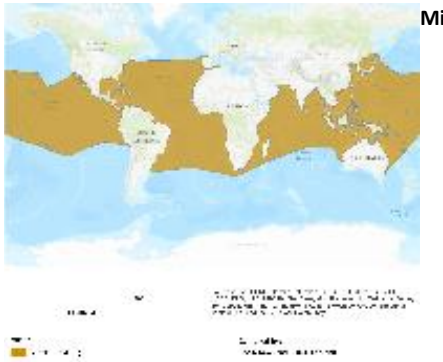
[718] Last, P., White, W., de Carvalho, M., Séret, B., Stehmann, M. and Naylor, G. 2016. Rays of the World. CSIRO Publishing, Clayton.
[719] Serena, F. 2005. Field identification guide to the sharks and rays of the Mediterranean and Black Sea. FAO Species Identification Guide for Fishery Purposes, FAO, Rome.
[720] Last, P.R., Naylor, G.J.P. and Manjaji-Matsumoto, B.M. 2016. A revised classification of the family Dasyatidae (Chondrichthyes: Myliobatiformes) based on new morphological and molecular insights. Zootaxa 4139(3): 345-368.
[721] Serena, F., Abella, A.J., Bargnesi, F., Barone, M., Colloca, F., Ferretti, F., Fiorentino, F., Jenrette, J. and Moro, S. 2020. Species diversity, taxonomy and distribution of Chondrichthyes in the Mediterranean and Black Sea. The European Zoological Journal 87(1): 497–536.
[722] Sherman, C.S., Bin Ali, A., Bineesh, K.K., Derrick, D., Dharmadi, Fahmi, Fernando, D., Haque, A.B., Maung, A., Seyha, L., Tanay, D., Utzurrum, J.A.T., Vo, V.Q. & Yuneni, R.R. 2021. Himantura uarnak. The IUCN Red List of Threatened Species 2021: e.T201098826A124528737
[723] Last, P.R., Naylor, G.J.P. and Manjaji-Matsumoto, B.M. 2016. A revised classification of the family Dasyatidae (Chondrichthyes: Myliobatiformes) based on new morphological and molecular insights. Zootaxa 4139(3): 345-368.
[724] https://www.gbif.org/species/9775198
[725] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=102778
[726] 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.
[727] 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.
[728] 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.
[729] 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.

	 https://www.iucnredlist.org/species/180326/1615368			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[730]. 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[731]. The species distribution map includes the entire coast of India. As per the available secondary information[732], [733], the species has not been reported in the coasts of Gujarat, as well as from the surroundings of Jamnagar area. Thus, its presence in the project's EAAA is less likely.	
84	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[734], 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[735]. Depletion refers to commercially unviable, and estimated to represent an approximately 90% loss or greater over the past 25-50 years[736]. 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[737].	Screened Out

[730] 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.
[731] Conand, C., Purcell, S., Gamboa, R. & Toral-Granda, T.-G. 2013. Holothuria nobilis. The IUCN Red List of Threatened Species 2013: e.T180326A1615368
[732] https://www.gbif.org/species/2279194
[733] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=353252
[734] 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.
[735] 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.
[736] 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.
[737] Skewes, T., Haywood, M., Pitchern, R. and Willan, R . 2004. Holothurians. National Oceans Office, Hobart, Australia.

	 https://www.iucnredlist.org/species/180257/1606648			Juveniles of this species settle in shallow seagrass beds and some may make it to deeper waters[738]. This species has been found to preferentially settle on seagrass such as *Thallassia hemprichi*[739]. The species distribution map includes the entire coast of India. As per the available secondary information[740], [741], the species has been solitary reported from the coast of Devbhumi Dwarka, but not from the Jamnagar area. Thus, its presence in the project's EAAA is less likely.	
85	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[742]. 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[743]. 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[744], [745], [746].	Screened Out

[738] 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.
[739] 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.
[740] https://www.gbif.org/species/2279170
[741] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=348150
[742] Ebert, D.A., Fowler, S. and Compagno, L. 2013. Sharks of the World. A Fully Illustrated Guide. Wild Nature Press, Plymouth, United Kingdom.
[743] 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
[744] Ebert, D.A., Fowler, S. and Compagno, L. 2013. Sharks of the World. A Fully Illustrated Guide. Wild Nature Press, Plymouth, United Kingdom.
[745] 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.
[746] 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/39341/2903170			The species distribution map includes the entire coast of India. As per the available secondary information[747], [748], the species has not been reported from the surroundings of Jamnagar area. Thus, its presence in the project's EAAA is less likely.	
86	Longfin Mako (*Isurus paucus*) 	**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[749]. 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[750]. 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[751], [752], [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 costs of Gujarat as well as surroundings of Jamnagar area. Thus, its presence in the project's EAAA is unlikely.	Screened Out

[747] https://www.gbif.org/species/5216248
[748] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=69677
[749] Ebert, D.A., Fowler, S. and Compagno, L. 2013. Sharks of the World. A Fully Illustrated Guide. Wild Nature Press, Plymouth, United Kingdom.
[750] 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
[751] Ebert, D.A., Fowler, S. and Compagno, L. 2013. Sharks of the World. A Fully Illustrated Guide. Wild Nature Press, Plymouth, United Kingdom.
[752] 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.
[753] 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.
[754] https://www.gbif.org/species/5216258
[755] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=103571

	https://www.iucnredlist.org/species/60225/3095898				
87	Broadfin Shark (*Lamiopsis temminckii*)  https://www.iucnredlist.org/species/169760690/124508850	**IUCN:** Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	The Broadfin Shark occurs in the northern Indian Ocean where it ranges from Pakistan to Thailand[756], [757], [758]. The Broadfin Shark occurs inshore on the continental shelf in depths of less than 50 m[759], [760]. The Broadfin Shark is a rare and poorly known species. Reports from India indicate that several shark stocks are either declining or have already collapsed[761]. The Broadfin Shark is particularly vulnerable to trawl fisheries and there are indications of increasing effort along the western coast of India. It is considered rare throughout most of its Indian range and rarely observed or reported from commercial fish catches along the Indian coast, except from the northwest of India (Maharashtra region) where it was once considered to be common as most of the available records are from Mumbai[762]. Although, the species distribution map includes the entire coast of India. However, as per the available secondary information[763], [764], [765], the species has not been reported from the costs of Gujarat as well as surroundings of Jamnagar area. Thus, its presence in the project's EAAA is unlikely.	Screened Out
88	Whitespotted Whipray (*Maculabatis gerrardi*)	**IUCN:** Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	Whitespotted Whipray is widespread in the Indo-Pacific region from the Arabian / Persian Gulf to Taiwan and includes Indonesia, and Southeast Philippines[766].	Screened Out

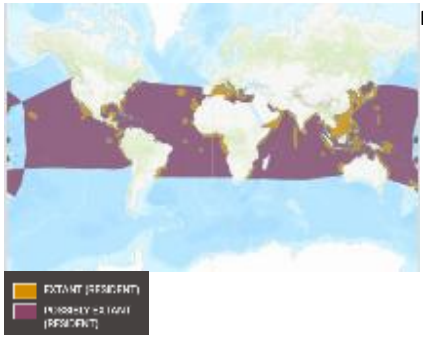
[756] White, W., Last, P., Naylor, G. and Harris, M. 2010. Resurrection and redescription of the Borneo broadfin shark Lamiopsis tephrodes (Fowler, 1905)(Carcharhiniformes: Carcharhinidae). In: Last, P., White, W.T. and Pogonoski, J. (eds), Descriptions of new sharks and rays from Borneo , pp. 49–60. Commonwealth Scientific and Industrial Research Organisation, Hobart, Australia.
[757] Akhilesh, K. V., White, W. T., Bineesh, K. K., Purushottama, G. B., Singh, V. V., Zacharia, P. U. 2016. Redescription of the rare and endangered Broadfin Shark Lamiopsis temminckii (Müller & Henle, 1839) (Carcharhiniformes:Carcharhinidae) from the northeastern Arabian Sea. Zootaxa 4175(2): 155-166.
[758] Psomadakis, P.N., Htun Thein, Russell, B.C. and Mya Than Tun. 2019. Field identification guide to the living marine resources of Myanmar. FAO Species Identification Guide for Fishery Purposes. FAO and MOALI, Rome.
[759] 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.
[760] Akhilesh, K. V., White, W. T., Bineesh, K. K., Purushottama, G. B., Singh, V. V., Zacharia, P. U. 2016. Redescription of the rare and endangered Broadfin Shark Lamiopsis temminckii (Müller & Henle, 1839) (Carcharhiniformes:Carcharhinidae) from the northeastern Arabian Sea. Zootaxa 4175(2): 155-166.
[761] Mohamed, K.S. and Veena, S. 2016. How long does it take for tropical marine fish stocks to recover after declines? Case studies from the Southwest coast of India. Current Science 110: 584–594.
[762] Akhilesh, K. V., White, W. T., Bineesh, K. K., Purushottama, G. B., Singh, V. V., Zacharia, P. U. 2016. Redescription of the rare and endangered Broadfin Shark Lamiopsis temminckii (Müller & Henle, 1839) (Carcharhiniformes:Carcharhinidae) from the northeastern Arabian Sea. Zootaxa 4175(2): 155-166.
[763] https://www.gbif.org/species/5215572
[764] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=143665
[765] Akhilesh, K. V., White, W. T., Bineesh, K. K., Purushottama, G. B., Singh, V. V., Zacharia, P. U. 2016. Redescription of the rare and endangered Broadfin Shark Lamiopsis temminckii (Müller & Henle, 1839) (Carcharhiniformes:Carcharhinidae) from the northeastern Arabian Sea. Zootaxa 4175(2): 155-166.
[766] Last, P., White, W., de Carvalho, M., Séret, B., Stehmann, M. and Naylor, G. 2016. Rays of the World. CSIRO Publishing, Clayton.

	 https://www.iucnredlist.org/species/161566/175219648			There are no population species-specific trend data for this species. Despite the lack of species-specific data, catches of sharks, rays, and skates from 1950 to 2014 have been reconstructed for the Chinese EEZ, based on landings data[767]. Although landings data are not a direct measure of abundance, these can be used to infer population reduction where landings have decreased while fishing effort has remained stable or increased[768]. The species occurs inshore on soft substrates down to depths of at least 60 m[769]. The species distribution map includes the entire coast of India. As per the available secondary information[770], [771], the species has been solitary reported from the coast of Somnath, but not from the Jamnagar area. Thus, its presence in the project's EAAA is less likely.	
89	Oceanic Manta Ray (*Mobula birostris*) 	**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[772]. 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[773], Japan[774], Brazil[775], and Mexico[776]. A 6-year study has catalogued more than 2,000 individuals in a single site, off mainland Ecuador[777]. 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[778]. 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	Screened Out

[767] Zeller, D., Pauly, D. 2015. Reconstructing marine fisheries catch data. Available at: www.seaaroundus.org.
[768] Sherman, C.S. et al. 2020. Maculabatis gerrardi. The IUCN Red List of Threatened Species 2020: e.T161566A175219648.
[769] Last, P., White, W., de Carvalho, M., Séret, B., Stehmann, M. and Naylor, G. 2016. Rays of the World. CSIRO Publishing, Clayton.
[770] https://www.gbif.org/species/9590829
[771] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=623862
[772] Last, P., White, W., de Carvalho, M., Séret, B., Stehmann, M. and Naylor, G. 2016. Rays of the World. CSIRO Publishing, Clayton.
[773] Holmberg J. and Marshall A.D. 2018. Manta Matcher Photo-identification Library. Available at: http://www. mantamatcher.org.
[774] 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.
[775] 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.
[776] Rubin, R. 2002. Manta rays: not all black and white. Shark Focus 15: 4-5.
[777] Holmberg J. and Marshall A.D. 2018. Manta Matcher Photo-identification Library. Available at: http://www. mantamatcher.org.
[778] 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.

	https://www.iucnredlist.org/species/198921/214397182			of 1,000 meters[779], [780]. It can spend long periods of time offshore without visiting shallow coastal waters[781]. The species distribution map includes the entire coast of India. As per the available secondary information[782], [783], the species has not been reported from the coasts of Gujarat as well as surroundings of the Jamnagar area. Thus, its presence in the project's EAAA is unlikely.	
90	Shorthorned Pygmy Devil Ray (*Mobula kuhlii*) 	**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[784], [785], [786]. 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[787], along the Chennai and Tuticorin coasts[788], and Mumbai[789], 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[790]. The Shorthorned Pygmy Devil Ray is an inshore, mainly shelf species found in continental coastal areas to 50 m deep[791], [792]. The species' distribution does not extend into the epipelagic zone.	Screened Out

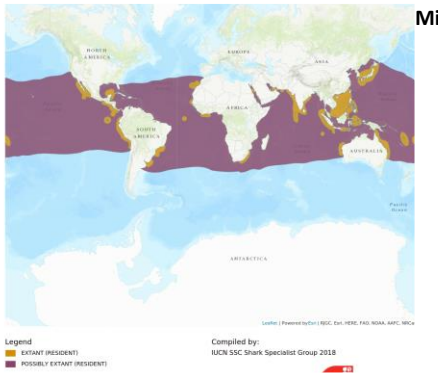
[779] Hearn, A.R., Acuna, D., Ketchum, J.T., Penaherrera, C., Green, J., Marshall, A., Guerrero, M. and Shillinger, G. 2014. Elasmobranchs of the Galapagos Marine Reserve. In: Denkinger, J. and Vinueza, L. (eds), The Galapagos Marine Reserve, Social and Ecological Interactions in the Galapagos Islands, pp. 23–59.
[780] 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.
[781] 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.
[782] https://www.gbif.org/species/9548142
[783] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=623966
[784] 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.
[785] 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.
[786] 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.
[787] 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.
[788] 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.
[789] 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.
[790] https://www.iucnredlist.org/species/161439/214405747#population
[791] Last, P., White, W., de Carvalho, M., Séret, B., Stehmann, M. and Naylor, G. 2016. Rays of the World. CSIRO Publishing, Clayton.
[792] 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/161439/214405747			The species distribution map includes the entire coast of India. As per the available secondary information[793], [794], the species has not been reported from the coasts of Gujarat as well as surroundings of the Jamnagar area. Thus, its presence in the project's EAAA is unlikely.	
90	Spinetail Devil Ray (*Mobula mobular*)  https://www.iucnredlist.org/species/110847130/214381504	**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[795] and its occurrence is patchy throughout its distribution[796]. 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 Tuticorin coast, and Mumbai[797], [798]. The studies represent a 51% decline in landings over approximately 10 years during which time fishing effort almost doubled[799]. 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[800], [801], [802], [803]. The species distribution map includes the entire coast of India. As per the available secondary information[804], [805], the species has been solitary reported from the coast of Dwarka, but not from the Jamnagar area. Thus, its presence in the project's EAAA is less likely.	Screened Out

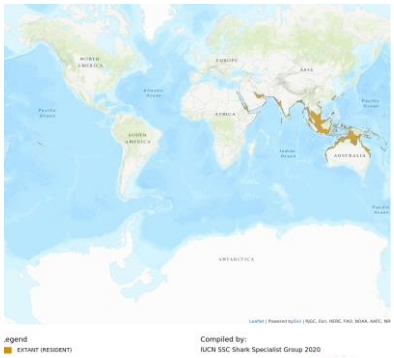
[793] https://www.gbif.org/species/2419221
[794] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=105922
[795] Notarbartolo di Sciara, G., Fernando, D., Adnet, S., Capetta, H. and Jabado, R. 2017. Devil rays (Chondrichthyes: Mobula) of the Arabian Seas, with a redescription of Mobula kuhlii (Valenciennes in Muller and Henle, 1841). Aquatic Conservation Marine and Freshwater Ecosystems 27: 197-218.
[796] 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.
[797] 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.
[798] 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.
[799] 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.
[800] 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.
[801] 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.
[802] 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.
[803] 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.
[804] https://www.gbif.org/species/2419188
[805] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=105923

91	Sicklefin Devil Ray (*Mobula tarapacana*)  https://www.iucnredlist.org/species/60199/214371388	**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[806], [807], [808]. 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[809], along the Chennai and Tuticorin coasts[810], and Mumbai[811]. 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[812]. 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[813]. The species distribution map includes the entire coast of India. As per the available secondary information[814], [815], the species has been solitary reported from the coast of Dwarka, but not from the Jamnagar area. Thus, its presence in the project's EAAA is less likely.	Screened Out
92	Bentfin Devil Ray (*Mobula thurstoni*)	**IUCN:** Endangered **IWP:** Not available **Restricted range:** 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[816], [817].	Screened Out

[806] 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 Oceanografia, Universidade Federal de Pernambuco.
[807] 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.
[808] 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.
[809] 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.
[810] 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.
[811] 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.
[812] 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.
[813] 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.
[814] https://www.gbif.org/species/2419179
[815] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=105926
[816] 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.
[817] 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/60200/214368409	**Migratory:** No		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[818], along the Chennai and Tuticorin coasts[819], and Mumbai[820], catches indicate depletion of stocks. The Bentfin Devil Ray occurs in neritic and oceanic waters from the surface to depths of 100 m[821]. The Bentfin Devil Ray is a seasonal visitor along productive coastlines with regular upwelling, off oceanic island groups, and near offshore pinnacles and seamounts[822], [823], [824], [825]. The Bentfin Devilray is sighted in both upwelling pelagic environments[826] and in shallow, productive, neritic waters[827], [828]. The species distribution map includes the entire coast of India. As per the available secondary information[829], [830], the species has not been reported from the coasts of Gujarat as well as surroundings of the Jamnagar area. Thus, its presence in the project's EAAA is unlikely.	
93	Sharptooth Lemon Shark (*Negaprion acutidens*)	**IUCN:** Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	Sharptooth Lemon Shark is widespread in coastal waters of the tropical and subtropical Indian and Northwest, Western Central, and Eastern Central Pacific Oceans[831], [832]. The Sharptooth Lemon Shark was observed in a global baited remote underwater video system (BRUV) survey of global coral reefs[833]. However, no species-specific information is	Screened Out

[818] 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.
[819] 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.
[820] 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.
[821] 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.
[822] 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.
[823] 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.
[824] 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.
[825] 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.
[826] 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.
[827] 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.
[828] 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.
[829] https://www.gbif.org/species/2419218
[830] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=105927
[831] Last, P.R. and Stevens, J.D. 2009. Sharks and Rays of Australia. Second Edition. CSIRO Publishing, Collingwood.
[832] Ebert, D.A., Fowler, S. and Compagno, L. 2013. Sharks of the World. A Fully Illustrated Guide. Wild Nature Press, Plymouth, United Kingdom.
[833] FinPrint. 2020. Global FinPrint. Available at: https://globalfinprint.org/

	 https://www.iucnredlist.org/species/41836/173435545			available. The continental margins of Asia and Africa, and some parts of the Pacific this species was rarely observed, suggesting that populations have declined substantially in those areas[834]. The Sharptooth Lemon Shark is demersal in shallow inshore and offshore waters at depths to at least 90 m and is often found on and around coral reefs and on sandy plateaus near coral[835], [836], [837]. It is also known to occur around and within the mangrove forests in certain areas, which may be used as nursery grounds[838]. The species distribution map includes the entire coast of India. As per the available secondary information[839], [840], the species has not been reported from the coasts of Gujarat as well as surroundings of the Jamnagar area. Thus, its presence in the project's EAAA is unlikely.	
94	Bleeker's Whipray (*Pateobatis bleekeri*)	**IUCN:** Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	Bleeker's Whipray occurs in the Western and Eastern Indian and Western Central Pacific Oceans from Pakistan to Malaysia[841], [842]. Although this species appears to be common in Pakistan and India, the population is suspected to have declined due to overall declines in batoids from intense and increasing fishing. There would be a ~95% decline if extrapolated over a period of three generation spans (75 years) as suggested in several studes[843]. Bleeker's Whipray is benthic from the surface to depths of 40 m[844].	Screened Out

[834] Simpfendorfer, C., Derrick, D., Yuneni, R.R., Maung, A., Utzurrum, J.A.T., Seyha, L., Haque, A.B., Fahmi, Bin Ali, A., , D., Bineesh, K.K., Fernando, D., Tanay, D., Vo, V.Q. & Gutteridge, A.N. 2021. Negaprion acutidens. The IUCN Red List of Threatened Species 2021: e.T41836A173435545

[835] Stevens, J.D. 1984. Life history and ecology of sharks at Aldabra Atoll, Indian Ocean. Royal Society of London. Proceedings. Biological Sciences. 222(1226): 79–106.

[836] Compagno, L.J.V. 1998. Carcharhinidae. In: K.E. Carpenter and V.H. Niem (eds). FAO species identification guide for fishery purposes. The living marine resources of the Western Central Pacific. Volume 2. Cephalopods, crustaceans, holothurians and sharks. FAO, Rome, pp. 1312-1360.

[837] Ebert, D.A., Fowler, S. and Compagno, L. 2013. Sharks of the World. A Fully Illustrated Guide. Wild Nature Press, Plymouth, United Kingdom.

[838] Bonfil, R. 2003. Consultancy on Elasmobranch Identification and Stock Assessment in the Red Sea and Gulf of Aden. Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden.

[839] https://www.gbif.org/species/2417905

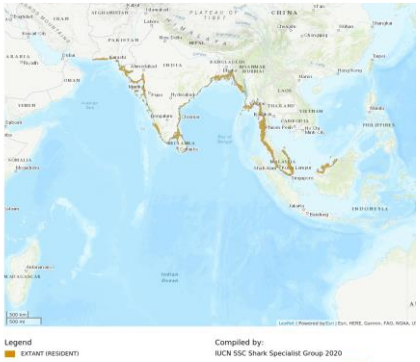
[840] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=106649

[841] Last, P.R., Naylor, G.J.P. and Manjaji-Matsumoto, B.M. 2016. A revised classification of the family Dasyatidae (Chondrichthyes: Myliobatiformes) based on new morphological and molecular insights. Zootaxa 4139(3): 345-368.

[842] Krajangdara, T. 2019. Sharks and Rays of Thailand. Country Report. Department of Fisheries, Thailand.

[843] Sherman, C.S., Akhilesh, K.V., Ali, M., Bin Ali, A., Bineesh, K.K., Derrick, D., Dharmadi, Fahmi, Fernando, D., Haque, A.B., Jabado, R.W., Khan, M., Maung, A., Seyha, L., Tanay, D., Utzurrum, J.A.T., Vo, V.Q. & Yuneni, R.R. 2020. Pateobatis bleekeri. The IUCN Red List of Threatened Species 2020: e.T104208524A175220678.

[844] Last, P.R., Naylor, G.J.P. and Manjaji-Matsumoto, B.M. 2016. A revised classification of the family Dasyatidae (Chondrichthyes: Myliobatiformes) based on new morphological and molecular insights. Zootaxa 4139(3): 345-368.

	 https://www.iucnredlist.org/species/104208524/175220678			The species distribution map includes the entire coast of India. As per the available secondary information[845], [846], the species has been solitary reported from the coast of Somnath, but not from the Jamnagar area. Thus, its presence in the project's EAAA is less likely.	
95	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[847]. Their core distribution is between approximately 30°N and 35°S, with occasional seasonal penetration to the north and south[848], [849]. 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). Combining data from both regions, it is likely that the global Whale Shark population has declined by >50% over the last 75 years[850]. Whale Sharks are found in both coastal and oceanic habitats[851]. Oceanic sightings are strongly correlated with temperature in the Indian and Atlantic oceans[852], with most occurring between 26.5° and 30°C in the Indian Ocean[853]. Depth was an important predictor in the Atlantic and Pacific Oceans; but was not significant in the Indian Ocean[854]. Whale	Screened Out

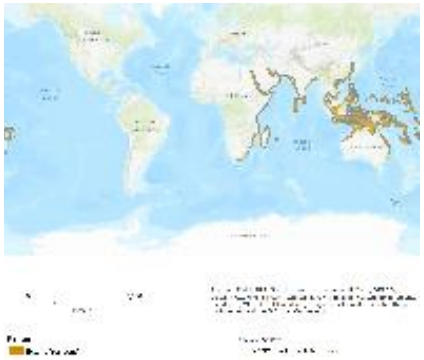
[845] https://www.gbif.org/species/9321767
[846] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=623868
[847] Rowat, D. and Brooks, K.S. 2012. A review of the biology, fisheries and conservation of the whale shark Rhincodon typus. Journal of Fish Biology 80: 1019-1056.
[848] Colman, J. 1997. A review of the biology and ecology of the whale shark. Journal of Fish Biology 51: 1219-1234.
[849] 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.
[850] https://www.iucnredlist.org/species/19488/2365291#population
[851] 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.
[852] 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.
[853] 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.
[854] 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			Sharks are highly mobile, with mean daily movement rates of 24–28 km based on tethered geopositioning tags[855]. The species distribution map includes the entire coast of India. As per the available secondary information[856], [857], the species has not been reported from the coasts of Gujarat as well as surroundings of the Jamnagar area. Thus, its presence in the project's EAAA is unlikely.	
96	Javanese Cownose Ray (*Rhinoptera javanica*) 	**IUCN:** Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	Javanese Cownose Ray is found in the Indian and Western Pacific Oceans ranging from Oman to the Philippines and north to Japan[858]. Despite the lack of species-specific data, catches of sharks, rays, and skates from 1950–2014 have been reconstructed for the Chinese and Viet Nam Exclusive Economic Zones (EEZ), based on landings data[859]. Overall, it is suspected that the Javanese Cownose Ray has undergone a 50–79% population reduction over the last three generation lengths (44 years). The Javanese Cownose Ray is benthopelagic in tropical waters from the surface to depths of 50 m[860], [861] (Last et al. 2016, Weigmann 2016). The species distribution map includes the entire coast of India. As per the available secondary information[862], [863], the species has not been reported from the coasts of Gujarat as well as surroundings of the Jamnagar area. Thus, its presence in the project's EAAA is unlikely.	Screened Out

[855] 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.
[856] https://www.gbif.org/species/2417522
[857] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=52188
[858] Last, P., White, W., de Carvalho, M., Séret, B., Stehmann, M. and Naylor, G. 2016. Rays of the World. CSIRO Publishing, Clayton.
[859] Pauly, D., Zeller, D. and Palomares, M.L.D. 2020. Sea Around Us Concepts, Design and Data. Available at: seaaroundus.org
[860] Last, P., White, W., de Carvalho, M., Séret, B., Stehmann, M. and Naylor, G. 2016. Rays of the World. CSIRO Publishing, Clayton.
[861] 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.
[862] https://www.gbif.org/species/5215779
[863] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=111724

	https://www.iucnredlist.org/species/60129/124442197				
97	Oman Cownose Ray (*Rhinoptera jayakari*)  https://www.iucnredlist.org/species/195474/175221403	**IUCN:** Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	Oman Cownose Ray is widely distributed throughout the Indian and Western Pacific Oceans from Mozambique to Japan[864]. Despite the lack of species-specific data, catches of sharks, rays, and skates from 1950–2014 have been reconstructed for the Chinese and Viet Nam Exclusive Economic Zones (EEZ), based on landings data[865]. Overall, it is suspected that the Oman Cownose Ray has undergone a 50–79% population reduction over the last three generation lengths (30 years). The Oman Cownose Ray is benthopelagic over the continental shelf, mostly inshore from the surface to depths of 50 m[866], [867]. The species distribution map includes the entire coast of India. As per the available secondary information[868], [869], the species has been solitary reported from the coast of Somnath, but not from the Jamnagar area. Thus, its presence in the project's EAAA is less likely.	Screened Out
98	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[870]. Population size information for the Indian Ocean-Southeast Asian subpopulation is limited. Indo-Pacific Leopard Shark are reported from fish markets across the region[871]. 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[872].	Screened Out

[864] Last, P., White, W., de Carvalho, M., Séret, B., Stehmann, M. and Naylor, G. 2016. Rays of the World. CSIRO Publishing, Clayton.
[865] Pauly, D., Zeller, D. and Palomares, M.L.D. 2020. Sea Around Us Concepts, Design and Data. Available at: seaaroundus.org
[866] Last, P., White, W., de Carvalho, M., Séret, B., Stehmann, M. and Naylor, G. 2016. Rays of the World. CSIRO Publishing, Clayton.
[867] 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.
[868] https://www.gbif.org/species/5215776
[869] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=607465s
[870] 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.
[871] 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.
[872] 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[873], [874], the species has not been reported from the coasts of Gujarat as well as surroundings of the Jamnagar area. Thus, its presence in the project's EAAA is unlikely.	
99	Indian Sharpnose Ray (*Telatrygon crozieri*)  https://www.iucnredlist.org/species/104087812/104087837	**IUCN:** Endangered **IWP:** Not available **Restricted range:** No **Migratory:** No	1 a	Indian Sharpnose Ray is found in the northern Indian Ocean in India[875]. This species was formerly distributed throughout the coastal waters of India but is now not present in the eastern states of Tamil Nadu and Andra Pradesh, and it is still present in Odisha and West Bengal states[876]. The landings of rays in India, Bangladesh, and Pakistan infer population reductions of 54–84% over three generation lengths (26 years). Hence, it is suspected that the Indian Sharpnose Ray has undergone a population reduction of 50–79% over the past three generation lengths (26 years) due to levels of exploitation[877]. The Indian Sharpnose Ray is demersal on continental and insular shelves down to depths of 50 m, but typically caught at 20–30 m depth[878]. The species distribution map includes the entire coast of India. As per the available secondary information[879], [880], the species has not been reported from the coasts of Gujarat as well as surroundings of the Jamnagar area. Thus, its presence in the project's EAAA is unlikely.	Screened Out

[873] https://www.gbif.org/species/8493577
[874] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=1303450
[875] Last, P., White, W., de Carvalho, M., Séret, B., Stehmann, M. and Naylor, G. 2016. Rays of the World. CSIRO Publishing, Clayton.
[876] https://www.iucnredlist.org/species/104087812/104087837#geographic-range
[877] https://www.iucnredlist.org/species/104087812/104087837#population
[878] Last, P., White, W., de Carvalho, M., Séret, B., Stehmann, M. and Naylor, G. 2016. Rays of the World. CSIRO Publishing, Clayton.
[879] https://www.gbif.org/species/11241124
[880] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=1244564

100	Giant River Prawn (*Macrobrachium rosenbergii*)  https://www.iucnredlist.org/species/197873/2503520	**IUCN:** Least Concern **IWP:** Not Available **Restricted range:** Yes **Migratory:** Yes	3a	The natural range of this species is eastwards from eastern Pakistan up to Borneo and Java[881]. The species is widely cultured both within its natural range and far beyond (Africa, South America). Despite being intensely studied for aquaculture purposes, the population trends in wild populations are unknown[882]. Giant River Prawn is found in inland freshwater areas including lakes, rivers, swamps, irrigation ditches, canals and ponds, as well as in estuarine areas. This species requires brackish water in the initial stages of their life cycle (and therefore they are found in water that is directly or indirectly connected with the sea)[883]. In Gujarat, about 4 ha area is involved in its farming near salt pans[884]. The species has been displayed as "possibly extant" in IUCN portal for throughout the nation (India)[885] and no information[886, 887] about natural population of the species is available from the EAAA.	Screened Out

[881] Wowor, D. and Ng, P.K.L. 2007. The giant freshwater prawns of the Macrobrachium rosenbergii species group (Crustacea: Decapoda: Caridea: Palaemonidae). Raffles Bulletin of Zoology 55: 321-336.
[882] De Grave, S., Shy, J., Wowor, D. & Page, T. 2013. Macrobrachium rosenbergii. The IUCN Red List of Threatened Species 2013: e.T197873A2503520
[883] https://agritech.tnau.ac.in/fishery/fish_freshwaterprawn.html
[884] Marine Products Export Development Authority, 2005
[885] https://www.iucnredlist.org/species/197873/2503520
[886] https://www.inaturalist.org/observations?place_id=any&subview=map&taxon_id=326807
[887] https://indiabiodiversity.org/observation/show/272385