

Environment and Social Impact Assessment Report: 600 MW Hybrid Power Project in Jaisalmer, Rajasthan

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Environment and Social Impact Assessment Report: 600 MW Hybrid Power Project in Jaisalmer, Rajasthan

Final Report



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Acronyms and Abbreviations

Abbreviation	Description
AAQ	Ambient Air Quality
AREPGL	Adani Renewable Energy Park (Gujarat) Limited
AGE(9)L	Adani Green Energy Nine Limited
AGE(7)L	Adani Green Energy Seven Limited
AGEL	Adani Green Energy Limited
AL	Agricultural Labourers
Amsl	Above mean sea level
Aol	Area of Influence
ATS	Agreement to Sell
BDL	Below Detectable Limit
BEE	Bureau of Energy Efficiency
BMTPC	Building Materials and Technology Promotion Council of India
CDGR	Community Disclosure and Grievance Redressal
CEA	Central Electricity Authority
CGWB	Central Ground Water Board
CL	Cultivators
CMS	Condition Monitoring System
CO	Carbon Monoxide
CO ₂	Carbon dioxide
CPCB	Central Pollution Control Board
CPR	Common Property Resources
CR	Critically Endangered
CSR	Corporate Social Responsibility
CTE	Consent to Establish
CTO	Consent to Operate
DEM	Digital Elevation Map
DG	Diesel Generator
DISH	Directorate Industrial Safety and Health Department
EC	Environment Clearance
EHS	Environment, Health and Safety
EIA	Environment Impact Assessment
EMF	Electromagnetic field
EMP	Environmental Management Plan
EPA	Environment Protection Act
EPC	Engineering, Procurement and Construction
EPFI	Equator Principles Financial Institutions
ERM	Environmental Resources Management

Abbreviation	Description
ESIA	Environment and Social Impact Assessment
ESMP	Environment and Social Management Plan
ESZ	Eco sensitive Zone
FCCC	Framework Convention on Climate Change
FPIC	Free, Prior and Informed Consent
FY	Financial Year
GHG	Greenhouse Gas
GIS	Geographic Information System
GoI	Government of India
GoR	Government of Rajasthan
GP	Gram Panchayat
GSI	Geological Survey of India
GSS	Grid sub-station
GW	Groundwater
HPD	Hybrid Project Developer
HH	Household
HWA	Hazardous Waste Authorization
IA	Impact Assessment
IFC	International Finance Corporation
ILO	International Labour Organisation
ISTS	Interstate Transmission System
IMD	Indian Meteorological Department
IREDA	Indian Renewable Energy Development Agency Limited
KL	Kilo litre
KLD	Kilo litre per day
kV	Kilowatt
kWh	Kilowatt per hour
LNG	Liquefied Natural Gas
LOA	Letter of Award
Mbgl	Meters below ground level
MNRE	Ministry of New and Renewable Energy
MoEFCC	Ministry of Environment, Forest and Climate Change
MoP	Ministry of Power
MSIHC	Manufacture, storage and import of hazardous chemicals
Mtoe	Million tons of oil equivalent
MW	Megawatt
NAAQS	National Ambient Air Quality Standards
NABL	National Accreditation Board for Testing and Calibration Laboratories

Abbreviation	Description
NFPA	National Fire Protection Authority
NGO	Non-Governmental Organisation
NGT	National Green Tribunal
NH	National Highways
NISE	National Institute of Solar Energy
NIWE	National institute of Wind Energy
NOC	No Objection Certificate
NOx	Oxides of Nitrogen
NQ	Noise Quality
NT	Near Threatened
O&M	Operation and Maintenance
OBC	Other Backward Caste
PCC	Pollution Control Committee
PESO	Petroleum and Explosives Safety Organisation
PHC	Public Health Centre
PM	Particulate Matter
PPE	Personal Protective Equipment
Ppm	Parts per million
PS	Performance Standards
PSS	Pooling Sub-station
PUC	Pollution Under Control Certificate
PGCIL	Power Grid Corporation of India Limited
PV	Photovoltaic
RoW	Right of Way
RRECL	Rajasthan Renewable Energy Corporation Limited
RSPCB	Rajasthan State Pollution Control Board
SC/ST	Schedule Caste/Schedule Tribe
SCADA	Supervisory Control and Data Acquisition
SECI	Solar Energy Corporation of India Limited
SDA	State designated agency
SEIAA	State Environmental Impact Assessment Authority
SO ₂	Sulphur Dioxide
SOP	Standard Operating Procedure
SPS	Safeguard Policy Statement
SPV	Special Purpose Vehicle
SS	Sub station
TDS	Total Dissolved Solids
TL	Transmission line

Abbreviation	Description
VD	Village Directory
WB	World Bank
WHO	World Health Organization
WTG	Wind Turbine Generator

EXECUTIVE SUMMARY

E.1 Project Background

Environmental Resource Management India Private Limited (hereinafter referred as ERM) has been commissioned by Adani Green Energy Limited (hereinafter referred as 'AGEL' or 'Client'), a subsidiary of the Adani Group. ERM is to undertake an Environmental and Social Impact Assessment (ESIA) study of a greenfield 600 MW AC hybrid, Wind (151.2 MW) and Solar (2*300 MW) power project (hereinafter referred as the "project"). The proposed 600 MW hybrid power project is being set up in Jaisalmer district of Rajasthan, India; the same is scheduled for Commissioning in July 2021. The project operates under two (02) SPV's M/s Adani Green Energy Seven Limited (AGE7L) & M/s Adani Green Energy Nine Limited (AGE9L), 100% subsidiaries company of M/s Adani Renewable Energy Park (Gujarat) Limited, which further is a subsidiary of AGEL.

AGEL is currently exploring for fund from international lenders, and this ESIA is prepared to help meet the requirement in terms of providing the lenders, an assessment of the project against international standards.

This report discusses the environmental and social baseline within which the proposed hybrid power project is commissioned and assesses the potential adverse and beneficial impacts that the project could have, along with suitable mitigation measures and an Environmental and Social Management Plan (ESMP) for the project.

E.2 Project Overview

The proposed 600 MW Solar-Wind Hybrid Power Project is located on land ranging from flat to undulating private shrub/waste land, agricultural land and gravel land across 18 villages in Fatehgarh and Pokhran Taluka of Jaisalmer District in the state of Rajasthan. Elevation at project site ranges from 235 m to 330 m above mean sea level.

As observed during ERM site visit, two small rivers (Sukri Nadi and Ghughri Nadi) were observed to traverse through the project area, small rivulets emerging from them are also present which eventually gets lost in sand dunes in their flow path. Multiple small dendritic and semi dendritic channels were also found to be present within the project area. Based on consultation with local community, it is understood that the water channel remains dry throughout the year and only gets water when there is heavy rain in the area, whereas for the ghughri nadi and sukri nadi they are ephemeral in nature. Additionally, in the project area it was observed that multiple small water ponds were observed within the agricultural fields, which were constructed by the owners of the field.

The proposed Project and associated facilities does not fall within 10 km of any Protected Areas such as National Parks, Wildlife Sanctuaries, etc. The nearest Protected Area and Important Bird Area (IBA) is Dessert National Park located at about 60 km west of the site. However, the Project is located in close proximity of the Great Indian Bustard (GIB) habitat known as GIB Arc and the boundary of its proposed Eco sensitive Zone. Rasla enclosures (1 and 2) are situated inside the Study area at approximately 2.8 km north of WTG FTN-266 and about 9.2 km southwest of the solar park boundary. While Guddi enclosure is located at about 15 km east of WTGs FAT-068 and FAT-639.

The project will use the existing gram panchayat road as approach road for the project. The gram panchayat road gets connected to National Highway (NH)-15 which crosses from within the project area. Nearest railway station is the Jaisalmer Railway Station located at an approximate aerial distance of 60 km from the project area. Nearest airport to the site is Jaisalmer Airport, located at an approximate aerial distance of 70 km from the study area.

The total land requirement for the Project is estimated at 2160 acre of land, out of which 1500 acre is for solar plant and 276 acre for WTGs, at 6 acres/WTGs, 286.6 acre for external transmission line and the remaining 98 acres of land is for internal & external access road, and internal transmission line.

The Project will have 72 operating WTGs with a capacity of 2.2 MW each.

E.3 Applicable Reference Framework

The applicable reference framework for undertaking the assignment comprised of the following:

- Applicable local and national environmental and social regulations (including that of the state nodal agency for renewable energy development);
- Position Statements of the Standard Chartered Bank
(<https://www.sc.com/en/sustainability/position-statements/our-framework/>)
- IFC Performance Standards on Environmental and Social Sustainability (2012);
- IFC/World Bank EHS General Guidelines;
- IFC/World Bank EHS Guidelines for Power Transmission and Distribution (2007);
- The Equator Principles, 2020; and
- IFC's Good Practice Handbook on Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets.

E.3.1 Applicability to IFC Performance Standards

The following IFC Performance Standards are applicable to the Project:

Description	Applicability	Objectives and Applicability to Project
IFC PS 1 - Assessment and Management of Environmental and Social Risks and Impacts	☒	<p>This PS aims to assess the existing social and environmental management systems of AREPGL, AGE(7)L & AGE(9)L 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.</p> <p>This ESIA is being conducted as part of the "identification of risks and impacts" requirement under the IFC PS 1. The management plan prescribed in this ESIA report will be implemented for mitigation of impacts identified.</p> <p>The developer, at the corporate level, has also established an Environmental and Social Management System, that will be implemented in conjunction with the management plan presented in this report.</p>
IFC PS 2 - Labour and Working Conditions	☒	<p>This PS is guided by a number of international conventions and instruments on labour and workers' rights. It recognises 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 in AGE(7)L & AGE(9)L as well as any contractors.</p> <p>The project activities will involve hiring of skilled, semi-skilled and unskilled labourers for both solar sites and wind sites during the construction phase. The project will have to develop a human resource policy and ensure non-discrimination and equal</p>

Description	Applicability	Objectives and Applicability to Project
		opportunity, protection of the workforce and occupational health and safety. Therefore, PS 2 is applicable to the Project.
IFC PS 3 - Resource Efficiency and Pollution Prevention	<input checked="" type="checkbox"/>	<p>PS-3 covers the use resources and materials as inputs and wastes that could affect human health. The objective of PS-3 are: 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, and to reduce project related GHG emissions. 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 HPD 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.</p> <p>The Project construction activities will lead to increased fugitive dust emissions, especially in the area it is being developed due to the presence of loose sandy soil and limited vegetation. The project activities will also lead to increase in ambient noise level during the construction phase and operation of wind turbines, which may impact the villages or sensitive receptors (identified) in the study area. In addition to this, the project activities will involve generation of waste and may involve abstraction of groundwater. Furthermore, Project will use water during construction phase for civil work and solar module cleaning during operation phase which may pose potential stress on existing common water resources such as water ponds/groundwater/canals etc. Therefore, PS 3 is applicable to the Project.</p>
IFC PS 4 - Community Health, Safety and Security		<p>This PS-4 requires due diligence to 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 to ensure 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 would affect the health and safety of the communities adjacent to it during construction phase.</p> <p>The Project activities will involve upgradation of village roads connecting the site and construction activities will lead to stress on the Project access road and on the area in general. Transportation of equipment and increased traffic in the area may lead to accidents and other threats on community health and safety. Furthermore, the Project may pose stress on common water resources such as IGNP canals, water ponds and groundwater due to use of significant amount of water during</p>

Description	Applicability	Objectives and Applicability to Project
		construction and operation phase. Therefore PS 4 is applicable to the project.
IFC PS 5 - Land Acquisition and Involuntary Resettlement	<input type="checkbox"/>	<p>Not Applicable</p> <p>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. The key themes covered under this are: compensation and benefits for displaced persons, consultation and grievance mechanism, resettlement planning and implementation, physical displacement, economic displacement. The PS-5 also prescribes private sector responsibility to supplement government actions and bridge the gap between governments assigned entitlements and procedures and the requirements of PS-5.</p> <p>All the land parcels identified/procured are private land procured/ to be procured on lease and the consultation has been done with land owners to take their consent before finalising the lease. The following condition has been fulfilled:</p> <ul style="list-style-type: none"> ■ Land markets for the land is available in the area; ■ The lease agreement took place with the land owner's informed consent; and ■ The lease rent is approximately 35 percent of the prevailing circle rate, as reported by local community; the same agreed by land owners prior to initiating the land leasing process <p>Furthermore, the project has not led to resettlement, physical displacement and economic displacement. Therefore, PS 5 is not applicable to the project.</p>
IFC PS 6 - Biodiversity Conservation and Sustainable Management of Living Natural Resources	<input checked="" type="checkbox"/>	<p>PS 6 aims to protect and conserve biodiversity; to maintain the benefits from ecosystem services; and to promote the sustainable management of living natural resources through the adoption of practices that integrates conservation needs and development priorities.</p> <p>Project area does not fall within Wildlife Institute of Indian (WII) identified GIB Priority Area. However, the project site is a part of larger landscape identified as GIB Potential Area by WII.</p> <p>The Project being in the close proximity of IUCN Critically Endangered (CR) Great Indian Bustard and Vulture and their habitat and area of good turnover of migratory birds, has possibility to affect these avifaunal species, hence the PS-6 is applicable</p>
IFC PS 7 - Indigenous Peoples	<input type="checkbox"/>	<p>Not Applicable</p> <p>This Performance Standard applies to communities or groups of Indigenous Peoples who maintain a collective attachment, i.e., whose identity as a group or community is linked, to distinct habitats or ancestral territories and the natural resources therein. PS-7 endeavour to ensure that the development process fosters full respect for the human rights, dignity, aspirations, culture, and natural resource-based livelihoods of Indigenous Peoples. Key</p>

Description	Applicability	Objectives and Applicability to Project
		<p>themes covered under PS-7 are: avoidance of adverse impacts, consultation and informed participation, impacts on traditional or customary lands under use, relocation of IPs from traditional or customary lands, and cultural resources.</p> <p>As confirmed during community consultations, interview with Patwari and consultation with the Project team, no indigenous peoples will be affected by the project activities and no ST land will be purchased.</p> <p>As per the discussion with project team and the local community, all the land procured for the solar plant and for WTGs is private land and there is no common property resource in the procured land parcels.</p> <p>The project does not envisage adverse impacts on communities of Indigenous peoples. Therefore, PS 7 is not applicable to the project.</p>
IFC PS 8 - Cultural Heritage	<input type="checkbox"/>	<p>Not Applicable</p> <p>For the purposes of PS-8, cultural heritage refers to (i) tangible forms of cultural heritage; (ii) unique natural features or tangible objects that embody cultural values; and (iii) certain instances of intangible forms of culture that are proposed to be used for commercial purposes. The requirements of PS-8 apply to cultural heritage regardless of whether or not it has been legally protected or previously disturbed.</p> <p>As confirmed during ERM site visit, no cultural heritage will be affected by the project activities. Therefore, PS 8 is not applicable to the project.</p>

E.3.2 Project Categorisation and Justification

The Project has been assessed as **Category A**. The selection of **Category A** is based on the following reasoning:

- The potential habitats for IUCN v2020-2 categorized Critically Endangered (CR) species such as Great Indian Bustard (GIB) (*Ardeotis nigriceps*), White-rumped Vulture (*Gyps bengalensis*), Indian Vulture (*Gyps indicus*) and Red-headed Vulture (*Sarcogyps calvus*) are likely to be present within and in the areas adjacent to the Project site. The GIB Arc, an area with majority of the movement and records of the GIB, is situated immediate vicinity of the Project site. The proposed ESZ of this arc is located at about 5.9 km east of WTG NEW-006. Also a GIB enclosure, which is a GIB Conservation Priority Area and a part of Desert National Park, is situated within the Study area. The consultations with locals confirmed that the movement of two pairs of GIB in this enclosure on annual basis. Also, since the GIB enclosures are located on either sides of the Project site, there is a possibility of inter-enclosure movement of the bird through the Project site.
- Similarly, three Critically Endangered Vulture species have been reported from the landscape of the Project site including Desert National Park (IBA). Consultations confirmed a regular movement and presence of CR Vulture species in larger number near Bhadariya, 20 km north of Project site. Endangered Egyptian Vultures (*Neophron percnopterus*) were also observed inside the Project area and areas along the route of 220 kV transmission line. The Vultures can fly great distances in search of food and thus their movement in the Project area and the areas along the 220 kV transmission line stretch cannot be ruled out

- The impacts of the wind farm development on all these species in this area are likely to be irreversible. Any planned mitigation can only be suggested based on the long term habitat and species monitoring in the wind farm and solar park and surrounding areas. A detailed Critical Habitat Assessment supported by long term bird and bat monitoring of wind farm along with the transmission line alignment is required to ascertain what level of mitigation measures will be required. The impacts anticipated to the biodiversity specifically bird and bats will likely be adverse (resulting in loss of population of species), irreversible (to the already threatened population of vultures and GIBs) from operating wind turbine blades (collision risk) and the electrical transmission infrastructure (electrocution and collision risk).
- **Unprecedented:** Development of solar power projects and wind farms is occurring in large numbers in the last decade and therefore several such projects are located across India. The proposed Project and its surrounding areas consist of a number of upcoming and operational wind and solar projects (Refer **Section 2.1.1**). Hence, the proposed 600 MW wind-solar hybrid Project can therefore not be considered an unprecedented activity.

Limited adverse impacts on the baseline: Solar and Wind based energy development Projects are less polluting source of energy and thus not likely to lead to any adverse impacts on the baseline environment during the operation phase. In terms of social impacts the land required is composed of private agricultural and culturable, fallow land waste land. The site location of the project does not involve any anticipated settlements and physical displacement.

E.4 Baseline Conditions

Environmental baseline data was collected through primary surveys as well as secondary sources by literature review and discussions with the concerned stakeholders. The environmental baseline has been assessed covering an area of 5 Km zone (hereinafter referred to as the study area) from the Project boundary. Secondary baseline data collection involved identifying and collecting available published material and documents. Information on various environmental aspects like soil, geology, hydrology, drainage, ecology etc., were collected from different government department, institutions, literature etc. & stakeholder consultations held undertaken during the site visit.

ERM team undertook a site survey on from 2nd July-8th July to understand the site setting and to map environmental sensitivities in the area. The site visit included a walkover of the site with the Adani site team. The rationale of this exercise was to understand the local environmental issues in the area.

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

- The triangulation of the information available from secondary sources through the information made available by the local community, both qualitative and quantitative;
- Formulation of the socio-economic baseline on the basis of a combination of primary and secondary qualitative and quantitative data; and
- 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.

E.4.1 Environmental Baseline

Climate and Meteorology:

As per the information provided by CGWB in the groundwater brochure for Jaisalmer district (2013), the district experiences arid type of climate. Mean annual rainfall in the district from 2001-2011 has been recorded to be 205.73 mm. Almost 90% of the total annual rainfall was received during the southwest monsoon, which enters the district in the first week of July and withdraws in the mid of September. Additionally, mean annual rainfall from 2001-2011 as per Fatehgarh weather station and

Pokhran weather station where the proposed site fall was recorded to be 280.14 mm 259.25 mm respectively.

M/s. Avon Food Labs Private Limited, an NABL accredited laboratory, was engaged for collection of baseline information on groundwater quality, surface water quality and soil quality. The primary baseline data was collected between 26th June and 27th June 2020. Furthermore, M/s Netel India Private Limited, an NABL accredited laboratory, was engaged for collection of baseline information on ambient air quality and ambient noise quality from 19th-26th August 2020.

Secondary baseline data collection involved identifying and collecting existing published materials and documents. Information on various environment aspects (like geology, hydrology, drainage pattern, ecology etc.), meteorology and socio economic aspects were collected from different institutions, government websites and literatures etc.

Topography:

The project is proposed on terrain with base elevations ranging from 219-338m above mean sea level. The solar plants of 2*300MW are proposed to be located at an elevation of 219-255 amsl. Similarly, majority of the WTG locations are finalised at an elevation ranging between 267-338 amsl. Analysis of digital elevation map for Project shows a trend in elevations increasing towards south with flat to minor undulating terrain with increasing elevations within the Project Aol. These minor undulating terrain can be categorised due to presence of sand dunes in the area.

Geology:

As per Hydrogeological Atlas of Jaisalmer district, Rajasthan (2013), the major part of the district is covered by Alluvium and wind-blown sand. The basement rocks are the metamorphites granites and rhyolites that are unconformably overlaid by dolomitic limestone, shale and sandstone of the Marwar Super Group. Resting over these with are the Jurassic rocks made up of the Lathi, Jaisalmer, Baisakhi and Bhadesar formation. These are followed by rocks of Parewar and Abur formation. Sumer formation consists of unconsolidated highly current bedded reddish, glauconitic sandstone and silty sandstone. Khuiala formation consists of limestone boulder bedded fossiliferous limestone and shales.

Landuse:

Based on the discussion with site representatives and observations from satellite images it is understood that the majority of the current land use of the project site is shrub/waste land followed by agricultural land, and gravel waste land which can be converted to non-agricultural land for industrial development.

Water resources:

Indira Gandhi Nahar Project (IGNP) Canal is the only surface water source for irrigation in the district. According to Indira Gandhi Nahar Department, Government of Rajasthan, the IGNP aims to irrigate the desert land of Western Rajasthan with Himalaya's water and provide drinking water to crores of inhabitants of this area. The canal originates from Harike barrage situated in Punjab. The IGNP canal enters Jaisalmer district near village Nachana and flows towards western direction.

The stage of ground water development in various blocks of Jaisalmer district varies from 60% to 206% which indicates that the scope for ground water development is already exhausted, mainly in Jaisalmer and Sankara blocks. Sankara block (where the proposed site fall) is categorised as **over-exploited** in terms of ground water development, whereas for barmer district the present stage of groundwater development in the district is 114.22%, which indicates that the scope for ground water development is already exhausted.

Soil:

As per the information provided by CGWB in the groundwater brochure for Jaisalmer district (2013), soils of the districts have been classified as Desert soil, sand dunes, red desertic soil, and Saline soil of depressions.

- **Texture:** The texture of soil samples analysed at four locations (S1, S2, S3 and S4) were found to be Sandy loam. Soil at all sampling locations comprised mostly of sand, with low concentrations of clay and silt;
- **pH:** Generally, soil pH in the range of 6.50-7.00 is considered to be best suited for growing most crops. The pH level in soil samples were observed to be 8.21 (S1), 7.58 (S2), 8.12 (S3) and 8.16 (S4) indicating slightly alkaline to moderately alkaline soil as per standard soil classification;
- **Electrical Conductivity:** EC is used to estimate the soluble salt concentration in soil, and is commonly used as a measure of salinity. The EC value of soil samples were found to be 581 $\mu\text{S/cm}$ (S1), 384 $\mu\text{S/cm}$ (S2), 680 $\mu\text{S/cm}$ (S3) and 354 $\mu\text{S/cm}$ (S4). This indicates low concentration of soluble salts in the soil;
- **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 level of iron in the soil samples were found 1647.18 mg/kg (S1), 1581.64 mg/kg (S2), 1746.90 mg/kg (S3) and 2074.78 mg/kg (S4). The level of copper in the soil samples were found below limit of quantification at all the sampling locations. The level of zinc in the soil samples were also found to be below limit of quantification except for S4 where the value was 5.18 mg/kg. Therefore, the soil is deficient of metals and micronutrients since copper and zinc (except for S4) does not occur in the soil sampling locations. Furthermore, it is to be noted that high concentration of iron in the soil has led to concentration of other metals being considerably low.

Surface water quality:

All the parameters were observed to be within permissible limit for both the sampling locations except for biological oxygen demand (BOD) for SW 2 (4.2 md/l) which exceeded the permissible limit. Increase in BOD can lead to decrease in dissolved oxygen in the water which may impact the aquatic life.

Ground water quality:

- **pH value:** pH of the groundwater samples were found to be within the range of 6.5 to 8.5;
- **Total Dissolved Solid (TDS):** TDS was observed to be above acceptable limits in GW-1 (3660 mg/l), GW-2 (4048 mg/l) and GW-3 (3224 mg/l). Since the groundwater samples were taken from an area characterised by shrub/waste land and agricultural fields and activities, mixing of soil contaminants (such as Iron) with groundwater through leaching and increase in evaporation due to irrigation activities can lead to high TDS;
- **Calcium:** Calcium content was found to be above permissible limits at GW-1 (288.6 mg/l). Hardness in most groundwater is naturally occurring from weathering of calcium bearing minerals. As can be observed in the previous paragraph, TDS in the groundwater samples was observed to be high. Therefore, high amount of calcium can be expected to occur in the groundwater. Furthermore, presence of limestone¹ also leads to high concentration of calcium in the groundwater as well once dissolved;
- **Chloride:** Chloride content was found to be above permissible limits at GW-1, GW-2 and GW-3. As can be observed in the previously, TDS in the groundwater samples was observed to be high. Therefore, high amount of chloride is bound to occur in the groundwater. Furthermore, high

¹ According to Department of Mines and Geology, Jaisalmer district is endowed with vast resources of cement grade limestone (<http://www.mines.rajasthan.gov.in/dmgcms/page?menuName=7mNDHM7a6IMXQWl3OsFRH0:455611:i3qn6G58v>)

chloride content can be attributed to presence of naturally occurring minerals in Jaisalmer district such as limestone and gypsum

- **Magnesium:** Magnesium was found to be above permissible limits in GW-1 (128.3 mg/l), GW-2 (105.9 mg/l) and GW-3 (189.5 mg/l). As can be observed in the previously, TDS in the groundwater samples was observed to be high. Therefore, high amount of magnesium can be expected to occur in the groundwater. Furthermore, presence of limestone leads to high concentration of magnesium in the groundwater as well once dissolved;
- **Sulphate:** Sulphate content was found to be above permissible limits at GW-1, GW-2 and GW-3. As can be observed in the previously, TDS in the groundwater samples was observed to be high. Therefore, high amount of sulphate can be expected to occur in the groundwater;
- **Total Hardness:** Hardness of water is considered to be an important factor to determine the portability and its domestic usage particularly for washing. Total hardness of water is correlated to the presence of bivalent metallic ions viz. **calcium and magnesium**. Total hardness values in the groundwater samples were found to be exceeding permissible limits at GW-1, GW-2 and GW-3 locations. Therefore, the groundwater may not be potable and/or suitable for domestic usage in these locations.
- **Zinc:** Zinc content was found be higher than permissible limit for all the locations.

Noise quality:

The equivalent ambient noise level for day time (Leq day) at all the monitoring locations were observed to be within the prescribed CPCB limits except at location NQ-4 which was exceeding the prescribed corresponding limits for a residential area during the day, and ambient noise level for night time (Leq night) at all the monitoring locations were observed to be exceeding the prescribed CPCB limits. The high noise levels during the night be attributed to high wind speeds during the period, and vehicular movement within the village and from nearby roads.

Air quality:

The analysis of results indicated that the values for PM 10, PM2.5, SO₂, NO₂, and CO were well within the permissible limit as prescribed by NAAQS. This can be attributed to low movement of vehicles in the area and no construction activities conducted in the month of August in the area.

Natural disasters:

- **Earthquake:** As per the data released by Building Materials & Technology Promotion Council (BMTPC) of Government of India and Disaster Management, Relief & Civil Defence Department of Government of Rajasthan, the Project is located in an area that is designated as Zone II that corresponds to MSK VI with nontectonic faults. This is classified as a low damage risk zone in terms of earthquake occurrence.
- **Wind/cyclone:** As per the data released by Building Materials & Technology Promotion Council (BMTPC) of Government of India and Disaster Management, Relief & Civil Defence Department of Government of Rajasthan, the Project site is located in an area that experiences high wind velocities $V_b = 47$ m/s and the zone is classified as high damage risk zone for cyclones.
- **Flood:** As per the data released by Building Materials & Technology Promotion Council (BMTPC) of Government of India and Disaster Management, Relief & Civil Defence Department of Government of Rajasthan, the Project site falls in an area which is not prone to flooding incidents.
- **Drought:** As per the data released by Disaster Management, Relief & Civil Defence Department of Government of Rajasthan, the Project site is located in an area where drought frequency is once in 3 years.

E.4.2 Social Baseline

The core zone for the baseline studies is considered within 2 km radius from the project area, where most of the impacts are anticipated, and the buffer zone is the area in the 5 km radius. The core, the buffer zone and the project footprint together comprise the “Aol” of the project, which is spread across 34 villages under three tehsils of Jaisalmer district. The concentration of villages is higher in Pokaran tehsil as compared to Fategarh.

The core zone of the AOI comprises of 18 villages while the buffer zone has 16 villages. Village wise predominant land use is as provided in the table below:

Village Name	Total Geographical Area	Forest Area	Area under Non-Agricultural Uses	Barren & Un-cultivable Land Area	Permanent Pastures and Other Grazing Land Area	Land Under Miscellaneous Tree Crops etc. Area	Culturable Waste Land Area	Fallows Land other than Current Fallows Area	Current Fallows Area	Net Area Sown
Loona Kalan	1561.69	0	166.99	188	287	0	18.7	208	24	669
Naya Khara	613	0	30	0	25	0	208	45	25	280
Achalpura	2530	0	1	7	7	0	550	0	0	1965
Neran	6259	0	757	9	729	0	2667	644	623	830
Naya Sanawara	4980	0	15	0	0	0	10	1584	386	2985
Dawara	9087.45	0	156.72	0	101.17	0	5398.17	0	0	3431.39
Sanawara	8552.04	0	64.04	74	663	0	958	0	2130	4663
Sadrasar	2295	0	21	28	3	0	414	496	222	1111
Amarsar	1503.31	0	0.16	23.35	42.75	0	0	304.15	24.05	1108.85
Motisar	2488	0	8	564	107	0	312	137	89	1271
Madhopura	5996	0	16	20	247	0	1257	1368	23	3065
Madasar	3860	0	41	12	385	0	655	2049	143	575
Lakhasar	2056	0	550	4	7	0	468	242	240	545
Sankra	5114	0	45	23	671	0	39	540	591	3205
Khetasar	4623	0	6	19	20	0	58	507	7	4006
Khuhra	3192	0	12	11	811	0	530	69	278	1481
Achla	1215.31	0	12.01	19.51	297.63	0	375.59	0	0	510.57
Bhainsara	6180.52	0	16.94	937.79	838.7	0	0	2162.9	94.99	2129.2
Core Total	72106.32	0	1918.86	1939.65	5242.25	0	13918.46	10356.05	4900.04	33831.01
Buffer Total	54573.13	813	1951.78	1697.87	2742.56	0	22928.22	3671.71	1227.79	19540.2
Aol	126679.45	813	3870.64	3637.52	7984.81	0	36846.68	14027.76	6127.83	53371.21

- The core zone has 3,712 households supporting a population of 22,520 individuals. The average size of the households is six across the core and buffer zone. The Sex Ratio in the Aol is 867 females per thousand males, which is higher than the district sex ratio of 842 (and very less than the national sex ratio of 933).
- The buffer zone comprises of 2,155 households supporting a population of 12,739 individuals. The buffer zone exhibits a sex ratio of 819 females per 1000 males, which is lower than the district figure of 852 females per 1000 males;
- The 100 percent of the population in the Aol falls in the rural category. The SC population in the core and buffer zone distributed to 11.27 percent and 7.39 percent, respectively;
- The total working population in the Aol is 43.07%. Out of the total working population, 47.78% is categorised as main workers (i.e. those who have worked for a period of 6 months); and remaining 52.22% are marginal workers (i.e. those who have not worked for a period of 6 months). The proportion of cultivators and agricultural labourers is 78.89%. Being a low-rainfall, arid region, the agricultural productivity is relatively lower than other parts of the state of Rajasthan. There is a significant proportion of population as other workers (18.74%), those engaged in some economic activity, but are not cultivators or agricultural labourers or in household industry;
- Within the study area, the number of the Govt. primary school is 35 which is comparatively more in number than the number of secondary schools (5) and senior secondary schools (2) in the AOI;
- As per the consultation with the local community, the level of educational attainment and status among male and female are similar until primary level (as every village have a primary school), post which, the level of education among the female started to decline. The main reason for the decline among the level of education among female is the culmination of the absence of educational infrastructure at the village level accompanied by a lack of transportation facilities.

E.4.3 Ecology Baseline

Based on the primary survey, consultations with community and the forest officials and secondary literature, it was observed that the potential habitats for IUCN v. 2020-2 categorized Critically Endangered (CR) Great Indian Bustard (GIB) (*Ardeotis nigriceps*) are present in the areas adjacent to the Project site and habitats for CR/EN Vulture species inside the Project site. According to a study carried out by Wildlife Institute of India (WII), this landscape has been divided into GIB Priority Area and GIB Potential Area considering the need of conservation efforts. The Project site is located outside the GIB Priority Area. However the entire site falls within the GIB Potential Area.

The key impacts identified include electrocution hazards and collision with transmission infrastructure and hazards from the rotating turbine blades. The impacts due to transmission infrastructure have been assessed as Critical, while due to operational turbines as Major. Since no WTG is located within the GIB priority area, the impact due to turbines may be reduced to moderate with the help of embedded controls such as maintaining a minimum set back distance of 500 m from GIB enclosures and all the water bodies, etc. Also, the embedded controls adopted by the Client such as installation of bird diverters on 33 kV and 220 kV transmission lines in all the areas, installation of suspended insulators, etc. will reduce the electrocution and collision impacts to major.

The vegetation clearance activity may also have critical ecological impacts which may further be reduced to some extent by avoiding the clearance of old mature trees in the Project area.

A long-term monitoring of entire Project site and the transmission line alignment is crucial which will help build a stronger baseline, understand the movement of migratory species and areas with the presence of EN, CR species such as GIB and Vultures in this landscape. This will help identify the high risk areas of the transmission line stretch and Project site. The mitigation measures can be revised based on the outcomes of the study to further reduce the impacts.

E.5 Stakeholder Engagement

According to the discussions undertaken with the local community and the project team, it is understood that the engagement by the project proponent with the local community was restricted to negotiations with landowners. These negotiations through the land aggregator are being undertaken with the identified landowners, with the help of the intermediaries in the area. According to the consultation with the local community, these meetings provided a basic understanding of the project and the purpose of the land procurement.

The key concerns and expectations that were raised during the stakeholder consultation process have been summarised below:

- **Key feedback received from local community regarding project :** It was informed during the consultation with the community that there is a drastic shift from agriculture based economy to non-agriculture based economy due to lack of irrigation facilities and decline in crop yield. There was a positive outlook towards the solar projects in the area. Although the area has witnessed development of various solar and wind projects in the past 5-10 years, the community desired more such projects in the vicinity. They expect to receive benefits from the project in terms of employment and development of infrastructure and the overall community. In addition they also demanded preference to the local community in contractor and employment opportunities from the project;
- **Key feedback received from identified land lessors who were consulted during the ERM site visit:** It was informed that the private landowners are willing to lease out their land due to the low productivity of the agricultural land, dependency on monsoons and lack of irrigation facilities. The compensation received after leasing out their land will be used for livelihood earning and starting of alternative livelihood option then farming. The major concern of the stakeholder group till now is related to availability of employment opportunities that the project will generate; and
- **Community Development activities:** The local communities were of the opinion that apart from the economic opportunities, the local community should also benefit from the project in terms of community development activities. Some of the key areas for development activities identified included medical infrastructure, access to middle and higher schools, and trainings for youth within the village. This can be done by collaborating with local NGOs working on these areas.

E.6 Key Identified Impacts

E.6.1 Impacts associated with construction phase

E.6.1.1 Environmental impacts:

- **Change in Land Use:** Based on review of the land use in the Project AoI, it was observed that majority of land use-land cover includes shrub/waste land (83.54%) followed by agricultural land (11.53%) and gravel waste land (4.93%). As observed during ERM site visit and discussion with site team, both WTGs and solar power plant will be located on private shrub/waste land, agricultural land and gravel waste land. Additionally, the external transmission line connecting the pooling substation will pass through shrub/waste land, and agricultural land. There is no major dependency for grazing on the land leased for the project. Since, majority of the land is shrub/waste land where no agricultural activities are taking place, thus, receptor sensitivity is assessed as low. Furthermore, it is understood that pooling substation, storage yard and site office will be developed on private shrub/waste land. The project activities such as strengthening the access road, installation of solar modules and WTGs and proposed internal and external transmission towers are expected to alter the land use of the area throughout the project life cycle.

- **Topography:** The Project area exhibits flat topography with minor undulations. Two small rivers (Sukhri Nadi and Ghughri Nadi) pass through the proposed project site. Few small water channels observed within the Project area were mostly dry throughout the year except for monsoon season. Since the proposed project, along with the access road, is mostly on a flat terrain the receptor sensitivity has been assessed to be low. The topography may be altered slightly due to the strengthening of approach roads, excavation work at the WTG sites and solar site, internal and external transmission line locations and PSS and SCADA. Clearing and levelling of land would be done prior to any civil work, although these changes are envisaged to be small and restricted to the immediate vicinity of the Project components. The impact magnitude has therefore been assessed as small considering the footprint of the Project.
- **Soil environment:** During the construction phase, the top soil will be susceptible to soil erosion to some extent due to site clearance activities. The region is characterised by red desertic soil and sandy soil which is loose in nature and thus soil erosion can occur easily in the Project area. The scale of site clearance will be small at WTG footprint, but since there are 72 turbines in the project the scale of site clearance will be moderate. At different parcels of land and in solar plant area and the pooling substations, excavated loose soil would be susceptible to erosion. The removal of stabilised top soil would result in slope destabilisation and increase in soil erosion. As for soil compaction, the strengthening of internal access roads and excavation and collection of soil will lead to soil compaction, thus increasing surface run-off and decreasing the percolation rate of the soil. However, since the Project is being developed in a drought prone area the impacts arising from soil compaction will be minimal. Therefore, the overall resource/receptor sensitivity is assessed as low to medium and the impact magnitude is assessed to be small to medium.
- **Waste generation:** General construction waste generated onsite will comprise of concrete, steel cuttings/filings, packaging paper or plastic etc. Municipal solid wastes consisting of food waste, plastic, the construction workforce will also generate glass and waste paper. A small proportion of the waste generated during construction phase will be hazardous and will include waste fuel, grease and waste oil containing rags.
- **Water resource consumption:** Water is a prime requirement for the execution of civil works, especially with regard to preparation of raw materials like concrete etc. for civil works associated with the Project (i.e. WTG foundation solar PV module installation, casting, construction of proposed site office, SCADA room). Source of water for the construction phase will be from IGNP canal, it can be sourced from Mohangarh pumping station. Based on estimates shared by AGE(7)L & AGE(9)L, approximately 145 KLD water will be required during peak time of construction phase for civil work and approximately 315 KLD water will be required for domestic purpose. The project IGNP canal is used for irrigation purpose, drinking purpose and also used by other power producers for sourcing water. Therefore, the receptor sensitivity is assessed to be high. However, since the construction phase of the Project will almost a year (~ 10-12 months), therefore, magnitude of impact is assessed as large;
- **Air Quality:** Air quality in the study area will be impacted in the form of fugitive dust emissions from construction/installation activities, vehicular emissions and exhaust emissions from DG sets. However, the construction activities are going to occur for almost a year (~10-12 months); The significance of impact is assessed to be moderate;
- **Ambient Noise:** The hybrid Project is spread across a larger area ~4240 acres (area required for transmission towers and the PSS have not been included in the area mentioned). The air quality impacts would be confined to 500 m of the construction activity area includes material storage area, villages located near to access routes etc. and will not have any long term impact on the ambient air quality of the area. However, the Project study area is characterised by presence of loose sandy soil and is prone to soil erosion, coupled with the fact that construction activities will involve increase in the number of vehicles entering the region. State Highways will be utilised along with village roads for transportation of construction materials. Villages along the state

highways and village roads in the Project AoI will be impacted due to increased emissions. Therefore, the receptor sensitivity is assessed as medium. Since the construction related activities will last for almost a year (i.e. 10-12 months), the impact magnitude is assessed to be medium.

- **Occupational and Community Health and Safety:** The construction phase activities such as the erection of the WTGs, installation of solar modules, construction of the transmission line and substations and movement of material and personnel may result in impacts on the health and safety of the workers and community. These activities will involve the use of heavy machinery and live transmission power lines. Furthermore, the movement of material and personnel via the access roads may result in injuries to workers or local community and their livestock due to accidents; The project is expected to follow corporate level OHS procedures established by AGEL. The SOPs cover aspects related to a) recognition and reporting of Incidents, Illness and safety hazards, b) use of personal protective equipment, c) training and development needs, d) transportation safety, and handling hazardous materials, and e) emergency response plan. Therefore, the significance of impact is expected to be minor to negligible;

E.6.1.2 Socio-economic impacts

- **Community health and safety:** The construction phase activities such as the erection of the WTGs, construction of the transmission line and substations and movement of material and personnel may result in impacts on the health and safety of the community. These activities will involve the use of heavy machinery and live transmission power lines. Furthermore, the movement of material and personnel via the access roads may result in injuries to people or livestock due to accidents;
- **In-migration of workers:** The in-migration of workers from outside the area will result into increased risk of conflict and social unrest due to cultural differences between the labourers and local community. Similarly, the in-migration may also lead to spread of communicable diseases due to contact and interaction between the labourer and the local community. Moreover, lack of proper sanitation or waste management facilities may also resulted in outbreak and transmission diseases. The in-migration will also resulted in increased pressure on basic facility such as water etc. Such pressure and demand may lead to inflation and increased prices of food items and basic commodities. As this impact is restricted to the construction phase the impact, magnitude is assessed as minor. However, post implementation of mitigation measures the impact significance is assessed to be negligible.
- **Impact on landholding and agricultural income:** As reported during the consultation, due to lack of irrigation facilities and dependence on rainfall, considerable section of the working population, working as agricultural labourers in the study area has reduced. Reportedly, none of the landowner consulted and the local community in the area practice sharecropping. Majority of the households are working as other works and cultivators. Therefore, sale of land is not expected to have significant impact on the agriculture labourers. The impact significance is envisaged to be minor, however, post implementation on mitigation measures the impact significance is assessed as negligible to minor.
- **Impact on employment opportunities:** The construction phase activities of the project including construction of access road, civil works, foundation activities, site clearance and security will involve semi-skilled and unskilled workers. According to the information available, the preference will be given to the local workers to be employed as a contractual workforce. It is understood that the establishment of the solar and wind power project in the area shall result in a shift of preferences of the local community from agriculture and livestock rearing for income. With the locals, preferring to be employed by the solar & wind power projects during the construction and operation phase, as drivers and security personnel. The local community is likely to benefit from the economic opportunities to be created from civil works during construction phase including, self-employment options for individuals possessing vocational or technical training skills like

electricians, welders, fitters etc; and, contracting opportunities for locals possessing tractors, dumper trucks or other vehicles which would be needed to carry away excavated soil and other material. The significance of the impact is assessed as positive.

- **Labour rights and welfare:** The projects will employ skilled, semi-skilled and unskilled workers, across the project lifecycle, which will include contractual and regular employees and local and migrant workers. The regular skilled workers are likely to be comprised of migrant workers, from different districts and states in the country, depending upon the need for technical expertise. The overall impact significance of the labour rights and welfare during the operation phase is assessed as minor.

E.6.1.3 Ecological impacts:

- **Vegetation Clearance:** For various activities such as excavation for the erection of WTGs and construction of ancillary facilities, construction of solar plant infrastructure, storage yards, access/internal roads, will cause loss of habitat and loss of connectivity of wildlife.
- **Laying of Approach Roads:** Approach roads are constructed to connect the WTGs and Solar project with the main access roads in the area. These are used during construction phase as well as in operational phase for maintenance activities. Following ecological concerns should be considered during the construction of approach roads.
 - Vegetation loss, Habitat continuity
 - Roadkills
 - Habitat disturbance

E.6.2 Operational Phase

Following are the key impacts identified during the operational phase:

- **Soil Environment:** During operation phase, the waste generated from Project will include domestic solid wastes at SCADA building and substation and hazardous wastes like waste oil from DG sets and transformers, and oil containing jutes and rags. The quantity of hazardous waste generated will be much lesser than the quantity generated during the construction stage. Therefore, the receptor sensitivity and impact magnitude is assessed as low and small. The hazardous waste generated will have to be through an approved vendors (which is yet to be identified) in accordance with Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, as amended. The hazardous wastes will be stored onsite at separate designated covered area provided with impervious flooring and oil spill control kit will be used for cleaning small spills and leaks. During operation phase, the quantity of municipal waste and hazardous waste generated is less and probability of the hazardous waste generation is only during maintenance work and therefore occasional. The waste generated would be routed through proper collection and containment;
- **Water Environment:** During O&M phase, water will be primarily required at the solar plant for module cleaning. The Project intends to implement both dry cleaning and wet module cleaning at site. Reportedly, there will be 24 module cleaning cycle per year comprising of 16 cycles of dry cleaning and 8 cycles of wet cleaning (2 dry cleaning followed by 1 wet cleaning) Water for operation phase will be sourced from IGNP canal. As per secondary research it is understood that the Indira Gandhi Nahar Department has reserved 0.87 MAF (1200 cusec) of water for drinking, energy projects, and other industries. It is understood that Water Resources Department will allocate required quantity of water from IGNP canal/ the nearest available source for cleaning of solar panels and auxiliary consumption for Solar PV Power Plants subject to the availability of water. Power Producer is expected to intimate estimated water requirement to RREC along with source of water, which AGE(7)L & AGE(9)L is yet to complete. Approximately 10,642 KL water

will be required per year for wet module cleaning. For domestic purpose approximately 5.4 KLD water will be required considering 40 manpower deployed at site during operation phase. Since the Project is considering wet module cleaning as well as dry module cleaning. Furthermore, there will be only 16 dry cleaning cycles and only 8 wet cleaning cycles per year therefore, receptor sensitivity and impact magnitude is assessed to be medium;

- **Water quality:** During operation phase, wastewater generation is expected to be from solar module cleaning. Additionally, sewage would be generated from substation and SCADA building, these will be of almost negligible quantity. Therefore, the receptor/resource sensitivity, which may be the groundwater and nearby surface water body, is assessed as medium as a two small rivers are found to pass from the project area with multiple small dendritic and sub dendritic channels present within the project area. The rivers have little flow and water round the year whereas the dendritic and sub dendritic channels are seasonal and are filled in the monsoon season, hence the impact magnitude is assessed to be small;
- **Noise generation:** There will be no noise generated from the solar power plant during operation phase. However, the emanation of noise from the operation of WTGs is of the following two types: (a) mechanical noise, from interaction of turbine components; and (b) aerodynamic noise, produced by the flow of air over blades. Mechanical sounds originate from the relative motion of mechanical components and the dynamic response among them.
- **Shadow Flickering:** Given the guidelines of 30 hours or less per year is considered to be acceptable, the operation of the wind farm theoretically results in shadow flicker impacts that could be considered as significant for the purposes of this study. The results show that theoretical shadow flickers impact in the real case scenario occur with 2 receptors with higher than 120 shadow hours per year, 1 receptor with shadow impact between 120 shadow hours per year to 60 hours per year, 13 receptor with shadow impact between 60 shadow hours per year to 30 hours per year and from a total of 153 receptors identified within the Project area;
- **Economy and Employment:** Depending upon the skill requirement, the local community should be given preference for employment, especially in semi-skilled and unskilled work. Especially as a security personnel for WTGs. The sourcing of local labour wherever possible should be made obligatory for the sub-contractors and in all major procurement activities; and
- **Hazards associated with Turbine Blades and Transmission Line Infrastructure:** The entire landscape of the Project site harbours several threatened bird species. Furthermore, 13 species protected under Schedule I of Indian Wildlife Protection Act 1972 have been reported from this landscape. Following impacts have been identified to these faunal species present in the landscape:
 - Electrical hazards to birds; and
 - Risk of collision with transmission lines.
 - Collision risk to bird and bat species.

E.6.3 Cumulative Impacts

During ERM site visit and based on discussion with site representative, the following projects were observed to be operational within 10 km of the proposed 600 MW hybrid Project.

- A 39.9 MW wind power plant developed by Suzlon and owned by Orange Renewable Power Private Limited is located near Bhainsara Village and other surrounding villages, few of the turbines are located approximately within a distance of 600m-1km from the turbine location of proposed 600MW project ;
- A 100 MW wind power project developed by Siemens Gamesa and owned by National Aluminium Company Limited (NALCO) located approximately 5 kms of the proposed project, few of the turbines are located at a distance of 1.5-2.5 kms from the proposed project. ;

- In addition to the above, AGEL is planning to develop a 390 MW and 700 MW solar and wind hybrid power project located within the 5 km radius of the Proposed 600 MW project.
- There are other upcoming wind power projects to be developed by Renew and Eden Renewables (capacities not known) within 5-10 km of the proposed project site.

The cumulative impact significance will not go beyond moderate for environmental and social impacts since hybrid power projects are projects with very low dependence on natural resources and are being developed to enhance the renewable energy sources in the country. Maximum dependence and impacts of solar and wind power projects on natural resources and the ambient environment are during the construction phase, which lasts for a short duration. As for ecology impacts, the Project site falls inside the Central Asian and West Asian-East African Flyways and supports the turnover high numbers of migratory birds in winter. The Project site is situated in close proximity to GIB habitat and there is a likelihood of the movement of GIB and Vultures inside the Project site. The existing windfarms and some future projects coming in this landscape may lead to an increased risk to these avifaunal species. Also siting of wind and solar parks in the natural habitats thereby affecting the thorny scrub vegetation and grasslands.

E.7 Key Mitigation Measures Identified

Following are the key mitigation measure identified for the Project:

- Ensure hazardous waste containers are properly labelled and stored onsite provided with impervious surface, shed and secondary containment system awaiting handling and disposal by an authorised vendor (authorised by the RSPCB and as per the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, as amended);
- The construction contractor should ensure daily collection and periodic (weekly) disposal of construction waste generated debris, concrete, metal cuttings wastes as per the Construction and Demolition Waste Management rules 2016;
- Spill, leakage and clearance plan to be adopted for immediate cleaning of spills and leaks;
- Use of licensed contractors for management and disposal of waste and sludge;
- Labourers will be given training towards proactive use of designated areas/bins for waste disposal and encouraged for use of toilets. Open defecation and random disposal of sewage will be strictly restricted.
- Prepare and implement water conservation scheme e.g., rainwater harvesting at the project site. A regular inspection for identification of water leakage and preventing water wastage.
- For construction uses, the low quality water will be blended with fresh water. Construction Labour deputed onsite to be sensitized about water conservation and encouraged for optimal use of water;
- All workers (regular and contracted) should be provided with training on Health and Safety policies in place with appropriate refresher courses throughout the life cycle of the Project;
- As part of the stakeholder engagement and information disclosure process, the community shall be provided with an understanding of the activities to be undertaken and the precautions taken for safety. Establish a grievance redressal mechanism in place, to allow for the employees and workers to report any concern or grievance related to work activities;
- Project should ensure a monthly monitoring and regular auditing mechanism for monitoring the sub-contractors and suppliers with respect to compliance to the applicable reference framework, in terms of resources, migrant workers, child labour and forced labour, health and safety, payment of wages etc.;
- Depending upon the skill requirement, the local community should be given preference for employment, especially in semi-skilled and unskilled work;

- Contracting opportunities for locals possessing tractors, dumper trucks or other vehicles which would be needed to carry away excavated soil and other material. Creation of indirect employment for local community through establishing small shops like tea stalls, supply of intermediate raw materials, repair outlets, hardware stores etc.;
- Measure to reduce the risk of prevalence of diseases should be developed, including screening of workers, undertaking health awareness amongst the workers, implementation of vector control programs, avoiding the presence of unsanitary conditions and better facilities in the project site, such as safe drinking water, proper waste collection and disposal etc.;
- Revegetation with native species of the cleared vegetation at shall be undertaken in order to provide a vegetation cover for the movement of smaller mammals;
- Unnecessary disturbance of neighbouring vegetation due to off-road vehicular movement, fuelwood procurement, needless expansion of labour camp and destruction of floral resources should be prohibited;
- The construction of approach roads for the Project should be carried out in a phased manner by focusing on clusters of WTGs at a given time to allow impacted fauna to adjust to the disturbed areas;
- When grasses or small shrubs are removed for access road construction, replanting of native species should be implemented after the construction phase Residual impact significance;
- Construction and transportation activities must be avoided at night (6:00 pm to 6:00 am), if possible. In case nighttime construction and transportation activities cannot be avoided, the following measures must be taken;
- A detailed and long term monitoring of bird and bat species (covering migratory as well as breeding season) within the Project study area should be undertaken for at least two years which may help understand the presence of threatened species inside the Project area and their movement. This will further help in assessing the site specific impacts and updating the mitigations measures;
- A minimum distance of 1000 m is recommended between turbines and habitats visited by bird species of conservation significance. It includes resting/roosting and feeding sites;
- Formulation of a traffic management plan for night time equipment transportation to avoid any potential accidents during night travel and ensure community health and safety while using village roads and state highways;
- Areas, where construction activities are being undertaken, shall be properly lighted, so as to ensure occupational health & safety and avoid any potential accident/incidents that could harm the Project workers;
- Cattle Carcass Management should be implemented as a precautionary measure for vulture presence in the area;
- Bird carcass monitoring should be commissioned in operation and maintenance phase, in which all bird carcasses found in the wind farm should be recorded and photographed with details about the distance from the closest wind turbine generator and the name of the wind turbine generator for at least two years; and
- Periodic bird mortality counts should be undertaken for the first two years of the wind farm operation to determine if there is any risk of CR and EN and migratory bird species collision from the wind farm. The mitigation measures should be revised based on the results of the monitoring.

E.8 Conclusion

The proposed project is a green energy project that will comprise of 72 operating WTGs and 1,900,462 solar PV modules to generate 751.2 MW power through wind (151.2 MW) and solar

(600MW) energy. Impacts due to proposed power project are short term, generally limited to construction phase and operation phase have negligible to critical environmental, ecological and social impacts. The Project and its key components such as access road, project office building, and transmission lines are likely to have potential environmental impacts on baseline parameters such as land use, water, ambient air quality, noise quality in the immediate vicinity of Project during the construction phase. The project is also likely have potential impact on water during operation phase due to cleaning of modules. Additionally, there will be impact due to noise and shadow flickers effect on the receptors present within the proposed Project area. Critically endangered species have been identified in the region. A detailed Critical Habitat Assessment supported by long term bird and bat monitoring of wind farm along with the transmission line alignment will be required to ascertain what level of mitigation measures will be required. The social impacts from the project are assessed to be generally beneficial in terms of local employment and overall local area development.

1. INTRODUCTION

Adani Green Energy Limited hereinafter referred as 'AGEL' or 'Client' (subsidiary of the Adani Group) has commissioned Environmental Resource Management India Private Limited (hereinafter referred as ERM) for undertaking an Environmental and Social Impact Assessment (ESIA) study of a greenfield 600 MW hybrid (wind 151.2 MW) and solar (2*300 MW) power project (hereinafter referred as the "project"). The proposed 600 MW hybrid power project is being set up in Jaisalmer district of Rajasthan, India; the same is scheduled for Commissioning in July 2021. The project operates under two (02) SPV's M/s Adani Green Energy Seven Limited (AGE7L) & M/s Adani Green Energy Nine Limited (AGE9L), 100% subsidiaries company of M/s Adani Renewable Energy Park (Gujarat) Limited, which further is a subsidiary of AGEL.

The power generated from the proposed Solar-Wind Hybrid project will be purchased by Solar Energy Corporation of India (SECI) awarded to the Adani Renewable Energy Park (Gujarat) Limited through Competitive bidding process on 'Build, Own, Operate' basis. The tenders were invited for 1200 MW ISTS Connected Wind-Solar Hybrid Power Project Capacity vide Request for Selection RfS No. SECI/ C&P/ HPD/ 1200MW/ HYB/ T2/ RfS/ 032019 dated 8th March 2019 issued by SECI for selection of HPDs for development of cumulative capacity of 1200MW. Adani Renewable Energy Park (Gujarat) Limited (AREPGL) has been issued letter of award (LOA) for aggregate capacity of 600MW LOA No. SECI/ C&P/ HPD/ T2/ LOA/ AREPGL/ P1/ 31698 dated 18th June 2019 and LOA No. SECI/ C&P/ HPD/ T2/ LOA/ AREPGL/ P2/ 31699 dated 18th June 2019 for development of ISTS-connected Wind-Solar Hybrid Power Project(s), generation and sale of wind-solar hybrid power under the above Rfs.

Adani Renewable Energy Park (Gujarat) Limited has formed two(02) Project companies, Adani Green Energy Seven Limited (AGE7L) & Adani Green Energy Nine Limited (AGE9L), hereafter called as "HPD" to execute the projects through two projects of 300MW capacity each (P1&P2). Project ID HPD-ISTS-T2-AREPGL-P1-300RJ of capacity Hybrid: 300MW (Solar PV: 300MW & Wind: 75MW) has been allotted to Adani Green Energy Seven Limited (AGE7L) and Project ID HPD-ISTS-T2-AREPGL-P2-300RJ of capacity Hybrid: 300MW (Solar PV: 300MW & Wind: 75MW) has been allotted to Adani Green Energy Nine Limited (AGE9L)

Subsequent to the completion of successful bidding process and based on the provisions of RfS terms and conditions, the HPD (AGE(7)L & AGE(9)L) has entered into PPA with SECI for purchase of wind solar hybrid power for a period of 25 years.

1.1 Purpose and scope of the ESIA

1.1.1 Purpose

AREPGL is currently exploring for fund from international lenders, and this ESIA is prepared to help meet the requirement in terms of providing the lenders, an assessment of the project against international standards. In this context, the project requires evaluating the environmental and social risks associated with the project and to implement mitigation measures to avoid adverse impacts for the remainder of the project's lifecycle.

This report discusses the environmental and social baseline within which the proposed hybrid power project is commissioned and assesses the potential adverse, and beneficial impacts that the project could have, along with suitable mitigation measures and an Environmental and Social Management Plan (ESMP) for the project. The following sections provide an understanding of the scope of work and the applicable reference framework for the ESIA.

1.1.2 Scope of the ESIA

The scope of work for ESIA of the 600 MW hybrid (Solar + Wind) power project entails the following:

- Identification of applicable local and national environmental and social regulations and relevant international E&S standards for solar PV, wind and hybrid power projects;

- Categorization of the projects based on IFC Performance Standards;
- Collection of baseline data for the project sites and surroundings with reference to the physical, biological and social components. Broad level E&S risks associated with the transmission line route will also be identified;
- Development of a broad level social consultation strategy so as to have meaningful consultations with all relevant stakeholders (limited to sample basis);
- Identification, prediction, quantification and evaluation of potential aspects and impacts of the proposed projects on various environmental and social sensitivities due to activities envisaged during construction, operation and decommissioning phases of the proposed projects;
- Preparation of an Environmental and Social Management Plan (ESMP) with monitoring requirements based on the above review and develop procedures for monitoring environment and social impacts on an ongoing basis and to identify and mitigate residual impacts that may occur subsequent to the completion of the ESIA;
- Preparation of draft ESIA report for AREPGL's review and final ESIA report for relevant environmental agencies and lenders based on AREPGL's comments.

1.1.3 Applicable reference framework

The applicable reference framework for undertaking the assignment comprised of the following:

- Applicable local and national environmental and social regulations (including that of the state nodal agency for renewable energy development);
- Position Statements of the Standard Chartered Bank (<https://www.sc.com/en/sustainability/position-statements/our-framework/>)
- IFC Performance Standards on Environmental and Social Sustainability (2012);
- IFC/World Bank EHS General Guidelines;
- IFC/World Bank EHS Guidelines for Power Transmission and Distribution (2007);
- The Equator Principles, 2020;
- IFC's Good Practice Handbook on Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets.

1.2 Project proponent

The Adani Green Energy Limited is one of the six publicly traded companies with combined revenues of \$13 billion under the Adani Group, which is an integrated business conglomerate in India. The Adani group was founded in 1988, and is a global integrated infrastructure player with businesses in key industry verticals - resources, logistics, energy and agro. **Figure 1.1** and **Figure 1.2** present Adani group's key verticals and AGEL's business portfolio.

Figure 1.1: Adani group key verticals and AGEL

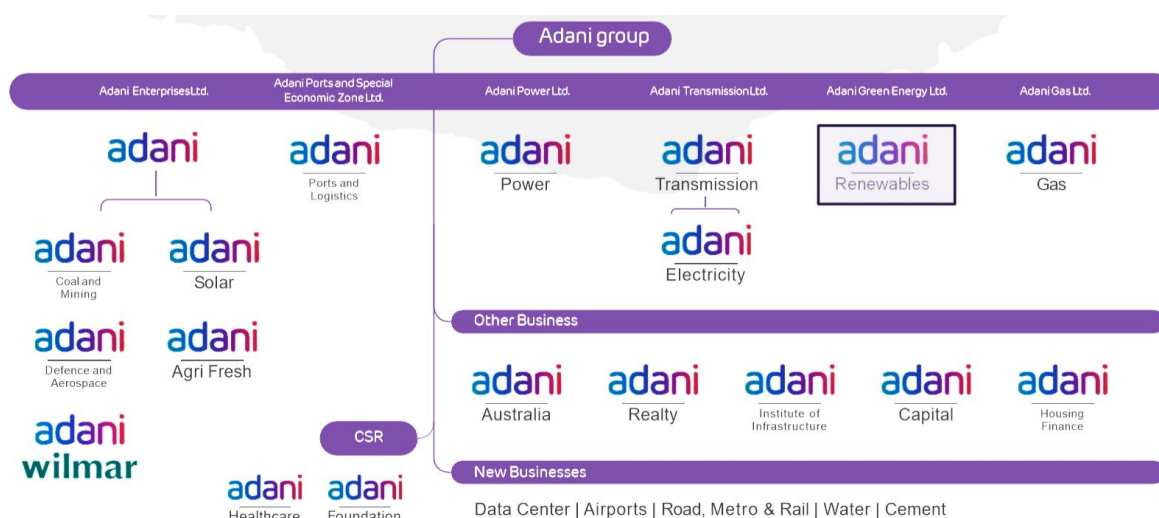
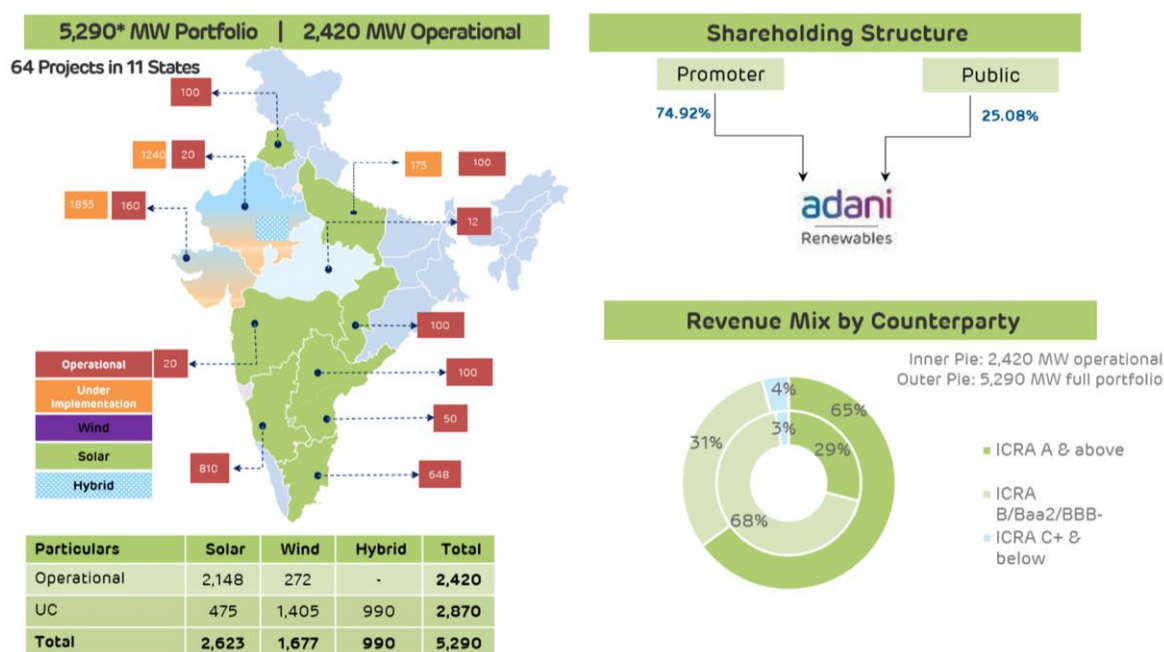


Figure 1.2: AGEL business portfolio



1.3 Project overview

Table 1.1 provides a brief snapshot and salient features of the proposed 600 MW hybrid power project. The location of the project is presented in **Figure 2.1** along with the spread of WTG locations, and Solar plant area identified for the project.

Table 1.1: Project overview – 600 MW Hybrid Power Project, Rajasthan

Particulars	Description
Project name	600 MW Solar-Wind Hybrid Power Project
Project Capacity	2*300.00 MW ac Solar, and 151.20 MW Wind

LOCATION DETAILS

Particulars	Description
Location coordinates	2°30'00"N Solar - 26°52'42.24"N, 71°29'56.49"E
Location details	Fatehgarh & Pokhran Tehsils, Jaisalmer District
Villages covered - Solar	Sanawara (Pokhran Tehsil, Jaisalmer District) Both the 300 MW solar plants shall be located in Sanawara village
Villages covered - Wind	Sanawara, Naya Sanawara, Lakhasar, Dawara, Sadrasar, Madhopura, Bhesada, Motisar, Details provided in Table 5.18 below.

LAND RELATED, & CONNECTIVITY DETAILS

Land type	Solar and Wind Project: Private Land
Land characteristic	Predominantly barren and culturable waste land with few portion of agricultural land (net sown area)
Total land required	Solar: 3,750 acres approx. Wind: 175-180 acres approx. Approximately 4240 acres
Mode of land procurement	Lease for 29 Years, 11 Months for both Solar and Wind locations
Nearest highway	National Highway NH-11, NH-68, NH-125
Nearest Major Town	Pokhran, Jaisalmer, Jodhpur, Phalodi, Bikaner
Nearest Railway Station	Jaisalmer, Jodhpur, Phalodi, Bikaner
Nearest Airport	Jaisalmer, Jodhpur, Bikaner
Nearest Sea Port	Mundra 750 km and Kandla 700 km

TECHNICAL SUMMARY – SOLAR

Solar Capacity	600.00 MW ac or 858MWp dc (2°429)
Total blocks	96 blocks (2°48 blocks)
Total number of modules	1,900,462

TECHNICAL SUMMARY – WIND

Wind Capacity	151.20MW
WTG capacity	2.1MW
# of WTGs	72

PLANT CONNECTIVITY

Internal pooling	Solar: 33 kV for solar, and 33 kV for wind Wind: 33 kV TL divided in 6 Clusters, approximate total length of 163.04 km
Transmission Line – Solar and Wind Pooling Substation to ISTS / CTU Substation	Voltage level at 220 kV, double circuit, with TL length ~31 km connecting to Fatehgarh-2, PGCIL Substation
Connecting grid substation	Evacuation voltage level at 220 kV, and substation voltage level at 765/400/220 kV connected to 765/400/220 kV Fatehgarh-2, PGCIL Substation

PPA & POWER SALE

Letter of award	18 th June 2019
PPA date	21 st January 2020
PPA effective date	15 th January 2020 and valid through 18 months from PPA effective date

Particulars	Description
PPA COD timeline	15 th July 2021, extension of +30 days to be granted by SECI under Force Majeure due to COVID-19 Lockdown
PPA execution partner	PPA executed with SECI, and the sale of power will be to SECI

PROJECT STATUS AS ON DATE OF SITE VISIT

Project Status	<p>Planning Phase.</p> <ul style="list-style-type: none"> 72 WTGs of 2.1 MW each have been finalised for the wind power generation The land for all the 72 WTGs has been finalised. For total 540 acres of land, the lease agreement has been executed, as reported. The total land procured for all the WTGs are private land. The land for the solar plant is in the process of finalisation. The entire land parcel identified and finalized for both 300 MW solar sites is private land. as per information, a MoU has been signed between AGE(7), AGE(9)L & identified land lessors; Internal Transmission Line: During consultation with land team of AGEL it was informed that no internal line has envisaged for both solar sites; however, for wind project, 33 kV internal transmission line, divided into 6 clusters and having its total length of approx 163.04 km shall connect it to PSS. The given hybrid project shall have two PSSs; one in Sanawara village within solar site and the other one in Sadrasar village. As informed, the land for both PSSs have been identified and finalized; External Transmission Line: The land for both PSSs have been finalized and the length of 220 kV external TL from proposed PSS to PGCIL GSS shall be ~31.1 Km; however, the total number of towers to be erected for external TL has not been finalized until date
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Source: Detailed Project Report dated June 2020, and site visit conducted July 2020

1.4 ESIA Methodology

The ESIA methodology adopted is depicted in table 1.2 below. The ESIA process has been undertaken following a systematic process which predicts and evaluates the possible impacts of the project on aspects of the physical, biological, socio-economic and cultural environment, and identifies the measures to be taken to avoid, minimise/reduce, mitigate, offset or compensate for adverse impacts; and to enhance positive impacts where practicable. The stages of the ESIA process are described below.

1.4.1 Screening

The project screening process was conducted via desktop study, prior to the scheduled site visit. This is done to gain a broad understanding of the project site and to determine applicable Environmental and Social impact assessment requirements.

1.4.2 Scoping

The main objective of the scoping is to ascertain the environmental issues associated with the project on which the ESIA study will be focused by review the project information and is to ascertain likely environmental issues associated with the project activities. This process helped in ensuring that all the relevant issues are identified and addressed in an appropriate manner in the ESIA study.

For this ESIA study, scoping (refer to **section 4**) has been undertaken to identify the potential Area of Influence for the project (and thus the appropriate study area), 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 stage is intended to ensure that the impact assessment focuses on issues that are most important decision-making and stakeholder interest.

1.4.3 Project description

In order to set out the scope of the project features and activities, with particular reference to the aspects which can impact on the environment, a project description is prepared. This is based on information as provided by AGE(7)L & AGE(9)L. The project description in detail is as provided in **Section 2** of this report.

1.4.4 Baseline conditions

Primary data collection was undertaken for this project, along with secondary information. The primary data collection included noise monitoring, air quality monitoring, water quality monitoring (both ground water and surface water), and soil monitoring. The secondary consultation included collection of baseline information through literature surveys and consultation with stakeholders in the study area. The detailed baseline characterisation for the project is provided in **Section 5** of this ESIA report.

1.4.5 Stakeholder consultations and Analysis

An effective ESIA process requires engagement with relevant stakeholders throughout the key stages. This assists in understanding stakeholder views on the project and in identifying issues that should be taken into account in the prediction and evaluation of impacts.

ERM identified/profiled the various stakeholders of the project, such as the project land owners, vulnerable social groups, the village-level key informants, the line departments (revenue, land, agriculture and forest), state/district administration and civil society organisations as well as developed an understanding of their stakes, interests and influences on the project.

Details of the Stakeholder Engagement activities undertaken for these projects to date are presented in **Section 6** of this report.

1.4.6 Impact assessment (IA)/ predictions

Impact identification and assessment starts with scoping and continues through the remainder of the ESIA Process. It is an iterative process and completes only when the effects of all identified impacts arising out of the project, including residual impacts, have been assigned a mitigation strategy. The IA comprises of four sequential steps:

- Impact Prediction;
- Impact Evaluation;
- Mitigation and Enhancement; and
- Residual Impact Evaluation.

The detailed impact assessment for the project is as given in **Section 7**.

1.4.7 Environmental and Social Management Plan (ESMP)

The Environmental and Social Management Plan (ESMP) has been developed to include the following:

- Introduction of purpose and aims of the ESMP;
- Summary of significant adverse impacts and potential risks;

- Mitigations and control technologies, safeguards etc. to minimize adverse impacts on air, water, soil, ecological and socioeconomic environment;
- Institutional mechanism - roles and responsibilities for ESMP implementation, training of ESMP implementation team;
- Action Plans for effective control measures to minimize adverse impacts/risks; and
- Monitoring program for effective implementation of the mitigations and ascertain efficacy of the environmental management and risk control systems in place.

The detailed Environmental and Social Management Plans for the project is as given in **Section 8**.

1.5 Limitations

- This ESIA report is based on scientific principles and professional judgment applied to facts with resultant subjective interpretations. Professional judgments expressed herein are based on the analysis of available data and information. The ESIA report was prepared with the following limitations;
- The assessment of the environment and social risks is limited to project information available at this stage of the project, discussion with stakeholders, secondary data collected, consultation with local community and observations made during site survey. Professional judgement and interpretation of facts has been applied for presenting inference from the collected information;
- The consultations undertaken as part of the ESIA were limited to the stakeholders, who were available for consultation during the site visit; which included land owners, local community, and Project site Team;
- As per the consultation it has been understood that the land owners consulted were the ones with whom the land lease has been completed;
- Consultation with the local community was limited to those villages only where the project has already procured the land. This was because that the land procurement for other project of Adani group is presently ongoing in the other villages and any consultations could result in creating hindrances or biases towards the land procurement process, in terms of artificially increasing the land price and increasing the number of claims;
- All surveys were conducted during the daylight hours and thus the bird activities recorded were restricted to diurnal hours only. No night surveys were carried out
- As rapid surveys were undertaken for a short duration, report does not address seasonal variability of the data.
- Due to the prevailing Public Health Emergency of International Concern i.e. Coronavirus Disease 2019 (COVID-19), limited consultation with local communities has been conducted.

1.6 Use of this report

ERM is not engaged in consulting or reporting for the purpose of advertising, sales promotion, or endorsement of any client interests, including raising investment capital, recommending investment decisions, or other publicity purposes. The client acknowledges that this report has been prepared for their and their clients' exclusive use and also agrees that ERM reports or correspondence will not be used or reproduced in full or in part for such purposes, and may not be used or relied upon in any prospectus or offering circular. The client also agrees that none of its advertising, sales promotion, or other publicity matter containing information obtained from this assessment and report will mention or imply the name of ERM. Nothing contained in this report shall be construed as a warranty or affirmation by ERM that the site and property described in the report are suitable collateral for any loan or that acquisition of such property by any lender through foreclosure proceedings or otherwise will not expose the lender to potential environmental or social liability.

1.7 Structure of the report

The structure of this ESIA report is as given in **Table 1.2 below**.

Table 1.2: Structure of the report

Section	Particulars	Description
Section 1.	Introduction	(this section) Introduction to the Project and ESIA methodology
Section 2.	Project Description	Technical description of the Project & related infrastructure and activities
Section 3.	Applicable Legal and Regulatory Framework	Discussion of the applicable environmental and social regulatory framework and its relevance for the Project.
Section 4.	ESIA Scoping	Description of the outcomes of the Screening exercise and description of the outcome of the Scoping exercise undertaken as part of the ESIA process.
Section 5.	Baseline Setting	An outline of the Environmental, Ecological and Social Baseline status in the area of the Project.
Section 6.	Stakeholder Engagement	An outline of the engagement with the stakeholder groups undertaken as part of the assessment process and the key issues identified from the same
Section 7.	Impact Assessment and Mitigation Measures	This section includes details of identified environmental impacts and associated risks due to project activities, assessment of the significance of impacts, and presents mitigation measures for minimizing and /or offsetting potential impacts identified.
Section 8.	Environmental and Social Management Plan	Outline of the Environmental and Social Management Plan (ESMP) taking into account identified impacts, proposed mitigation measures, and monitoring requirements
Section 9.	Impact Summary and Conclusion	Summary of impacts identified for the Project.
Annexure A	WTG Profiling of 72 WTGs	
Annexure B	Photo Log	

2. PROJECT DESCRIPTION

This section provides a description of the project in terms of location, facilities and associated project infrastructure and activities during the project lifecycle and facilitates an identification of the potential impacts on resources and receptors that could result from Project activities during the planning, construction, operation and decommissioning stages.

2.1 Project Location and Site Setting

As mentioned in **Table 1.1** of this report, the proposed 600 MW Solar-Wind Hybrid Power Project is located on land ranging from flat to undulating private fallow land, dunes, agricultural land (net area sown) and culturable waste land across 18 villages in Fatehgarh and Pokhran Taluka of Jaisalmer District in the state of Rajasthan. Elevation at project site ranges from 235 m to 330 m above mean sea level. The Project lies between the following coordinates:

- Northern most point: 26°54'37.97"N, 71°30'54.31"E
- Southern most point: 26°33'1.66"N, 71°27'51.40"E
- Western most point: 26°47'50.44"N, 71°21'33.92"E
- Eastern most point: 26°43'28.50"N, 71°39'22.16"E

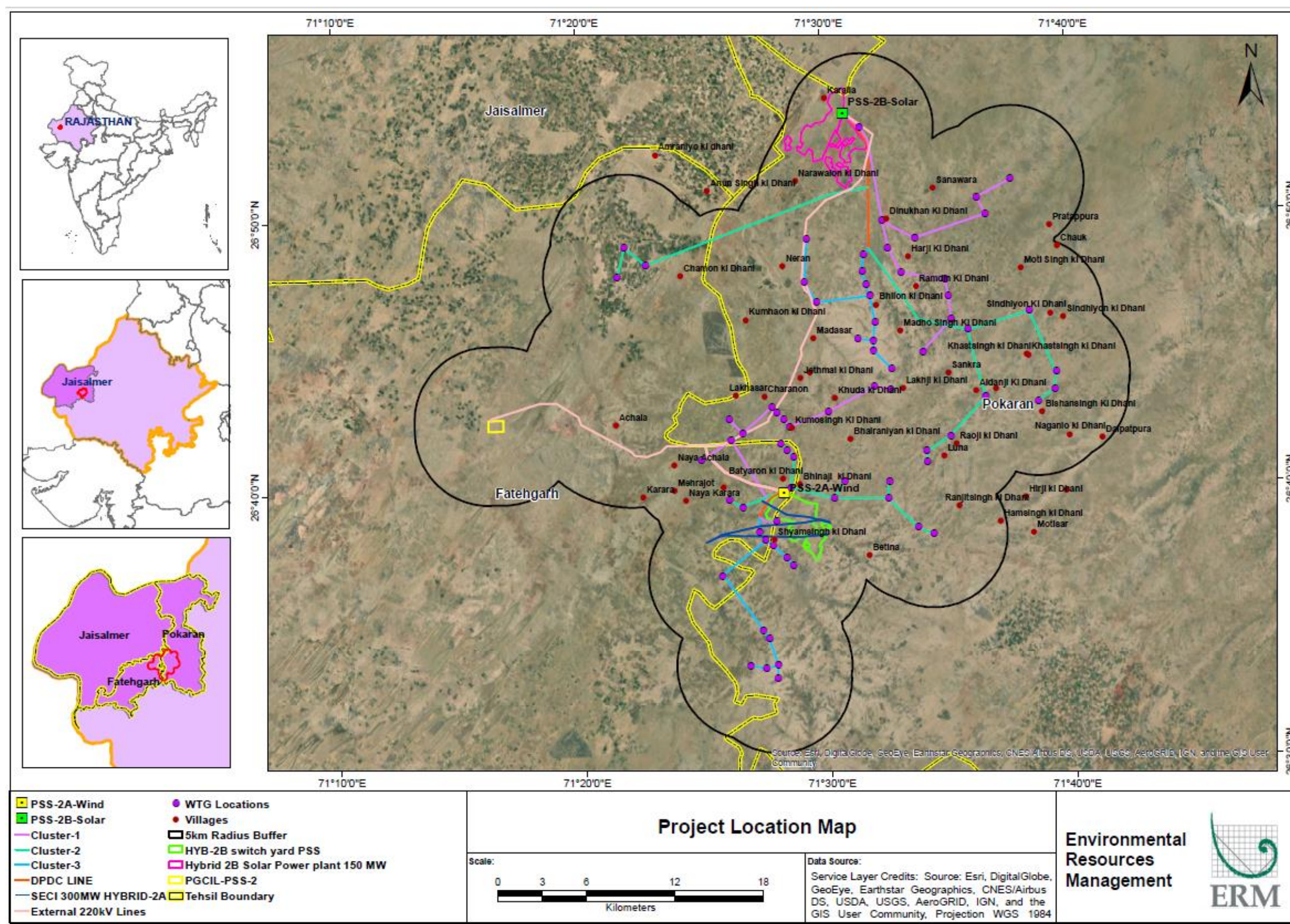
As observed during ERM site visit, two small rivers (Sukri Nadi and Ghughri Nadi) were observed to traverse through the project area, small rivulets emerging from them are also present which eventually gets lost in sand dunes in their flow path. Multiple small dendritic and semi dendritic channels were also found to be present within the project area. Based on consultation with local community, it is understood that the water channel remains dry throughout the year and only gets water when there is heavy rain in the area, whereas for the ghughri nadi and sukri nadi they are ephemeral in nature. Additionally, in the project area it was observed that multiple small water ponds were observed within the agricultural fields, which were constructed by the owners of the field.

The proposed Project and associated facilities does not fall within 10 km of any Protected Areas such as National Parks, Wildlife Sanctuaries, etc. The nearest Protected Area and Important Bird Area (IBA) is Dessert National Park located at about 60 km west of the site. However, the Project is located in close proximity of the Great Indian Bustard (GIB) habitat known as GIB Arc and the boundary of its proposed Eco sensitive Zone. Rasla enclosures (1 and 2) are situated inside the Study area at approximately 2.8 km north of WTG FTN-266 and about 9.2 km southwest of the solar park boundary. While Guddi enclosure is located at about 15 km east of WTGs FAT-068 and FAT-639.

The project will use the existing gram panchayat road as approach road for the project. The gram panchayat road gets connected to National Highway (NH)-15 which crosses from within the project area. Nearest railway station is the Jaisalmer Railway Station located at an approximate aerial distance of 60 km from the project area. Nearest airport to the site is Jaisalmer Airport, located at an approximate aerial distance of 70 km from the study area.

The location of the Project and its study area is as shown in **Figure 2.1**

Figure 2.1: Map Showing Location of the Project Area



2.1.1 Other Renewable Projects in Vicinity

The areas surrounding the project site are characterised by operational wind power plants. Three operational wind power plants were observed within the study area. The details of the wind plants observed within 5-10 km from the site along, with their distance from the proposed project site, are as follows.

- A 39.9 MW wind power plant developed by Suzlon and owned by Orange Renewable Power Private Limited is located near Bhainsara Village and other surrounding villages, few of the turbines are located approximately within a distance of 600m-1km from the turbine location of proposed 600MW project ;
- A 100 MW wind power project developed by Siemens Gamesa and owned by National Aluminium Company Limited (NALCO) located approximately 5 kms of the proposed project, few of the turbines are located at a distance of 1.5-2.5 kms from the proposed project. ;
- In addition to the above, AGEL is planning to develop a 390 MW and 700 MW solar and wind hybrid power project located within the 5 km radius of the Proposed 600 MW project.
- There are other upcoming wind power projects to be developed by Renew and Eden Renewables (capacities not known) within 5-10 km of the proposed project site

2.2 Major components of the Hybrid project

The proposed 600 MW hybrid power project is a combination of solar and wind power plant, which includes two projects of 300MW solar and 75 MW wind plant each. As per the detailed project report, a total number of approx. 1,900,462 solar modules and 72 wind turbines are proposed for the project. The details of major component of solar and wind power project is given below:

2.2.1 600 MWac (2*300MW) Solar Power Project

The proposed 2*300 MW Solar Power Projects will include the following components and associated facilities as presented in **Table 2.1**

Table 2.1: Major components

Component	Manufacturer	Model
PV Modules (Proposed)	LONGi Solar	LR4-72HPH 440M~445M
	Risen Solar	RSM144-6-445-460BMDG
Inverter	Huawei	SUN2000-185KTL-INH0
Additional Infrastructure		
Transmission Line and Tower	The Transmission line of 220 KV (double circuit) will transvers a patch of approximately 31 km length to 765 KV/400 KV/200KV Power Grid Corporation India Limited (PGCIL) Fatehgarh-2 Substation from PSS-2A-Wind & PSS-2B-Solar Pooling Substations. The total number of towers to be installed for the transmission line is yet to be finalised.	
Storage Room	Storage room to be constructed for storing solar panels, oil drums etc.	
Site Office	Site office containers to be installed at Site during operation of the solar plant	
Access Road	Internal access road will be constructed within the plant for commuting purpose	

Source : Detailed Project Report, AGE(7)L & AGE(9)L, 2020

Table 2.2: Technology design parameter

Component	Description
DC Installed capacity	858 MWp (2*249 MWp)
AC installed capacity	600 MW (2*300 MW)
No. of installed modules	1,900,462 approx
No. of inverters	3750 (2*1875 Nos)
No. of MV transformers	Not Finalised
Transformer (step-up)	33 kV to 220 kV
Mounting structure	Horizontal Single Axis Tracker for the proposed project
Mounting system	Fixed mounting system

2.2.2 151.2 MW Wind Power Project

AGE(7)L & AGE(9)L has proposed to install 72no. of WTGs of Suzlon make SuzlonS120. Turbines will be arranged in a manner such that minimum distance between two turbines is 9.4 times of rotor diameter. The Wind Power Project will include the following components:

Table 2.3: Wind Power Project Component and Additional Infrastructure

Component	Manufacturer	Model
WTGs	Suzlon	SUZLON S120
Additional Infrastructure		
External Transmission Line and Tower	Length of 220 kV TL from proposed PSS to PGCIL GSS shall be ~31.1 Km; The total number of towers to be installed for the all the transmission lines are yet to be finalised.	
Internal Transmission Line	Wind: 33 kV internal transmission line, divided into 6 clusters and having its total length of approx 163.04 km shall connect it to PSS.	
Storage Room	Storage room to be constructed for storing solar panels, oil drums etc.	
Site Office	Site office containers to be installed at Site during operation of the solar plant	
Access Road	As per consultation, internal access road will be built within plant for commuting purposes; however the route map of the same has not been finalized.	

2.2.3 Power Evacuation Infrastructure for 600 MW Hybrid Power Plant

The proposed 600 MW Solar-wind Hybrid power project will have below mentioned evacuation arrangement

Components	Description
Plant's Internal Connectivity	
Internal Pooling- Solar	33 kV
Internal Pooling - Wind	33 kV
Solar and Wind Hybrid Power Pooling Sub-station	
Location	Solar Pooling substation: PSS-2B-Solar, located in Village Sanwara

Components	Description
Switchyard Ownership	Project Company
Incoming Voltage Level	33 kV
Outgoing Voltage Level	220 kV
Power Transformer Rating	33 kV
Internal Transmission Line- Connecting WTGs to the Pooling Substation	
Location of Pooling substation	Wind Pooling Substation: PSS-2A-Wind, located in village Sadrasar
Length of Internal Transmission Line	Approximately 163.04 km
TL Voltage Level	33 kV
Total no. of Towers	Yet to be finalised
External Transmission Line – Solar and Wind Pooling Substation to ISTS/CTU Substation	
TL Voltage Level	220 kV
Type	Double Circuit
Length	Approx. 31 km
Connecting Grid ISTS Substation	
Substation Name	765/400/220 kV Fatehgarh-2, PGCIL Substation
Evacuation Voltage Level	220 kV
Substation Voltage Level	765/400/220 kV
Substation Ownership	Power Grid Corporation of India Limited (PGCIL)

Source: Detailed Project Report, AGE(7)L & AGE(9)L

2.3 Wind Turbine Profiling

ERM undertook desk-based profiling of the WTG locations shared by AGE(7)L & AGE(9)L in the form of a google earth (kmz) file. The Project will have 72 operating WTGs with a capacity of 2.1 MW each. Currently, land survey has not been carried out and the land identification for 72 WTG locations is in process.

Based on the E&S profiling of 72 WTGs, ERM visited 6 WTG locations which consisted of sensitivities within 500 m, such as a road, structure and settlements which has been presented in **Table 2.4**. The Photo documentation of the 6 WTG locations visited by ERM and the solar power plant location have been presented in **Appendix B**.

Additionally, WTG profiling of the 72 WTG locations identified by AGE(7)L & AGE(9)L has been presented in **Appendix A**.

Table 2.4: Sensitive receptors (Abstract structures) within 500 metres of proposed WTG locations

S.No	WTG ID	Latitude (Decimal)	Longitude (Decimal)	Nearest village	North	South	East	West	Remarks	Receptor type (within 500 metres)	Receptor ID	Approximate distance from WTG location (metres)	Direction from WTG	Receptor Latitude (Decimal)	Receptor Longitude (Decimal)
1.	FAT-339	26.79252305°	71.58303542°	Sanawara	Barren and Un-culturable Land	Barren and Un-culturable Land	Fallow Lands	Barren and Un-culturable Land	At the time of site visit, The land parcel at the location of the Turbine was found to be tilled, can be considered as a current fallow land.	Settlements	STLMNT25	204.91		26.79223627°	71.58511132°
									The settlements were properly fenced and grazing was observed within a distance of 50 m from the zero point of the turbine. Manmade ponds were alos present.	Structure	STR44	298.00	SE	26.79002025°	71.58404905°
									Cattle such as goat and camles were also observed to be tied near the settlements. Village Road connecting Sankara to Sanawara was observed to be passing at a distance of 220m						
2.	FAT-044	26.72804205°	71.53351231°	Sadrsar	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Current Fallow	Trees were observed near the zero point of the turbine location.	Settlements	STLMNT9	178.88	N	26.72947527°	71.53267396°
									A cluster of pucca houses (approx. 8-10 houses) were observed at a distance of 250m	Structure	STR29	463.55	W	26.72473670°	71.53275299°
									Agricultural activities were observed to be undertaken in the near vicinity of the turbine. The agriculture is mainly rain fed, the land can be considered as fallow land .	Structure	STR28	382.58	S	26.72724734°	71.52896598°
3.	FAT-261	26.74857692°	71.56726616°	Sankara	Barren and Un-culturable Land	Fallow Land	Net Sown Area	Net Sown Area	The land was observed to be in use for agriculture. Properly fenced with barbed wire.	Settlement	STLMNT14	265.89	SW	26.74625900°	71.56650263°
									The turbine location is at a distance of 200 m from the internal village road 8-10 houses were observed to be present across the road at a distance of approximately 300 from the turbine location. Gound Water abstraction structure was found to be present near the settlements	Settlement	STLMNT15	368.38	NW	26.75162636°	71.56591623°
4.	FTN187	26.61925888°	71.47628142°	Bhainsara	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Road is running from NW to SE at 87.5m SW to the proposed turbine location	Structure	STR43	430.29	SE	26.61544015°	71.47759438°
5.	FAT-143	26.79725725°	71.35943742°	Dawara	Fallow Lands	Fallow Lands	Fallow Lands	Fallow Lands	Identified settlement - is a small group (3 to 4) structures together	Structure	STR17	174.50	E	26.79716115°	71.36125162°
										Settlement	STLMNT7	251.80	W	26.79736840°	71.35690969°
										Settlement	STLMNT8	272.88	N	26.79964642°	71.35947523°

6.	FAT-193	26.72071514°	71.60913433°	Khetasar	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Patch of net area sown is observed in South	Structure	STR8	75.22	NE	26.72126700°	71.60962200°
										Structure	STR9	482.94	SW	26.71867073°	71.60482800°

Source: ERM Site Visit dated 2nd-8th July 2020

2.4 Project phases and activities

The development activities envisaged for the project can be divided into four phases: (a) Planning; (b) Construction; (c) Operation & Maintenance and (d) Decommissioning. A summary of the activities to be undertaken during each phase is provided in the subsequent sections.

Table 2.5: Project phase and associated key activities

Project Phase	Associated Activities
Project planning and survey <i>(Current phase of the Project)</i>	<p>The planning phase activities ideally include:</p> <ul style="list-style-type: none"> ■ Selection of potential wind farm site; ■ Selection of potential solar plant site; ■ Site surveys – topographical, geotechnical, electrical, etc.; ■ Micro-siting of windfarm; ■ Approvals and clearances – power evacuation, grid synchronisation, pollution, safety, etc.; ■ Design and finalization of contractors; ■ Land acquisition/ transfer/ lease/allotment; ■ Undertaking various studies including ESIA, Bird and Bat baseline assessment, critical habitat assessment; and ■ Route survey assessment. <p>As part of the planning phase, the following activities have been carried out:</p> <ul style="list-style-type: none"> ■ Identification and finalisation of land area for solar and wind site; ■ The 72 WTG locations have been finalized and the consultations with private land-owners is in process ■ Route survey assessment for external transmission line connecting pooling substation to PGCIL Fatehgarh-2 ISTS Substation; ■ Identification and finalisation of locations for pooling substation, storage yards and site office that will support the Project activities; and ■ The aggregators for land have been contracted while; finalization of other contractors is under process.
Construction	<p>The construction phase activities will include:</p> <ul style="list-style-type: none"> ■ Site preparation including contractor mobilisation, erection of fencing or suitable barriers, construction of site compound and laying down areas; ■ Establishment of polling substation, site office and storage yard; ■ Upgrading of internal roads including laying of cables; ■ Site clearance; ■ Establishment of borrow pits (if required); ■ Installation of Solar PV modules; ■ Laying of turbine foundations, turbine delivery and installation; ■ Completion of internal electric connections;

Project Phase	Associated Activities
	<ul style="list-style-type: none"> ■ Turbine testing to verify proper operation of the facility; and ■ Commissioning
Operation and maintenance	<p>The operation and maintenance phase activities will include:</p> <ul style="list-style-type: none"> ■ Monthly cleaning of PV modules; ■ Control of vegetation viz. weeds, bushes etc. within the site and those immediately surrounding it; ■ Routine inspection and monitoring of all PV modules, WTGs and associated structures viz. cables, transformers, inverters, mounting structures etc.; ■ Operation and maintenance of ancillary facilities such as pooling substation; ■ Inspection and maintenance of transmission lines; ■ Inspection and maintenance of internal pathways and access roads; and ■ Annual shut down for maintenance of WTGs and solar modules which will mostly include cleaning and greasing, change of parts etc <p>The average design life of infrastructure, as well as the solar and wind farms, are estimated to be 25 years to 30 years (respectively) from the date of commissioning. This depends on the quality of periodic maintenance of the WTGs, solar modules as well as supporting infrastructures. Regular maintenance would be required to ensure that the turbines and modules are kept in optimal working order. Most day to day facility operations would be done remotely through the use of computer networks using SCADA, but some limited maintenance and repair activities would be undertaken on site.</p>
Decommissioning	<p>The decommissioning activities include:</p> <ul style="list-style-type: none"> ■ At the end of this life cycle, the solar modules and wind turbines will either be revamped or replaced with higher capacity or superior technology, or disposed as per the then applicable legislation; ■ If decommissioned, all components excluding foundations and internal roads of the project will be removed and the site will be restored to its pre-construction state; ■ The concrete pedestals of the ground mounted structure and turbine foundations will be demolished and removed from the sub-surface and covered with top soil; ■ Infrastructure (such as road, transmission line, etc.) is likely to be handed over to the government for their use.

Source: Discussion with Site representative in July 2020

2.5 Resource requirement

The resource requirement for construction and operation phases of the proposed project have been assessed based on assumptions and discussions with AGE(7)L & AGE(9)L Project team. The resource requirements are as elaborated below.

2.5.1 Land Requirement for the Project

The given Hybrid project comprises of two 300 MW solar sites and one, 151.2MW wind site. As per the information shared by land team of Adani and seprate consultations held with engaged

aggregators, it has been informed that approximately 3900 Acres of Private land will be taken on lease for both the Solar sites and approximately 340 Acres of land will be taken on lease for wind site, which will have 72 WTGs in total,

During consultation with land team of Adani and local aggregators, it was informed that, the land parcels for both the solar and wind sites have been identified. The process of lease agreements for solar sites have not started until date, however the private land lessors for both the solar sites have been identified. Similarly, the process of carrying out lease agreements for WTG locations have already started since December 2019. Based on the site visit and review of site through Google earth imagery, it has been understood that project will not lead to any physical displacement also it will not lead to any landlessness in the area. The project land is being lease on mutual negotiations and Sale Deed agreement.

The project may however lead to some economic loss in the area, due to taking agricultural land on lease and which shall also have standing crops on it. Based on consultation with AGE(7)L & AGE(9)L's land team it was understood that, to avoid any economic loss to impacted landowners, the land would be finally taken by both AGE(7)L & AGE(9)L during off-seasons/ non-cropping seasons, irrespective of AGE(7)L having the consent through Lease-Deed of the land. The land required for the wind power project is required for the following components:

- Wind Turbine Generators(WTGs);
- 2 Solar Sites
- ROW for transmission lines -33Kv internal and 400kV external
- Pooling Sub Station(PSS)

Reportedly, the total land requirement for the Project is estimated to be approximately 4240 acre of land, out of which 3900 acres would be for two solar plants and 340 acres for WTGs, at ~6 acres/ WTGs. The details pertaining to land required for internal and external transmission lines have not been shared with ERM team.

2.5.1.1 Land Procurement Methodology

The land for the hybrid project comprises of private land for both solar parks and for 151.2 WTG locations. This review was carried out based on the consultations undertaken with the project land team on the site, land aggregators appointed by the project, land lessors and the local community. However, not all of the land lessors could be consulted during the site visit due to unprecedented situation caused by COVID-19 pandemic.

Land Procurement methodology for two solar sites

The land to be taken on lease for two solar sites shall be a private land. As per information, both AGE(7)L & AGE(9)L through its aggregators have identified the private land parcels and their respective land owners, however no lease agreements have been carried till date between both AGE(7)L, AGE(9)L and respective landowners.

As per consultations, the land for both the solar sites shall be taken on lease for 29 years 11 months, through a process of consultation and mutual agreement with the landowners. As per consultations with Project team, landowners and the local community, a lease amount of INR 8400/ Bigha/ annum has been offered by AGE(7)L & AGE(9)L which is as per the current market rate. Further, based on mutual agreement and consent of private landowners, a formal lease agreement will be carried out between AGE(7)L, AGE(9)L and private land lessors.

Land Procurement methodology for ~72 WTG locations

Similarly, the private land for 72 WTG locations have been identified and reportedly, 22 lease agreements (for approximately 55 Acres of land) have been signed until date, however the details

pertaining to lease agreements, MoU etc. have not been shared with ERM team. The process of carrying out lease agreements for WTG locations with private land lessors started in December 2019 and is expected to be completed by November 2020.

The project has engaged local aggregators named M/s Dalweer Enterprises. Pvt. Ltd., M/s Prem Singh and M/s Lakh Singh to support the land procurement process with the assistance of local support from key intermediaries at the village level.

Land Procurement for TL

Internal TL Route

During consultation with land team of AGE(9) L & AGE(7)L it was informed that no internal line has envisaged for both solar sites; however, for wind project, 33 kV internal transmission line, divided into 6 clusters and having its total length of approx 163.04 km shall connect it to PSS.

The given hybrid project shall have two PSSs; one in Sanawara village within solar site and the other one in Sadrasar village. As informed, the land for both PSSs have been identified and finalized; however, the details pertaining to PSS's land procurement has not been shared with ERM; also the details pertaining to any additional land to be procured for "Right of Way" has not been shared with ERM team. Reportedly, the construction of internal and external transmission lines will be undertaken based on Indian Electricity Act, 2003 and Indian Telegraph Act, 1885, however further details regarding total number of tower footprints, area covered under tower footprints etc. was not finalized at the time of site visit by ERM team.

External TL Route

The land for both PSSs have been finalized and the length of 220 kV external TL from proposed PSS to PGCIL GSS shall be ~31.1 Km; however, the total number of towers to be erected for external TL has not been finalized until date.

As per consultation with land team of Adani, the construction of internal and external transmission lines will be undertaken based on Indian Electricity Act, 2003 and Indian Telegraph Act, 1885. During discussion with land team of AGE(7)L & AGE(9)L it was reported that the compensation for "Right to use" of the land coming under tower footprint and RoW between two towers will be paid on the basis of mutual negotiations and market rate of the land. The details pertaining to total number of towers to be erected for external TL, the process of its compensation and total amount of compensation have not been shared with ERM.

Land Requirement for the Project and the Existing Procurement Status

The land requirement for the project is comprised of the land for the solar plant, WTGs, transmission line, pooling substation, access road and site office.

Table 2.6: Land Requirement for the Project (in Acres)

Project Component	Total Land proposed to be taken on lease (in acres)	Easement Rights (in acres)	Land Category	Comments
Hybrid Project (Solar and Wind power plant)	4240 (as per the estimate given by the land team of AGEL)		Private land	<ul style="list-style-type: none"> ■ Solar Plant: The 3900 Acres of land required for both the solar sites shall be a private land and will taken on lease for 29 years 11 months at the rate of of INR 8400/ Bigha/ Annum, which is the current marker rate. ■ Currently the process of land and owner identification is in it's finalization stage. As per information, AGEL through it's aggretators have identified the private land parcels and their respective land owners, however no lease agreements have been carried till date between AGEL and resepective landowners. ■ WTGs: the private land for 72 WTG locations have ben finalized and reportedly, 22 lease agreemnts (for approximately 55 Acres of land) have been signed until date, however the details pertaining to lease agreements, MoU etc. have not been shared with ERM team. ■ Internal Transmission Line: During consultation with land team of AGEL it was informed that no internal line has envisaged for both solar sites; however, for wind project, 33 kV internal transmission line, divided into 6 clusters and having its total length of approx 163.04 km shall connect it to PSS. ■ The given hybrid project shall have two PSSs; one in Sanawara village within solar site and the other one in Sadrasar village. As informed, the land for both PSSs have been identified and finalized; ■ External Transmission Line: The land for both PSSs have been finalized and the length of 220 kV external TL from proposed PSS to PGCIL GSS shall be ~31.1 Km; however, the total number of towers to be erected for external TL has not been finalized until date

Project Component	Total Land proposed to be taken on lease (in acres)	Easement Rights (in acres)	Land Category	Comments
				<ul style="list-style-type: none"> ■ Access Road: The project will use the existing gram panchayat road as an external road. However, the project might need to reinforce the road for movement of heavy vehicles. In addition, the project shall construct ~30 km of internal access road; however the route map for the same has not been finalized.
Break-up of total land into each component				
Solar Plants (300 MW + 300 MW)	3900	Not Applicable	Private Land	Total land has been identified and is in finalization stage; however, the process of lease agreements had not started at the time of ERM's site visit.
WTGs	340	Not Applicable	Private land	The land required for each WTG is 6 acres. The land parcels for all the 72 WTGs have been identified and 22 lease agreements for approximately 55 Acres of land had been completed at the time of ERM's site visit.
Access Road	NA	Not Applicable	Not Available	<p>As reported, the project will to the extent possible use the existing gram panchayat roads. However, the project might need to reinforce the road for movement of heavy vehicles.</p> <p>The standard width of the access road requires for transportation of component of WTGs is 6 meters; there might be the case where project will require to increase the width of the existing roads. In such cases project will have an option for land purchase.</p> <p>For internal access road project has planned to develop 30 km road within site premises. The route map for the same has not been finalized and shared with ERM.</p>
Internal Transmission Line (33 KV)	NA	Not Required ²	Not Available	As per consultations, no internal line has envisaged for both solar sites; however, for wind project, a 33 kV internal transmission line having its length of approx. 163.04 Km shall connect it to both PSSs. The land for both the PSSs have been

² As per the Np. 3/7/2015-Trans order dated of Ministry of Power dated October 5, 2015, there is no requirement of RoW for 11 kV transmission line.

Project Component	Total Land proposed to be taken on lease (in acres)	Easement Rights (in acres)	Land Category	Comments
				identified and finalized, however the details pertaining to the same have not been shared with ERM.
External Transmission Line (220 kV)	NA	Yet to Finalised	Not Available	The land for both the PSSs have been finalized and the length of 220 kV external TL from proposed PSS to PGCIL GSS shall be ~31.1 Km; however, land required, RoW and total number of towers to be erected for external TL has not been finalized until date.
Pooling Sub-Station and site office (PSS)	NA	Not Applicable	Private land	The project has already identified and finalized the land for two pooling sub-stations, one in Sanawara village within solar site and the other one in Sadrasar village. The details pertaining to land taken for PSS have not been shared with ERM .

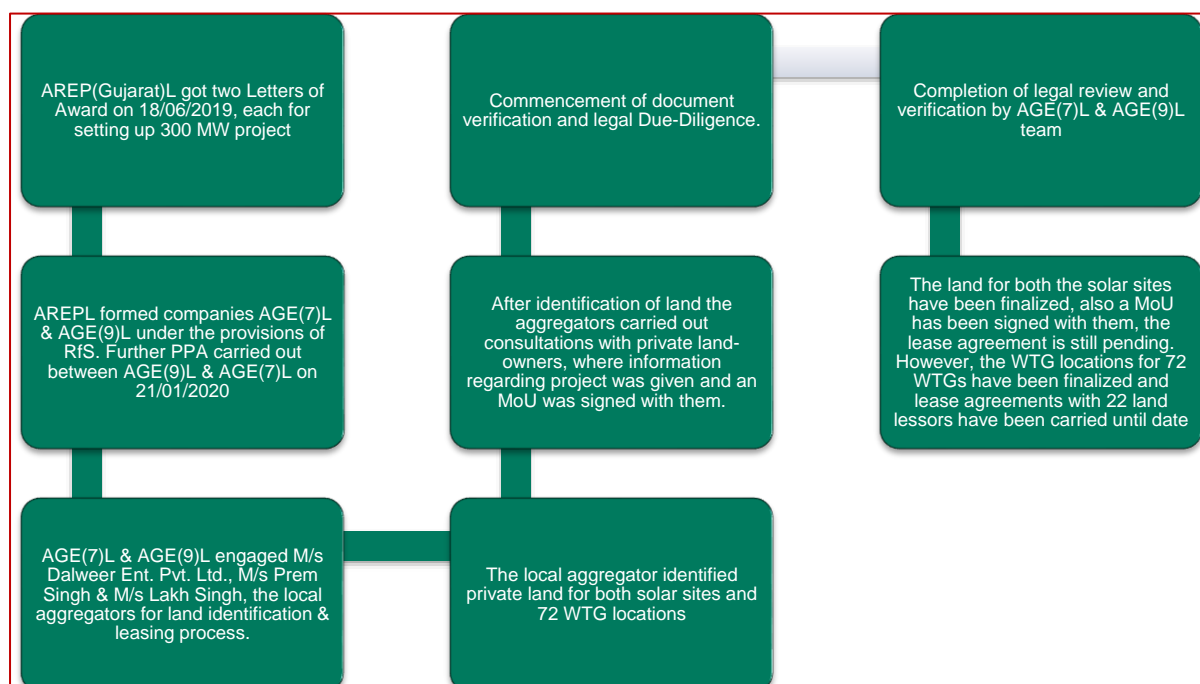
Note: Reportedly, the project will not set-up any labour camp or the lay down area for WTGs will be there inside the identified solar plant, hence there will be no requirement of temporary land for the Project.

2.5.1.2 Land Procurement Process

Identification/ Procurement of Land

As reported, the Project is in the process of land procurement for both solar plants and WTGs. The locations of both solar plants, 72 WTGs, PSS, internal and external TL etc. have been finalized and is in the process of carrying out lease agreement.

Figure 2.2: Land procurement process flow of the project



2.5.1.3 Key Points of Lease Agreement

The lease agreement will be signed between both AGE(7)L & AGE(9)L and the respective land lessors for both solar sites and WTG locations. The key points of lease agreement is delineated below:

- The tenure of Lease agreement shall be of 29 years and 11 months;
- Lease rent will be INR 8400/ Bigha annum or 21,000/ Acre/ annum, which will be paid on Half Yearly basis, irrespective of the aspects like difference in land quality, location of land (in terms of proximity to major roads and other infrastructure);
- As reported by the local community during the consultation the lease rent (INR 21,000) is equal to approximately 35 percent of market rate³ of the land;
- There will be a special clause in the Lease agreement, where in the event of delay in payment of Lease Rent by Lessee, Lessor shall have the right to charge interest at the rate of 15 percent per annum for the delayed period and this late payment interest shall be payable along with the Lease Rent payable for the particular year;

³ As reported by the Patwari (government official who maintain land records in the given area), the market rate of land in the area is INR 60,000/acre.

- Lease rent will be Escalated @ 5 percent yearly after every second year on current rates, and lease Rent will be paid directly to owners of land, through Demand Draft payable to their bank account;
- The lessor shall unconditionally agrees that he/she cannot terminate the Lease Deed during the term of 29 years and 11 months. However, the Lessor can terminate the Lease Deed for non-payment of Lease Rent, if it remains due for Four (4) instalments.; and
- The lessee shall give 1 (one) year prior notice before expiry of Lease period to the Lessor of its intention to renew the Lease. If the Lessor does not agree for such extension, the Lessee shall vacate the said land on the expiry of Lease Period, notwithstanding anything contrary content elsewhere.

Market rate

The market price is the current price at which the land can be bought or sold. As informed by the local community the prevailing market rate of land in the area is INR ~ 1, 00,000- 1, 25,000/ Bigha.

2.5.1.4 Project specific land related issues

Based on the information made available, the key observations pertaining to the land related issues are mentioned below:

Table 2.7: Key Sensitivities related to land procurement for project

Sensitivity	Details
Tribal Land/Schedule V Area ⁴	The project area does not fall under Schedule V ⁵ area as defined by the Indian Constitution.
Tribal (Schedule Tribe) Land	According to the information available and the consultation with the siteteam, the land identified for the project comprise of private land, and no tribal land shall be taken on lease or will be directly or indirectly affected by the project. As per the discussion with project team and the local community, all the land procured for the solar plant and for WTGs is private land and there is no common property resource in the procured land parcels.
Forest Land	As per the available information there is no forest land has been procured for the project
Encroachment	Based on the discussion with the project team and the local community, the land parcels identified for the project are primarily comprised of private agricultural land. The land belongs to the individual farmers, having necessary title deeds. No encroachments were observed or reported during the site visit.

⁴ In the Constitution of India, the expression "Scheduled Areas" means such areas as the President may by order declare to be Scheduled Areas. The criteria followed for declaring an area as Scheduled Area are preponderance of tribal population; compactness and reasonable size of the area; under-developed nature of the area; and marked disparity in economic standard of the people. These criteria are not spelt out in the Constitution of India but have become well established. (Source: Official website of the Ministry of Tribal Affairs (MoTA), Government of India (GoI). URL: <http://tribal.nic.in/Content/DefinitionofScheduledAreasProfiles.aspx>. Accessed on July 02, 202003.01.2018.

() Common Property Resources (environmental) are natural resources owned and managed collectively by a community or society rather than individuals.

⁵ The Schedule V areas comprise of the areas identified in the Paragraph 6 of the Fifth Schedule of the Indian Constitution. These areas comprise of those tribal inhabited areas which are located in other parts of the country than North-East India, including areas in Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Himachal Pradesh, Madhya Pradesh, Jharkhand, Maharashtra, Orissa and Rajasthan.

Sensitivity	Details
Common Property Resources (CPR)	The land presently identified for the project components is comprised primarily of agricultural land and does not impact any common property resources.
Cultural Heritage	No Cultural Heritage sites were identified in the project area.
Landlessness	According to the information made available by the project team and the consultations with the local community, it is understood that the land procurement for the project has not resulted in landlessness of any land owners

Source: ERM site visit, July, 2020

2.5.2 Manpower requirement

The proposed 600 MW hybrid project is in its planning and land identification stage. The EPC contractor, manpower requirement for construction and operation phase, labour camp, organizational structure for EHS&S management during the construction phase, etc., have not been finalized, however the same were discussed tentatively during consultation with site team. Details have been given below.

2.5.2.1 Construction phase

As informed during consultation with site team of AGE(7)L & AGE(9)L, the total number of work force required during construction phase for civil, mechanical and electrical work during normal and peak period is estimated to be approximately 2330 for 600 MW hybrid solar-wind site. The details of activities carried out by workforce engaged during construction phase shall be:

Activities in civil work:

- Earth Work
- Concrete work
- Foundation Work
- Masonry Work (with Bricks, Concrete Blocks, Rubble Masonry)
- Plaster Work
- Painting Work
- Grouting of Structural Columns & Equipment
- Flooring Work
- Concrete Paving & Vacuum Dewater Flooring
- Road Work
- Boundary & levelling

Activities in Mechanical work:

- Structural steel fabrication

Activities in Electrical work:

- For Switch yard
- For erecting and installing Transformers
- To install Power & control Cables
- To install PV Modules / Wind Turbine Generator machines
- For Electrical and Control Systems
- HT & LT Switchgears
- DC Cable

■ Inverters

Most of the work force/ labourer requirement for the Project especially the un-skilled and semi-skilled labourers shall be met from the local villages and semi-skilled and skilled labourers shall be the migrant labours from other state or different locations. The appointed sub-contractors shall provide the accommodation facility during construction phase. No land parcels or locations were identified for labour camps at the time of site visit by ERM team.

2.5.2.2 Operation phase

The project is in its planning and land identification stage, the details pertaining to the total in-direct manforce (i.e. in-direct staff, like security guards, house-keeping staff etc.) required during operational phase of the project has not been finalized, hence were not shared with ERM team. However, basis of consultation with site team of Adani and review of proposed organization structure, few key roles and responsibilities of staff to be engaged during operational phase have been mentioned below

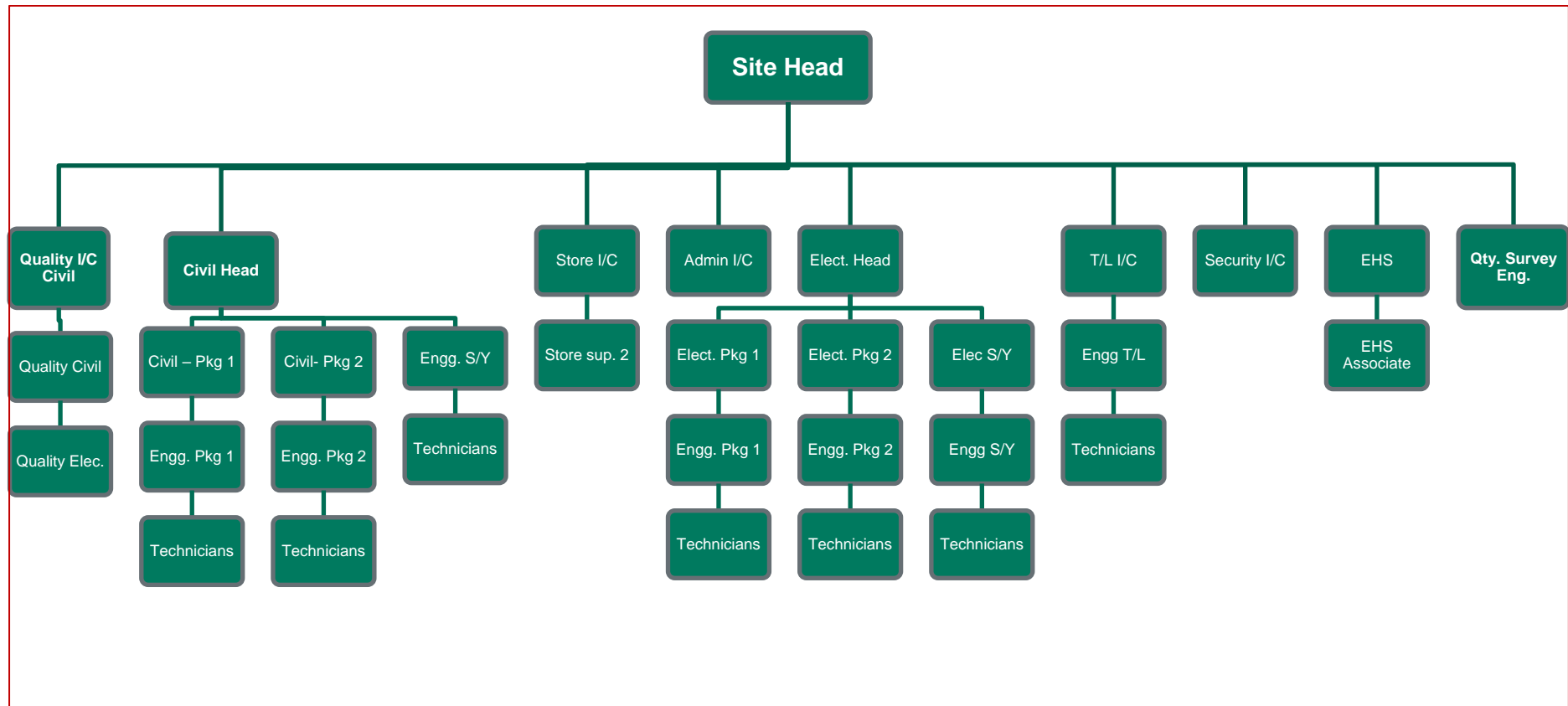
The Project shall be supervised by the Project Director of AVP. The key Head Office personnel and their reporting requirements have been described below:

- Site Head will be responsible for supervising all Project related aspects. Project Development Coordinator, Civil head, Electrical head, EHS head, QTY Survey engineer, In-Charge for 33 KVA internal transmission line, Land Head, Contract Management and site HR head. The Site Head will be responsible for overall Operation and Maintenance of the plant, and will supervise Engineer and Technicians O&M. Plant head will also be responsible for overseeing partnership between Adani and appointed contractors. Plant head will be responsible for coordinating every aspect of the Project, from reviewing and approving contract terms to coordinating deadlines, approving budgets and more;
- The EHS Environment, Health & Safety (EHS) Head will be responsible for ensuring of EHS related aspects, such as compliance related aspects and occupational health & safety related aspects, are being strictly adhered to by the Project team. There will be two off role EHS officers who will be responsible for overlooking the Environment, Health and Safety aspects associated with the Project. The EHS officers will be reporting to the EHS Manager deployed at the Site.
- Under land division there will be a separate team for land related documentation and for internal roads, KVA lines, RoW. The entire team will report to site Land team's DGM, who will further report to Site In-Charge. As per information, the entire lease- deed agreement will be carried out on the name of Adani land team's Assistant Manager. During site visit, two personnels including Assistant Manager from land team were consulted.

2.5.2.3 Project organization structure

The proposed Project Organisational structure has been presented in **Figure 2.3**.

Figure 2.3: Project Organisation Structure



Source: AGE(7)L & AGE(9)L

2.5.3 Water resource requirement

Based on discussion with AGE(7)L & AGE(9)L team, it is understood that source of water for the Project will be through tankers supplied by private contractors from Indra Gandhi Canal. The water will not be sourced from nearby surface water bodies, such as local ponds and other surface water bodies, during ERM site visit, it is understood that water channels and water ponds in the area are mostly dry and only gets filled for 5-6 months during monsoon season. Two Epimeral rivers (Ghugri Nadi and Sukri Nadi) traverse through the project area, multiple small dendritic and sub dendritic channels are present around the project area.

The primary source of water for the Project is Indira Gandhi Nahar Pariyojna (IGNP) canal⁶. As per the Rajasthan Wind and Hybrid Energy Policy, 2019, water resource department of Rajasthan is authorized to allocate required quantity of water from IGNP canal's nearest available source for cleaning of solar panels and auxiliary consumption for Solar PV power plants subject to availability of water⁷. The project is required to intimate estimated water requirement to Rajasthan Renewable Energy Corporation Limited (hereinafter referred to as 'RREC') along with the source of water. After assessing the estimate, case of water requirement will be forwarded to the Water Resource Department. The modifications required, if any, in the existing canal system will be undertaken by the Water Resource Department at the cost of the Project. Currently, water is being supplied to other power producers from the canal in Suratgarh, Barsingar, Guda, Ramgarh etc.

Based on discussion with AGE(7)L & AGE(9)L team, it is understood that source of water for the Project will be through IGNP Canal.

AGE(7)L & AGE(9)L has not registered the 2*300MW solar * 2*75MW wind Hybrid Project under Rajasthan Wind and Hybrid Energy Policy 2019. Furthermore, AGE(7)L & AGE(9)L is yet to submit request application with RRECL to allocate water from IGNP canal.

2.5.3.1 Construction phase

Water required during construction phase will be for civil work and domestic purpose. As per the project details shared by client, approximately 145 KLD water will be required during peak time of construction phase for civil work. Furthermore, approximately 315 KLD water will be required for domestic purpose.

The water requirement for construction activities will be met through IGNP canal.

2.5.3.2 Operation Phase

The water required during operation phase of the project will be mainly for washing the solar modules, domestic and drinking purposes. There will be no water requirement for the wind turbines.

The Project propose to implement both dry cleaning and wet module cleaning at site. Reportedly, there will be 24 module cleaning cycle per year comprising of 16 cycles of dry cleaning and 8 cycles of wet cleaning (2 dry cleaning followed by 1 wet cleaning). Water for operation phase will be sourced from IGNP Canal.

Wet Cleaning System

Approximately, 0.7 litre/module/wash cycle will be required in wet cleaning. Since, total no. of modules to be installed at the solar plant are 1,900,462 therefore approximately 1,330 KL water will be required per cycle. Considering, 8 cycles per year for wet cleaning, approximately 10,642 KL water will be

⁶ According to Indira Gandhi Nahar Department, Government of Rajasthan, reservation of water in IGNP canal for drinking, energy projects, army, industries and other uses is 1200 cusec.

⁷ Section 34.2 of the Rajasthan Wind and Hybrid Energy Policy, 2019. Link: <https://jalore.rajasthan.gov.in/content/dam/doitassets/jalore/pdf/Rajasthan%20Wind%20and%20Hybrid%20Energy%20Policy2019.pdf>

required per year. Since the plant will be operational for 30 years, total water consumed in the operation phase duration will be 3,19,277 KL of water.

Dry Cleaning System

Adani, at the corporate level intends to adopt dry cleaning technique for module cleaning and aspires to achieve zero water consumption. AGE(7)L & AGE(9)L has proposed to implement 16 cycles of dry module cleaning at 600 MW site with wet module cleaning. There are majorly four types of dry cleaning methods including vehicle-mounted, semi-automated, portable and fully-automated. However, for Hybrid projects of AGEL and its subsidiaries at Rajasthan, tractor-mounted technology has been proposed to be implemented. Reportedly, tractor mounted dry cleaning technology has been already piloted at one of AGEL's operational sites at Rawra, in Jodhpur district in the state of Rajasthan.

Tractor Mounted Dry Cleaning System

Tractor - mounted cleaning systems includes a brush attached to a tractor that drives between the PV module rows. The brush is installed on a crane jib, which places it over the PV module. Each machine is designed with its own system for regulating the pressure of the brushes on PV modules so as to prevent any damage to any PV module. This type of cleaning system does not possess any problem with regards to distance and tilt angle deviations between module - mounting structures.

However, for the vehicles to approach the PV modules, a minimum distance is required between the rows. This depends on the device and ranges from 2.5 to 3.0 meters. Additionally, a manoeuvring area at the end of the rows is required for vehicle to turn around with ease. The weight of the cleaning device on top of the PV module is within the tolerances allowed by the module manufacturer.

Specifications of Tractor Mounted Dry Cleaning System:

Particulars	Specifications
Operate with	Tractor hydraulics
Air Compressor	Double head
Working width	4.0 mtr (adjustable)
Tractor Power	45 HP tractor with Power Steering
Wheel	Front: 7.50 x 16; Rear: 14 x 9.28

2.5.4.1 Construction Phase

Major raw materials required for the construction phase are fencing material, construction materials like cement, sand, aggregate that will be sourced by EPC contractors from local areas. Since the project is in planning phase, The amount of raw material and equipment required for construction activities are not finalised yet.

2.5.4.2 Operation phase

Raw materials during the operational phase will be in the form of supplies for the site staff and maintenance needs for the solar modules, WTGs and ancillary facilities. The supplies for the site staff will include food, water and basic needs, which can be procured from neighbouring towns, such as Pokhran or Jaisalmer. The maintenance needs for the WTGs, including fuel, oil and spare parts will be procured from dedicated suppliers through O&M contract.

2.5.5 Power Requirement

2.5.5.1 Construction phase

Power requirement during the construction phase will be met through Diesel Generators (DG). Reportedly, one DG set of 5kVA will be installed at site during construction phase.

2.5.5.2 Operation Phase

As per the DPR, auxiliary power supply requirement may be catered from the power evacuation supply source, consequently the auxiliary energy consumption shall be deducted from the energy generated from the plant. Reportedly, source of power for SCADA system and all related hardware shall be from auxiliary power supply. Additionally, Uninterrupted Power Supply (UPS) having four hours back up and one DG set of 5 kVA will be installed at the site office for power back up.

2.5.6 Fire safety and security

2.5.6.1 Construction Phase

Appropriate firefighting system and equipment is expected to be provided throughout the construction period. The fire extinguishers are expected to be placed at all strategic locations such as site office, storage yard, near construction area, welding area, etc. Besides this, emergency contact numbers shall also be displayed onsite.

2.5.6.2 Operation Phase

Suitable fire protection and fighting systems viz. portable fire extinguishers, fire buckets and automatic fire detection system are expected to be made available at the entire PV array and WTG area, inverter stations, main control room and switchyard. The aforesaid systems and equipment's will conform to National Fire Protection Authority (NFPA) fire safety standards and local fire authority requirements. Firefighting arrangements for electrical utilities like transformers etc. is expected to be in accordance to tariff advisory committee, Central Board of Irrigation and Power (CBIP), Indian Standard (IS) 10028 i.e. Code of practice for selection, installation and maintenance of transformers, National Fire Protection Association (NFPA) 70 and 15 requirements.

2.6 Pollution streams and control measures

Pollution streams during construction phase will include air emissions, wastewater generation and solid waste generation.

2.6.1 Waste Generation

2.6.1.1 Construction phase

The solid waste generated by the Project will consist of domestic solid waste from temporary site office and labour camps (if provided); construction debris, hazardous waste such as waste oil, lubricants, oil contaminated rags; electronic waste like broken PV module etc.;

- As a means of best practice, hazardous wastes will be stored onsite at separate designated covered area provided with impervious flooring and secondary containment. The storage containers/ bins/ drum will be clearly marked and identified for their hazards. Before completion of 90 days, hazardous waste materials will be sent to RSPCB/CPCB authorised vendor for eventual disposal at the Common Hazardous Waste Treatment, Storage and Disposal Facility (CHWTSDF). AGE(7)L & AGE(9)L have not yet identified an authorised hazardous waste vendor for disposal of e-waste and hazardous material across hybrid solar-wind power plants.
- Construction debris generated on Site will be used for backfilling and levelling and other debris shall be used for road construction;

- Domestic solid waste will be disposed at disposal ground of local municipality;

2.6.1.2 Operation phase

During the operational phase, the waste generated from the Project would ideally include domestic solid waste at the site office and pooling substation and hazardous waste like waste oil, lubricants and oil contaminated rags will be generated during maintenance activities;

- The hazardous wastes will be stored onsite at separate designated covered areas provided with impervious flooring. The storage containers/bin/drums will be clearly marked and identified for their hazards;
- As reported, the hazardous wastes will be disposed of in accordance with Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016. as amended, through an identified authorized hazardous waste recycler, which will be identified in the later stage of the project;
- Domestic waste collected, segregated onsite and handed over to local Municipal Corporation for disposal.
- Battery waste generated from UPS, PSS and site office will be given back to the manufacturer from whom new batteries will be purchased under the buy-back arrangement.

2.6.2 Air emissions

2.6.2.1 Construction phase

There will be impact on air quality due to onsite construction activities. The likely emissions from construction activities would include the following:

- Fugitive emissions from site clearing, material handling, transportation, piling, use of construction machinery, etc.;
- Fugitive dust emissions from unpaved roads;
- Vehicular emissions from increased traffic volume from vehicles used for transport of construction material; transportation of PV modules, WTGs and accessories; and
- Exhaust emissions from operation of diesel generators.

To control air emission during construction phase from operation of DG sets, adequate stack height as per CPCB norms should be provided to ascertain regulatory compliance. Fugitive dust emission arising from various activities such as piling, transportation of material (loading and unloading), vehicular movement (on unpaved roads) is expected to be minimized through sprinkling of water and maintaining vehicular speed to 10-15 km/hr. Vehicular emission is expected to be controlled through proper maintenance of vehicles and vehicles with proper PUC is expected to be operated at project Site.

Based on discussion with site team, it is understood during construction phase the Project is not expected to install batching plant at site and construction material such as concrete mixture and other raw material will be directly transferred at site by the contractor. Hence there will be no air and noise emission due to presence of batching plants.

2.6.2.2 Operation phase

Based on assumptions, under normal operating conditions, there would be no gaseous emissions from the operating areas. However, there is a likelihood of gaseous and fugitive dust emissions, albeit in smaller concentrations, owing to the operation of maintenance vehicles and emission from operation of DG sets. As a means of best practice and adherence to country regulations, well maintained vehicles with proper PUC should only be used for operation and maintenance purposes.

2.6.3 Waste water generation

2.6.3.1 Construction phase

The liquid wastewater generated during the construction phase will include domestic sewage from Project site office, labour camps and any other accommodation or office facility established for the Project.

As part of the site preparation stage, a drainage and sewerage system will be constructed for the site office. The sewerage system will consist of soak pits for the collection of wastewater from the camp kitchen and washing areas and office facility. Sewage from the toilets will go into lined septic tanks. Sewage disposal trucks from Municipality will be used to periodically remove the sludge/sewage from the site.

2.6.3.2 Operation phase

The operation phase will have negligible wastewater generation. Septic tank and soak pits will be provided at SCADA building and CMS monitoring station for disposal of sewage.

Additionally, Waste water generated from cleaning of solar modules will be percolated into the ground.

2.6.4 Noise pollution

2.6.4.1 Construction phase

During construction phase, noise will be generated primarily during the day time. Noise will be generated from moving vehicles as well as construction equipment and machineries, including the D.G sets utilized for power. In case residential receptors are present in the vicinity of the construction site, i.e. within 500 m, these receptors are likely to be impacted by noise during construction (refer to **Appendix A** for the receptors). Other receptors of noise pollution are the construction workers

As a control measure, it is expected that noise emission from the vehicles and equipment does not exceed 91 dB(A) (for Passenger or commercial vehicles with gross vehicle weight above 12000 kg as specified in Central Motor Vehicles Rules, 1989). D.G. sets are also expected to be provided with acoustic enclosures and workers near noise generating machines will be provided with earplugs as a safeguard against high noise hazards.

2.6.4.2 Operation phase

Under normal operations, none of the activities of solar power plant will generate noise. Any activities generating from maintenance work will be restricted to daytime only. However, when in operation, wind turbines produce noise from mechanical and aerodynamic sources:

- Aerodynamic noise emanates from the movement of air around the turbine blades and tower. The types of aerodynamic noise may include low frequency, impulsive low frequency, tonal, and continuous broadband. In addition, the amount of noise may rise with an increasing rotation speed of the turbine blades. Therefore turbine designs which allow lower rotational speeds in higher winds is expected to be followed to limit the amount of noise generated;
- Mechanical noise may be generated by machinery in the nacelle of the wind turbines

2.7 Analysis of alternatives and project justification

As per IFC Performance 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. The following scenarios have been taken into consideration:

- Project vs No Project scenario;

- Alternate Source for Power Generation;
- Alternate Location for Project Site;

2.7.1 Project vs No Project scenario

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 load generation balance report 2019-20 of the Central Electricity Authority, the current power supply scenario is deficient in the state of Rajasthan and the entire northern region. The below table showcases the actual power scenario in Rajasthan and the northern region for the year 2018-19.

Table 2.8: Actual Power Supply Scenario (in terms of energy requirement) in 2018-19 for Rajasthan and Northern Region

State/Region	Requirement (MU)	Availability (MU)	Deficit (MU)	Deficit (%)
Rajasthan	79,815	79,626	-189	-0.2
Northern Region	3,82,493	3,77,595	-4,898	-1.3

Source: Load generation balance report 2019-20 of the Central Electricity Authority
(<http://www.cea.nic.in/reports/annual/lqbr/lqbr-2019.pdf>)

In order to meet the gap in demand and supply, renewable/non-conventional sources of power will be required to supplement the conventional sources. The project being renewable source of power generation will contribute towards bridging the gap between demand and supply. The project presents an opportunity to utilize the potential for solar power generation. A “No Project Scenario” will not address the issue of power shortage. An alternative without the project is undesirable, as it would worsen the power supply-demand scenario, which would be a constraint on economic growth.

2.7.2 Alternate source of power generation

India is a large and fast growing economy, and according to Planning Commission of India, the country's primary energy use is expected to increase by four to five times by 2031-32. Even though India's energy basket has a mix of all resources such as coal, lignite, oil, natural gas, LNG, nuclear, hydro, and wind power, the dominance of coal is conspicuous with a prominent share of approximately 50%.

The efficiency of fuels is compared on the basis of their energy content and oil is considered as the standard for this comparison. One tonne of oil can generate 42 billion Joules or 10 Billion calories of energy whereas one tonne of Indian thermal coal can generate only 4.1 Billion calories. Thus 1 Mt of Indian coal is 0.41 Mtoe (Million tonnes of oil equivalent). Taking the thermal efficiency of the power plant and other losses in the system into consideration, in the case of coal-fired boilers, the equivalence between electricity and fossil fuels is 1 Billion kWh = 0.28 Mtoe. Electrical energy in kWh can be converted to kJ or kcal and can be expressed as Mtoe. One billion KWh of energy generated from wind power is equivalent to 0.086 Mtoe, since the intermediate stages of energy production don't generate any heat.

Table 2.9: Lifecycle Emissions from Power Sources

LCA Emissions (g CO ₂ equivalent/kWh)	Wind	Solar	Nuclear	Coal
Implementation	13.7	37.5	1.2	3.6
Operation	4.7	12.0	12.4	918.8

LCA Emissions (g CO ₂ equivalent/kWh)	Wind	Solar	Nuclear	Coal
Decommissioning	0.6	0.5	0.4	52.2
Total	19	50	14	975.3

Source: Report on developmental impacts and sustainable governance aspects of renewable energy projects, Ministry of New and Renewable Energy

As evident from the table above, the emission of CO₂ per kWh of energy generated from a Coal based power plant is more than that of the emission from a solar based power plant. The only emissions from the Renewable energy technologies are the emissions from fossil sources used in the production and manufacturing of equipment, waste disposal during construction, recycling etc. These life-cycle emissions are significantly lower as indicated in the table above.

Furthermore, the below table elaborates upon the advantages and disadvantages of various power generation systems.

Table 2.10: Advantages and Disadvantages of Various Power Generation Systems

Mode	Disadvantage	Advantage
Thermal Power Plant	<ul style="list-style-type: none"> High fossil fuel consumption. Large quantities of water requirement for cooling High volume of emissions from operation Accumulation of fly ash (in case of coal powered installations) Upstream impact from mining and oil exploration GHG emission estimated as 228gCeq/kWh 	<ul style="list-style-type: none"> Large scale production potential Moderate gestation period Relatively inexpensive Wider distribution potential
Hydropower Plant	<ul style="list-style-type: none"> Site specific, dependent on reservoir/river etc. Downstream impact on flow Long gestation period Acute and chronic social and ecological impacts 	<ul style="list-style-type: none"> GHG emission estimated as low as 1.1gCeq/kWh for run of river projects
Nuclear Power	<ul style="list-style-type: none"> Availability of fuel source Hazards associated with radioactive material High cost of project Long gestation period Risk of fallout and meltdown scenarios and its impacts on the local populace and environment. 	<ul style="list-style-type: none"> Cheaper power generation GHG emissions as low as 2.5gCeq/kWh
Wind Power	<ul style="list-style-type: none"> Land requirement of about 2.0 to 2.5 acres (1 ha approx.) per MW Site specific (associated to wind pattern) Expensive installation 	<ul style="list-style-type: none"> Pollution levels are insignificant Inexpensive power generation Inexhaustible source GHG emissions as low as 2.5gCeq/kWh for the Production Chain
Solar Power	<ul style="list-style-type: none"> Large land requirement 	<ul style="list-style-type: none"> Pollution levels are insignificant

Mode	Disadvantage	Advantage
	<ul style="list-style-type: none"> ■ <u>Site specific to solar insolation</u> ■ <u>Expensive installation</u> ■ <u>Concrete foundation on larger area</u> 	<ul style="list-style-type: none"> ■ <u>Inexpensive power generation</u> ■ <u>Inexhaustible source</u> ■ <u>GHG emissions as low as 8.2gCeq/kWh for the Production Chain</u>

Source: International Atomic Energy Agency (IAEA)

2.7.3 Water Consumption

The water requirements for producing the different primary energy carriers vary; also, there are significant differences between the different types of electricity generation. Several evaluation methods are being employed to assess the footprint of electricity generation through various ways. The methods are often referred to those by the developed regions to compare energy and water uses; where certain measurements and statistics are a common and accepted practice.

Solar and wind power projects have been known to use almost insignificant water, in comparison to nuclear and coal based power projects.

According to the American Wind Energy Association (AWEA), wind uses less than 1/600 and solar utilise 1/20 as much water per unit of electricity produced as does nuclear, and approximately 1/500 and 3/50 respectively as much as coal. As per AWEA, water consumption (technology gallons/MWh) is as follows: Nuclear – 620; Coal – 490; Oil – 430; Wind – 1; Solar – 30.

2.7.4 Alternative Location for the Project Site

Solar and Wind projects are less polluting energy generation projects which are site specific and dependent on the availability of solar irradiance and wind resource. The following sub sections provide feasibility of alternate locations for the Project site.

2.7.4.1 Solar Project Site

Solar irradiance mapping done by Solar Energy Corporation of India (SECI) through National Renewable Energy Laboratory (NREL), based on which potential areas are notified by SECI.

The current site selected is a high solar power potential site with irradiation of 5.5-6.0 kWh/m²/day and availability of 300 sunny days. The final selection of the project site depends upon availability of a contiguous patch of land that is willingly sold by land owners. Hence, the option of choosing an alternative area for solar is not available to a project developer.

The proposed project site has the following location advantages:

- Site with high solar irradiation;
- No ecological sensitive receptor such as national Parks, Wildlife Sanctuary, within 10 km radius;
- No reserve or protected forest within 5 km radius;
- No cultural property of archaeological importance within 5 km radius; and
- There exists no obstacles around the site in the form of trees, buildings etc. that could lead to near shading.

2.7.4.2 Wind Project Site

Similarly, wind resource mapping and power potential assessment is done by C-WET, based on which potential areas are notified by C-WET. The option of choosing an alternative area can be considered, should there be any such requirement. Within the potential area, there is a possibility as well as flexibility of moving the individual WTG locations (micro siting) to avoid any potential environmental and social issue or risks like:

- Impact on environmental sensitive receptors like prime agricultural land, vegetation and tree cover, surface water bodies and forests etc.;
- Impacts on nearby residents due to the noise and shadow flickering generated due to the operation of WTGs; and
- Impacts on social sensitive receptors like schools, hospitals, human habitation, individual dwellings, government lands, common property resources etc

2.7.5 Conclusion

Further to the above mentioned reasons, it would be significant to conclude that:

- The Project is environment friendly with minimal greenhouse gas emissions;
- It is the most feasible choice of power generation in the state; and
- It will contribute towards the state of Rajasthan attaining self-sufficiency in power supply

3. APPLICABLE LEGAL AND REGULATORY FRAMEWORK

3.1 Introduction

The following reference framework is applicable to the Project:

- Applicable environmental and social regulations and policies in India and the State of Rajasthan;
- Institutional Framework for the implementation of the regulations; and
- Position Statements of the Standard Chartered Bank
- International Standards including:
 - IFC Performance Standards on Environmental and Social Sustainability (2012);
 - IFC/World Bank General EHS Guidelines (2007); and
 - IFC/World Bank EHS Guidelines for Electric Power Transmission and Distribution (2007);
 - The Equator Principles 2020;
 - IFC's Good Practice Handbook on Cumulative Impact Assessment and Management Guidance for the Private Sector in Emerging Markets

3.2 Permitting Status of the Project

3.2.1 Environmental Clearance under EIA Notification, 2006

As per the EIA Notification (2006) and its amendments, the Solar Power project does not require any environmental clearance from the Ministry of Environment Forest and Climate Change (MoEFCC) or the State Environmental Impact Assessment Authority (SEIAA).

Based on ERM's review, the table below provides a list of applicable EHS&S regulations along with its applicability to the project, status of the compliance, remarks and recommendations.

3.2.2 Consent to Establish and Consent to Operate under The Air (Prevention and Control of Pollution) Act, 1981 and The Water (Prevention and Control of Pollution) Act, 1974

As per latest notification from the Central Pollution Control Board (CPCB), dated 07/03/2016 [Ref No: B-29012/ ESS (CPA)/2015-2016], and dated 18/01/2017 [Ref No: B-29012/ESS(CPA)/2016-17] "Solar power generation through solar photovoltaic cell, wind power and mini hydel power (less than 25 MW)" has been classified to "white category" from "green category" and therefore "there shall be no necessity in obtaining 'Consent to Establish and Operate' for white category of industries except for an intimation to the concerned SPCB and PCC office.

3.2.3 Hazardous Waste Authorization under Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 and its Amendments

According to Hazardous and Other Wastes (Management and Transboundary Movement) Amendment Rules, 2019, an occupier shall not be required to obtain an Hazardous Waste Authorization from SPCB in case Consent to Establish (CTE) or Consent to Operate (CTO) is not required under The Air (Prevention and Control of Pollution) Act, 1981 and The Water (Prevention and Control of Pollution) Act, 1974. Provided that the hazardous and other wastes generated by the occupier shall be given to the actual user, waste collector or operator of the disposal facility in accordance with CPCB guidelines. Since the Project does not require CTE and CTO, hence Project is exempted from obtaining hazardous waste authorization.

3.3 Policies and Regulations Specific to the Government of Rajasthan

3.3.1 Rajasthan Wind and Hybrid Energy Policy 2019

In order to promote Solar Power Projects, and meeting the energy requirements of Rajasthan and India, the Government of Rajasthan have Rajasthan Wind and Hybrid Energy Policy, 2019. The objective of this Policy is to establish Rajasthan as a National leader in wind energy including wind-solar hybrid in phased manner by creating the policy frame work for promoting use of Renewable Energy in various applications and move towards achieving following objectives:

- Contributing to long term energy security of Rajasthan as well as ecological security by reduction in carbon emissions;
- Providing a long term sustainable solution for meeting energy needs and to considerably reduce dependency on depleting fossil fuel resources like coal, oil and gas;
- Productive use of abundant waste land, thereby utilizing the un-utilized/under utilized barren land for creation of renewable energy hub.
- Creating favourable conditions for Wind Energy manufacturing capabilities by providing fiscal/Non fiscal incentives.
- Generating large direct and indirect employment opportunities in Wind and ancillary industries and allied economic activities etc.
- Creation of skilled and semi-skilled man power resources through promotion of technical and other related training facilities.
- Creating an R&D hub for deployment of various combinations of RE power technologies like Wind-Solar hybrid and Storage technologies which will focus on improving efficiency in existing applications and reducing cost of balance of system

3.4 National administrative requirement

A brief description of the relevant enforcement agencies with respect to the institutional framework is described in **Table 3.1**.

Table 3.1: Enforcement Agencies relevant to the Project

Agency	Functions
Central Level	
Ministry of Environment Forests and Climate Change (MoEFCC)	<p>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:</p> <ul style="list-style-type: none"> ■ Environmental policy planning; ■ Effective implementation of legislation; ■ Issuing guidelines under EP Act for environment protection; ■ Monitoring and control of pollution through Central Pollution Control Board and State Pollution Control Boards; ■ Environmental clearance for industrial and development projects covered under EIA Notification; ■ Monitoring of compliance conditions stipulated in Environmental clearance through its regional offices; ■ Promotion of environmental education, training and awareness; ■ Forest conservation, development, and wildlife protection; and

Agency	Functions
	<ul style="list-style-type: none"> ■ Protection of Coastal areas. <p>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.</p>
Central Pollution Control Board	<p>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:</p> <ul style="list-style-type: none"> ■ 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.
Ministry of New and Renewable Energy (MNRE)	<ul style="list-style-type: none"> ■ 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.
Central Electricity Authority (CEA)	<p>The Central Electricity Authority (CEA) is a statutory organization constituted under Section 3 of the repealed Electricity (Supply) Act, 1948, here in after replaced by the Electricity Act, 2003. Some of the functions performed by CEA include the following:</p> <ul style="list-style-type: none"> ■ Advise the Central Government on the matters relating to the national electricity policy, formulate short-term and perspective plans for development of the electricity system and coordinate activities of the planning agencies for the optimal utilization of resources to sub-serve the interests of the national economy and to provide reliable and affordable electricity to all consumers; ■ Specify the technical standards for construction of electrical plants, electric lines and connectivity to the grid; ■ Specify the safety requirements for construction, operation and maintenance of electrical plants and electric lines; ■ Promote and assist in the timely completion of schemes and projects for improving and augmenting the electricity system; ■ Collect and record the data concerning the generation, transmission, trading, distribution and utilization of electricity and carry out studies relating to cost, efficiency, competitiveness and such like matters; ■ Make public from time to time the information secured under this Act, and provide for the publication of reports and investigations; ■ Advise any State Government, licensees or the generating companies on such matters which shall enable them to operate and maintain the electricity system

Agency	Functions
	under their ownership or control in an improved manner and where necessary, in coordination with any other Government, licensee or the generating company owning or having the control of another electricity system; etc.
Central Ground Water Authority	<ul style="list-style-type: none"> ■ 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.
State Level	
Rajasthan Renewable Energy Corporation Limited (RRECL)	<p>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 main objectives of the RRECL are</p> <ul style="list-style-type: none"> ■ To generate electricity through renewable sources like wind and solar on decentralized manner; ■ To conserve energy in rural areas; ■ To import and adopt viable technology and machinery in the areas of Non-conventional energy sources and ensures post installation service; and ■ To impart training and to promote research and development in the field of Non-conventional energy sources. ■ To grant approval to power producers for access to water from IGNP canal
Department of Environment, Rajasthan	<ul style="list-style-type: none"> ■ The Environment Department is the apex body in the States 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. ■ Activities like pollution Control & Monitoring of Water, Air, Noise and other related areas, Conservation of Natural resources, Environment Monitoring, Environment Education etc. are co-ordinated by this department.
Rajasthan State Pollution Control Board (RSPCB)	<ul style="list-style-type: none"> ■ RSPCB is responsible for implementing various environmental legislations in the state, mainly including Water (Prevention and Control of Pollution) Act, 1974, Air (Prevention and Control of Pollution) Act, 1981, and some of the provisions under Environmental (Protection) Act, 1986 and the rules framed there under like, Biomedical Waste (M&H) Rules, 1998; Hazardous Waste (M&H) Rules, 2008; Municipal Solid Waste Rules, 2000 etc. SPCBs functions under the administrative control of Environment Department of the State.
Labour Department, Government of Rajasthan	<ul style="list-style-type: none"> ■ The Department of Labour is responsible for formulation, implementation, and enforcement of the labour laws in the Rajasthan state. It also undertakes prevention and settlement of industrial disputes, Industrial safety, Health and

Agency	Functions
	promotes welfare of workers in the undertakings falling within the sphere of the State.
Gram Panchayats	<ul style="list-style-type: none"> ■ The local Panchayats are empowered with management of local resources like forests, groundwater, common land and infrastructure like roads, buildings etc. ■ NoC have to be obtain from the Gram Panchayat before the development of the Project. Reportedly, the gram panchayat NOCs from all the villages are under process.
Directorate Industrial Safety and Health Department (DISH)	<p>The Directorate Industrial Safety and Health Department enforces the provisions of Factories Act 1948 and State Factories Rules and the rules made there under to ensure the safety health and welfare of the workers. It also plays a significant role in regularizing working hours, and working conditions and reducing the accident and dangerous occurrences in the factories, redressal of the grievances of the workers in respect of Safety Health and Welfare through a set of policies and programs developed by both the Central and State Government. Some of the functions of DISH are</p> <ul style="list-style-type: none"> ■ Eliminating inequality and discrimination in the work place; ■ Enhancing occupational health and safety awareness and compliance in the workplace; ■ Workforce and community participation, to employers, employees, workplaces, communities, businesses and unions; and ■ Providing policy advice and analysis to government on labour and employment related matters.
Rajasthan State Forest Department	<ul style="list-style-type: none"> ■ To protect, develop and manage the forest and wildlife resources of the state. ■ To implement policies and programmes of the State Government with regard to protection, development and management of forest and wildlife resources of the state. ■ To enforce acts, laws, rules and regulations pertaining to the protection and management of forests and wildlife. ■ To take steps for the implementation of the National Forest Policy & State Forest Policy. ■ To recruit, train and deploy forestry personnel in protection, development and management of forests and wildlife. ■ To check the process of desertification through massive Afforestation Programmes in desert and IGNP areas of the State. ■ To undertake plantations on large scale on available revenue wastelands. ■ To promote Farm Forestry by distributing seedlings to the farmers for planting on their farmlands. ■ To take necessary steps to carry out the notification of the forest areas and declaration of wildlife sanctuaries and National Parks. ■ To take extra measures for the conservation and protection of the endangered flora and fauna of the state. ■ To carry out the harvesting of the silviculturally mature crops as per the prescription of the working plan/management plan. ■ To carry out the commercial exploitation of Tendu Leaves & other NTFPs.

Agency	Functions
	To regulate the sawmills of the state as provided in the Sawmill Rules.To create awareness among the people so as to achieve their fullest involvement in the protection, development and management of forests and wildlife resources of the state.

3.5 Applicable regulatory/Policy framework

The key regulations that are relevant to the Project across its lifecycle are summarized in **Table 3.2**. This table should be used to update/develop a comprehensive legal register for the project which can be regularly monitored for compliance as well as updated to reflect changes/non-applicability of regulations, policies and standards.

Table 3.2: Applicability of key legislations and other standards of the reference framework for the project

Topic and Reference	Pre-construction	Construction	Operations	Decommissioning	Agency Responsible	Remarks
Indian laws, regulations and policies						
The Electricity Act 2003	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	■ Central Electricity Authority	■ Generating company deemed to obtain a license under this Act and also to comply with all safety requirement as per rule 29 to 46 under chapter 6.
Rajasthan Wind and Hybrid Energy Policy, 2019	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	■ Government of Rajasthan	■ Refer to Section 3.3.1
Rajasthan Renewable Energy Corporation Limited	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	■ Government of Rajasthan	AGE(7)L & AGE(9)L has not submitted application with RREC to allocate water from IGNP canal
Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013; National Rehabilitation and Resettlement Policy, 2007; and The Rajasthan Land Acquisition Act, 2014	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	■ Government of Rajasthan	The Acts and the Policy will not be applicable to the Project, as the land for the Project is procured on Lease basis. The Acts and Policy will only be applicable if the land procurement for the Project, will lead to the land acquisition and/or negotiation settlement where the government involvement is there in the process of land procurement.
Environment Protection						
Environment Protection Act, 1986 and as amended till date	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	■ RSPCB ■ MoEFCC ■ CPCB	■ Permissible limits for ambient air quality, water quality, noise limits has been laid down by CPCB under EP Act, 1986 which requires to be complied with. ■ Based on the notification released by the Central Pollution Control Board (CPCB Ref No: B-29012/ ESS (CPA)/2015-20168), “Solar projects, wind power projects and mini hydro projects (less than 25 MW)” have been moved from “green category” to “white category” and there shall be no necessity of obtaining Consent to Operate, an intimation to SPCB/PCC shall suffice. ■ Based on discussion with Site representative, it is understood that during construction phase, the project is not expected to install batching plant at Site and construction material such as concrete mixture will be directly transferred at Site by the contractor. In addition to this, it is envisaged that DG sets of 5 KVA will be installed at Site for lighting purpose and power back up. Hence CTE and CTO under Air Act, 1981 and Water Act 1974 are not applicable for the Site. AGE9L & AGE7L have shared Project Execution Intimation letter for development of 300 MW Wind-Solar hybrid project each with Rajasthan State Pollution Control Board (RSPCB) vide reference no. AGE9L/RPCB/300 MW ADANI/001 & AGE7L/RPCB/300 MW ADANI/001 dated 06.07.2020 and received acknowledgement on the same from RSPCB on 13.07.2020
The Air (Prevention And Control Of Pollution) Act, 1981						
The Water (Prevention And Control Of Pollution) Act 1974						
The Noise (Regulation & Control) Rules, 2000 and as amended up to 2010	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	■ RSPCB	■ 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 context of the Project, AGE(7)L & AGE(9)L and their contractors will need to abide by the limits prescribed for residential zones.
Ambient Noise Standards	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	■ RSPCB ■ MoEFCC	■ As the project is in rural/residential set up, noise standards for residential area will be applicable for the project.

⁸ http://cpcb.nic.in/uploads/Latest_Final_Directions.pdf

Topic and Reference	Pre-construction	Construction	Operations	Decommissioning	Agency Responsible	Remarks
Solid Waste Management Rules 2016	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> RSPCB local municipal bodies 	<ul style="list-style-type: none"> All bio-degradable, non-biodegradable and domestic hazardous wastes generated from the project will be managed by AGE(7)L & AGE(9)L (the waste generator) in accordance to the relevant provision of this Rule.
Manufacture, Storage and Import of Hazardous Chemicals (MSIHC) Rules, 1989 and as amended	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> RSPCB 	<ul style="list-style-type: none"> Rules will be applicable during construction and operation phases if chemicals stored at site satisfy the criteria laid down in the Rules.
The Batteries (Management and Handling) Rules 2001 as amended later	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> RSPCB 	<ul style="list-style-type: none"> Rules will be applicable during construction and operation phases as the project will use Batteries for power back up. Filing of Half Yearly return by bulk consumers and auctioneers of batteries to State Pollution Control Board as per Form 8 and 9 under Rules10 (2) (ii) and 11 (ii) respectively
E-waste (Management) Rules, 2016	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> RSPCB 	<ul style="list-style-type: none"> Rules will be applicable as electrical and electronics as listed in the Schedule I of the aforesaid rules will be used and will require replacement within the lifecycle of the whole project as well during decommissioning.
Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> RSPCB 	<ul style="list-style-type: none"> Refer Section 3.2.3 Since the project does not require CTE and CTO under the Air Prevention and Control of Pollution Act, 1981 (Air Act, 1981) and Water Prevention and Control of pollution) Act, 1974 (the Water Act 1974) Hazardous waste authorization is not applicable for the project, on a condition that the project will have to dispose hazardous waste through an authorised hazardous waste vendor
The Factories Act, 1948 and Rajasthan Factories Rules, 1951	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Deputy Chief Inspector of Factories 	<ul style="list-style-type: none"> AGE(7)L & AGE(9)L and its contractors will need to comply with all requirement of factories rules and participate in periodic inspection during the Operations Phase.
Building and Other Construction Workers Act, 1996;	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Labour Department, Government of Rajasthan 	<ul style="list-style-type: none"> AGE(7)L & AGE(9)L will need to comply with the requirements of the regulations.
Inter-state Migrant Workers Act, 1979						
Contract Labour Act, 1970						
The Child Labour (Prohibition and Regulation) Act, 1986	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> Labour Department, Government of Rajasthan 	<ul style="list-style-type: none"> AGE(7)L & AGE(9)L and its contractors will need to comply with the requirements of these regulations.
Bonded Labour (Abolition) Act 1976						
Minimum Wages Act, 1948						
Equal Remuneration Act 1976						
Workmen's Compensation Act, 1923						
Maternity Benefit (Amendment) Act, 2017						
Companies Act, 2013	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Ministry of Corporate Affairs 	<ul style="list-style-type: none"> According to Schedule 135 sub-section 1, the companies meeting the threshold criteria specified should spend in every financial year, at least 2% of the average net profits of the company made during the three immediately preceding financial years, in pursuance of CSR Policy. The project will need to comply with the requirements as stated in the law.
No Objection Certificates	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> Respective Gram Panchayats 	<ul style="list-style-type: none"> The given permission will be required for procuring both Government and Private land Reportedly, AGE(7)L & AGE(9)L has initiated the process for obtaining gram panchayat NOCs from the respective villages, where the Project falls

Topic and Reference	Pre-construction	Construction	Operations	Decommissioning	Agency Responsible	Remarks
International treaties and conventions						
Conventions on the Conservation of Migratory species of wild animals and migratory species	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	■ State Forest Department	■ Migratory bird in the project area bears protection from killing under Convention of Migratory Species (CMS) to which India is a signatory. Wetlands being utilized by these species are also protected under this convention.
Kyoto Protocol: The 3rd Conference of the Parties to the Framework	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	■ MoEFCC, Government of India	--
Convention on Climate Change (FCCC) in Kyoto in December 1997 introduced the Clean Development Mechanism (CDM) as a new concept for voluntary greenhouse-gas emission reduction agreements.						
Forest Conservation Act 1980	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Rajasthan State Forest Department	The project should ensures the Forest Land is avoided for project related activities, In case, the forest land is required should be followed with proper approval process.
Wild Life (Protection) Act, 1972	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Rajasthan State Forest Department (Wildlife)	Impacts to Schedule I species due to project activities should be avoided, minimized and mitigated
International Standards and Guidelines						
IFC Performance Standards, 2012	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	■ Project Proponent and Lenders	■ During the construction, operation and eventual decommissioning of the site, the following guidelines will need to be followed.
IFC General EHS Guidelines, 2007	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
IFC EHS Guidelines for Power Transmission and Distribution, 2007	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
IFC Guidelines for Wind Energy Projects	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
IFC/WB Air Emissions and Ambient Air Quality Standards	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
IFC/WB Guidelines for treated sanitary sewage discharges	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
IFC/WB Noise Standards	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
Equator Principles, 2020	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		

Note: The legislation mentioned above is not the comprehensive list. However, these are the key legislation applicable to the Project.

3.6 National Environmental Standards

The Central Pollution Control Board (CPCB) has stipulated different environmental standards w.r.t. ambient air quality, noise quality, water and waste water for the country as a whole under EP Act, 1986. Following standards are applicable to the project and need to be complied with during the project life cycle.

- National Ambient Air Quality Standards (NAAQ Standards), as prescribed by MoEFCC vide, Gazette Notification dated 16th November, 2009;
- Drinking water quality- Indian Drinking Water Standard (IS 10500: 2012);
- General standards for discharge as prescribed under the Environment Protection Rules, 1986 and amendments (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);
- Noise standards specified by the MoEFCC vide Gazette notification dated 14th February, 2000 (Noise Pollution (Regulation and control) Rules, 2000); and
- Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.

3.7 International Safeguard Requirements

3.7.1 IFC Requirements and applicability

IFC applies the Performance Standards to manage social and environmental risks and impacts and to enhance development opportunities in its private sector financing in its member countries eligible for financing. The Performance Standards may also be applied by other financial institutions choosing to support them in the proposed project. These performance standards and guidelines provide ways and means to identify impacts and affected stakeholders and lay down processes for management and mitigation of adverse impacts. Together, the Client is required to meet the stipulations of all the eight Performance Standards throughout the life of an investment in the case such an investment is being sought either from IFC or any other institution which follows IFC standards.

Table 3.3: IFC Performance Standards and their Applicability

Description	Applicability	Objectives and Applicability to Project
IFC PS 1 - Assessment and Management of Environmental and Social Risks and Impacts	☑	<p>This PS aims to assesses the existing social and environmental management systems of AREPGL, AGE(7)L & AGE(9)L 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.</p> <p>This ESIA is being conducted as part of the “identification of risks and impacts” requirement under the IFC PS 1. The management plan prescribed in this ESIA report will be implemented for mitigation of impacts identified.</p> <p>The developer, at the corporate level, has also established an Environmental and Social Management System, that will be implemented in conjunction with the management plan presented in this report.</p>
IFC PS 2 - Labour and Working Conditions	☑	<p>This PS is guided by a number of international conventions and instruments on labour and workers’ rights. It recognises that the</p>

Description	Applicability	Objectives and Applicability to Project
		<p>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 in AGE(7)L & AGE(9)L as well as any contractors.</p> <p>The project activities will involve hiring of skilled, semi-skilled and unskilled labourers for both solar sites and wind sites during the construction phase. The project will have to develop a human resource policy and ensure non-discrimination and equal opportunity, protection of the workforce and occupational health and safety. Therefore, PS 2 is applicable to the Project.</p>
IFC PS 3 - Resource Efficiency and Pollution Prevention	<input checked="" type="checkbox"/>	<p>PS-3 covers the use resources and materials as inputs and wastes that could affect human health. The objective of PS-3 are: 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, and to reduce project related GHG emissions. 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 HPD 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.</p> <p>The Project construction activities will lead to increased fugitive dust emissions, especially in the area it is being developed due to the presence of loose sandy soil and limited vegetation. The project activities will also lead to increase in ambient noise level during the construction phase and operation of wind turbines, which may impact the villages or sensitive receptors (identified) in the study area. In addition to this, the project activities will involve generation of waste and may involve abstraction of groundwater. Furthermore, Project will use water during construction phase for civil work and solar module cleaning during operation phase which may pose potential stress on existing common water resources such as water ponds/groundwater/canals etc. Therefore, PS 3 is applicable to the Project.</p>
IFC PS 4 - Community Health, Safety and Security		<p>This PS-4 requires due diligence to 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 to ensure 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,</p>

Description	Applicability	Objectives and Applicability to Project
		<p>hazardous material safety, natural resource issues, exposure to disease, emergency preparedness and response, and security personnel requirements. The project would affect the health and safety of the communities adjacent to it during construction phase.</p> <p>The Project activities will involve upgradation of village roads connecting the site and construction activities will lead to stress on the Project access road and on the area in general. Transportation of equipment and increased traffic in the area may lead to accidents and other threats on community health and safety. Furthermore, the Project may pose stress on common water resources such as IGNP canals, water ponds and groundwater due to use of significant amount of water during construction and operation phase. Therefore PS 4 is applicable to the project.</p>
IFC PS 5 - Land Acquisition and Involuntary Resettlement	<input type="checkbox"/>	<p>Not Applicable</p> <p>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. The key themes covered under this are: compensation and benefits for displaced persons, consultation and grievance mechanism, resettlement planning and implementation, physical displacement, economic displacement. The PS-5 also prescribes private sector responsibility to supplement government actions and bridge the gap between governments assigned entitlements and procedures and the requirements of PS-5.</p> <p>All the land parcels identified/procured are private land procured/ to be procured on lease and the consultation has been done with land owners to take their consent before finalising the lease. The following condition has been fulfilled:</p> <ul style="list-style-type: none"> ■ Land markets for the land is available in the area; ■ The lease agreement took place with the land owner's informed consent; and ■ The lease rent is approximately 35 percent of the prevailing circle rate, as reported by local community; the same agreed by land owners prior to initiating the land leasing process <p>Furthermore, the project has not led to resettlement, physical displacement and economic displacement. Therefore, PS 5 is not applicable to the project.</p>
IFC PS 6 - Biodiversity Conservation and Sustainable Management of Living Natural Resources	<input checked="" type="checkbox"/>	<p>PS 6 aims to protect and conserve biodiversity; to maintain the benefits from ecosystem services; and to promote the sustainable management of living natural resources through the adoption of practices that integrates conservation needs and development priorities.</p> <p>Project area does not fall within Wildlife Institute of Indian (WII) identified GIB Priority Area. However, the project site is a part of larger landscape identified as GIB Potential Area by WII.</p>

Description	Applicability	Objectives and Applicability to Project
		The Project being in the close proximity of IUCN Critically Endangered (CR) Great Indian Bustard and Vulture and their habitat and area of good turnover of migratory birds, has possibility to affect these avifaunal species, hence the PS-6 is applicable
IFC PS 7 - Indigenous Peoples	<input type="checkbox"/>	<p>Not Applicable</p> <p>This Performance Standard applies to communities or groups of Indigenous Peoples who maintain a collective attachment, i.e., whose identity as a group or community is linked, to distinct habitats or ancestral territories and the natural resources therein. PS-7 endeavour to ensure that the development process fosters full respect for the human rights, dignity, aspirations, culture, and natural resource-based livelihoods of Indigenous Peoples. Key themes covered under PS-7 are: avoidance of adverse impacts, consultation and informed participation, impacts on traditional or customary lands under use, relocation of IPs from traditional or customary lands, and cultural resources.</p> <p>As confirmed during community consultations, interview with Patwari and consultation with the Project team, no indigenous peoples will be affected by the project activities and no ST land will be purchased.</p> <p>As per the discussion with project team and the local community, all the land procured for the solar plant and for WTGs is private land and there is no common property resource in the procured land parcels.</p> <p>The project does not envisage adverse impacts on communities of Indigenous peoples. Therefore, PS 7 is not applicable to the project.</p>
IFC PS 8 - Cultural Heritage	<input type="checkbox"/>	<p>Not Applicable</p> <p>For the purposes of PS-8, cultural heritage refers to (i) tangible forms of cultural heritage; (ii) unique natural features or tangible objects that embody cultural values; and (iii) certain instances of intangible forms of culture that are proposed to be used for commercial purposes. The requirements of PS-8 apply to cultural heritage regardless of whether or not it has been legally protected or previously disturbed.</p> <p>As confirmed during ERM site visit, no cultural heritage will be affected by the project activities. Therefore, PS 8 is not applicable to the project.</p>

3.7.2 World Bank Group EHS Guidelines for Wind Energy, 2015

The EHS Guidelines for wind energy include information relevant to environmental, health, and safety aspects of onshore and offshore wind energy facilities. It is applicable to wind energy facilities from the earliest feasibility assessments, as well as from the time of the environmental impact assessment, and continue to be applied throughout the construction and operational phases.

The key requirements stated in the EHS guidelines includes but not limited to following:

- Consideration should be given to turbine layout, size, and scale in relation to the surrounding landscape and seascape character and surrounding visual receptors (e.g. residential properties, users of recreational areas/route);
- Consideration should also be given to the proximity of turbines to settlements, residential areas, and other visual receptors to minimize visual impacts and impacts on residential amenity, where possible;
- Wind turbines produce noise through a number of different mechanisms, which can be roughly grouped into mechanical and aerodynamic sources. Noise impacts to be assessed on the receptors according to their environmental sensitivity (human, livestock or wildlife);
- Site selection is critical to avoiding and minimizing potential adverse impacts on biodiversity. Site selection should include proximity of the proposed wind energy facility to sites of high biodiversity value in the region (including those located across national boundaries);
- Shadow flicker may become a problem when potentially sensitive receptors (e.g., residential properties, workplaces, learning and/or health care spaces/facilities) are located nearby, or have a specific orientation to the wind energy facility. Impact of shadow flicker to be assessed on potentially sensitive receptors (e.g. residential properties, workplaces, health care spaces, etc.);
- Occupational health and safety hazards during construction, operation and decommissioning;
- Management of community health and safety hazards including but not limited to blade and ice throw, aviation, marine navigation and safety, electromagnetic interference and radiation, public access, etc.;
- Environmental Monitoring program to be implemented.

4. ESIA SCOPING

For this 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 stage is intended to ensure that the impact assessment focuses on issues that are most important decision-making and stakeholder interest. The scoping exercise was undertaken on the basis of the information available on the project, the discussions with the project team and the prior understanding of ERM of solar power projects. Potential impacts have been identified through a systematic process whereby the features and activities (both planned and unplanned) associated with the operation and maintenance and decommissioning phases of the project have been considered with respect to their potential to interact with resources/ receptors.

Potential impacts have each been classified in one of three categories:

- **No interaction:** where the project is unlikely to interact with the resource/ receptor (e.g., wholly terrestrial projects may have no interaction with the marine environment);
- **Interaction likely, but not likely to be significant:** where there is likely to be an interaction, but the resultant impact is unlikely to change baseline conditions in an appreciable/detectable way;
- **Significant interaction:** where there is likely to be an interaction, and the resultant impact has a reasonable potential to cause a significant effect on the resource/receptor.

As a tool for conducting scoping, the various project features and activities that could reasonably act as a source of impact were identified, and these have been listed down the vertical axis of a **Potential Interactions Matrix**. The resources/receptors relevant to the Baseline environment have been listed across the horizontal axis of the matrix.

Each resulting cell on the Potential Interactions Matrix thus represents a potential interaction between a project feature/activity and a resource/ receptor.

4.1.1 Scoping matrix

All environmental and social impacts and risks described in IFC's Performance Standards and E&S Guidelines have been considered for the interaction matrix. The Potential Interactions Matrix for Project activities and likely impacted resources/ receptors is presented in **Table 4.1**.

The interaction matrix has been colour coded to indicate those interactions that are relevant to the Project (coloured in black), possible (coloured in grey) or scoped-out (coloured in white). Those interactions that are grey are 'scoped out', but the ESIA report includes a discussion that presents the evidence base (e.g., past experience, documented data, etc.) used to justify the basis upon which this decision was made.

Interactions that are likely to lead to significant impacts are presented in **Table 4.2**, and will be the focus of the impact assessment. Owing to site conditions there are certain possible interactions that will not take place. As a result these interactions have been "scoped out" and are presented in **Table 4.3**

4.1.2 Cumulative impacts

A cumulative impact is one that arises from a result of an impact from the Project interacting with an impact from other similar activities to create an additional impact. It was observed during the site reconnaissance survey that the project falls in an area characterised by presence of other wind and solar power projects and has some wind plants within a 5-10 km radius, with some hybrid power projects still in the pipeline. Therefore, cumulative impacts have been assessed and discussed in this report.

Table 4.1: IFC Performance Standards and their Applicability

Environmental and Social Resources / Receptors Project Activity/ Hazards	Topography and Drainage	Land Environment	Land scape – Visual Impact	Soil Environment	Groundwater Resources	Surface Water	Air Environment	Noise Environment	Terrestrial Ecology	Aquatic Ecology	Loss of land base livelihood	Employment Opportunity	Infrastructure and services	Occupational Health and safety	Community Health and safety
Pre-construction phase															
Land procurement															
Construction Phase															
Development/strengthening of access roads															
Site clearance and site preparation															
Transportation of construction materials															
Mobilising and operating construction equipment, machinery and DG sets															
Transportation of solar modules, WTGs and ancillary facilities															
Foundation excavation, piling and construction for solar mounts, WTG foundation, site office, transformers, etc.															
Erection and Installation of WTGs															
Laying of Transmission Lines															
Construction of PSS, and Site Office(s)															
Internal Electrical Cables, WTG															
Operation and Maintenance Phase															
Washing of solar modules															
Commissioning and Operation of WTGs															
Grass cutting															
Regular Inspection and Maintenance of equipment															
Cumulative Impacts arising from solar and wind projects in the area															
Decommissioning															
Removal of WTG parts and PV Modules															
Removal of ground mounted structures, WTGs components and ancillary facilities															
Removal of transmission lines															
Restoration of Project Site															

= Represents “no” interactions is reasonably expected

= Represents interactions reasonably possible but none of the outcome will lead to significant impacts

= Represents interactions reasonably possible with one of the outcomes leading to potential significant impact

Table 4.2: Identified interactions with potential significant impacts

Interaction (between project activity and Resource/Receptor)	Justification for Expectation of Potentially Significant Impacts
Changes in Land Use	<ul style="list-style-type: none"> ■ Construction of temporary structures during the construction phase, such as stockyard etc., would lead to changes in the land use albeit for a short period; ■ Setting up the project would require clearing of vegetation for Project related activities; ■ Installation of solar panels, WTGs and other components, paving and widening of access roads, setting up site office will lead to permanent change in land use; and ■ Restoration of solar plant site after Project cycle will reverse the land use to the original one. ■ Clearing of vegetation for Project related activities; ■ Laying of transmission lines and towers, paving and widening of access roads, setting up of WTG towers, components and site office will lead to permanent change in land use; and ■ Restoration of wind farm site after Project cycle will reverse the land use to the original one.
Alteration of Topography and drainage	<ul style="list-style-type: none"> ■ Analysis of the Project site as well as its surrounding area exhibits primarily flat terrain with slight undulation. Project activities (e.g., site development, construction of access roads) are likely to result in alteration in the topography and drainage of this area.
Impact on Soil / Land Environment	<ul style="list-style-type: none"> ■ Vehicle movement can compact or erode soil further; ■ Improper waste disposal can contaminate soil and groundwater; ■ Removal of top soil at WTGs, ancillary facilities and transmission tower sites; ■ Storage and handling of hazardous waste (e.g. fuel and lubricant) and accidents/negligence leading to leaks and soil contamination; ■ Generation of hazardous waste during operation of the Project e.g. small amounts of waste oil; and ■ Restoration of site after project life cycle.
Impact on Air Quality	<ul style="list-style-type: none"> ■ Operation of D.G. sets, vehicular movement and construction activities can cause fugitive and point source emission.
Impact on Water Environment	<ul style="list-style-type: none"> ■ Construction of the project will require water from local sources to carry out its activities. Further, PV module cleaning will require large quantity of water. Therefore, there can be impact on surface/ground water resource; ■ However, semi- dry cleaning methods for module cleaning would decrease impact on local water environment.
Increased Ambient Noise Levels	<ul style="list-style-type: none"> ■ Operation of construction equipment, machinery, piling, D.G. sets, vehicular movement and maintenance activities would increase the ambient noise levels; ■ Operation of WTGs ■ Local communities, such as that of Neran, Sanawara, Sadrasar, Sankara etc villages, may be disturbed due to higher than anticipated noise.
Ecology	<ul style="list-style-type: none"> ■ Impact on habitats and species may result from vegetation clearance, construction of site and access roads. Impact to avifauna may also occur due to electrocution with the transmission lines.

Interaction (between project activity and Resource/Receptor)	Justification for Expectation of Potentially Significant Impacts
Local Economy and Employment	<ul style="list-style-type: none"> Local community might chose to work during the construction of access roads and other project components and as security guards for the plant and WTGs. There is also a likelihood of reduced dependence on agriculture for income. If the project hires migrant labourers, contractors and subcontractors they might stay in local villages and could provide an influx of money into local businesses. However, inadequate accommodation facilities provided to the migrant workers in the vicinity of local inhabitation can also result into unsafe and unhygienic conditions in the local areas. Such as an incident of fire in kitchen area of labour colony can cause damage to property and people in the neighbourhood, and likewise impacts
Land-based Livelihoods	<ul style="list-style-type: none"> There will be no land-based livelihood will be impacted by the Project. The land parcel identified/procured for the project are private land and the land will be leased out. The key stakeholders to get impacted due to this impact are landowner who will lose their agricultural land who were dependent on these farms for primary income generation. The main land-based livelihood in the area is agricultural activity. However, the agriculture in the study area is dependent on monsoons and practice rain-fed water for agriculture. Agricultural production is highly dependent on adaptable climatic conditions. Therefore, the employment opportunity in the Project, will give the sustain income source to the local people and will reduce uncertain income from agricultural activities.
Community Health & Safety	<ul style="list-style-type: none"> Community health and safety hazards include noise pollution, increased traffic, dust pollution and any effects due to structural damage. In the case of spills/leaks, there is a potential for fire hazards and soil/water contamination. In addition, if migrant labourers are hired the level of interface that locals have with the migrant workers of the project may determine spread of communicable diseases.
Labour and Human Rights	<ul style="list-style-type: none"> The internal policies of the developer, contractors and subcontractors will largely determine the labour and working conditions practiced in the project throughout its lifecycle. However, the scale of impacts either positive or negative will be observed mainly during the construction stage when the number of workers engaged is the highest compared to other stages of the project.
Cumulative Impact	<ul style="list-style-type: none"> Due to presence of other wind and solar projects within a 5-10 km radius, there are chances of decline in water level in the area due to water requirement during module cleaning and domestic purpose and increase the noise level in the area. Based on the consultation with the site team, it is understood that the supply water to all the projects is done through tankers from IGP canal in the area and the water; Land rates in the area have increased due to multiple solar and wind projects being developed in the area. Also there will be further loss of agricultural land. Also, construction phase of current and upcoming projects in the area may cause increased air emissions and noise levels.

Table 4.3: Scoped out interactions

Impact Title	Reason for Scoping-Out
Impact on ambient air quality during operation phase	<ul style="list-style-type: none"> ■ The power generation process will not have any air emissions; ■ The site activities will be mainly scheduled maintenance work for solar PV modules and WTGS.
Indigenous People	<ul style="list-style-type: none"> ■ As per the review of Census data and consultations with the local community, it has been identified that the Aol does not have a significant presence of Scheduled Tribe population. The Census data shows a presence of only 4.29% STs in the Aol and 4.60% in the Core zone. No direct impacts on indigenous people have been envisage during this impact assessment study. ■ As confirmed during community consultations and interview with engaged aggregators and the land team of Adanai; no indigenous peoples will be affected by the project activities; however no details pertaining to identified land- lessors have been shared with ERM team; and ■ Also, in discussion with project team and the local community, all the land procured for the solar plant and for WTGs is private land and there is no common property resource in the procured land parcels. ■ The route of EL has bee finalized; however, the details regarding land typology, ownership, usage etc. have not been shared with ERM team
Demography (Influx and Displacement)	<ul style="list-style-type: none"> ■ The projects will not result in any physical displacement of the local community. Also, as reported by the project team and per the DPR, the unskilled labour requirement for the construction phase will primarily be recruited from the local community, the influx of population in the study area due to the project is expected to be restricted to the skilled employees of AGE(7)L and AGE(9)L and its contractors
Impact on cultural resources and heritage structures	<ul style="list-style-type: none"> ■ No structures bearing cultural, historical, religious or spiritual significance are located within the vicinity of the project; ■ Community consultations and discussions with the site team of AGE(7)L and AGE(9)L also confirmed that the project would not affect any such structure.
Natural/Common Property Resources	<ul style="list-style-type: none"> ■ Common property resources either due to traditional use or recognizable rights (legal) include animal grazing land, pathways of commute, meeting/gathering areas etc. Such areas may be belonging to a private owner or government but used by the community at large; ■ Based on the consultation with local community, it was understood that villagers have their animal grazing land, community hall etc within the village and no such common property has been procured by the project.

5. BASELINE SETTING – ENVIRONMENT, ECOLOGY, AND SOCIAL

This section presents environment, ecological and socio economic baseline of the study area for the proposed 600 MW solar-wind hybrid power project in Pokhran & Fatehgarh tehsil, Jaisalmer district of Rajasthan, India.

5.1 Context

Baseline refers to the physical, biological, cultural and human conditions that will prevail in the absence of the project, including interactions amongst them. Establishing baseline helps in understanding the prevailing environmental, ecological and socio-economic status of the study area. It provides requisite information of the biophysical and social environment for decision makers to take appropriate measures regarding the project.

Establishing baseline provides the background environmental and social conditions for prediction of the future environmental characteristics of the area before setting up of the project. It also helps in environmental and social management planning and provides a basis to finalize a strategy for minimizing any potential impact due on surrounding environment due to setting up of the project.

This section establishes the baseline environmental, ecological and socio-economic status of the proposed site and surrounding area to provide a context within which the impacts of the proposed solar-wind hybrid power project are to be assessed.

5.2 Area of influence

For the purpose of the baseline establishment and impact assessment, an Area of Influence (Aol) has been identified. This sub section provides an understanding of the Aol identified and the reasons for the same

5.2.1 Study area

The area of up to 5 km radius from the project boundary (solar-wind hybrid plant area) has been demarcated as study area for the project (refer **Figure 5.1**) by considering the extent of project impact in terms of noise, water resources, human settlement, cultural heritage sites, location of labour sites, location of the access roads besides considering the actual land area which has been procured for the project and its utilities footprints The study area includes 53 villages

5.2.2 Project Footprint Area

The Project Footprint is the area that may reasonably be expected to be physically touched by Project activities, across all phases. Physically, there is no demarcation or fencing for the Project Site boundary and hence it is contiguous with the rest of the area. The Project footprint area considered for the Project includes 500 m for environmental parameters, 2 km for social parameters and 5 km for ecological parameters.

The Footprint for Project includes land used for setting up the Solar PV's, erection of WTGs, transformer rooms, storage of materials, site office, and internal and external transmission lines (Refer **Figure 5.2**).

5.2.3 Project area of influence

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. These factors are incorporated in the definition of the Project's Area of Influence (Aol).

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

- **Environmental parameters:** Project site boundary, immediate vicinity, access road and surroundings, i.e. a study area of approximately 5 km (hereafter referred to as the Aol) distance from project line has been used to depict these parameters;
 - Air Quality: Dust emissions, fugitive dust- typically up to 500 m from a construction area and 100 m from operations and maintenance area;
 - Noise: Noise impact area (defined as the area over which an increase in environmental noise levels due to the Project can be detected) –typically 1 km from operations;
 - Land environment: The impacts on soil and land- typically up to 100 m from project foot print area;
- **Ecological Environment (Terrestrial and Aquatic):** This includes: (a) the direct footprint of the project comprising the wind farm; (b) The areas immediately adjacent to the project footprint within which a zone of ecological disturbance is created through increased dust, human presence and project related activities (e.g., trampling, transportation activities);
- **Social and Cultural:** The Aol for the project is identified as the area within a 5 km radius from the project footprint area and/or area identified beyond 5 km that is directly impacted by project activities.

5.2.4 Core and buffer zone

This Aol is in turn, divided into a core and buffer zone. This division of the Aol into two zones is based on the understanding that the majority of the impacts from the project (during the project lifecycle) would be contained within a 500 m radius (core zone) from the Project Footprint in terms of spread and intensity, with the buffer zone (5 km radius) appearing to have limited interaction with the project.

For the purpose of socio economic baseline assessment, core (2 km from project site) and buffer zones (beyond 2 km and within 5 km of project site).

The Buffer Zone is the area which does not have direct impact on land or environment, however it is demarcated in case the impact on core zone are sometimes/often extended to near-by areas. Usually the impact on buffer zone are more inclined towards, noise, air and water pollution. In cases it also has impact over labour, land ownership, migration and accessibility to any natural resources.

5.3 Environmental baseline

Environmental baseline data was collected through primary surveys as well as secondary sources by literature review and discussions with the concerned stakeholders. The environmental baseline has been assessed covering an area of 5 Km zone (hereinafter referred to as the study area) from the Project boundary. Secondary baseline data collection involved identifying and collecting available published material and documents. Information on various environmental aspects like soil, geology, hydrology, drainage, ecology etc., were collected from different government department, institutions, literature etc. & stakeholder consultations held undertaken during the site visit.

A brief description of the existing physical environment within the project site is detailed in the sections below.

5.3.1 Environmental Baseline Methodology

The following sub sections provide an understanding of the methodology followed for establishment of the environmental baseline.

5.3.1.1 Site Visit

ERM team undertook a site survey on from 2nd July-8th July to understand the site setting and to map environmental sensitivities in the area. The site visit included a walkover of the site with the Adani site team. The rationale of this exercise was to understand the local environmental issues in the area.

Understanding of the Project site and surrounding area using available latest high-resolution satellite imagery of the study area was initially conducted prior to the site visit to identify environmental and social sensitive receptors located within the Aol.

As part of this site visit, primary data was collected from sensitive spots and other places inside the Aol and secondary information regarding the baseline was collected. The following sub sections provide an understanding of the same.

5.3.1.2 Primary Baseline Data Collection

M/s. Avon Food Labs Private Limited, an NABL accredited laboratory, was engaged for collection of baseline information on groundwater quality, surface water quality and soil quality. The primary baseline data was collected between 26th June and 27th June 2020. Furthermore, M/s Netel India Private Limited, an NABL accredited laboratory, was engaged for collection of baseline information on ambient air quality and ambient noise quality from 19th-26th August 2020. The primary baseline data was collected for aspects detailed out in **Table 5.1**. Primary baseline monitoring locations have been showcased in **Figure 5.10**.

Table 5.1: Primary Data Collection

Environmental Attribute	No. of Locations/Area	Frequency	Remarks
Ground Water Quality	Four (04)	Once during monitoring period	Groundwater was collected from gound water abstraction structures within the study area.
Surface Water Quality	Two (02)	Once during monitoring period	Surface water was collected from two village ponds within the study area
Soil Quality	Four (04)	Once during monitoring period	Soil collected from agricultural field, scrub land and gravel waste land, within the study area.
Noise Quality	Eight (08)	Once during monitoring period	Ambinet Noise monitoing donenear to the sensitive receptors within the project area
Ambinet Air Quality	Four (04)	Once during monitoring period	Ambinet Air Quality monitoing done near to the sensitive receptors within the project area

5.3.1.3 Secondary Baseline Data Collection

Secondary baseline data collection involved identifying and collecting existing published materials and documents. Information on various environment aspects (like geology, hydrology, drainage pattern, ecology etc.), meteorology and socio economic aspects were collected from different institutions, government websites and literatures etc. Secondary data was collected for the aspects as given in **Table 5.2**

Table 5.2: Secondary Baseline Data Collection

SN.	Attribute	Source of Data Collection
1	Meteorological data	India Meteorological Department (IMD)
2	Geology, geomorphology, hydrogeology and hydrology	Geological Survey of India (GSI) and Central Ground Water Board
3	Land use	Through Satellite Imageries

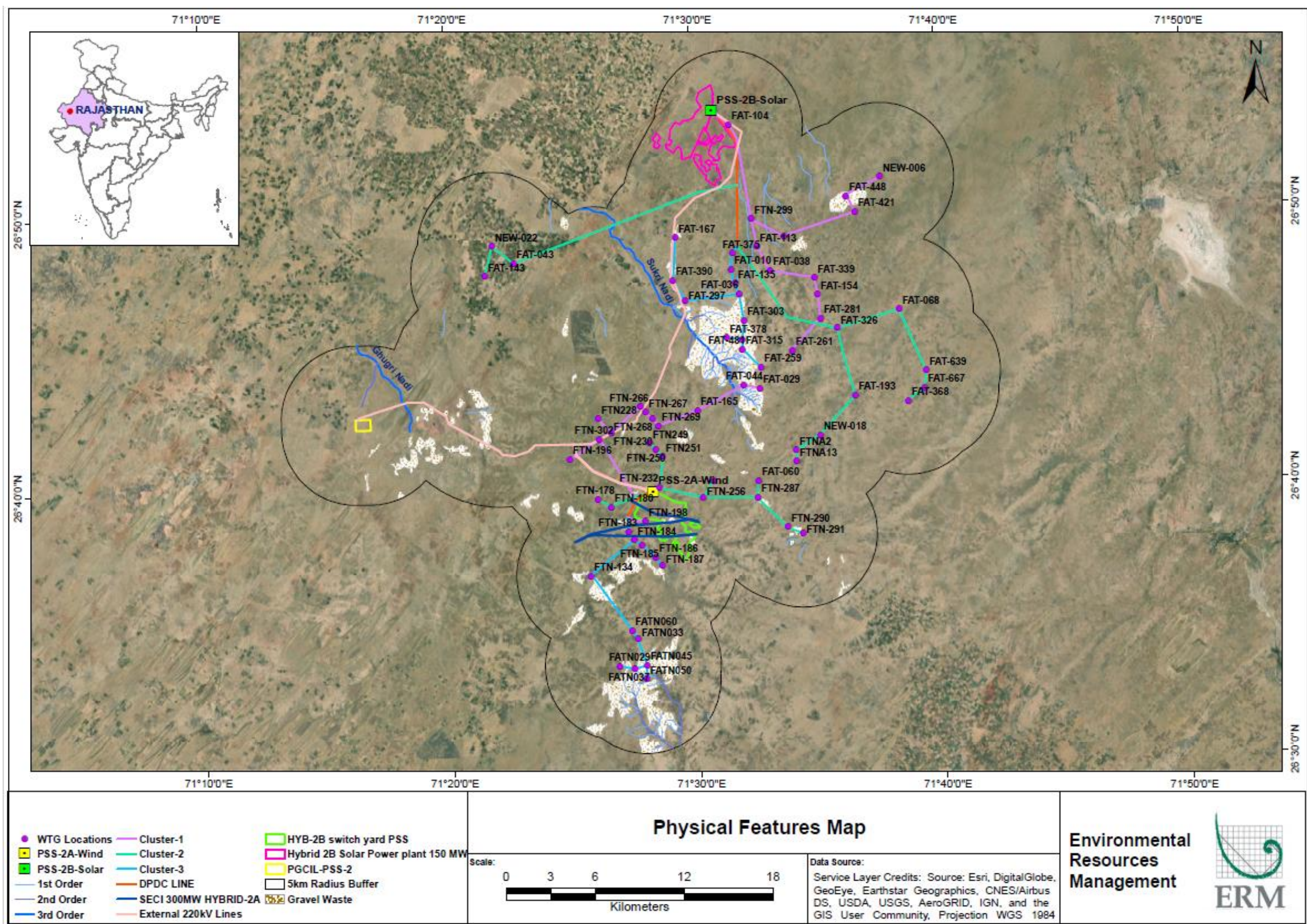
SN.	Attribute	Source of Data Collection
4	Eco-sensitive Areas	Wildlife Institute of India ENVIS Centre on Wildlife and Protected Areas and Birdlife International Website
5	Natural Hazards	Building Materials and Technology Promotion Council of India (BMTPC) Meteorological Department

5.3.2 Physical Features

A brief description of the existing physical environment within the project site is detailed in the sections below. The physical features map of the study area is showcased in **Figure 5.1**. The map displays the following features that are located within 5 km radius from the Project site:

- The Project site, including the location of the proposed solar power plant and identified 72 WTG locations;
- Villages and settlements within 5 km radius;
- Road network around the site, comprising of village roads and National Highway-15; and
- Other features such as schools, shops, temples and water ponds.

Figure 5.1: Map Showing Physical Features in the Study Area



Source: ERM India

5.3.3 Climate and Meteorology

5.3.3.1 Jaisalmer District

As per the information provided by CGWB in the groundwater brochure for Jaisalmer district (2013), the district experiences arid type of climate. Mean annual rainfall in the district from 2001-2011 has been recorded to be 205.73 mm. Almost 90% of the total annual rainfall was received during the southwest monsoon, which enters the district in the first week of July and withdraws in the mid of September. Additionally, mean annual rainfall from 2001-2011 as per Fatehgarh weather station and Pokhran weather station where the proposed site fall was recorded to be 280.14 mm 259.25 mm respectively.

The district experiences extreme heat in summer and cold in winter due to its location in dessert area. Both day and night temperatures increase gradually and reach their maximum in May and June. The temperature varies from 48°C in summer to 2°C in winter. Atmosphere in the district is generally dry except during the monsoon period. The humidity is highest in August with mean daily relative humidity of 43%. The annual maximum potential evapotranspiration in the district is 1850 mm and it is highest in the month of June and lowest in the month of December.

5.3.4 Land Use and Land Cover

Land use/ cover inventories are an essential component in land resource evaluation and environmental studies due to the changing nature of land use patterns in the Aol. Based on the discussion with site representatives and observations from satellite images it is understood that the majority of the current land use of the project site is shrub/waste land followed by agricultural land, and gravel waste land which can be converted to non-agricultural land for industrial development.

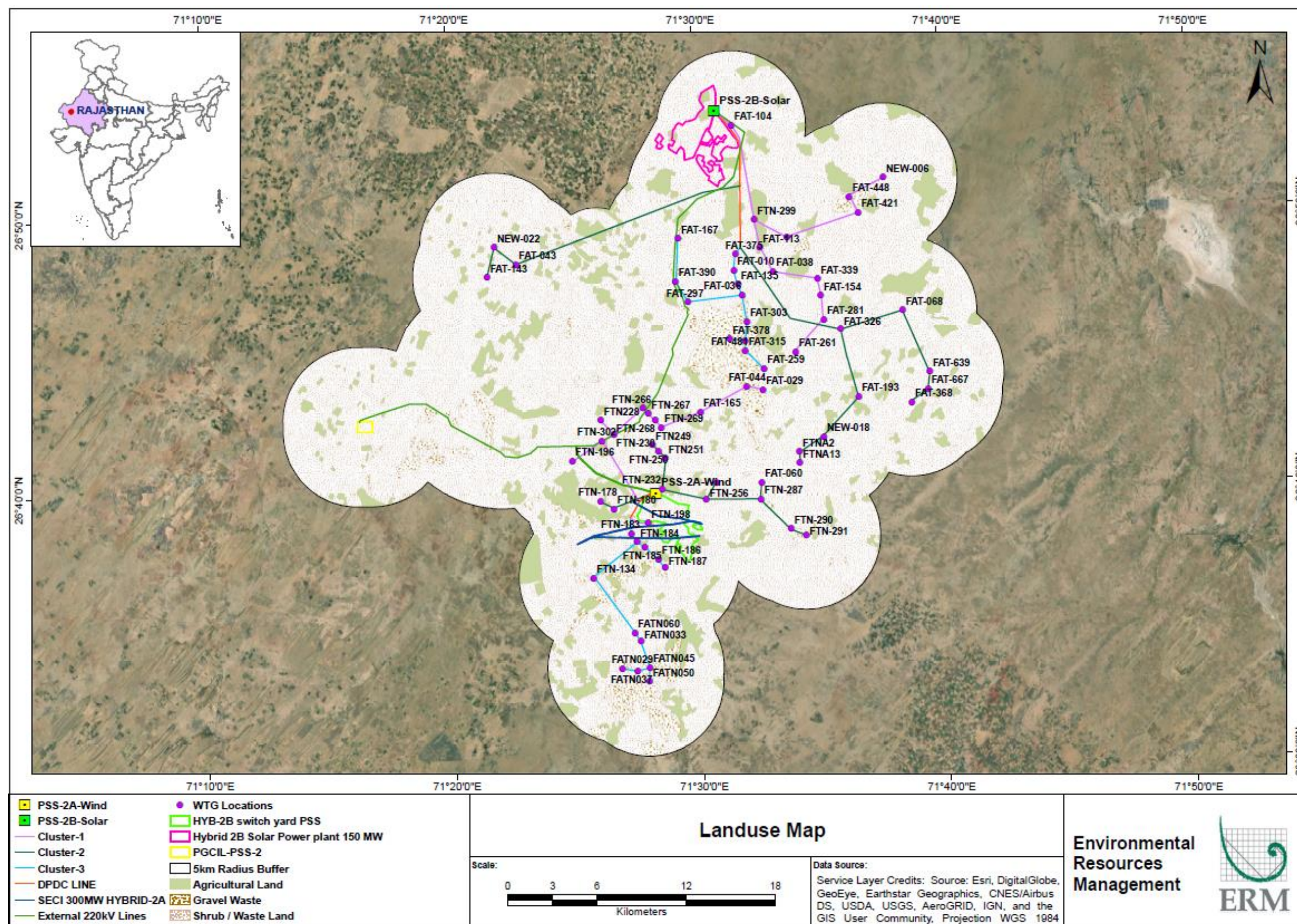
A detailed analysis of the land use and land cover has been presented in **Table 5.3**. Map displaying the land use/land cover within the study area is presented as **Figure 5.2**.

Table 5.3: Land Use Break-Up of the Project Aol

Landuse Category	Area SqKM	Percentage
Agricultural Land	145.51592	11.53
Gravel Waste Land	62.202003	4.93
Shrub/Waste Land	1053.93652	83.54
Total	1261.65444	100.00

Source: ERM India

Figure 5.2: Land Use and Land Cover of Project Aol

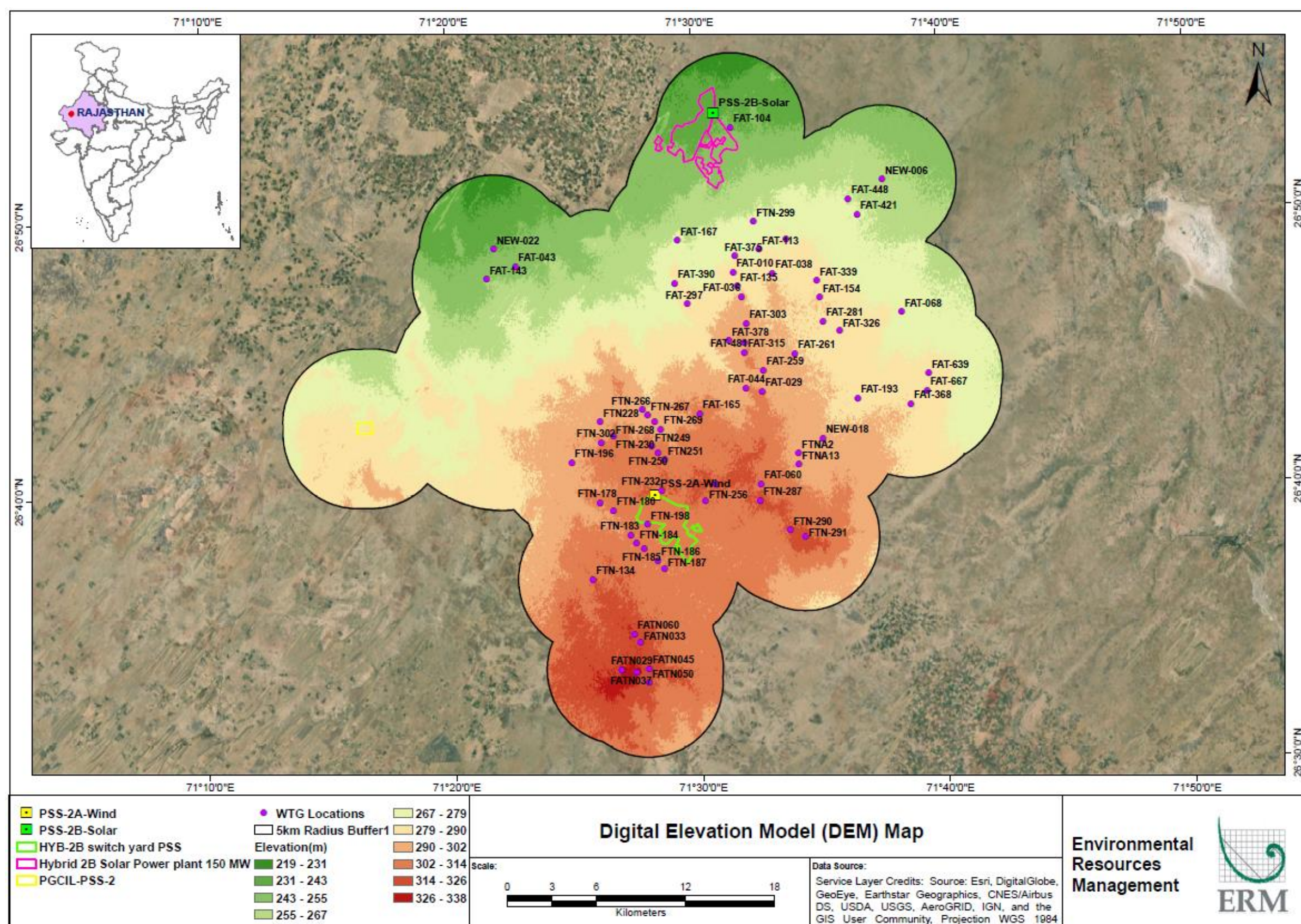


Source: ERM India

5.3.5 Topography

Based on satellite images and ERM site visit, it was observed that the project is proposed on terrain with base elevations ranging from 219-338m above mean sea level. The solar plants of 2*300MW are proposed to be located at an elevation of 219-255 amsl. Similarly, majority of the WTG locations are finalised at an elevation ranging between 267-338 amsl. Analysis of digital elevation map (**Figure 5.3**) for Project shows a trend in elevations increasing towards south with flat to minor undulating terrain with increasing elevations within the Project Aol. These minor undulating terrain can be categorised due to presence of sand dunes in the area.

Figure 5.3: Digital Elevation Map



Source: ERM India

5.3.6 Geology

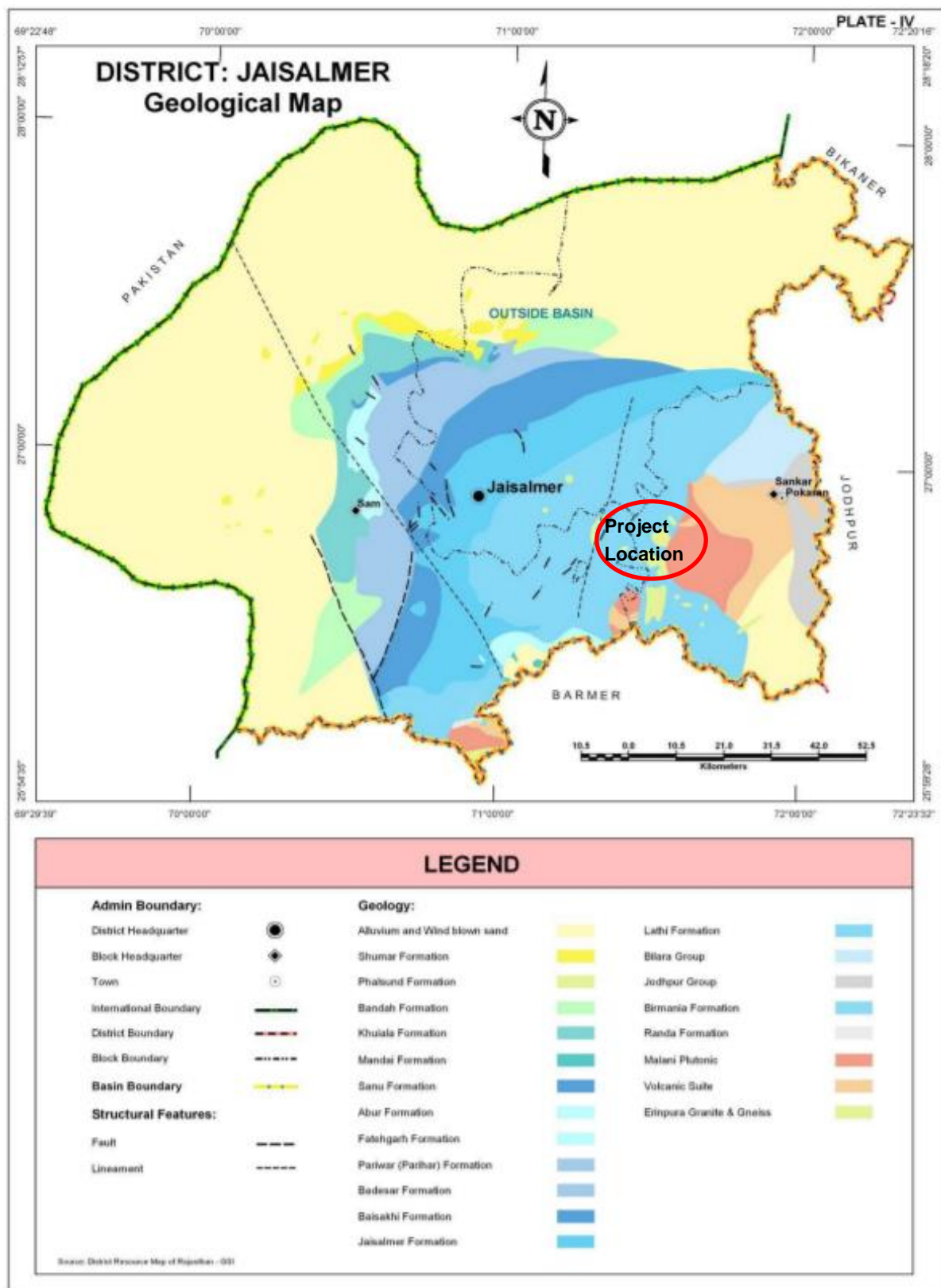
5.3.6.1 Jaisalmer District

As per Hydrogeological Atlas of Jaisalmer district, Rajasthan (2013), the major part of the district is covered by Alluvium and wind-blown sand. The basement rocks are the metamorphites granites and rhyolites that are unconformably overlaid by dolomitic limestone, shale and sandstone of the Marwar Super Group. Resting over these with are the Jurassic rocks made up of the Lathi, Jaisalmer, Baisakhi and Bhadesar formation. These are followed by rocks of Parewar and Abur formation. Sumer formation consists of unconsolidated highly current bedded reddish, glauconitic sandstone and silty sandstone. Khuiala formation consists of limestone boulder bedded fossiliferous limestone and shales. The geology of Jaisalmer district is described in **Table 5.4** and map for the same is presented in **Figure 5.4**.

Table 5.4: Geology of Jaisalmer District

Age/Super Group	Group/Series	Formation
Recent to Sub Recent	Alluvium and Sand Dunes	Brown, sand, silt and gravel
Unconformity		
Paleocene to Eocene	Sumar Series	Sandstone, limestone, bentonitic clay, fuller's earth and lignite seams
	Bandha Series	
	Khulala Series	
Unconformity		
Cretaceous	Abur Series	Sandstone, limestone, clay and lignite
	Parewar Series	
Unconformity		
Mesozoic	Bhadesar Series	Ferruginous Sandstone
	Baisakhi Formation	Calcareous Sandstone
	Jaisalmer Formation	Fossiliferous limestone, sandstone, etc.
	Lathi Formation	Sandstone, shale, etc.
Unconformity		
		Birmanian Formation
Unconformity		
		Randha Formation
Unconformity		
Marwar		Malanivolcanics and Jalore Granite

Figure 5.4: Geology of Jaisalmer District



Source: Hydrogeological Atlas of Jaisalmer district, Rajasthan (2013)

5.3.7 Water Resources

5.3.7.1 Drainage and surface water sources

Jaisalmer District

According to Central Ground Water Board (CGWB) brochure of Jaisalmer District (2013), the district is a part of the 'Great Thar Desert'. The terrain around Jaisalmer town, within a radius of about 60 km is stony and rocky. The area is barren, undulating with its famous sand dunes. There are no perennial rivers streams in the district and it lies in the watershed area of Barmer basin. Small nallas are purely seasonal and ephemeral with the result that there is lack of effective discharge in the event of heavy precipitation.

Indira Gandhi Nahar Project (IGNP)

Indira Gandhi Nahar Project (IGNP) Canal is the only round the year surface water source for irrigation in the two district. According to Indira Gandhi Nahar Department, Government of Rajasthan, the IGNP aims to irrigate the desert land of Western Rajasthan with Himalaya's water and provide drinking water to crores of inhabitants of this area. The canal originates from Harike barrage situated in Punjab. From Harike, 204 km long Indira Gandhi Feeder starts, which has 170 km length in Punjab and Haryana and balance 34 km in Rajasthan. This canal enters in Rajasthan at Hanumangarh. From tail of Indira Gandhi Feeder 445 km long Indira Gandhi Main Canal starts which passes through Sri Ganganagar and Bikaner districts and ends at Mohangarh in Jaisalmer. The IGNP Project has been envisaged for utilization of 7.59 million acre feet (MAF) water out of Rajasthan's share in surplus water of Ravi- Beas rivers. The main objectives of the IGNP are as follows:

- To provide irrigation facilities in desert area to meet the increasing demand of agricultural products.
- To provide water for drinking and industrial uses.
- Drought proofing of the area and improving living conditions.
- To meet the needs of drinking water, fodder etc. for the animal wealth in the region.
- To provide opportunities for employment and overall development of the area.

According to Central Ground Water Board (CGWB) brochure of Jaisalmer District (2013), the IGNP canal enters Jaisalmer district near village Nachana and flows towards western direction. It has a command area falling to the north of the canal. Major irrigation in the area is through Nachana Branch System, Sagarmal Gopa Branch System, Shaheed Birbal Shakha System and part of Charanawala Branch System.

The uses of the canal in districts of Rajasthan are in the following ways:

- Irrigation is being done every year in districts where water is being sourced from IGNP, where, earlier it was very difficult to arrange even drinking water;
- Drinking water from this canal is being supplied to various villages, towns & cities of Bikaner, Jodhpur, Sri Ganganagar, Hanumangarh, Jaisalmer, Jodhpur, Churu, Nagaur and Barmer;
- Water for Power generation is being supplied to various power projects of Suratgarh, Barsingsar, Guda, Ramgarh, Giral, Rajwest etc. and various Industries.

As per Rajasthan Solar Energy Policy, 2019, one of the incentives that the Govt. of Rajasthan is offering to renewable energy developers is access to water for project related activities which also includes cleaning of modules. As per secondary research it is understood that the Indira Gandhi Nahar Department has reserved 0.87 MAF (1200 cusec) of water for drinking, energy projects, and

other industries⁹. It is understood that Water Resources Department will allocate required quantity of water from IGPN canal/ the nearest available source for cleaning of solar panels and auxiliary consumption for Solar PV Power Plants subject to the availability of water. Power Producer is expected to intimate estimated water requirement to RREC along with source of water, which AGE(7)L & AGE(9)L as understood have yet to complete. As mentioned earlier, AGE(7)L & AGE(9)L are yet to submit a request for obtaining access to water from IGPN.

Observations from ERM Site Visit

During ERM site visit, two small rivers (Sukhri Nadi and Ghughri Nadi) and some small nallahs were observed to be present within the Project site, along with small village ponds located near villages falling within core and buffer zone. As observed in drainage map below, there are few dendritic and sub dendritic drainage passing through the study area. However, the sub dendritic drainage channels remain dry throughout to only receive water during monsoon season, whereas the dendritic channel may have water throughout the year but with little flow in the water body due to less water round the year. **Figure 5.5** presents drainage pattern in the study area.

5.3.7.2 Surface Water Quality Assessment

The surface water quality assessment is undertaken to understand the baseline surface water quality of the study area. Water samples were collected from village ponds from villages in the study area. A map showing location of water sampling is presented in **Figure 5.10**. Monitoring has been considered for the villages falling within the study area. The following results were observed, details presented in **Table 5.5**

Table 5.5: Primary water quality monitoring locations

Location Code	Location name	Coordinates	Selection criteria
SW 1	Madhopura Village near Naga Narayan Temple	N 26°45'36.06" E 71°32'14.97"	Understanding the existing surface water quality in the study area and assess any impact on surface water quality due to proposed project
SW 2	Near Deg Rai Temple	N 26°42'28.99" E 71°19'26.44"	

Source: ERM Monitoring conducted, June 2020

Table 5.6: Surface water analysis of the study area

Parameter	Units	Results		Permissible Limit ¹⁰	Test method
		SW 1	SW 2		
Colour	Hazen	< 4.0	< 4.0	300 Max	IS : 3025(P-4)
Odour	—	Odourless	Odourless	—	IS : 3025(P-5)
pH	—	7.82	8.16	6.5- 8.5	IS : 3025(P-11)
Temperature	°C	28.0	28.3	—	APHA 23nd Edn,2550- B
Electrical Conductivity	µS/cm	221.0	956.0	—	APHA 23nd Edn,4500H+B
Nitrite	mg/l	BDL (DL-0.02)	BDL (DL-0.02)	—	IS : 3025(P-34)
Nitrate	mg/l	BDL (DL-0.1)	0.8	50.0 Max	IS : 3025(P-34)

⁹ <http://www.water.rajasthan.gov.in/content/water/en/ignpd/dataroom/salientfeaturesofIGNP.html#>

¹⁰ As per IS 2296 Inland surface Water class C

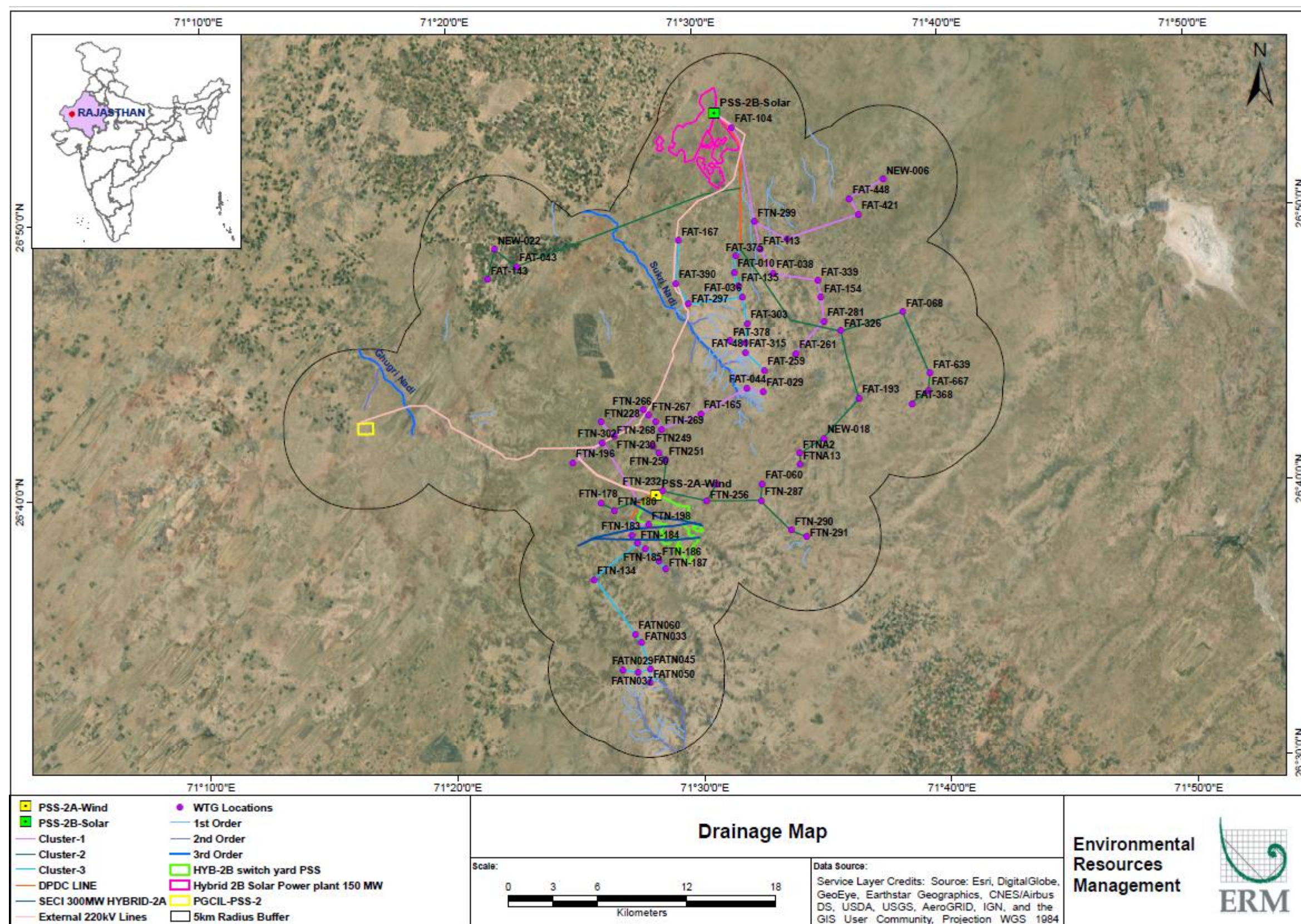
Parameter	Units	Results		Permissible Limit ¹⁰	Test method
		SW 1	SW 2		
Dissolved Oxygen	mg/l	6.8	5.4	4.0 Min	APHA 23nd Edn,4500-O
BOD	mg/l	2.8	4.2	3.0 Max	APHA 23nd Edn,5210 - B & D
Bacteriological Parameters					
Total Coliform	-	Absent	Absent	–	IS : 15185-2016
Faecal Coliform	-	Absent	Absent	–	IS : 1622-1981

Source: ERM Monitoring conducted, June 2020

Discussion of Results

All the parameters were observed to be within permissible limit for both the sampling locations except for biological oxygen demand (BOD) for SW 2 (4.2 md/l) which exceeded the permissible limit. Increase in BOD can lead to decrease in dissolved oxygen in the water which may impact the aquatic life.

Figure 5.5: Map showing Drainage Pattern in the Project Aol



Source: ERM India

5.3.7.3 Hydrogeology

As per CGWB brochure of Jaisalmer District (2013), hydrogeological formations forming aquifer in the district vary from Proterozoic to Quaternary in age. The main water bearing formations in the district are granites, lathi sandstone, tertiary sandstone and quaternary alluvium. In quaternary alluvium, ground water occurs under semi-confined to unconfined conditions, in semi consolidated tertiary and mesozoic formations, it occurs under unconfined to confined conditions and in weathered and fractured zones in hard rocks, it occurs under phreatic conditions. The groundwater condition in the district under different hydrological units is as described below.

- **Granites:** Granites form aquifer system in south-eastern part of Jaisalmer district. They are practically impervious and ground water is restricted to the weathered residuum, fractures, joints etc. Bore wells fitted with hand pump and large diameter dug wells are feasible only at selective locations.
- **Marwar Super Group:** The consolidated sedimentary formations belonging to Marwar Super Group (Upper Proterozoic to lower Palaeozoic) consisting of sandstone, shale and limestone form aquifer in eastern part of Jaisalmer district. Ground water occurs in primary porosity of sandstone and secondary porosity of sandstone and limestone. Depth to water level varies from 45m to 60m and yield of wells varies from 1 to 3 litres per second (lps).
- **Cenozoic and Mesozoic Formations:** The semi-consolidated formations belonging to Mesozoic and Cenozoic groups comprise of Lathi formation, Jaisalmer formation, Baisakhi formation, Bhadesar formation, Parewar formation, Abur formation and Tertiary formation.

Lathi sandstone is the most productive aquifer system in the district. Lathi basin covers an area of 7500 sq km, out of which only 3270 sq km area has usable quality of ground water. The ground water in Lathi occurs under perched as well as main water table conditions and under confined condition. The eastern part of Lathi is unsaturated, except for perched saturated zone which supplies water locally to villages. The depth to water level and piezo metric head ranges from 30 to over 120 m. The perched water table occurs between 6 and 30 m below ground level. The piezo metric surface is shallower in area north of Jaisalmer-Pokhran road due to topographic depression.

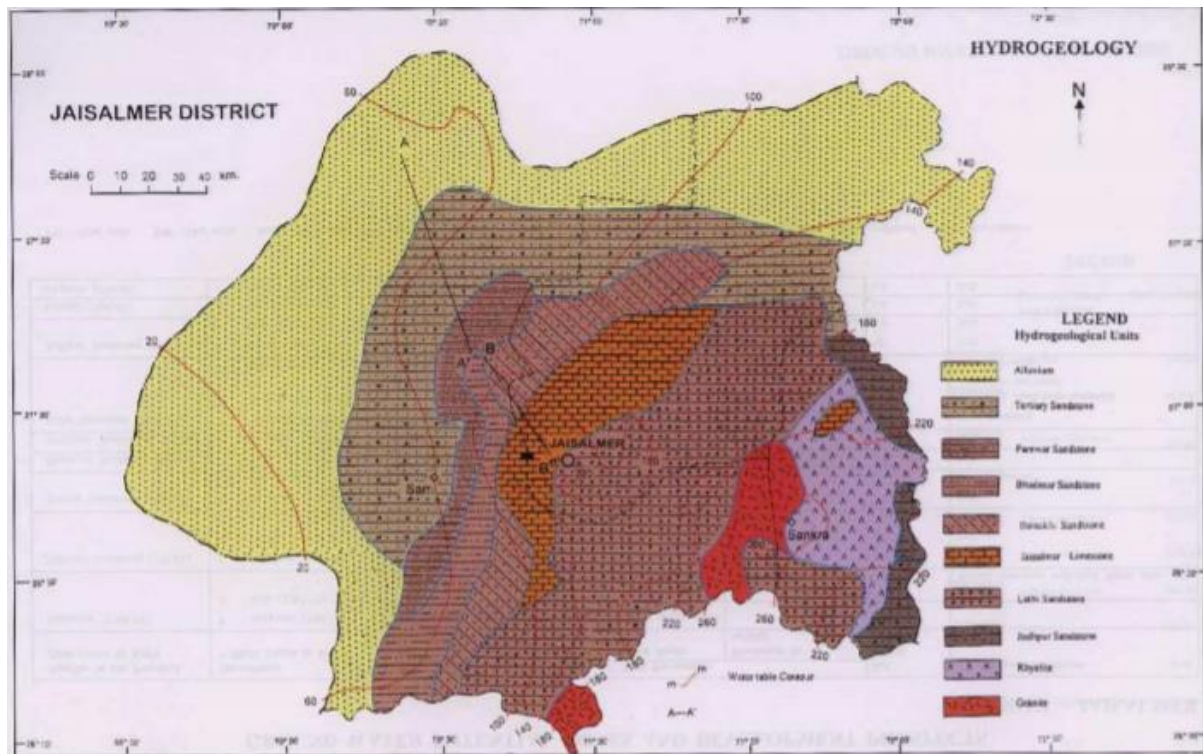
Jaisalmer formation forms aquifer in the central part of Jaisalmer district. In limestone and sandstone with shale intercalations, ground water occurs under unconfined to confined conditions. Depth to water level varies generally from 10 to 70 m. Yield of the formation is generally less than 5 lps. Baisakhi, Bhadesar, Parewar & Abur formations are predominantly clayey and shaley. These formations do not form hydrogeologically significant units. They form aquifers in small isolated patches only. Depth to water level varies from 20 to more than 100 m. Yield of formations is generally less than 4 lps.

Tertiary formations comprising of Sanu, Khuiala and Bandha formations are predominantly argillaceous in nature consisting of fine grained sandstone, limestone, shale, clay, fuller's earth and gypsum. The major part of the formation contains saline ground water. Depth to water level varies from 50 to more than 80 m. Yield of the formation is generally less than 10 lps.

- **Quaternary Formation:** Quaternary sediments comprising of unconsolidated aeolian sand and alluvium are important due to their widespread occurrence. The sediments are comprised of sand, silt, clay, gravel, calcareous and ferruginous concretions and occur in northern, western and southern parts of the area. Sand, gravel and admixture of these form fairly thick, extensive, discontinuous potential aquifers in western and northern parts of Jaisalmer district. However a major part of alluvium contains saline ground water. Ground water occurs under unconfined to confined conditions down to 300 mbgl. The perched water table condition occurs at shallow depth in clay beds and kankars which arrest the rain water of local precipitation. The Depth to water level varies from less than 10 m to more than 60 m and becomes shallower towards the northwest. Yield of the wells is generally less than 10 lps.

The hydrogeological map of Jaisalmer district is presented in **Figure 5.6**.

Figure 5.6: Hydrogeological Map of Jaisalmer District



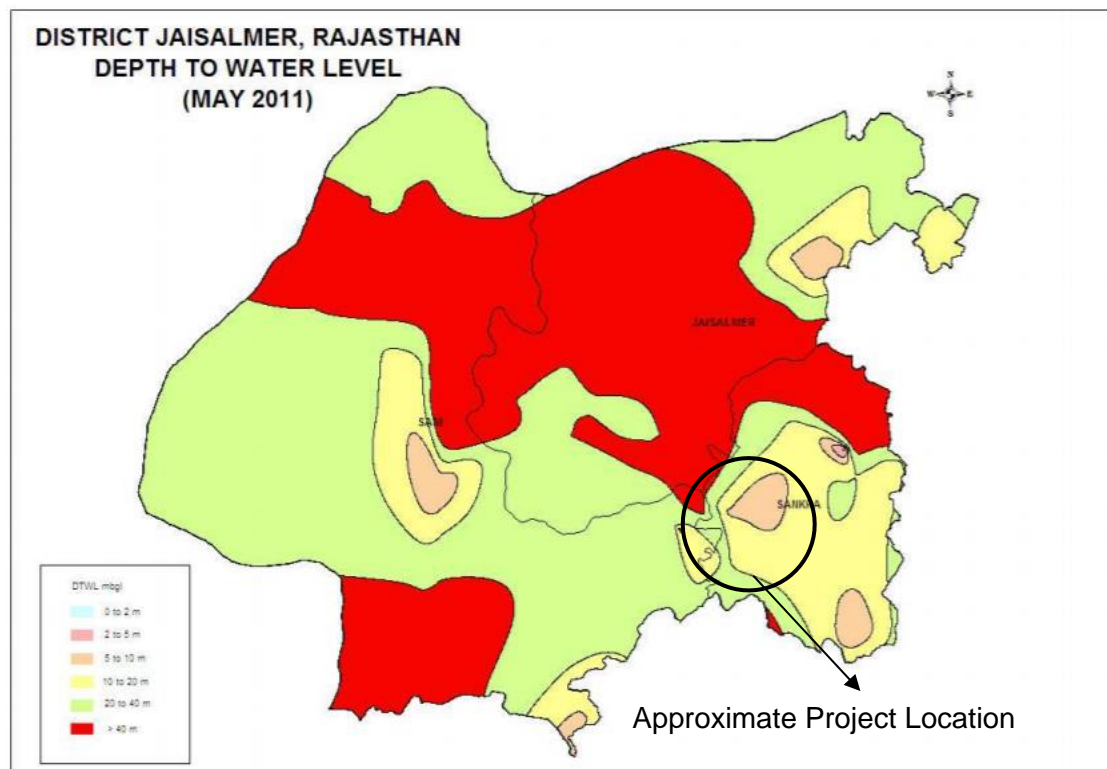
Source: CGWB, Information Brochure for Jaisalmer district, 2013

5.3.7.4 Groundwater resources

As per the information provided by CGWB in the groundwater brochure for Jaisalmer district (2013), the overall stage of groundwater development of the district is 138%. The stage of ground water development in various blocks of Jaisalmer district varies from 60% to 206% which indicates that the scope for ground water development is already exhausted, mainly in Jaisalmer and Sankara blocks. Only Sam block falls in safe category and has scope for further ground water development. The major part of the block has saline quality of ground water. Out of the three blocks in the district, two blocks i.e. Jaisalmer and Sankara (where the proposed site fall) are categorised as **over-exploited**, whereas Sam block is categorised as safe in terms of ground water development. The net annual groundwater availability excluding salinity in the Sankara block is estimated to be 33.21 MCM, out of which existing gross ground water draft for domestic and industrial use is estimated to be 0.40 MCM.

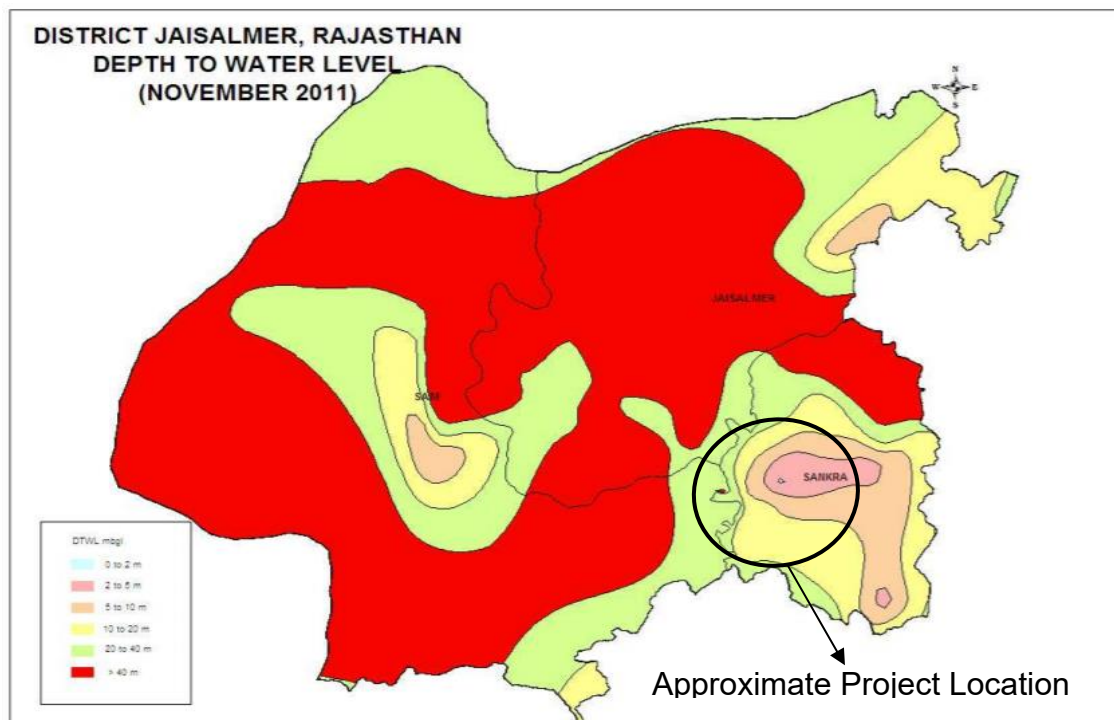
According to the study undertaken by CGWB for Jaisalmer district in 2013, the depth to water level in the district during pre-monsoon (2011) varied largely from 1.85 to 108.86 mbgl. Over a major part of the district, water levels are deeper (more than 20 m). Water levels more than 40 m were recorded in northern and southern parts of the district. As per **Figure 5.7** depth of water level in study area ranges between 5 m to more than 40 m during pre-monsoon. Furthermore, the depth to water level varied from 1.24 to 116.1 mbgl during post-monsoon. Wells in major parts of Jaisalmer and Sam blocks registered water levels deeper than 40 mbgl. During post-monsoon, the depth of water level in the study area was observed to be between 2 m to 40 m (**Figure 5.8**).

Figure 5.7: Depth of water level in Jaisalmer district in Pre Monsoon (May, 2011)



Source: Central Ground Water Brochure, Jaisalmer District, 2013

Figure 5.8: Depth of water level in Jaisalmer district in Post Monsoon (November, 2011)

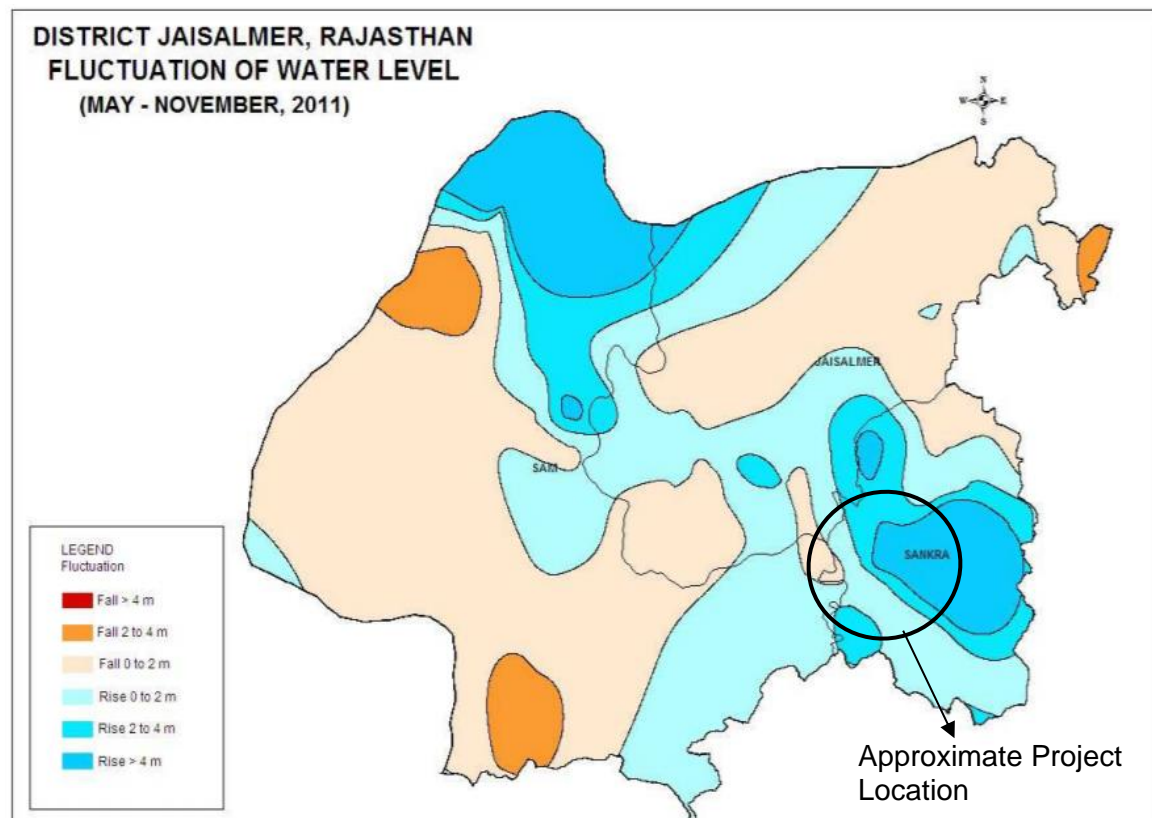


Source: Central Ground Water Brochure, Jaisalmer District, 2013

Water level fluctuations

Analysis of Pre- and Post-monsoon water level data of 2011 (May and November) indicates that 65% of the wells monitored by CGWB shows rise in water levels and the remaining 35% wells have shown fall in water level as presented in **Figure 5.9**. Furthermore, the analysis also indicated that, in general, **declining trend in water** levels has been registered in most parts of Jaisalmer and **Sankara blocks** (where the Project site falls) and some part of Sam block. The maximum decline was in Jaisalmer block while maximum rise was recorded in Sam block. The declining trend ranges from 0 to 25 cm/year while the rising trend varies from 0 to 50 cm/year.

Figure 5.9: Seasonal Water Level Fluctuation (Pre & Post Monsoon), 2011



Source: Central Ground Water Brochure, Jaisalmer District, 2013

Groundwater quality

According to the groundwater assessment undertaken by CGWB for Jaisalmer district in 2013, the quality of ground water in the district varies largely from fresh to saline. There is a wide range in the salinity of ground water in the phreatic and confined aquifers. The quality of ground water in northern, north western and south-eastern parts of the district is saline. The groundwater quality in the district of Jaisalmer is as given below.

- **Fluoride concentration** in ground water varies from 0.3 mg/l at Khudi to 4.23 mg/l at Bhadriyas. High fluoride area (greater than 1.5 mg/l fluoride) exists in north-eastern and eastern parts of the district covering major part of **Sankara** and northern half of Jaisalmer block;
- **Iron concentration** in ground water has been found to vary from 0.04 mg/l at Lawa to 2.1 mg/l at Bhaisada. Iron concentration in excess of maximum permissible limit of 1 mg/l was observed in localized pockets in Jaisalmer block and adjoining areas of Sam and **Sankara blocks** in the southern part of the district;

- **Nitrate concentration** in ground water was found to vary from 10 mg/l at Lawa to 229 mg/l at Khudi. Nitrate in excess of the maximum permissible limit of 45 mg/l was reported in 64% of the samples analysed by CGWB;
- The **Electrical Conductivity (EC)** in the district varies from 870 $\mu\text{S/cm}$ at 25°C at Khuiyala to 9800 $\mu\text{S/cm}$ at 25°C at Kharia Kua. The eastern, western and southern parts have comparatively better quality of water where EC is less than 3000 $\mu\text{S/cm}$ at 25°C.

Groundwater Quality Assessment

The ground water quality assessment is done to understand the baseline surface water quality of the study area. Water samples were collected from village borwells, tubewells and handpumps in the study area. A map showing location of water sampling is presented in **Figure 5.10**. Monitoring has been considered for the villages falling within the study area. The following results were observed, details presented in **Table 5.7**

Table 5.7: Primary ground water quality monitoring locations

Location Code	Location name	Coordinates	Selection criteria
GW 1	Sankara Village	N 26°44'29.30" E 71°35'14.91"	Understanding the existing ground water quality in the nearby habitation and assess any impact on ground water quality due to proposed project
GW 2	Sanwara Village	N 26°51'16.66" E 71°34'55.82"	
GW 3	Bhainsara Village	N 26°36'53.05" E 71°28'55.46"	
GW 4	Madhopura Village	N 26°48'08.62" E 71°29'21.58"	

Source: ERM Monitoring conducted, June 2020

Table 5.8: Ground water analysis of the study area

Parameter and units	Units	Results				As per IS 10500, Permissible limit	Test method
		GW 1	GW2	GW3	GW4		
Physical Parameters							
Colour	Hazen Units	<4.0	<3.0	<10.0	<5.0	15	IS : 3025(P-4)
pH	-	7.29	8.10	7.99	7.83	6.5-8.5	IS : 3025(P-11)
Turbidity	NTU	1.5	1.8	3.5	1.2	5	IS : 3025(P-10)
Temperature	°C	27.5	27.8	28.2	27.5	—	APHA 23nd Edn,2550- B
Conductivity	µS/cm	6090.0	6670.0	5480.0	1685.0	—	APHA 23nd Edn,4500H+B
Total Suspended Solids (TSS)	mg/l	4.8	5.6	10.8	7.4	...	APHA 23nd Edn,2540 D
Total Dissolved Solids	mg/l	3660.0	4048.0	3324.0	1056.0	2000	IS : 3025(P-16)
Chemical Parameters							
Anionic Detergent	mg/l	BDL(DL-0.05)	BDL(DL-0.05)	BDL(DL-0.05)	BDL(DL-0.05)	1	IS:13428,2005 Annex. K
Barium	mg/l	0.053	0.068	0.029	0.05	0.7	IS : 3025(P-65)
Calcium	mg/l	288.6	125.0	89.8	40.1	200	IS : 3025(P-40)
Salinity	ppt	1.9	2.8	2.3	0.5	**	APHA 23nd Edn,2520-B
Chloride	mg/l	1024.7	1529.5	1234.6	239.9	1000	IS : 3025(P-32)
Copper	mg/l	0.003	BLQ (LOQ-0.002)	BLQ (LOQ-0.002)	BLQ (LOQ-0.002)	1.5	IS : 3025(P-65)
Fluoride	mg/l	1.0	0.9	1.2	0.6	1.5	APHA 23nd Edn,4500F-D
Iron	mg/l	BLQ (LOQ-0.1)	BLQ (LOQ-0.1)	0.54	0.33	0.3	IS : 3025(P-53)
Magnesium	mg/l	128.3	105.9	189.5	38.9	100	IS : 3025(P-46)

Parameter and units	Units	Results				As per IS 10500, Permissible limit	Test method
		GW 1	GW2	GW3	GW4		
Manganese	mg/l	0.04	BLQ (LOQ-0.002)	0.459	0.039	0.3	IS : 3025(P-65)
Oil & Grease	mg/l	BDL(DL-3.0)	BDL(DL-3.0)	BDL(DL-3.0)	BDL(DL-3.0)	**	APHA 23nd Edn,5520-B
Nitrate	mg/l	5.6	6.4	3.5	1.4	45	IS : 3025(P-34)
Phenolic Compound	mg/l	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	BDL(DL-0.001)	0.002	IS : 3025(P-43)
COD	mg/l	BDL(DL-5.0)	BDL(DL-5.0)	BDL(DL-5.0)	BDL(DL-5.0)	**	APHA 23nd Edn,5210-B
BOD (3 Days, 27°C)	mg/l	BDL(DL-2.0)	BDL(DL-2.0)	BDL(DL-2.0)	BDL(DL-2.0)	**	IS : 3025(P-44)
Sulphate	mg/l	520.60	612.40	580.2	132.50	400	IS : 3025(P-24)
Phosphate	mg/l	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)	BDL(DL-0.1)	—	APHA 23nd Edn,4500-P
Total Alkalinity	mg/l	272.0	216.0	120.0	228.0	600	IS : 3025(P-23)
Total Hardness	mg/l	1248.0	748.0	1004.0	260.0	600	IS : 3025(P-21)
Dissolved Oxygen	mg/l	5.1	4.8	5.6	4.9	**	APHA 23nd Edn,4500-O
Zinc	mg/l	8.237	0.130	0.416	0.601	0.003	IS : 3025(P-65)
Cadmium	mg/l	BLQ (LOQ-0.002)	BLQ (LOQ-0.002)	BLQ (LOQ-0.002)	BLQ (LOQ-0.002)	0.003	IS : 3025(P-65)
Lead	mg/l	0.007	BLQ (LOQ-0.002)	BLQ (LOQ-0.002)	BLQ (LOQ-0.002)	0.01	IS : 3025(P-65)
Mercury	mg/l	BLQ (LOQ-0.0008)	BLQ (LOQ-0.0008)	BLQ (LOQ-0.0008)	BLQ (LOQ-0.0008)	0.001	IS : 3025(P-48)
Polychlorinated biphenyle	mg/l	BLQ (LOQ-0.00005)	BLQ (LOQ-0.00005)	BLQ (LOQ-0.00005)	BLQ (LOQ-0.00005)	0.0005	AFLPL/SOP/CH/INH/167
Total Petroleum Hydrocarbon	mg/l	BDL (DI-0.1)	BDL (DI-0.1)	BDL (DI-0.1)	BDL (DI-0.1)	**	USEPA Method 9671 B

Parameter and units	Units	Results				As per IS 10500, Permissible limit	Test method
		GW 1	GW2	GW3	GW4		
Arsenic	mg/l	BLQ (LOQ-0.002)	BLQ (LOQ-0.002)	BLQ (LOQ-0.002)	BLQ (LOQ-0.002)	0.05	IS : 3025(P-65)
Chromium	mg/l	BLQ (LOQ-0.002)	BLQ (LOQ-0.002)	BLQ (LOQ-0.002)	BLQ (LOQ-0.002)	0.05	IS : 3025(P-65)

Bacteriological Parameters

Total Coliform	–	Absent	Absent	Absent	Absent	Absent	IS : 15185-2016
Faecal Coliform	–	Absent	Absent	Absent	Absent	Absent	IS : 1622-1981

Source: ERM Monitoring conducted, June 2020

** Permissible limits not as per IS 10500

Discussion of Results

- **pH value:** pH of the groundwater samples were found to be within the range of 6.5 to 8.5;
- **Total Dissolved Solid (TDS):** TDS was observed to be above acceptable limits in GW-1 (3660 mg/l), GW-2 (4048 mg/l) and GW-3 (3224 mg/l). Since the groundwater samples were taken from an area characterised by shrub/waste land and agricultural fields and activities, mixing of soil contaminants (such as Iron) with groundwater through leaching and increase in evaporation due to irrigation activities can lead to high TDS;
- **Calcium:** Calcium content was found to be above permissible limits at GW-1 (288.6 mg/l). Hardness in most groundwater is naturally occurring from weathering of calcium bearing minerals. As can be observed in the previous paragraph, TDS in the groundwater samples was observed to be high. Therefore, high amount of calcium can be expected to occur in the groundwater. Furthermore, presence of limestone¹¹ also leads to high concentration of calcium in the groundwater as well once dissolved;
- **Chloride:** Chloride content was found to be above permissible limits at GW-1, GW-2 and GW-3. As can be observed in the previously, TDS in the groundwater samples was observed to be high. Therefore, high amount of chloride is bound to occur in the groundwater. Furthermore, high chloride content can be attributed to presence of naturally occurring minerals in Jaisalmer district such as limestone and gypsum
- **Magnesium:** Magnesium was found to be above permissible limits in GW-1 (128.3 mg/l), GW-2 (105.9 mg/l) and GW-3 (189.5 mg/l). As can be observed in the previously, TDS in the groundwater samples was observed to be high. Therefore, high amount of magnesium can be expected to occur in the groundwater. Furthermore, presence of limestone leads to high concentration of magnesium in the groundwater as well once dissolved;
- **Sulphate:** Sulphate content was found to be above permissible limits at GW-1, GW-2 and GW-3. As can be observed in the previously, TDS in the groundwater samples was observed to be high. Therefore, high amount of sulphate can be expected to occur in the groundwater;
- **Total Hardness:** Hardness of water is considered to be an important factor to determine the portability and its domestic usage particularly for washing. Total hardness of water is correlated to the presence of bivalent metallic ions viz. **calcium and magnesium**. Total hardness values in the groundwater samples were found to be exceeding permissible limits at GW-1, GW-2 and GW-3 locations. Therefore, the groundwater may not be potable and/or suitable for domestic usage in these locations.
- **Zinc:** Zinc content was found be higher than permissible limit for all the locations.

5.3.8 Soil Type and Classification

As per the information provided by CGWB in the groundwater brochure for Jaisalmer district (2013), soils of the district have been classified below.

- **Desert Soil:** Desert soil area is occupied by alluvium and windblown sand, yellowish brown, sandy to sandy loam, loose, structure less, well drained with high permeability occurring in major part of the district.
- **Sand dunes:** These are non-calcareous soils, sandy to loamy sand, loose, structure less and well drained. These occupy northern, western, south western and north eastern parts of the district.

¹¹ According to Department of Mines and Geology, Jaisalmer district is endowed with vast resources of cement grade limestone (<http://www.mines.rajasthan.gov.in/dmgcms/page?menuName=7mNDHM7a6IMXQWI3OsFRH0;455611;3qn6G58v>)

- **Red desertic soil:** These are pale brown to reddish brown soils, structure less, loose, and well drained. Texture varies from sandy loam to sandy clay loam. These soils occur in eastern, central and southeastern parts of the district.
- **Saline soil of depressions:** This type of soil is found in salt lakes. They are dark grey to pale brown, heavy soils with water table very near to the surface and are distinctly saline.

5.3.9 Soil Quality Assessment

Soil characteristics within the study area, especially the physical quality and fertility of the soil have been characterized by analysing soil samples collected from five (05) locations in August 2020. A map showing location of water sampling is presented in **Figure 5.10**.

Since the study area for 600MW project partially overlaps with the 390 MW Hybrid Wind-Solar Power Project in Jaisalmer District, monitoring has been considered for the villages falling within the study area. The monitoring location considered have been mentioned in **Table 5.9**, following results were observed, details presented in **Table 5.10**

Table 5.9: Details of Soil Sampling Locations

Location Ref	Coordinates		Location
	Latitude	Longitude	
S1	26°43'53.32"N	71°25'4.61"E	Sample collected from location between village Rasla and Madasar
S2	26°50'49.34"N	71°35'42.41"E	Sample collected from an agricultural field located approximately 525 m northwest of Sanawara village.
S3	26°52'8.42"N	71°26'40.49"E	Sample Collected near Dhayasar village
S4	26°48'8.90"N	71°21'22.04"E	Sample collected near Madhopura village

Source: ERM Monitoring conducted in June 2020

Table 5.10: Results of Soil Sampling in the Study Area

S. No.	Parameters	Units	S1	S2	S3	S4
1.	pH	-	8.21	7.58	8.12	8.16
2.	Porosity	%	57.7	52.8	52.8	52.7
3.	Permeability	cm/hr	29.0	28.0	30.0	29.0
4.	Electrical Conductivity	µS/cm	581.0	384.0	680.0	354.0
5.	Nitrate	mg/kg	8.2	3.4	7.3	4.3
6.	Nitrite	mg/kg	0.2	0.1	0.2	0.2
7.	Phosphate	mg/kg	0.2	0.3	0.2	0.20
8.	Barium	mg/kg	9	15.79	12.5	14.56
9.	Total Petroleum Hydrocarbon (TPH)	mg/kg	BDL (DL-0.1)	BDL (DL-0.1)	BDL (DL-0.1)	BDL (DL-0.1)
10.	CEC	meq./100 ml	6.8	6.9	6.8	6.9
11.	Chromium	mg/kg	BLQ(LOQ-27.28)	BLQ(LOQ-27.28)	BLQ(LOQ-27.28)	BLQ(LOQ-27.28)

S. No.	Parameters	Units	S1	S2	S3	S4
12.	Arsenic	mg/kg	1.07	1.85	2.45	3.51
13.	Cadmium	mg/kg	BLQ(LOQ-2.01)	BLQ(LOQ-2.01)	BLQ(LOQ-2.01)	BLQ(LOQ-2.01)
14.	Mercury	mg/kg	BLQ(LOQ-0.25)	BLQ(LOQ-0.25)	BLQ(LOQ-0.25)	BLQ(LOQ-0.25)
15.	Nickel	mg/kg	BLQ(LOQ-6.0))	6.31	7.24	9.11
16.	Manganese	mg/kg	63.5	84.76	101.6	102.8
17.	Zinc	mg/kg	BLQ (LOQ-4.21)	BLQ (LOQ-4.21)	BLQ (LOQ-4.21)	5.18
18.	Lead	mg/kg	BLQ(LOQ-5.77)	BLQ (LOQ-5.77)	BLQ(LOQ-5.77)	BLQ(LOQ-5.77)
19.	Iron	mg/kg	1647.18	1581.64	1746.9	2074.78
20.	Copper	mg/kg	BLQ(LOQ-5.37)	BLQ(LOQ-5.37)	BLQ(LOQ-5.37)	BLQ(LOQ-5.37)
21.	Texture	-	Sandy Loam	Sandy loam	Sandy loam	Sandy loam
22.	Sand	%	71.8	72.1	72.4	72.5
23.	Clay	%	10.6	11.2	10.5	10.3
24.	Silt	%	17.6	16.7	17.1	17.2

Source: ERM Monitoring conducted in June 2020

BLQ: Below Limit of Quantification

LOQ: Limit of Quantification

The above results have been compared with the standard soil classification as given in **Table 5.11**

Table 5.11: Standard Soil Classification

SN.	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

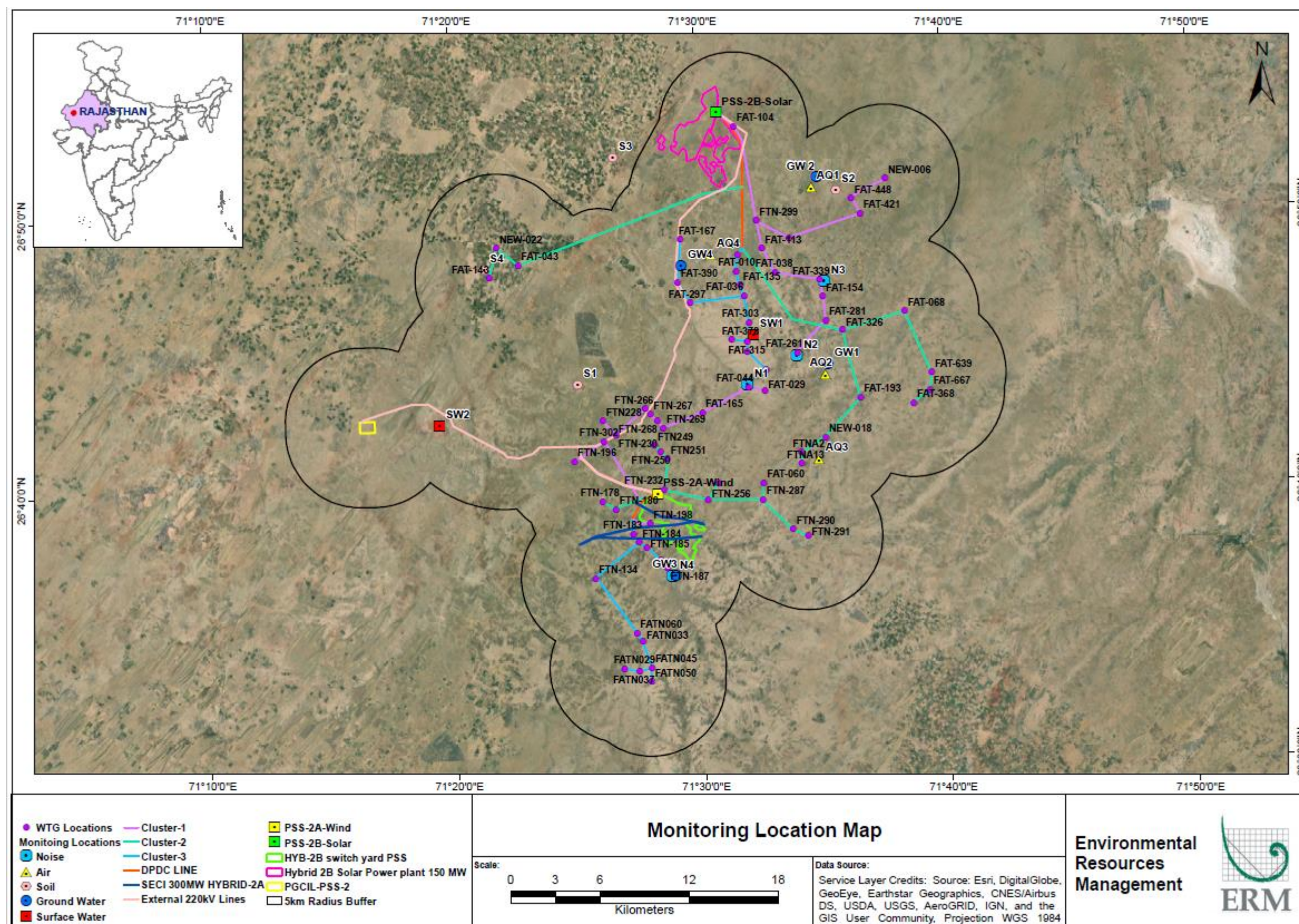
SN.	Soil Test Parameters	Classification
		0.81-1.00: sufficient >1.0 more than sufficient
4	Nitrogen (kg/ha)	Up to 50 very less 51-100 less 101-150 good 151-300 Better >300 sufficient
5	Phosphorus (kg/ha)	Up to 15 very less 16-30 less 31-50 medium, 51-65 on an average sufficient 66-80 sufficient >80 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

5.3.9.1 Discussion of Results

- **Texture:** The texture of soil samples analysed at four locations (S1, S2, S3 and S4) were found to be Sandy loam. Soil at all sampling locations comprised mostly of sand, with low concentrations of clay and silt;
- **pH:** Generally, soil pH in the range of 6.50-7.00 is considered to be best suited for growing most crops. The pH level in soil samples were observed to be 8.21 (S1), 7.58 (S2), 8.12 (S3) and 8.16 (S4) indicating slightly alkaline to moderately alkaline soil as per standard soil classification;
- **Electrical Conductivity:** EC is used to estimate the soluble salt concentration in soil, and is commonly used as a measure of salinity. The EC value of soil samples were found to be 581 $\mu\text{S/cm}$ (S1), 384 $\mu\text{S/cm}$ (S2), 680 $\mu\text{S/cm}$ (S3) and 354 $\mu\text{S/cm}$ (S4). This indicates low concentration of soluble salts in the soil;
- **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 level of iron in the soil samples were found 1647.18 mg/kg (S1), 1581.64 mg/kg (S2), 1746.90 mg/kg (S3) and 2074.78 mg/kg (S4). The level of copper in the soil samples were found below limit of quantification at all the sampling locations. The level of zinc in the soil samples were also found to be below limit of quantification except for S4 where the value was 5.18 mg/kg. Therefore, the soil is deficient of metals and micronutrients since copper and zinc (except for S4) does not occur in the soil sampling locations. Furthermore, it is to be noted that high concentration of iron in the soil has led to concentration of other metals being considerably low.

Figure 5.10: Map Showing Environmental Monitoring Locations



5.3.10 Noise Quality

According to noise monitoring conducted by Netel India Pvt Ltd from 19th- 26th August 2020 for the proposed 600MW Solar-Wind Hybrid Project in the state of Rajasthan, the following results were observed (**Table 5.13**). Details of the ambient noise monitoring locations are presented in **Table 5.12** below.

Table 5.12 Details of Ambient Noise Monitoring Locations

Location Reference	Coordinates		Location
	Latitude	Longitude	
NQ-1	26°43'46.05"N	71°31'57.76"E	Village Khurda
NQ-2	26°44'46.43"N	71°33'59.38"E	Village Sankara
NQ-3	26°47'28.34"N	71°35'8.98"E	Sankdo Village
NQ-4	26°36'49.98"N	71°28'46.95"E	Bhainsara Village

Source: Primary monitoring, 19th-26th August, 2020 by Netel India Pvt Ltd

Table 5.13 Ambient Noise Levels in the Study Area

Locations	Noise level (dB(A))					Applicable CPCB Standard (dB(A))- Residential Landuse	
	Leq Day	Leq Night	Lmax	Lmin	L90	Day time	Night time
NQ-1	49.01	45.37	51.4	42.6	45.06	55	45
NQ-2	51.41	47.07	60.1	40.3	42.56	55	45
NQ-3	54.58	52.07	59.2	48.1	48.81	55	45
NQ-4	55.55	54.06	61.7	46.6	48.70	55	45

Source: Primary monitoring, 19th-26th August, 2020 by Netel India Pvt Ltd,

Note: Day time is considered from 6 am to 10 pm and night time is considered from 10 pm to 6am.

CPCB limits for residential area during daytime and night time are 55dB (A) and 45 dB (A) respectively, commercial area during daytime and night time are 65dB (A) and 55 dB (A) respectively and industrial area during daytime and night time are 75dB (A) and 70 dB (A) respectively.

The equivalent ambient noise level for day time (Leq day) at all the monitoring locations were observed to be within the prescribed CPCB limits except at location NQ-4 which was exceeding the prescribed corresponding limits for a residential area during the day, and ambient noise level for night time (Leq night) at all the monitoring locations were observed to be exceeding the prescribed CPCB limits. The high noise levels during the night be attributed to high wind speeds during the period, and vehicular movement within the village and from nearby roads.

5.3.11 Air Quality

According to noise monitoring conducted by Netel India Pvt Ltd from 19th- 26th August 2020 for the proposed 600MW Solar-Wind Hybrid Project in the state of Rajasthan, the following results were observed (**Table 5.15**). A map showing location of air sampling location is presented in **Figure 5.10**. The monitoring location considered has been mentioned in **Table 5.14**.

Table 5.14: Air Quality Monitoring Location

S.No.	Sampling ID	Location	Longitude	Latitude
1	AAQ1	Sankra Village	26°44'6.18"N	71°35'7.64"E
2	AAQ2	Madhav Pura Village	26°48'31.70"N	71°30'34.82"E
3	AAQ3	Sanwara Village	26°50'55.84"N	71°34'42.29"E
4	AAQ4	Loona Village	26°41'1.34"N	71°34'49.41"E

Source: Primary monitoring, 19th-26th August, 2020 by Netel India Pvt Ltd,

Table 5.15: Air Quality Index of Study Area

S.No.	Parameter	AAQ1	AAQ2	AAQ3	AAQ4	NAAQS Permissible Limits (µg/m ³)
1.	Particulate Matter (PM10)	61.8	53.6	58.7	55.1	100
2.	Particulate Matter (PM 2.5)	25.2	20.8	23.9	22.6	60
3.	Sulphur Dioxide (SO ₂)	11.7	14.6	17.2	17.	80
4.	Nitrogen Dioxide (NO ₂)	14.	22.3	23.6	23.6	80
5.	Carbon Monoxide (CO)	569	379	542	774	2000 (8 hours)

Source: Primary monitoring, 19th-26th August, 2020 by Netel India Pvt Ltd,

Interpretation of Results

The analysis of results indicated that the values for PM 10, PM2.5, SO₂, NO₂, and CO were well within the permissible limit as prescribed by NAAQS. This can be attributed to low movement of vehicles in the area and no construction activities conducted in the month of August in the area.

5.3.12 Natural hazards

Disaster Management, Relief & Civil Defence Department Rajasthan and Building Materials & Technology Promotion Council (BMTPC), Government of India, have published hazard maps of Rajasthan. As per these maps the study area falls under the respective hazard zones as given in **Table 5.16**. Hazard zonation maps of the state for earthquake, wind/cyclone, flood and drought are presented in below tables.

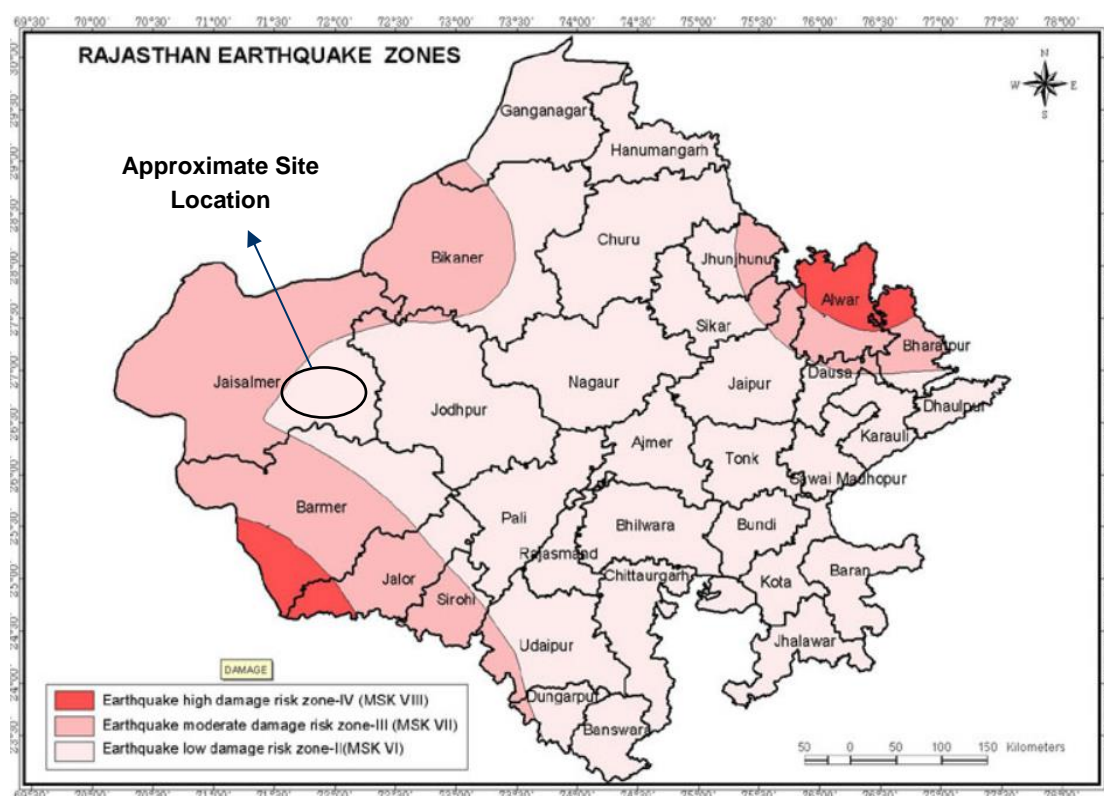
Table 5.16: Natural Hazard Details, Jaisalmer

Characteristics	Details
Earthquake	As per the data released by Building Materials & Technology Promotion Council (BMTPC) of Government of India and Disaster Management, Relief & Civil Defence Department of Government of Rajasthan, the Project is located in an area that is designated as Zone II that corresponds to MSK VI with nontectonic faults. This is classified as a low damage risk zone in terms of earthquake occurrence.
Wind/cyclone	As per the data released by Building Materials & Technology Promotion Council (BMTPC) of Government of India and Disaster Management, Relief & Civil Defence Department of Government of Rajasthan, the Project site is located in a an area that experiences high wind velocities Vb= 47 m/s and the zone is classified as high damage risk zone for cyclones.
Flood	As per the data released by Building Materials & Technology Promotion Council (BMTPC) of Government of India and Disaster Management, Relief & Civil Defence

Characteristics	Details
	Department of Government of Rajasthan, the Project site falls in an area which is not prone to flooding incidents.
Drought	As per the data released by Disaster Management, Relief & Civil Defence Department of Government of Rajasthan, the Project site is located in an area where drought frequency is once in 3 years.

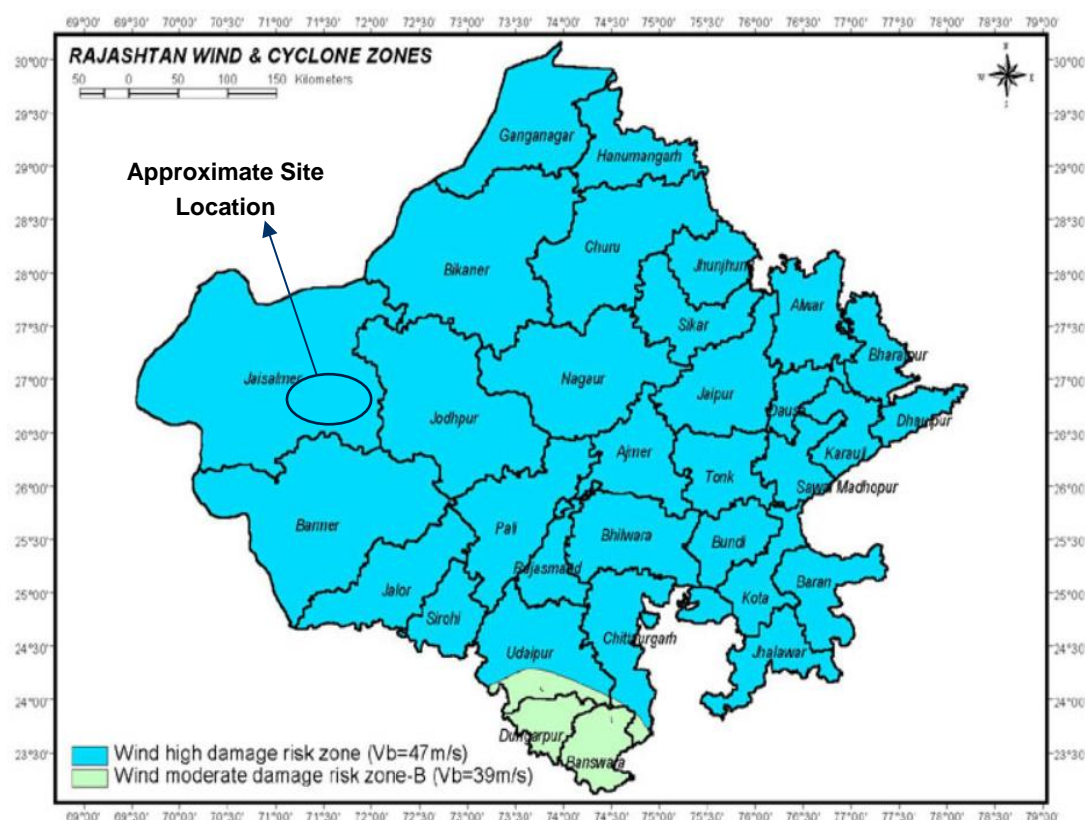
Source: Disaster Management, Relief & Civil Defence Department Rajasthan and Building Materials & Technology Promotion Council (BMTPC), Government of India.

Figure 5.11: Map Showing Earthquake Zones in Rajasthan



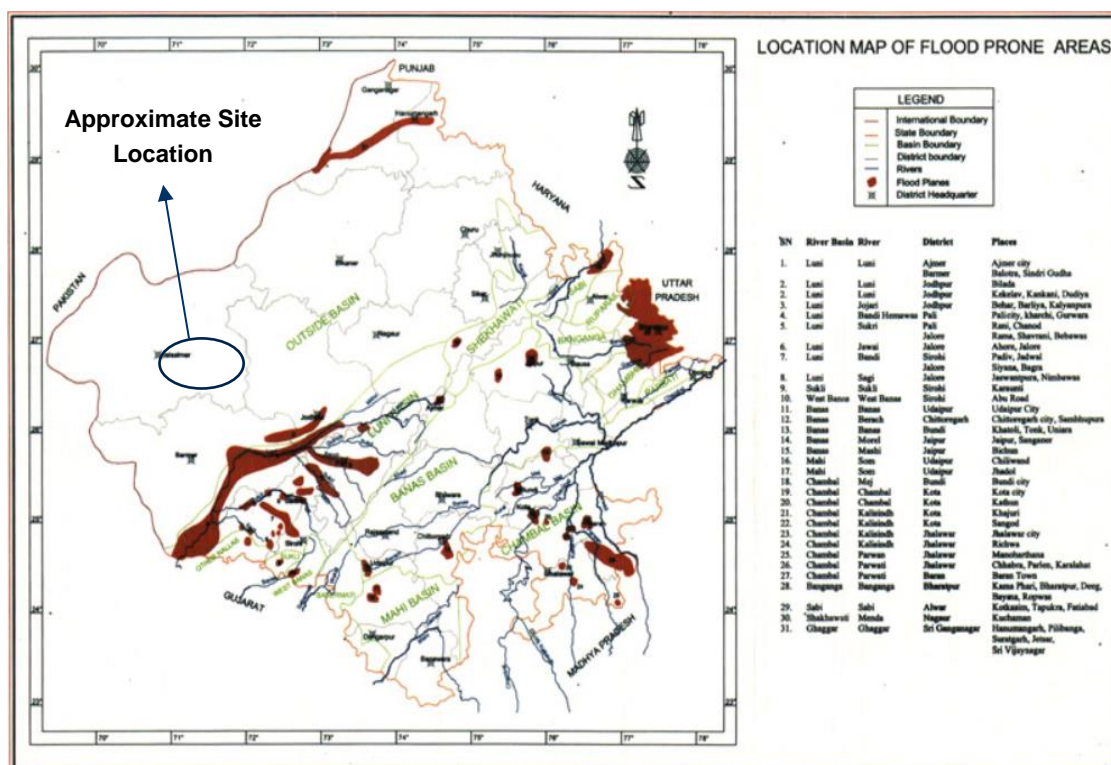
Source: Disaster Management, Relief & Civil Defence Department, Government of Rajasthan

Figure 5.12: Map Showing Wind and Cyclone Zones in Rajasthan



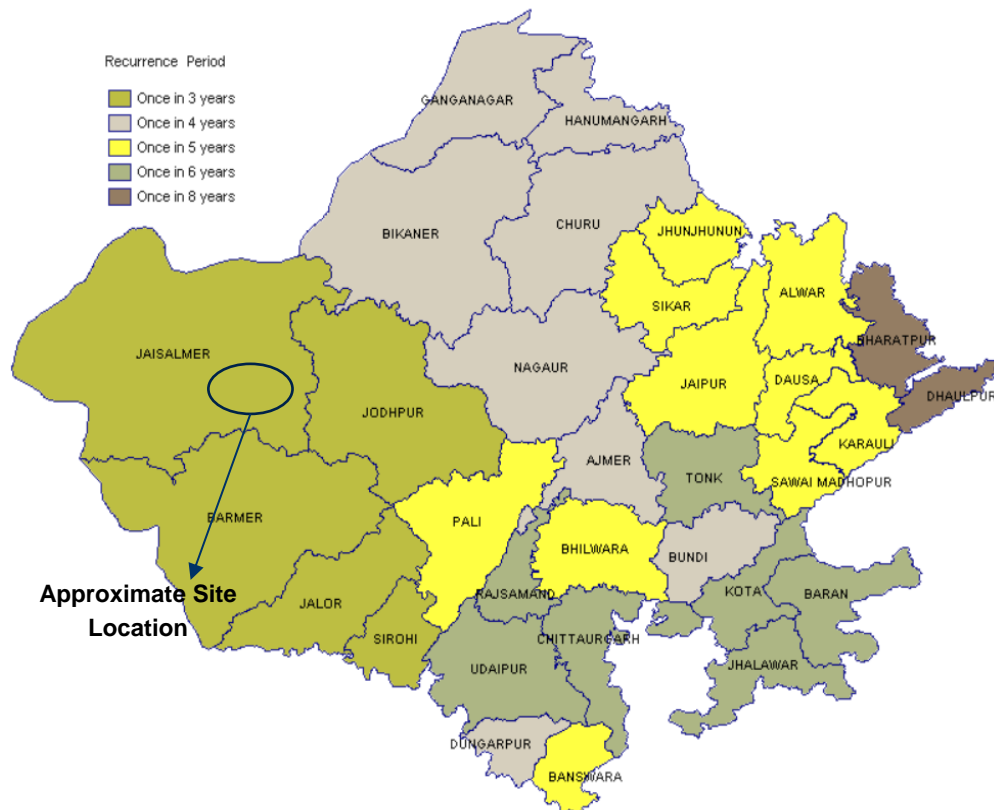
Source: Disaster Management, Relief & Civil Defence Department, Government of Rajasthan

Figure 5.13: Map showing Flood Prone Areas in Rajasthan



Source: Disaster Management, Relief & Civil Defence Department, Government of Rajasthan

Figure 5.14: Map Showing Drought Frequency in Rajasthan



Source: Disaster Management, Relief & Civil Defence Department, Government of Rajasthan

5.4 Socio-Economic Environment

This section provides an understanding of the following aspects:

- Administrative set up of the district;
- Demographic profile of the villages in the project area;
- Social groups present;
- Vulnerable groups identified;
- Livelihood profile of the community
- Land use patterns in the area;
- Common property resources;
- Social and physical infrastructure available in terms of the education and health infrastructure; and
- Water supply for irrigation and drinking purposes, sanitation facilities and connectivity.

This understanding is based on the secondary information available at district, sub-district and village level (as per Census of India 2011) as well as informed by consultations undertaken by ERM during the site visit.

5.4.1 Approach

In-order to develop a social baseline and further carry out an impact assessment for the project, a participatory approach was adopted. The participatory approach was taken with an understanding that, it will integrate the local understanding and perspective of local community into the impact & risk identification and it's mitigation measure. The purpose of such an approach was to allow for:

- The validation 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; and
- 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.

5.4.1.1 Primary Data/ Information Collection/Site Consultations

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

Table 5.17 Consultations undertaken during the site visit

Date	Stakeholder Details	Remarks
04 th July 2020	<ul style="list-style-type: none"> ■ Discussion with the site team (i.e. EHS staff & Assistant Land Procurement staff); ■ Community consultations in Madhopura & Sanawada village 	
05 th July 2020	<ul style="list-style-type: none"> ■ Consultation with aggregator M/s Dalveer Enterprises Pvt. Ltd., ■ Consultation with local community in Loona Kalan village; 	<ul style="list-style-type: none"> ■ Assistant Manager/ Adani is the lesse from Adani. His name is used as a “Lesse”/ representative of Adani, in the contract agreement

Date	Stakeholder Details	Remarks
	<ul style="list-style-type: none"> ■ Consultation with Assistant Manager of land team, Adani; ■ Consultation with Sarpanch cum land owner of Neran 	<ul style="list-style-type: none"> ■ The Sarpanch is one of the private landowners, that are giving land on lease for solar park
06 th July 2020	<ul style="list-style-type: none"> ■ Consultation with DGM (Land & Liasioning team), Adani and local aggregator 	<ul style="list-style-type: none"> ■ The DGM is the Nodal officer from Adani, who is available at site level.

As part of these consultations, an attempt was made to develop an understanding of the stakeholder group's key concerns and expectations from the project, the stakeholder group's perception of the project and to triangulate the secondary information available on the area.

5.4.1.2 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 Census Handbook, Jaisalmer
- Primary Census Abstract data of India, 2011
- Village Directory Census data of India, 2011; and
- Agricultural Contingency plan for Jaisalmer, 2011.

5.4.1.3 Area of Influence Profile (Aol)

The core zone for the baseline studies has been considered within 2 km radius from the project area, where most of the impacts are anticipated, and the buffer zone is the area in the 5 km radius. The core, the buffer zone and the project footprint together comprise the "Aol" of the project, which is spread across 34 villages under three tehsils of Jaisalmer district. The villages of core zone comes under Pokhran and Fatehgarh tehsil, while Jaisalmer covers two villages under buffer zone. The concentration of villages is higher in Pokhran tehsil as compared to Fatehgarh and Jaisalmer tehsils. The villages lying in the core and buffer zone of the Aol have been also listed below.

Table 5.18 Core and Buffer Zone Villages

S. No.	Core Area Villages	Tehsil	S. No.	Buffer Area Villages	Tehsil
1.	Loona Kalan	Pokaran	1.	Pratappura	Pokaran
2.	Naya Khara	Pokaran	2.	Chok	Pokaran
3.	Achalpura	Pokaran	3.	Keraliya	Pokaran
4.	Neran	Pokaran	4.	Dalpatpura	Pokaran
5.	Naya Sanawara	Pokaran	5.	Rajgarh	Pokaran
6.	Sanawara	Pokaran	6.	Khelana	Pokaran
7.	Sadrasar	Pokaran	7.	Mulasar	Pokaran
8.	Amarsar	Pokaran	8.	Karada	Pokaran
9.	Motisar	Pokaran	9.	Baiteena	Pokaran
10.	Madhopura	Pokaran	10.	Loona Khurd	Pokaran
11.	Madasar	Pokaran	11.	Moolana	Fatehgarh
12.	Lakhasar	Pokaran	12.	Mehrajot	Fatehgarh
13.	Sankra	Pokaran	13.	Lakhaniyon Ki Dhani	Fatehgarh
14.	Khetasar	Pokaran	14.	Adroi @ Bhillon Ki Dhani	Fatehgarh

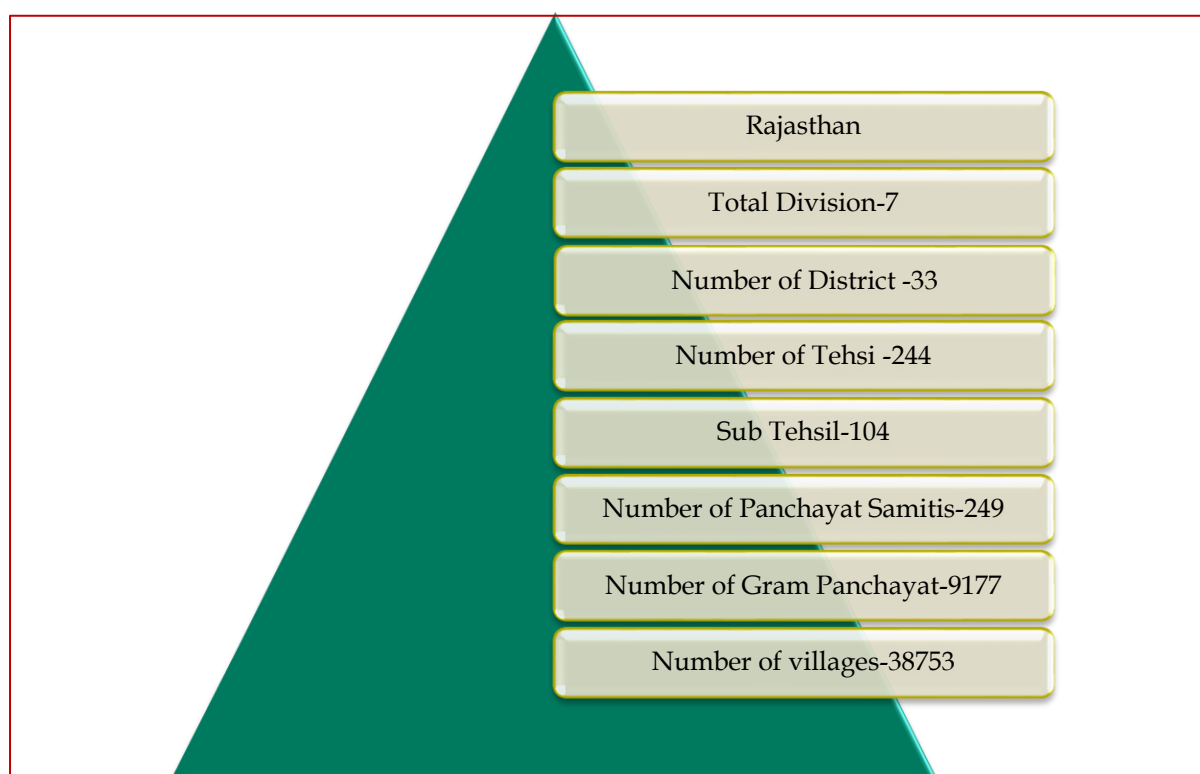
S. No.	Core Area Villages	Tehsil	S. No.	Buffer Area Villages	Tehsil
15.	Khuhra	Pokaran	15.	Nagon Ki Dhani	Jaisalmer
16.	Bhainsara	Pokaran	16.	Sutharon Ki Dhani	Jaisalmer
17.	Dawara	Fatehgarh			
18.	Achla	Fatehgarh			

Source: Census of India 2011 data

5.4.2 State Profile: Rajasthan

Rajasthan covers an area of 342,239 square kilometres (132,139 sq. mi) or 10.4 percent of the total geographical area of India. It is the largest Indian state by area and the seventh largest by population. Rajasthan shares its border with the Pakistani provinces of Punjab to the northwest and Sindh to the west, along the Sutlej-Indus river valley. Elsewhere it is bordered by five other Indian states, Punjab to the north; Haryana and Uttar Pradesh to the northeast; Madhya Pradesh to the southeast; and Gujarat to the southwest. The details pertaining to other details like, total number of districts, tehsils etc. has been provided below in below.

Figure 5.15 Administrative Structure of Rajasthan



Source: Census of India 2011 data

The State comprises of a population of 3, 42,239 individuals, which is pre-dominantly rural, forming 75.13 % of the State's total population. The sex ratio in the State is 928, which is significantly lower than that of India which stands at 943 females per 1000 males as per census 2011 data.

The literacy rate of Rajasthan is nearly 66.10 %, which is lower than that of the country, at 74.04%. The male literacy rate is relatively higher, at 79.19% while the female literacy rate is 52.12 % which is also lower than the national female literacy rate of 65.46 %.

Table 5.19 Demographic Profile of Rajasthan

Attribute	Number	% of India
Area (sq. km)	3,42,239	10.4
Total population	6,85,48,437	5.66
Males	3,55,50,997	5.77
Females	3,29,97,440	5.66
Sex ratio	928	NA
Percentage of rural Population	75.13	NA
Percentage of urban population	17,048,085	NA
Percentage of SC population	18.51	NA
Percentage of ST population	13.48	NA
Total literacy rate	66.10	NA
Male Literacy rate	79.19	NA
Female Literacy Rate	52.12	NA

Source: Census of India 2011 data

5.4.2.1 District Profile: Jaisalmer

The project is located in Jaisalmer district. The district is located within a rectangle lying between 26°.4' – 28°.23' North parallel and 69°.20'-72°.42' east meridians. It is the largest district of Rajasthan and one of the largest in the country. Jaisalmer is surrounded on the north by Bikaner, on the west & south-west by Pakistan border, on the south by Barmer and Jodhpur, and on the east by Jodhpur and Bikaner districts. The length of international border attached to District is 571 km¹².

Jaisalmer is a part of the Great Indian Thar Desert. Most of the area in the district is barren, undulating with sand dunes and slopes towards the Indus valley and the Runn of Kutchh. There is no perennial river in the district and the groundwater in the district is very low¹³.

Table 5.20 District Profile

Variables	Jaisalmer District
Area (sq. km)	38,401
Total Population	6,69,919
Males	3,61,708
Female	3,08,211
Population Growth (percentage) ¹⁴	31.81
Total Households	1,17,171
Rural Households	1,00,427
Urban Households	16,744
Average Household Size	5.72

¹² <https://jaisalmer.rajasthan.gov.in/content/raj/jaisalmer/en/about-jaisalmer/geographical-and-physical-features.html#> (Accessed on June 30, 2020)

¹³ <https://jaisalmer.rajasthan.gov.in/content/raj/jaisalmer/en/about-jaisalmer/geographical-and-physical-features.html#> (Accessed on June 30, 2020)

¹⁴ Population Growth from year 2001 to 2011

Variables	Jaisalmer District
Sex Ratio ¹⁵	852
Child Sex Ratio (0-6 age)	874
Population density ¹⁶ (sq. km)	17
Total Child Population (0-6 Age)	1,30,463
Male Population (0-6 Age)	69,610
Female Population (0-6 Age)	60,853
Total Literacy Rate ¹⁷ (percent)	57.22
Male Literacy Rate (percentage)	72.04
Female Literacy Rate (percentage)	39.71

Source: Census of India 2011 data

In 2011, Jaisalmer had population of 669,919 of which male and female were 361,708 and 308,211 respectively. In 2001 census, Jaisalmer had a population of 508,247 of which males were 279,101 and remaining 229,146 were females. Jaisalmer District population constituted 0.98 percent of total Maharashtra population. In 2001 census, this figure for Jaisalmer District was at 0.90 percent of Maharashtra population.

There was change of 31.81 percent in the population compared to population as per 2001. In the previous census of India 2001, Jaisalmer District recorded increase of 24.39 percent to its population compared to 1991.

Average literacy rate of Jaisalmer in 2011 were 57.22 compared to 50.97 of 2001. If things are looked out at gender wise, male and female literacy were 72.04 and 39.71 respectively. For 2001 census, same figures stood at 66.26 and 32.05 in Jaisalmer District. Total literate in Jaisalmer District were 308,653 of which male and female were 210,415 and 98,238 respectively. In 2001, Jaisalmer District had 201,960 in its district.

With regards to Sex Ratio in Jaisalmer, it stood at 852 per 1000 male compared to 2001 census figure of 821. The average national sex ratio in India is 940 as per latest reports of Census 2011 Directorate. In 2011 census, child sex ratio is 874 girls per 1000 boys compared to figure of 869 girls per 1000 boys of 2001 census data.

5.4.2.2 Tehsil Profile: Pokhran, Fatehgarh, & Jaisalmer

The three tehsils of Pokhran and Fatehgarh comprise of nearly 85.5 percent of the total population of Jaisalmer district. In terms of SC population, Jaisalmer tehsil has a higher share of 16.64 percent followed by Fategarh tehsil having 16.04 percent. The ST population in the tehsils is highest in Jaisalmer tehsil followed by Fategarh tehsil. In terms of sex ratio, Pokhran tehsil exhibits a relatively higher number of females per 1000 males (878) in comparison to Fatehgarh and Jaisalmer tehsils, which have sex ratio of 836 and 861, respectively.

¹⁵ It is the number of females per 1000 males.

¹⁶ Population Density is a measurement of population per square kilometer

¹⁷ It denotes ability to write a letter in any language. Literacy status assessment made for population 7 years and over.

Table 5.21 Demographic Profile of Tehsil

Attribute	Jaisalmer District	Pokhran Tehsil	Fatehgarh Tehsil	Jaisalmer Tehsil
Population	669919	303662	101020	1,67,698
% of District Population	100	45.33	15.1	25.03
% of SC Population	14.8	14.13	16.04	16.64
% of ST Population	6.3	5.7	6	9.24
Sex Ratio	852	878	836	861
% Total Literacy Rate	57.22	55.68	54.7	55
% Female Literacy Rate	39.71	37.9	35.3	37.50

Source: Census of India 2011 data

5.4.3 Demographic profile

There are a total of 34 villages that fall within 5 km radius of the proposed solar-wind hybrid project. The total population as per 2011 Census of India data is 35259 living in 5867 households. The largest village in terms of population is the village of Sankra. The overall population density of the study area is 27.83 people per square kilometre, which is higher than that of the district.

The table below clearly states that the condition of literacy is very poor in the study area, where Core zone has a literacy rate of 53.45% and Buffer zone has 51.90% literacy rate. Similarly the total vulnerable community, i.e. SC & ST, is 14.16%, having 9.87% SC population and 4.29% ST population. The village wise population details are provided below

Table 5.22 Demographic Profile of Aol

SI No.	Sub District Name	Village Name	Total Households	Total Population of Village	Avg HH Size	Sex Ratio	SC%	ST%	Literacy Rate	Male literacy rate	Female literacy rate
1.	Pokaran	Loona Kalan	69	351	5.09	877	1.99	0.00	48.00	65.75	27.91
2.	Pokaran	Naya Khara	119	776	6.52	902	6.31	3.09	62.30	75.85	47.04
3.	Pokaran	Achalpura	182	978	5.37	831	7.06	0.00	58.40	77.96	33.82
4.	Pokaran	Neran	240	1501	6.25	907	17.52	0.27	57.05	70.91	42.41
5.	Pokaran	Naya Sanawara	195	1102	5.65	813	1.81	12.70	51.23	72.03	25.46
6.	Fatehgarh	Dawara	211	1363	6.46	822	0.00	2.71	57.58	73.50	37.45
7.	Pokaran	Sanawara	304	1947	6.40	811	26.71	0.87	46.50	67.93	20.23
8.	Pokaran	Sadrasar	101	720	7.13	989	5.97	21.11	36.43	56.32	16.18
9.	Pokaran	Amarsar	137	746	5.45	903	14.08	0.00	39.70	58.02	17.95
10.	Pokaran	Motisar	118	700	5.93	862	22.86	0.00	69.30	83.39	52.61
11.	Pokaran	Madhopura	197	1175	5.96	827	0.43	17.28	54.28	74.19	30.94
12.	Pokaran	Madasar	196	1274	6.50	942	25.75	0.16	54.41	73.03	34.69
13.	Pokaran	Lakhasar	67	285	4.25	748	0.00	0.00	68.33	87.22	44.86
14.	Pokaran	Sankra	648	3945	6.09	889	13.08	0.79	54.39	73.66	32.64
15.	Pokaran	Khetasar	256	1701	6.64	754	11.17	0.00	57.68	78.18	31.30
16.	Pokaran	Khuhra	230	1431	6.22	842	3.35	28.72	35.07	55.50	11.89
17.	Fatehgarh	Achla	65	462	7.11	848	0.00	0.00	45.41	68.97	18.54
18.	Pokaran	Bhainsara	377	2063	5.47	854	10.42	0.78	61.72	82.42	36.64
Sub-Total- Core Zone			3712	22520	6.07	855	11.27	4.60	53.45	72.52	31.15
19.	Jaisalmer	Nagon Ki Dhani	81	477	5.89	916	0.00	5.87	65.35	81.50	47.51
20.	Jaisalmer	Sutharon Ki Dhani	1	8	8.00	600	0.00	0.00	62.50	80.00	33.33
21.	Pokaran	Pratappura	95	543	5.72	834	3.13	17.68	69.68	88.13	48.42
22.	Pokaran	Chok	160	748	4.68	820	0.00	0.13	72.89	85.84	57.14
23.	Pokaran	Keraliya	168	1175	6.99	926	0.43	4.51	44.28	59.78	27.80
24.	Pokaran	Dalpatpura	204	1361	6.67	864	0.73	4.34	24.98	34.44	14.00
25.	Pokaran	Rajgarh	227	1338	5.89	658	5.16	5.08	52.68	69.43	27.38
26.	Pokaran	Khelana	107	588	5.50	776	5.10	0.00	50.21	61.80	36.07
27.	Pokaran	Mulasar	60	376	6.27	843	0.00	0.00	53.07	64.02	40.69
28.	Pokaran	Karada	111	756	6.81	929	0.00	0.00	30.61	41.61	18.35
29.	Fatehgarh	Moolana	433	2526	5.83	763	11.01	0.00	54.21	68.62	34.44
30.	Fatehgarh	Mehrajot	105	572	5.45	882	0.00	0.00	50.99	76.02	21.26

SI No.	Sub District Name	Village Name	Total Households	Total Population of Village	Avg HH Size	Sex Ratio	SC%	ST%	Literacy Rate	Male literacy rate	Female literacy rate
31.	Fatehgarh	Lakhaniyon Ki Dhani	56	309	5.52	873	0.00	0.00	68.25	80.88	53.45
32.	Pokaran	Baiteena	185	947	5.12	850	19.22	0.00	62.89	79.76	43.14
33.	Pokaran	Loona Khurd	134	845	6.31	825	41.42	0.00	57.31	77.14	32.35
34.	Fatehgarh	Bhilon Ki Dhani	28	170	6.07	828	0.00	100.00	64.14	83.54	40.91
Sub-Total-Buffer Zone			2155	12739	5.91	819	7.39	3.73	51.90	67.05	33.20
Total (Core+Buffer)			5867	35259	6.01	842	9.87	4.29	52.89	70.51	31.88

Source: Census of India 2011 data

5.4.3.1 Gender Profile

The status of gender with respect to health, diet intake and employment participation¹⁸ is very low at state level, suggesting discrimination towards women, lack of opportunities and limited role in the decision making process.

Similarly at the “Aol” level, it was informed during community consultations that male members of the family often manage market relations, trade or the sale aspects. Although, there are “Self Help Women Groups” in almost all the villages, in spite of that their access to market and mobility is very limited. The Sex Ratio in the Aol is 842 females per thousand males, which is lower than the district sex ratio of 852 (and very less than the national sex ratio of 933).

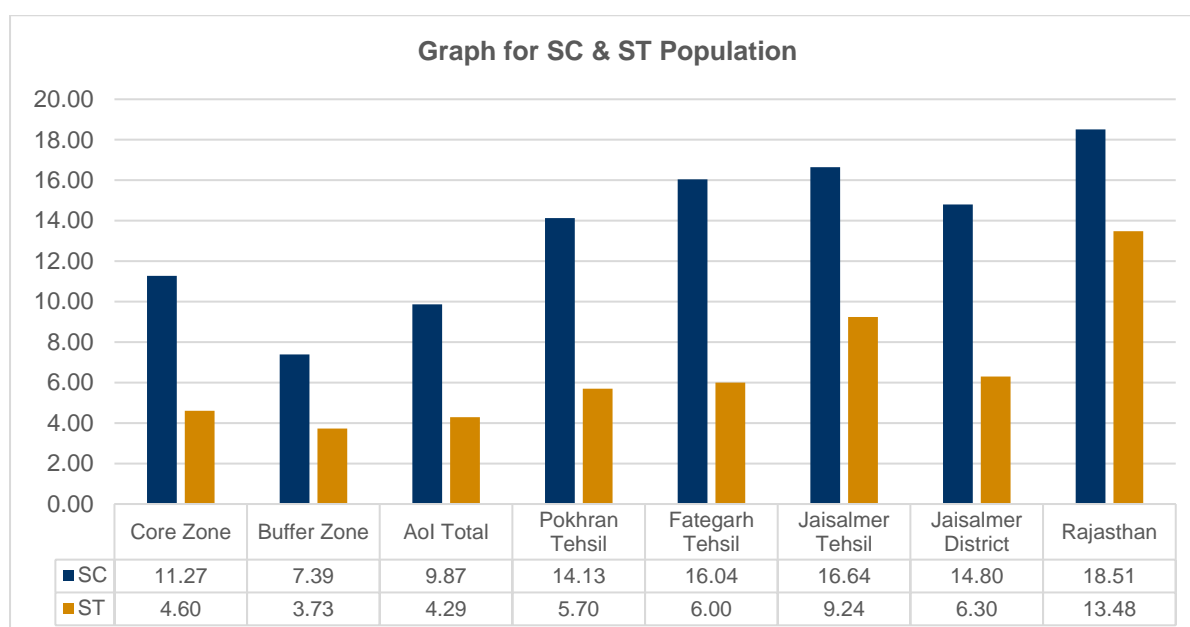
5.4.3.2 Social Stratification

As per community consultations and review of census data, 2011, it has been identified, that the entire “Aol” falls under rural category. The **Figure 5.16**, below clearly states that the SC population in Core zone villages is 11.27%, while in Buffer zone it is 7.39%.

Similarly, the ST population in Core villages is 4.60%, which is comparatively more than 3.73% ST population in Buffer zone villages. The Jaisalmer tehsil has the highest SC population of 16.64%, followed by Fategarh tehsil, having 16.04% SC population. Jaisalmer tehsil has the highest ST population of 9.24%, among three given tehsils.

During consultations, it was informed that the major ST group in the Aol, is Bhil. The livelihood pattern of SC population does not significantly differ from the general community. Further, according to the discussions with the local community, they possess smaller landholdings; however, there is no exact detail, pertaining to landless communities in Core zone villages.

Figure 5.16 Proportion of SC and ST Population in the villages of Aol vis-à-vis Tehsil, District and State



Source: Census of India 2011 data

As per consultations with the local community, there is no caste-based distinction in terms of habitation patterns; the various caste groups reside together in given villages and the caste-based

¹⁸ <https://www.ijcmas.com/7-5-2018/Tanuja%20Jukariya,%20et%20al.pdf>

settlements are homogenous in nature. In addition, there are no differences across the social groups in terms of access to resource and other economic opportunities.

As per the consultation with the local community, the following groups are found in Aol and are presented here in almost the same hierarchical order as they are represented in the Aol:

- **Rajput:** The Rajput caste has the majority of the population in Aol. They are the native caste of Rajasthan. They form the bulk of the cultivators in the village. They belong to the warrior caste. As per the consultation with the local community, in Aol, most of the irrigated land is owned by Rajput.
- **Meghwals:** The Meghwals are primarily found in the north-western parts of India and belong to the Scheduled Caste. Traditionally, they have been a part of the weaver community in India.
- **Suthar:** The Suthar or Sutar is a Hindu caste within the Vishwakarma community of India. They are also found in the province of Sindh in Pakistan. Their traditional occupation is that of carpentry and they are classified as a Scheduled Caste.
- **Dholi:** Dholi (coming from the word Dhol, known as drum) people are a community, indigenous to Rajasthan and are traditionally engaged in music and play drums during weddings and other festive occasions.
- **Bhil:** Bhil are an Indo-Aryan speaking ethnic group in Rajasthan. The livelihood pattern of Bhil population does not significantly differ from the general community.
- **Muslims:** There is a fair share of Muslim community in Aol. As per the consultation with local community there is some proportion of population are Muslim population in every village of Aol.

Box 5.1 Bhil Community

In Rajasthan, certain cities are named after the Bhil Kings who once ruled the region. Kota, for instance got its name from Kotya Bhil; Bansara is derived from Bansiya Bhil; and Dungarpur is named after Dungariya Bhil¹⁹.

The Bhil tribe makes up 39% of the total tribal population of Rajasthan and is the largest tribe in South Asia. Classified in two groups, there are Eastern or Rajput Bhils and the central or pure Bhils²⁰.

Agriculture, animal husbandry and poultry is main source of income, other source are farming and labour. These people occasionally involving in robbery, and theft because of poverty they possess known as agricultural equipments, and also known is aware of repairing them. Gum, ayurvedic medicines and honey also collected by these people, and sell these products to generate income. Their economic situation also very horrible because the area of agricultural land is small and number of people in family is more and this land area is divided among these communities. Thus each member got only small piece of land for cultivation. Therefore each family is under the pressure of debt, and other than kharif crop there is no their organized business available to increase their income consequently, their per capita income is also very low. In this tribe barter system of market is famous for purchase of the good and businessperson make fool them and take advantage due to their ignorance. In their society there is lot of ill practices as- throwing from the society & the drinking, feast on the occasion of the death etc. these things also responsible for the poverty among this tribe. Animal husbandry is also source of income in these people.

5.4.4 Land use pattern

The land use in the Aol could be broadly defined by the following categories: agricultural, cultural wasteland, forest and barren land. The **Figure 5.17**, denotes that out of the total geographical area of 126679.45 hectares, nearly 42% is Net sown area, while 29% is culturable waste land. These two categories of land accounts for nearly 71% of land in the Aol.

Rest, 6% is permanent pastures & grazing land; as per consultations, there is a huge dependency of local community on this land category. As understood, there is a huge cattle population in the area,

¹⁹ <http://ignca.gov.in/divisionss/janapada-sampada/tribal-art-culture/adivasi-art-culture/the-bhils-of-rajasthan/>

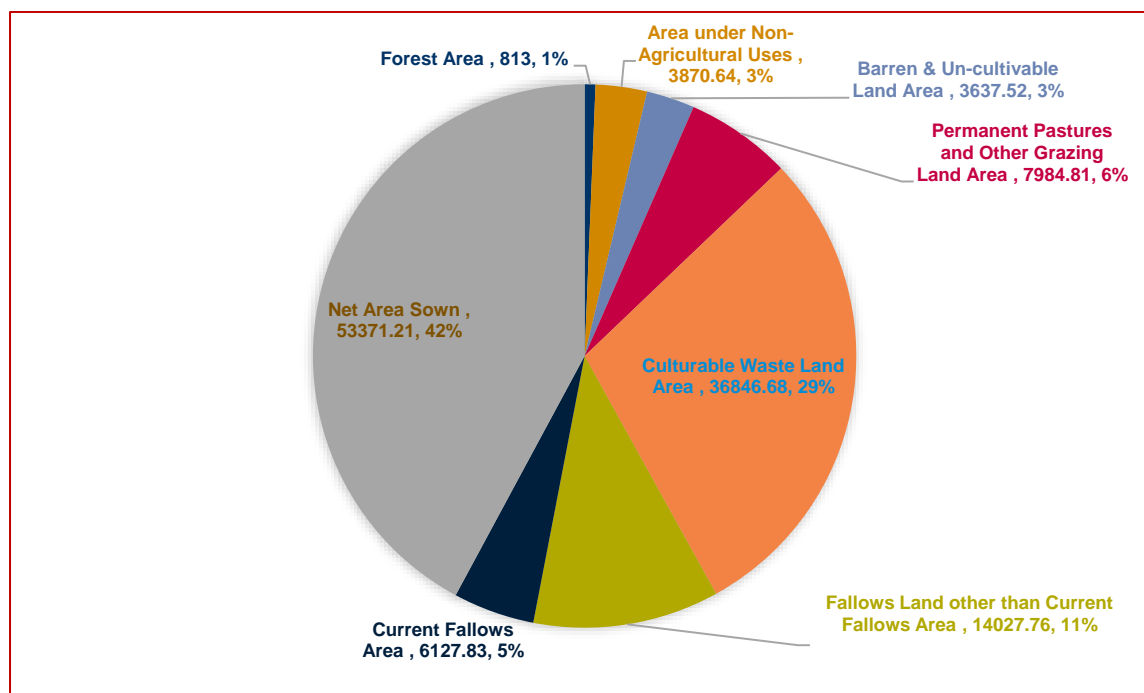
(Accessed on July 01, 2020)

²⁰ <https://www.ohmyrajasthan.com/bhil-tribe-rajasthan> (Accessed on July 01, 2020)

especially bovine animals. Their fodder requirement is mostly met through these government grazing land parcels.

In addition to the above land categories, there is 1% of forestland cover in the AoI, 3% is barren land, 5% current fallows land and 3% land area which is under non-agricultural usage.

Figure 5.17 Land Use in the AoI



Source: Census of India 2011 data

5.4.4.1 Land holding Pattern

At the outset, it is important to state that the landholdings are typically large in the core area, in comparison to buffer zone, as informed during community consultations. As the AoI has 29% culturable waste land, 5% fallows land, 3% under non-agricultural usage and barren un-cultivable land respectively, a land holding of 7-8 hecatres would not of much significance as the soil quality and lack of access to irrigation water renders the holdings less productive as far as income generation is concerned.

In Villages like Loona Kalan, Neran and Madhopura, where detailed community consultations were held with identified land-owners and other participants from local community, it was informed that nearly everyone present in the meeting had 20- 150 Acres of land holding. The identified landowners further added that they will have sufficient land left with them, even after giving land on lease for project.

During consultation in Madhopura & Neran, people from SC & ST community informed that there were 10-12 landless households in village from their community, who have been given 37.5 Bigha (i.e. 15 Acre) of land on “patta” for 99 years by District authority and Gram Panchayat. As informed, there are few “Patta owners” also among the identified landowners who will lease their land for the upcoming project.

The same pattern of land-holdings were identified in other villages also, of the Core zone. As per consultation, people have sufficient land holding and there is no landless household; however lack of water for irrigation and rainfall result in low productivity or often draught like situation. In off-seasons,

local community is left with no other option than to migrate or work as labours, irrespective of their land-holdings.

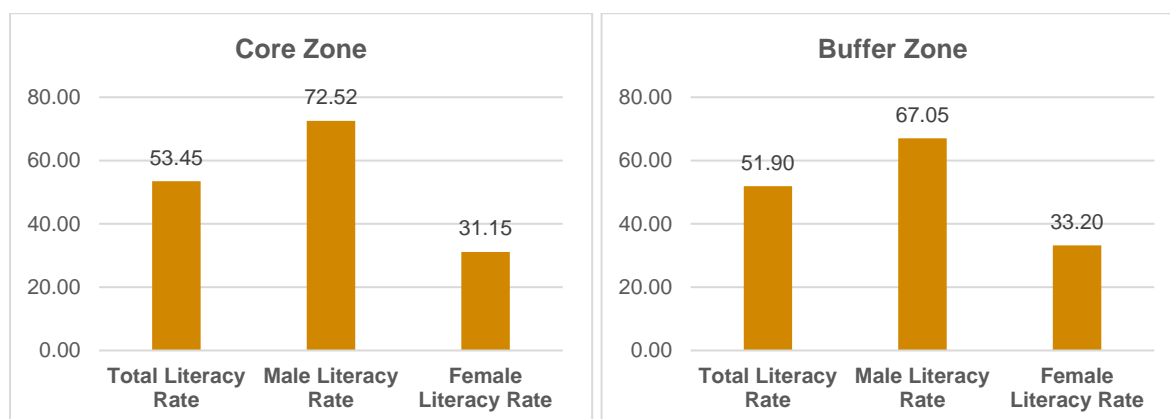
5.4.5 Literacy Profile

The literacy rates are almost equally low at all three levels, District, block and Aol; however, relatively, the male literacy rate in Core zone villages is little higher at 72.52%. The female literacy rates are significantly low, i.e. 31.15% in Core zone villages and 33.20 in Buffer zone villages.

The community consultations suggest that the girls are not given equal opportunities to study, as boys. The other reasons behind the low female literacy rate are, unavailability of higher education schools in the village, engagement of girls in household work/ chores, “*purdah*” system, early marriages and local doesn’t prefer girls to send them far away from the villages to study, which results as a low academic qualification and high dropout rate among girls.

The boys usually complete school education and those belonging to financially affluent families go for higher education, graduate courses in colleges or join technical courses like Industrial Training Institutes (ITI) in Pokhran, Jodhpur & Jaislamer; while rest are engaged in enconomic activities to support their family.

Figure 5.18 Comparative overview of the Literacy Rate in Study Area (in %)



Source: Census of India 2011 data

5.4.6 Livelihood Profile

Based on the 2011 Census data, the total working population in the Aol is 43.07%. Out of the total working population, 47.78% is categorised as main workers ((i.e. those who have worked for a period of 6 months); and remaining 52.22% are marginal workers (i.e. those who have not worked for a period of 6 months). The proportion of cultivators and agricultural labourers is 78.89%. Being a low-rainfall, arid region, the agricultural productivity is relatively lower than other parts of the state of Rajasthan. There is a significant proportion of population as other workers (18.74%), those engaged in some economic activity, but are not cultivators or agricultural labourers or in household industry. This indicates that the local working population is also finding employment in sectors such as industries, trades and services. As informed during site consultations, a sizeable proportion of local community, are employed in nearby villages and cities as security guards (at Suzlon Power project in Loona Khurd and nearby villages), carpenters, construction labours, labourers in stone crushing plants, local cement plants, small entrepreneurs and some owned petty shops; animal husbandry has a considerable percentage as well. The **Table 5.23** lists the working population in the study area.

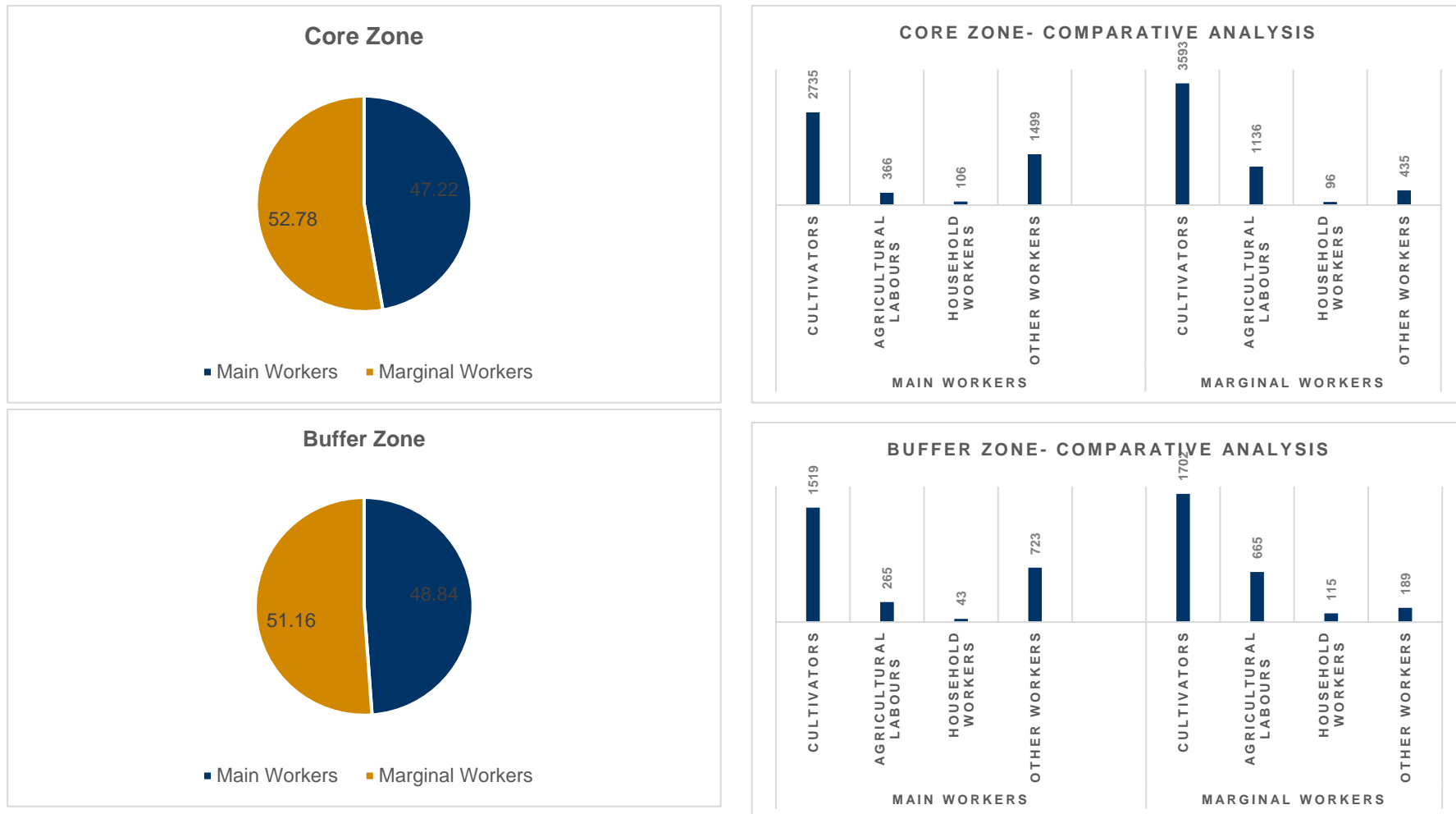
Table 5.23 Working Population in Study Area

SI No.	Sub District Name	Village Name	Total Workers	Total Main Workers	Cultivators	Agricultural Labours	HH Workers	Other Workers	Total Marginal Workers	Cultivators	Agricultural Labours	HH Workers	Other Workers
1	Pokaran	Loona Kalan	176	146	140	1	0	5	30	10	20	0	0
2	Pokaran	Naya Khara	406	185	143	16	0	26	221	185	8	0	28
3	Pokaran	Achalpura	466	316	272	0	0	44	150	93	55	2	0
4	Pokaran	Neran	545	151	4	7	5	135	394	47	154	1	192
5	Pokaran	Naya Sanawara	469	218	104	18	7	89	251	167	65	6	13
6	Pokaran	Bhainsara	920	270	167	24	19	60	650	394	246	1	9
7	Pokaran	Sanawara	911	453	273	0	0	180	458	444	1	0	13
8	Pokaran	Sadrasar	235	208	123	19	3	63	27	2	17	0	8
9	Pokaran	Amarsar	375	8	2	0	1	5	367	207	153	3	4
10	Pokaran	Motisar	387	14	11	1	1	1	373	223	77	4	69
11	Pokaran	Madhopura	581	135	57	4	5	69	446	354	54	0	38
12	Pokaran	Madasar	571	181	159	4	2	16	390	234	145	2	9
13	Pokaran	Lakhasar	149	104	92	0	6	6	45	0	1	44	0
14	Pokaran	Sankra	1554	1046	414	238	19	375	508	422	56	3	27
15	Pokaran	Khetasar	1000	556	440	20	33	63	444	372	56	6	10
16	Pokaran	Khuhra	641	322	166	4	0	152	319	310	3	0	6
17	Fatehgarh	Achla	222	101	0	2	0	99	121	119	1	1	0
18	Fatehgarh	Dawara	358	292	168	8	5	111	66	10	24	23	9
Sub Total			9966	4706	2735	366	106	1499	5260	3593	1136	96	435
19	Jaisalmer	Nagon Ki Dhani	216	129	86	13	1	29	87	3	0	0	84
20	Jaisalmer	Sutharon Ki Dhani	6	3	0	0	0	3	3	0	0	0	3
21	Pokaran	Pratappura	51	46	8	0	0	38	5	2	0	0	3
22	Pokaran	Chok	359	168	93	12	1	62	191	169	13	0	9
23	Pokaran	Keraliya	444	183	69	8	1	105	261	24	106	109	22
24	Pokaran	Dalpatpura	762	45	30	12	0	3	717	347	369	0	1
25	Pokaran	Rajgarh	549	61	23	0	2	36	488	391	61	4	32
26	Pokaran	Khelana	271	271	246	18	0	7	0	0	0	0	0
27	Pokaran	Mulasar	200	28	20	2	0	6	172	144	28	0	0
28	Pokaran	Karada	415	39	34	2	0	3	376	355	20	1	0
29	Pokaran	Loona Khurd	369	145	88	15	0	42	224	164	56	1	3

SI No.	Sub District Name	Village Name	Total Workers	Total Main Workers	Cultivators	Agricultural Labours	HH Workers	Other Workers	Total Marginal Workers	Cultivators	Agricultural Labours	HH Workers	Other Workers
30	Pokaran	Baiteena	231	229	173	31	1	24	2	0	2	0	0
31	Fatehgarh	Mehrajot	257	244	126	2	3	113	13	0	0	0	13
32	Fatehgarh	Lakhaniyon Ki Dhani	133	44	5	0	0	39	89	87	2	0	0
33	Fatehgarh	Moolana	906	870	477	150	34	209	36	14	3	0	19
34	Fatehgarh	Bhilon Ki Dhani	52	45	41	0	0	4	7	2	5	0	0
Sub Total			5221	2550	1519	265	43	723	2671	1702	665	115	189
Total			15187	7256	4254	631	149	2222	7931	5295	1801	211	624

Source: Census of India 2011 data

Figure 5.19 Key Occupational Profile Aspects



Source: PCA Data, 2011

The following categories given above comprises of the main occupational activities within the Aol:

- Farm Based Activities: Cultivators, Agricultural Labourers and Livestock rearing;
- Non-farm based activities: Carpenters, Contract Labourers in graphite mining, stone crushing plants and petty shops.

At the time of impact assessment, some WTGs of Suzlon and Photon were in operational stage, while other wind projects of clients like, Inox, Eden Solar etc. were in land procurement and planning stage. People during consultation in Loona Kalan informed, that nearly 25 people from their villages and Loona Khurd, have been engaged as security guards at Suzlon power project in Loona Khurd and nearby areas and 10 people from their village have been engaged as security guard at Photon power project.

5.4.6.1 Farm Based Livelihood

Agriculture and allied occupations form the major source of income and livelihood for the households in the study area. The proportions of cultivators and agricultural labourers account for 72.18%; and have been discussed in the section above. Given below is the figure for both barren and cultivated land in the Aol.

- Bajra and Guar are the main Kharif crops. These crops are almost entirely rain fed. Due to lack of irrigation facilities and limited rainfall in winter season, mainly, kharif crop is obtained in the region;
- *Moong* (pulses) and *Jeera* (cumin seeds) are the two main Rabi crops in the Aol villages;
- Crops and productivity are entirely irrigation based, households with adequate water resources and access to water resources, are able to grow Rabi crops. Main Rabi crops are wheat and vegetables.

Figure 5.20 Barren & Cultivated agricultural fields in the Aol



Source: ERM Site Visit July 2020

Data provided in the figure above, shows that, in agriculture sector, a higher proportion of workers are engaged as agricultural labourers in both main and marginal workers category. This is because there are very limited employment opportunities in the area and people own or have option to work as cultivator or in its allied activities.

The table given below gives a detailed insight of the productivity of crops in the area and its market rate.

Table 5.24 Productivity and related costing of major cash crop in AoI

Crop	Agricultural Season	Costing per acre	Production per acre	Price per quintal
Bajra	June-October (Monsoon)	800-850	50 Kg (at the time of low rain) 4 quintals (at the time of good rain)	1,700-2000
Guar	June-October (Monsoon)	1750-2000	50 Kg (at the time of low rain) 4 quintals (at the time of good rain)	3500-4000
Jeera	November-January	4000-5000	1.5 to 2 quintals	15,000 to 20,000

Source: Community Consultations undertaken by ERM India, July 2020

The agriculture-based livelihood category comprises of cultivator, sharecroppers and agriculture labours. The agriculture in the study area is dependent on monsoons and rain water for agriculture. Agricultural production is highly dependent on adaptable climatic conditions. The area enjoys a sub-tropical monsoon climate that is characterized by seasonal rainfall, moderate temperature and humidity. Temperature, rainfall and other parameters collectively play the critical role of crop growth, flowering and fruiting. Bajra, is the major food crop, while Guar and Cumin are the major commercial crops grown in the AoI. The social consultations revealed that in terms of productivity, Bajra is one of the stable cash crops in the region and is cultivated on a mass scale. .

Box 5.2 Constraint of the existing farming system

Climatic Constraints

Irregular Rainfall: The rainfall in the AoI is very irregular. The rains are mostly received as brief showers. Due to irregular rainfall, rain-fed crops suffer from the moisture stress condition at their critical growth stages. Thus climate is the main factor for low yield potential of the region.

Water Resources

There are very limited groundwater resources in the AoI. The minimum depth of 200-300 feet, further the groundwater is highly saline in nature is unsuitable for irrigation. The AoI is not connected with the major dam.

Social Constraints

Migration of farming community for looking at other works

The weakness of the coo-operative rural credit structure

Shortage of agricultural labour

The poor economic condition of farmers

Source: Community Consultation undertaken by ERM India, July 2020

Sharecropping & Agricultural Labour

Sharecropping is understood as an agreement, an informal contract between two parties where one party (usually landless or marginal farmer) works for a landowner in exchange for output (in kind exchange) at whatever ratio agreed upon. Sharecropping system is being followed in the AoI; however mainly on the irrigated land and only among limited families. This is in fact a common form undertaking cultivation in the study area.

The sharecropping system comprises of two individuals, the landowner who provides land for cultivation and the active partner who contributes raw materials in the form of seed inputs, fertilizers and machinery (tractor) and other resources (including labour). Of the total yield, nearly two-thirds share is taken over by the landowner and the farmer retains about one-third of the share. Typically, some of the large landowners allow this form of cultivation to take place.

The small and medium sized landowners cultivate by themselves and employ labourers during the harvest period. The agricultural labourers play an important role during the harvest season all over the

region. The harvesting is usually done within a small period (2-3 days usually). Mostly the labourers are procured from within the village or sometimes even from the neighbouring villages.

5.4.6.2 Non-Farm Based Livelihood

Wage Labour

Though agriculture and allied activities form an important source of livelihood, however they are not sufficient for sustenance of livelihoods in the study area. In particular, across a diverse base of social groups and communities, the land holding pattern and livelihood dependence patterns also vary. As per the census data above, nearly 18.74% workers are engaged in "Other work"; out of which Core Zone has 19.41% workers engaged in Other work while Buffer zone has 17.47% engaged as Other workers. The daily wage rate for men was reported to be INR 400 per day and INR 300- 400 per day for women

As per information, there are also some on-going social infrastructure projects of Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA) in the nearby villages/ locality, where people are given an opportunity to engage as casual labours.

As informed during site consultations, a sizeable proportion of local community, are employed in nearby villages and cities as security guards (at Suzlon Power project in Loona Khurd and nearby villages). People during consultation in Loona Kalan informed, that nearly 25 people from their villages and Loona Khurd, have been engaged as security guards at Suzlon power project in Loona Khurd and nearby areas and 10 people from their village have been engaged as security guard at Photon power project.

People added that the setting up of the Hybrid (Solar-Wind) Power plant in the area is expected to provide employment opportunities, especially in the form of engagement of security personnel at the solar plant site. Community consultations indicated that the youth now prefer working on these plants to agriculture.

Migration

The Aol has limited opportunities and avenues for youth populace. There is a considerable proportion of the youth population, who have to migrate out of village to work. These migrant labourers work in nearby cities like Jaipur, Jodhpur and even states like, Gujarat, Madhya Pradesh and Punjab etc. The migrant workforce usually engages as carpenters, construction labours, labourers in stone crushing plants, graphite mines, local cement plants, small entrepreneurs and some owned petty shops etc.

Animal Husbandry

Animal husbandry plays an important part in the rural economy and is another source of household income. The potential and practice of livestock based livelihoods is, and has been traditionally influenced by the topography of the place, the climate, socio-economic conditions and lifestyle of the people. In addition, the social norms and caste groups also influence the livelihood patterns. The livestock consists of non-descript local varieties of cattle, buffaloes, goats, sheep and camels. A typical household in the project villages has livestock including cows, buffaloes, goats and sheep. Goats and Sheeps are reared for meat, milk, hair and skins in Aol, mainly farming communities as a supplementary income source from milk. Camels and Donkeys are reared for breeding purpose and selling them as load-carrying animals.

Figure 5.21 Livestock in the Core area villages



Source: ERM Site Visit July 2020

During consultation in villages like, Madhopura, Neran and Loona Kalan etc., it was reported that, mostly every village has a dedicated grazing land area, a total of 5242.25 ha land which is 7.27% of the total geographical area of Core zone villages, is used as grazing land.

Also during rainy season or good cropping season, crop products like, husks, crop residues, plant leaves etc. are used as fodder; further, during dry season government aid is given, where cattle from villages are collected at certain point, usually at Gram Panchayat level and fodder is provide to them.

Box 5.3 Government aid for fodder

During community consultation in Neran village, it was informed that currently a camp was organized at Gram Panchayat level by a local Govt. since one month. As per information, 200 cattle/ day are fed at the camp. This camp facility would be provided for the entire dry season.

As a process, cattle owners with herd of cattle from village migrate to nearby camp (aided by government) for entire dry season for survival. In-order to avail the Govt. aid for fodder during dry season, cattle-owners/ farmers have to provide their Aadhar Card and Residential proof details to camp authorities, basis of which they avail the aid.

Source: Community Consultation undertaken by ERM India, July 2020

5.4.6.3 Social and Physical Infrastructure

Drinking Water Supply and Sanitation

In arid/semi-arid regions such as the study area, water scarcity remains one of the most common problems. The drinking water supply sources include main water include tap water, tube wells, open dug wells. Almost all villages in the study area have water supply through Rajasthan government Water Supply Scheme, as informed by the local community every household have water storage tanks at the household level, where they store water coming through Water Supply or through water tankers. The Narmada Water Supply Scheme also supplies water in some parts of the study area.

Figure 5.22 Hand- pump in the Core Area



Source: ERM Site Visit July 2020

It can be observed that 28 villages in the Aol have access to the tank/ pond/ lake water. It is understood that the facility of tubewell/borehole is available in 13 villages and facility of hand pump is available in 27 villages in the AOI. The table indicates that seven villages have access to rivers/ canals in the Aol, out of which 4 are in Core zone. The villages in Core zone which have access to river/ canals are Naya Khara, Sadrasar, Sankra and Khuhra. Further, other sources of water such as spring and others are also available in the AOI.

In arid/semi-arid regions such as the study area, water scarcity remains one of the most common problems. The drinking water supply sources include main water include tap water, tube wells, open dug wells. Almost all villages in the study area have a water supply through overhead tanks and common taps. The Narmada Water Supply Scheme also supplies water in some parts of the study area..

Table 5.25 Source of Water in Aol

SI No.	Villages	Tap Water- Treated +Untreated	Covered & Un-covered Well	Hand Pump	Tube Wells/ Borewells	Spring	River/ Canal	Tank/ Pond/ Lake	Others
1	Loona Kalan	NA	NA	Available	NA	NA	NA	NA	NA
2	Naya Khara	NA	Available	Available	NA	NA	Available	Available	Available
3	Achalpura	NA	Available	Available	NA	NA	NA	NA	NA
4	Neran	Available	NA	Available	Available	NA	NA	Available	NA
5	Naya Sanawara	Available	Available	Available	Available	Available	NA	Available	NA
6	Dawara	NA	NA	Available	Available	NA	NA	NA	Available
7	Sanawara	Available	Available	Available	Available	Available	NA	Available	NA
8	Sadrasar	NA	NA	Available	Available	NA	Available	Available	NA
9	Amarsar	NA	NA	Available	NA	NA	NA	Available	NA
10	Motisar	NA	Available	Available	NA	NA	NA	Available	Available
11	Madhopura	NA	Available	Available	NA	NA	NA	Available	NA
12	Madasar	NA	Available	Available	NA	NA	NA	Available	NA
13	Lakhasar	NA	Available	NA	NA	Available	NA	Available	Available
14	Sankra	Available	Available	Available	Available	NA	Available	Available	Available
15	Khetasar	Available	Available	Available	Available	NA	NA	Available	NA
16	Khuhra	Available	Available	Available	NA	Available	Available	Available	NA
17	Achla	NA	NA	NA	NA	NA	NA	NA	Available
18	Bhainsara	Available	NA	Available	Available	Available	NA	Available	Available
	Core Zone	7	11	16	8	5	4	14	7
19	Nagon Ki Dhani	NA	NA	NA	NA	NA	Available	Available	NA

SI No.	Villages	Tap Water-Treated +Untreated	Covered & Un-covered Well	Hand Pump	Tube Wells/ Borewells	Spring	River/ Canal	Tank/ Pond/ Lake	Others
20	Sutharon Ki Dhani	NA	NA	NA	NA	NA	Available	NA	NA
21	Pratappura	NA	Available	Available	NA	Available	NA	Available	Available
22	Chok	NA	Available	Available	NA	NA	NA	Available	NA
23	Keraliya	Available	NA	Available	Available	NA	NA	Available	Available
24	Dalpatpura	Available	Available	Available	NA	Available	NA	Available	NA
25	Rajgarh	Available	NA	Available	Available	NA	NA	Available	Available
26	Khelana	NA	Available	Available	NA	Available	NA	Available	NA
27	Mulasar	NA	Available	NA	NA	NA	NA	Available	NA
28	Karada	Available	Available	Available	NA	Available	NA	Available	Available
29	Moolana	Available	Available	Available	Available	NA	NA	Available	NA
30	Mehrajot	Available	NA	Available	NA	NA	NA	Available	Available
31	Lakhaniyon Ki Dhani	NA	NA	NA	NA	NA	NA	Available	NA
32	Baiteena	Available	Available	Available	Available	Available	NA	Available	Available
33	Loona Khurd	NA	NA	Available	NA	NA	NA	Available	NA
34	Bhilon Ki Dhani	NA	NA	NA	Available	NA	Available	NA	Available
Buffer Zone		7	8	11	5	5	3	14	7
Total		14	19	27	13	10	7	28	14

Source: Census of India 2011 data

Irrigation

Canals in addition to natural rainwater in Jaisalmer District are the main source of irrigation in the study area. Community consultations in the study area suggest that bore wells and water sourcing through lift-irrigation schemes, wherever possible form the main source of irrigation. As per the Jaisalmer District Contingency Plan, the study area falls in partly safe and partly semi-critical of groundwater availability.

Table 5.26 Sources of Irrigation and the Area Irrigated, Jaisalmer District

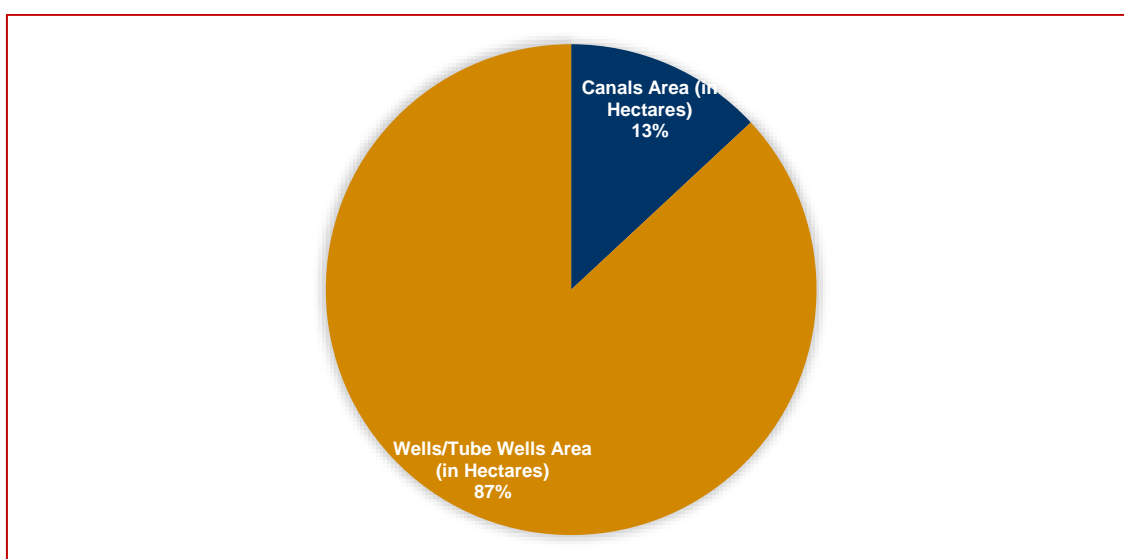
Sources	Number	Area ('000 ha) Gross	% of total irrigated area
Canals		141.6	73.8
Bore wells	30417	50.1	25.8
Lift Irrigation schemes	111	—	—
Other Sources			0.2

Source: Agricultural Contingency Plan, 2016, Jaisalmer District <http://agricoop.nic.in/sites/default/files/RAJ14-Jaiselmer-9.3.2012.pdf>

In the Aol almost 42% of the total geographical area, i.e. 53371.2 ha out of total 126679.45 ha geographical area is net sown area.

As per table above, a total of 73.8% which is 141.6 ('000) ha of net irrigated are is irrigate by canals, 25.8% by borewells and 0.2% by other sources at district level; while at Aol level 87% of the total irrigated area is cultivated by water sourced from wells, tube-wells and rest 13% from canals.

Figure 5.23 Irrigation sources in the study area



Source: Census of India 2011 data

Cooking Fuel

During consultations with the local community in village Pratappura, Loona Kalan etc. it was informed that mostly all the households have LPG (Liquified Petroleum Gas) connections and is one of the important sources of cooking fuel. In addition, people in the Aol also have accessibility to nearby government land and fallow land for dry woods, which is used as fuel for cooking.

In addition, cow dung cakes, dry woods collected from trees nearby (trees. Shrubs near settlement area etc.) are also supplement the requirements of cooking-fuel.

Electricity

All the villages in the Core zone except Naya Khara and Sadrasar have access to household electricity supply for nearly 20- 22 hours. There is usually a power cut for 2-3 hours daily, especially during summers. While, the power supply for agricultural purposes is not available in eight villages namely, Naya Khara, Neran, Sadrasar, Amarsar, Madasar, Lakhasar, Achla and Bhainsara.

Education

Table 5.27 clearly states that there are more educational infrastructures in Core zone than in Buffer zone. There are 23 Govt. primary schools, 11 private pre-primary schoola and 8 private primary schools in Core zone. Aol has total 22 Govt. middle schools, out of which 17 are in Core zone villages also there are five private middle schools, 5 each in core and buffer zone. There are two Govt. senior secondary schools, each in core and buffer zone.

Table 5.27 Educational Infrastructure in Aol

Sl No.	Village Name	Private Pre-Primary School	Govt Primary School	Private Primary School	Govt Middle School	Private Middle School	Govt Secondary School	Private Secondary School	Govt Senior Secondary School
1	Loona Kalan	0	0	0	0	0	0	0	0
2	Naya Khara	1	1	1	0	1	0	0	0
3	Achalpura	1	1	1	0	1	0	0	0
4	Neran	2	1	2	1	0	1	0	0
5	Naya Sanawara	1	1	1	1	0	0	0	0
6	Dawara	0	2	0	2	0	0	0	0
7	Sanawara	1	1	0	1	0	1	0	0

SI No.	Village Name	Private Pre-Primary School	Govt Primary School	Private Primary School	Govt Middle School	Private Middle School	Govt Secondary School	Private Secondary School	Govt Senior Secondary School
8	Sadrasar	0	1	0	0	0	0	0	0
9	Amarsar	0	1	0	0	0	0	0	0
10	Motisar	0	1	0	0	0	0	0	0
11	Madhopura	0	3	0	3	0	0	0	0
12	Madasar	1	1	0	1	0	0	0	0
13	Lakhasar	0	0	0	0	0	0	0	0
14	Sankra	2	2	2	2	2	1	1	1
15	Khetasar	0	3	0	3	0	0	0	0
16	Khuhra	1	2	0	2	0	0	0	0
17	Achla	0	0	0	0	0	0	0	0
18	Bhainsara	1	2	1	1	1	1	0	1
Core Zone		11	23	8	17	5	4	1	2
19	Nagon Ki Dhani	0	0	0	0	0	0	0	0
20	Sutharon Ki Dhani	0	0	0	0	0	0	0	0
21	Pratappura	0	1	0	0	0	0	0	0
22	Chok	1	1	0	0	0	0	0	0
23	Keraliya	1	1	0	1	0	0	0	0
24	Dalpatpura	1	1	1	1	1	0	0	0
25	Rajgarh	1	1	1	1	1	0	1	0
26	Khelana	0	1	0	0	0	0	0	0
27	Mulasar	0	0	0	0	0	0	0	0
28	Karada	0	1	0	0	0	0	0	0
29	Moolana	1	2	1	2	1	1	0	0
30	Mehrajot	0	1	0	0	0	0	0	0
31	Lakhaniyon Ki Dhani	0	0	0	0	0	0	0	0
32	Baiteena	1	1	1	0	1	0	0	0
33	Loona Khurd	1	1	1	0	1	0	0	0
34	Bhilon Ki Dhani	0	0	0	0	0	0	0	0
Buffer Zone		7	12	5	5	5	1	1	0
Aol		18	35	13	22	10	5	2	2

Source: Census of India 2011 data

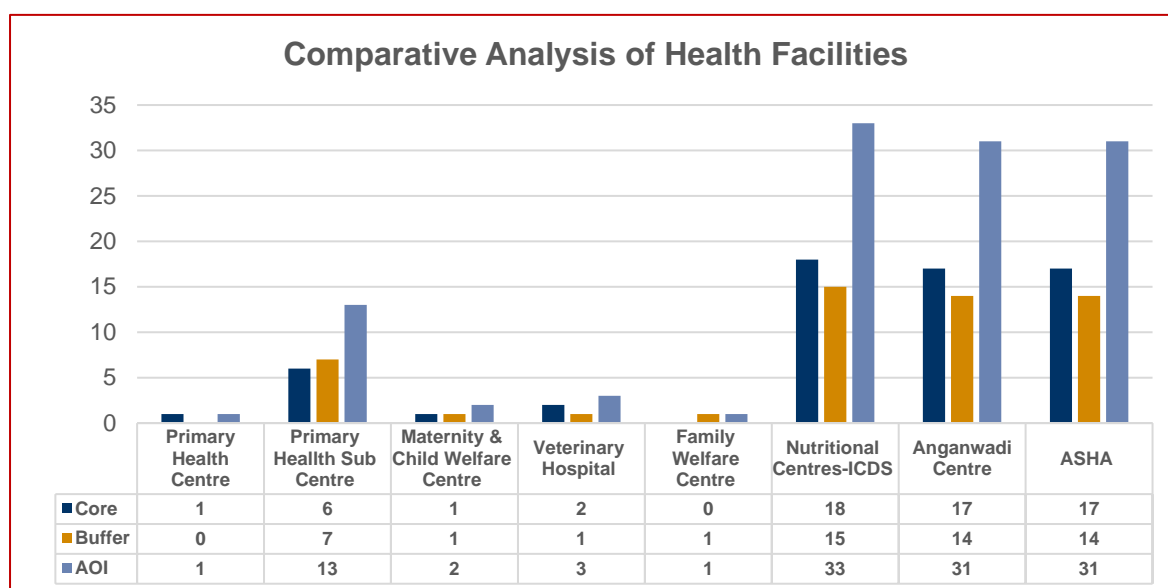
As per the consultation with the local community in village Madhopura, Loona Kalan and Neran; the level of educational attainment and status among male and female are similar until primary level (as every village have a primary school), post which, the level of education among the female declines, due to accessibility restrictions. There are no colleges in villages or nearby areas, boys either live or travel to nearby cities like, Pokhran, Jaisalmer, Jodhpur for higher education.

Health Facilities and Health Seeking Behaviour

In the Core Zone, there is one Primary Health Centre located in Sankra village. In addition, there are six (6) Primary Health Sub-Centres located in Neran, Dawara, Sanawara, Madasar, Sankra and Bhainsara. Sankra has one maternity and child welfare centre. There are no veterinary centre for animal care.

Pokhran and Jaisalmer are the main nearby town for medical care where government hospitals are located. The villagers have to go to Jaisalmer, which is approximately 100 to 120 km away and usually commute by hiring a vehicle. The Auxiliary Nurse Midwife (ANM) guides the women of the villages regularly, and there is high adoption of institutional deliveries in the area, with the provision of Ambulance in the villages to facilitate commutation of women to Government hospital at the time of delivery

Figure 5.24 Number of Health Facility amongst core, buffer and Aol



The figure above presents the details of the health facilities available in the Aol villages. There is no Community Health Centre (CHC) in the study area and only one Primary Health Centres (PHC) in the AOl, which is in Core zone; although, it is understood through the table that there 13 Primary Health sub-centres in the Aol villages.

The figure above also states that there is one Family welfare centre, 33 ICDS centres, 31 Anganwadis and ASHA workers respectively, at Aol level

5.4.6.4 Key Highlights

The socio-economic baseline description in the above section was aimed at entirely capturing the characteristics and social features in the project area. The baseline also in a way was discussed in order to highlight both the strengths and weaknesses in this particular area. The intention was to capture the statistical trends as presented in the secondary data and to capture the descriptive narratives as presented by the community members at the local level and through the voices of the administrative officials who form a bridge between the community and good governance.

Some of the major community concerns in the district and in the study area were witnessed to be:

- Harsh weather and sandy soil;
- Low agricultural productivity;
- Poor education and health indicators;
- Marginalized status of women;
- Unskilled labour force and migration; and
- Lack of drinking water and irrigation facilities.

Most of these have already been discussed in the context to the Aol. The following table provides a summary of the identified areas along with some suggestions of the potential areas to intervene/ support. These however could be taken up in collaboration with any of the NGOs or with the Government. However, it must be noted that these are not isolated problems but are closely interlinked and feed into each other.

The list mentioned below is tentative and can be further improvised through continuous engagement with the communities in the study area.

Table 5.28 Key Needs Identified and Potential Areas of Intervention

Key Areas	Problems/Gaps Identified	Potential Areas of Intervention
Education	<ul style="list-style-type: none"> ■ Low female literacy rates; ■ High drop-out rates among girls after primary/middle school; ■ Lack of high educational infrastuctures, i.e. colleges, ITI training centres etc., within Aol. 	<ul style="list-style-type: none"> ■ Training/Awareness regarding female education; ■ Establishing adult literacy programs (for females); ■ More ITI training institutes should come up in the Aol or nearby areas.
Health	<ul style="list-style-type: none"> ■ Low levels of institutional deliveries; ■ Health centres lack facilities and any equipment; ■ Access constraints: distance from village to medical care facilities; 	<ul style="list-style-type: none"> ■ Awareness programmes at village level; ■ Periodical health camps and check-ups targeting women and children at the village itself to ensure continuous monitoring;
Watershed/ Agriculture	<ul style="list-style-type: none"> ■ Dependence on rain-fed agriculture system; ■ Reliance on single crop; ■ Vulnerability during lean seasons and drought period; ■ Scarcity of pasture and water availability for cattle; 	<ul style="list-style-type: none"> ■ Adopting a watershed approach and enhancing land productivity; ■ Water harvesting/storage structures that can enhance the area under production; ■ Establishing semi-earthen/earthen water harvesting structures; ■ Farm binding work for soil and moisture conservation work; ■ Provision of fodder for livestock
Drinking Water and Toilets	<ul style="list-style-type: none"> ■ Drinking water access and availability for irrigation 	<ul style="list-style-type: none"> ■ Construction of water storage and retention structures; ■ Construction of additional storage tanks and wells
Alternative employment opportunities	<ul style="list-style-type: none"> ■ High unemployment levels among youth; ■ Lack of skilled labour availability in the study area; ■ Lack of adequate employment opportunities other than agriculture/ wage labour; ■ High migration patterns and changing socio-economic dynamics; 	<ul style="list-style-type: none"> ■ Skill training programmes based on promoting agro-allied activities and health care; ■ Aligning livelihood training programs through training in dairy farming, livestock rearing and horticulture; ■ Creating self-employment opportunities;

5.5 Ecology and biodiversity baseline

Primary ecological surveys were undertaken between 6th and 11th July 2020. This section discusses the ecological baseline of the landscape of the Project site based on primary data, secondary resources, publications and ERM's previous experience of working in this landscape for projects of similar nature (Solar and Wind).

5.5.1 Objective

The ecological surveys were undertaken with the following objectives:

5.5.1.1 Flora

- Identification of sensitive habitats, and forest land falling within the determined study areas (core + buffer zone);
- Classification of flora for any threatened, protected or endemic floral species prevailing in the study areas (including wind farm) based on field surveys; and
- Identification of areas protected under international conventions, national or local legislation and those recognized nationally and internationally for their ecological, landscape, cultural or other related value.

5.5.1.2 Fauna

- Identification of fauna (specifically amphibians, birds, mammals and reptiles) based on direct sightings, calls, pug marks, droppings, nests, etc.;
- Identification and classification of any species recognized as threatened (in accordance with the IUCN Red List v 2020-2 and according to the schedules of the Indian Wildlife (Protection) Act 1972 and amendments;
- Identification of areas which are important or sensitive for ecological reasons including their breeding, nesting, foraging, resting, over wintering areas including wildlife migratory corridors /avian migratory routes; and
- Identification and assessment of aquatic ecological resources within the study area.

5.5.2 Approach and methodology

5.5.2.1 Desktop review

A desktop review (published document) was carried out to determine the land use and land cover (Toposheet, Satellite imagery), vegetation type (Champion and Seth, 1968) and floral and faunal species assemblage in the study area. Information provided by developer (WTG location, vital installations) was also considered during desktop review process.

5.5.2.2 Determining study area

To conduct the survey, a core and buffer zone was delineated, so that ecological receptors and impacts on them can be established during the ESIA process. The core and buffer zone is as follows:

- Core Zone: 500 m radius from each of the proposed WTG locations and Solar Plant boundary; and
- Buffer Zone: 5 km radius from each of the proposed WTG/Solar Plant boundary.

The above core and buffer zones were established based on sensitivities identified during desktop review and experience gathered from multiple wind farm ecological assessments carried out by ERM in the last few years.

5.5.2.3 Baseline ecological survey

A baseline survey was carried out to determine the existing ecological conditions and to facilitate an adequate assessment of the project's impacts upon ecology and development of appropriate mitigation measures. The baseline survey has two parts:

(i) Secondary data collection and (ii) Primary data collection

Secondary data collection

Secondary baseline data regarding sensitive ecological habitat (National Park, Sanctuary, Ecological Sensitive Area, Migratory Corridor, habitat of endangered, vulnerable and range restricted species etc.), flora & fauna in the study area, forest cover was collected from reliable sources like published documents, the ENVIS portal on Wildlife and Protected area in India, wetland atlas, IBA etc. Consultations will be carried out with local people during site visit to understand major flora & fauna in the study area, presence of any IUCN v2020-2 listed threatened species and Schedule I species or other species having conservation value and pressures on forest resource. Key consultations were undertaken with:

- Local Communities: on presence of various avifaunal and mammalian species
- Forest Department: on presence of critically endangered species in project area and immediate surroundings

Primary data collection and survey

A. Habitat survey

- Different habitats identified by the desktop review were visited. Data regarding the type and quality of habitat with reference to flora and fauna supported were collected.

B. Floral Survey

- Major floral species in different types of habitats were visually identified using published manuals and recorded.

C. Faunal Survey

- Faunal species from the study area were recorded based on direct sightings, indirect evidences such as dung, droppings, scats, pugmarks, scratch signs, burrows, nests etc. Consultations with local communities were carried out by displaying pictorial representations of species anticipated in the area to confirm whether there have been any recent sightings. The species occurring within the study area were surveyed using the below methods:
- **Amphibians:** Amphibians are often restricted to natural and constructed ponds during the hottest parts of the day²¹. All such water bodies were visited during the hottest parts of the day to determine the presence of amphibians along the shaded ledges of the water body.
- **Reptiles:** Reptile presence were determined through the use of Intensive Time Constrained Search Methods^{22 23}. The method is adapted for the terrain by targeting rocks and logs located around water bodies or recently dried streams, hedges and along the trunks of higher vegetation.
- **Avifauna:** An adapted avifaunal survey method for onshore wind farm assessments was utilized for the purpose of this study²⁴. The adapted survey method focuses on key habitat features, preferred time of day to ensure maximum bird activity and target species (e.g. birds of prey and waterfowl). Any avifaunal species encountered by visually sighting or hearing bird calls was

²¹ Knutson et. al. 2004. Agricultural ponds support amphibian populations. *Ecological Applications*. 14 (3): 669-684

²² Welsh, H.H., jr. 1987. Monitoring herpetofauna in woodlands of north western California and south west Oregon: a comparative strategy. Pp. 203-213. In: Multiple – Use Management of California's hardwood resources. T.R. Plumb, N.H. Pillsbury (eds. Gen. Tech. Regional Environmental Planning. PSW – 100) US Department of Agriculture, Forest Service

²³ Welsh, H.H. Jr. and Lind, A. 1991. The structure of the herpetofaunal assemblage in the Douglas-fir/hardwood forests of northwestern California and south western Oregon. Pp: 395-411. In: Wildlife and vegetation of unmanaged Douglas-fir forests. (Tech. Coords). L.F. Ruggiero, K.B. Aubry, A.B. Carey and M.H. Huff. Ge. Tech. Rep. PNW-GTR-285. Portland, OR: US. Department of Agriculture, Forest Service.

²⁴ Scottish Natural Heritage (SNH). 2014. Recommended bird survey methods to inform impact assessment of onshore wind farms.

recorded. Birds were identified along motorable roads, around water bodies and in clumps of higher vegetation during the hottest parts of the day. Binoculars and standard field guides²⁵ were used for avifaunal identification.

- **Water body survey:** As part of primary survey, major water bodies in a radius of 5 km of the wind farm were identified and visited during the site reconnaissance. The water bodies were visited to determine presence of water and identify activity of the water birds.
- **Mammals:** Mammal surveys were conducted along motorable roads, near water bodies and in grassy terrain. Individuals will be identified through direct (visual sighting) and indirect (pellets, tracks, paw marks and scat) methods. Species were then identified using standard literature.

5.5.3 Habitat assessment

The Study area consists of variety of habitats such as open scrub, grassland, agricultural land. The major habitats are further described below. The habitats present in the Study area are depicted in Figure 5.26.

5.5.3.1 Scrublands and sand dunes

The predominant habitat of the study area is open and dense scrub land interspersed with grasslands (prominent in post monsoon season) along with sand dunes and interdunal plains. The landscape of the Project site is mostly vegetated with the species such as *Prosopis cineraria*, *Acacia nilotica*, *Acacia catechu*, *Acacia senegal* and shrubs of *Salvadora oleoides*, *Capparis decidua*. In the grassland habitats, the species such as *Cenchrus bifloris*, *Cenchrus ciliaris*, *Dactyloctenium aegyptium*, *Aristida funiculata*, *Tragus racemosus*, *Cyperus bulbosus* and *Cymbopogon jwarancusa* can be seen.

5.5.3.2 Agricultural land

The agriculture in the study area is mostly rainfed and mainly undertaken during the post monsoon season. The major crops cultivated here include Pearl millet (*Pennisetum glaucum*), Cluster bean (*Cyamopsis tetragonoloba*), Mustard (*Brassica campestris*) and Isabgol (*Psyllium husk*).

In the agricultural landscape, the species such as *Prosopis cineraria* and *Tecomella undulata*, *Ziziphus nummularia*, *Ziziphus mauritiana*, *Clerodendrum phlomidis*, *Balanites aegyptium*, *Calotropis procera* are found. *Acacia tortilis* is the common species used for plantation and the rehabilitation of Gauchar lands of the region.

5.5.3.3 Aquatic habitat

The only major water body falling within 5 km radius of the Project site was visited during the Site visit to establish the presence of aquatic species in the vicinity of the Project site. The water body is located near Degray Mata Mandir on Devikot road and good amount of activity of migratory birds has been reported from this water body. Consultation with the locals also confirmed the presence of migratory avifaunal species including raptors and Cranes during the winter season.

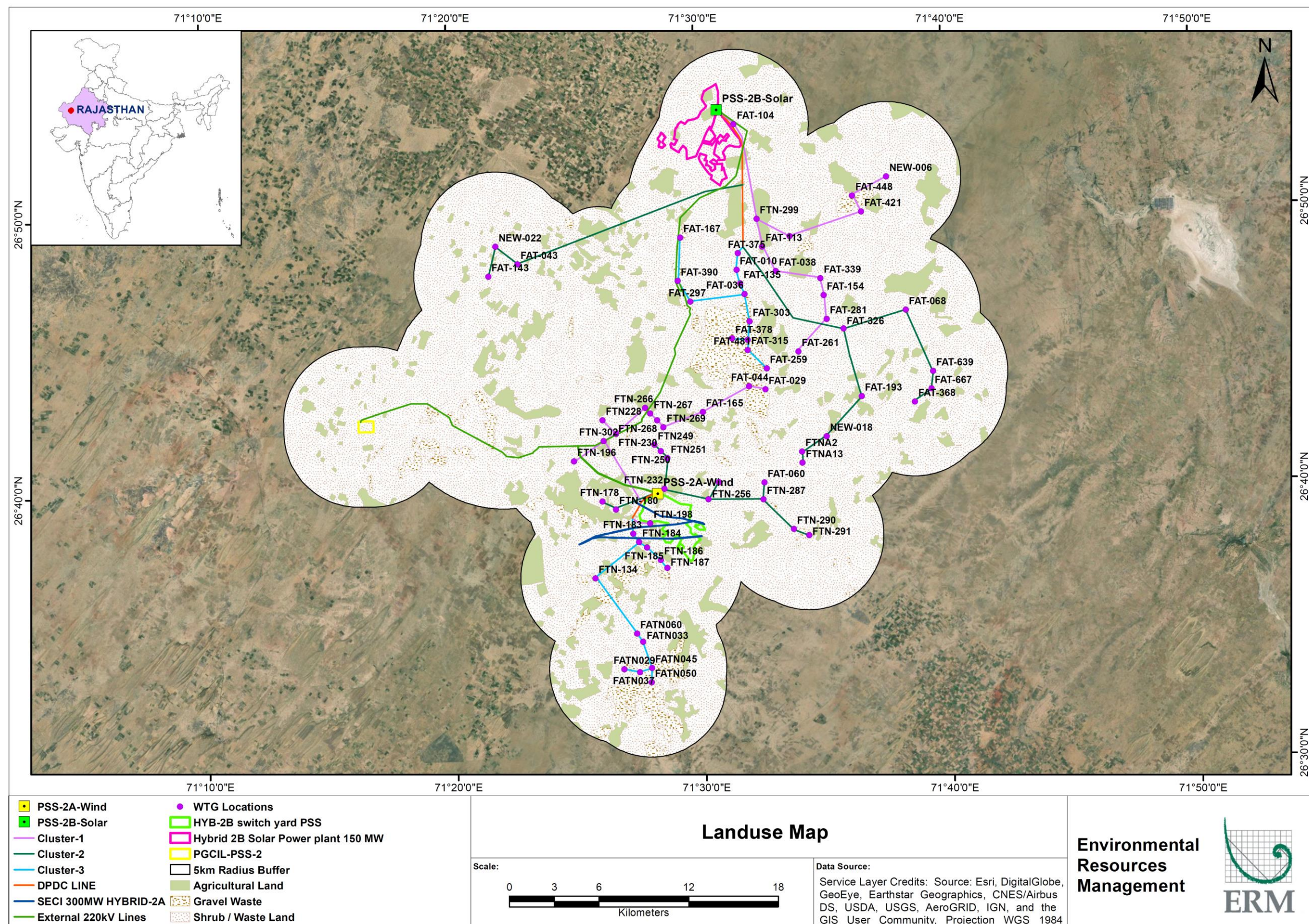
²⁵ Grimmet, R. Inskipp, C. and Inskipp, T. 2013. Birds of the Indian Subcontinent - Second Edition. Published by Christopher Helm, 49-51 Bedford Square, London.

Figure 5.25: Water Body at Degrai Mata mandir in the project area



Source: ERM Site Visit, July 2020

Figure 5.26 Habitats available within the Study Area



5.5.4 Floral Assessment

5.5.4.1 Vegetation type and classification

Vegetation Classification of the habitats within the Study area is discussed hereunder.

Table 5.29 Vegetation Classification of the Area

Classification Scheme	Classification
Biogeographical Province of India ²⁶	3A. Desert-Thar
Agro Ecological Sub Region (ICAR) ²⁷	Western Plain, Kutch and part of Kathiwar Peninsula (Hot arid eco-region)
Agro-Climatic Region (Planning Commission) ²⁸	Western Dry Region- (XIV)
Agro Climatic Zone (National Agricultural Research Project)	Arid Western Zone (RJ-1)

5.5.4.2 Floral Diversity

The list of the floral species observed and reported from this landscape has been provided in **Table 5.30**

Table 5.30 Floral Species Reported from the Landscape

SN	Botanical Name	Local Name
1	<i>Prosopis cineraria</i>	Khejri
2	<i>Tecomella undulata</i>	Rohida
3	<i>Ziziphus mauritiana</i>	Bordi
4	<i>Azadirachta indica</i>	Neem
5	<i>Acacia senegal</i>	Kumat
6	<i>Acacia nilotica</i>	Babool
7	<i>Tamarix aphylla</i>	Faras
8	<i>Cordia myxa</i>	Gonda
9	<i>Capparis decidua</i>	Ker
10	<i>Balanites aegyptiaca</i>	Hingota
11	<i>Salvadora persica</i>	Jal(Khara)
12	<i>Prosopis juliflora</i>	Keekar
13	<i>Choloroxylon swietenia</i>	Giri
14	<i>Leptadenia reticulata</i>	Kheenp
15	<i>Ziziphus zizyphus</i>	Bar
16	<i>Conmiiphora wiglattii</i>	Gugal
17	<i>Ziziphus nummularia</i>	Thar Beri

²⁶ Wildlife Institute of India - ENVIS Centre

²⁷ http://iasri.res.in/agridata//12data%5Cchapter1%5Cdb2012tb1_3.pdf

²⁸ http://iasri.res.in/agridata//12data%5Cchapter1%5Cdb2012tb1_2.pdf

SN	Botanical Name	Local Name
18	<i>Leptadenia pyrotechnica</i>	Kheemp
19	<i>Calligonum polygonoides</i>	Phog
20	<i>Acacia jacquemontii</i>	Banwali
21	<i>Barleria prionitis</i>	Vajradanti
22	<i>Mimosa hamata</i>	Alai
23	<i>Lycium barbarum</i>	Murali
24	<i>Crotalaria burhia</i>	Senia
25	<i>Haloxylon salicornicum</i>	Lana
26	<i>Aerva persica</i>	Bui
27	<i>Tephrosia purpurea</i>	Beyani
28	<i>Cassia auriculiformis</i>	Sonamukhi
29	<i>Lasiurus sindicus</i>	Sewan, Common Grasses
30	<i>Panicum antidotale</i>	Sewan
31	<i>Cenchrus bifloris</i>	Murat
32	<i>Cenchrus ciliaris</i>	Bhurat
33	<i>Dactyloctenium indicum</i>	Dhaman
34	<i>Aristida funiculata</i>	Gandhiya
35	<i>Tragus racemosa</i>	Lamp
36	<i>Cyperus bulbosus</i>	Hiran Chugi
37	<i>Cymbopogon jwarancusa</i>	Moth
38	<i>Aristida mutabilis</i>	Bura
39	<i>Panicum turgidum</i>	Deser Grass

Source: Primary Survey, ERM's previous experience of working in this landscape

5.5.5 Faunal assessment

The faunal assessment was undertaken based on the primary survey and secondary resources including scientific publications, reports, etc. The subsequent sections describe the faunal diversity found in the Study area.

5.5.5.1 Herpetofauna

Minimal activity of herpetofaunal species was observed during the primary survey. Three species were observed in the study area viz. Indian fringe-fingered Lizard (*Acanthodactylus cantoris*), Brilliant Ground Agama (*Trapelus agilis*) and Common Skittering Frog (*Euphlyctis cyanophlyctis*). A total of eight herpetofaunal species have been reported from this area including seven reptiles and one amphibian species. Four species of lizards are found in this region. Bengal Monitor (*Varanus bengalensis*) is categorised as Least Concern (IUCN LC v 2020-2) and listed under Schedule I of Wildlife (Protection) Act 1972 (IWPA). While Spiny-tailed Lizard (*Saara hardwickii*) is listed under Schedule II of IWPA.

All the other recorded and reported herpetofaunal species are either Least Concern or not evaluated and not listed under IWPA. (Refer Table 5.31)

Table 5.31 Herpetofaunal Species reported from Study Area

SN	Family	Common Name	Scientific Name	IUCN Status (v 2020-2)	IWAP 1972 Schedule	Source
1	Agamidae	Brilliant Ground Agama	<i>Trapelus agilis</i>	NA	NA	PS
2		Laungwala Long-headed Lizard	<i>Bufo laungwalaensis</i>	NA	NA	SS
3		Spiny Tailed Lizard	<i>Saara hardwickii</i>	NA	II	SS
4	Lacertidae	Indian fringe-fingered Lizard	<i>Acanthodactylus cantoris</i>	NA	NA	PS
5	Varanidae	Bengal Monitor	<i>Varanus bengalensis</i>	LC	I	SS
6	Viperidae	Russell's Viper	<i>Daboia russelii</i>	LC	IV	SS
7		Saw-scaled viper	<i>Echis carinata</i>	LC	IV	SS
8	Dicroglossidae	Common Skittering Frog	<i>Euphlyctis cyanophlyctis</i>	LC	NA	PS

Note: NA: Not Assessed, LC: Least Concern; PS: Primary Survey, SS: Secondary Sources
Secondary sources²⁹

Primary sources: Primary survey, Community consultations and ERM's previous experience of working in this landscape

Figure 5.27 Herpetofaunal Species observed in the Study Area



Indian Fringe-toed Lizard



Common skittering frog



Brilliant Ground Agama

²⁹ Management Plan of Desert National Park







5.5.5.2 Avifauna

This section discusses the avifaunal diversity recorded and reported from the Study area. Based on the primary survey, available secondary data and ERM's previous experience of working in this landscape, a total of about 80 species of birds have been reported from this area.

Key points about the avifaunal diversity of the landscape have been presented below:

- Primary survey recorded 32 bird species belonging to 13 families;
- **Two threatened** species viz. Endangered (IUCN EN v. 2020-2) Egyptian Vulture (*Neophron percnopterus*) and Vulnerable (IUCN VU v. 2020-2) Tawny Eagle (*Aquila rapax*) were observed in the Study area;
- Five IWPA **Schedule I** species viz. Black-winged Kite (*Elanus caeruleus*), Egyptian Vulture (*Neophron percnopterus*), Tawny Eagle (*Aquila rapax*), White-eyed Buzzard (*Butastur teesa*) and Indian Peafowl (*Pavo cristatus*) were observed during the survey;
- A total of 80 avifaunal species belonging to have been reported from this landscape;
- Four **Critically Endangered** (IUCN CR v 2020-2) species viz. Great Indian Bustard (*Ardeotis nigriceps*) and White-rumped Vulture (*Gyps bengalensis*), Indian Vulture (*Gyps indicus*) and Red-headed Vulture (*Sarcogyps calvus*) have been reported from study area and neighbouring landscape;
- **Endangered** (IUCN EN v 2020-2) Steppe Eagle (*Aquila nipalensis*) has also been reported from this area;
- **Vulnerable** (IUCN VU v 2020-2) Eastern Imperial Eagle (*Aquila heliaca*) and Four Near Threatened (IUCN NT v 2020-2) species viz. Cinereous Vulture (*Aegypius monachus*), River Tern (*Sterna aurantia*), Black headed Ibis (*Threskiornis melanocephalus*) and Eurasian Spoonbill (*Platalea leucorodia*) have been reported to be present in this landscape;
- A total of 15 species reported from this area are listed under **Schedule I** of Indian Wildlife (Protection) Act, 1972 and have been accorded the highest degree protection. A total 22 **migratory** and 56 resident bird species have been reported based on the secondary sources;
- Consultations with the locals confirmed the recent sighting records of Critically Endangered (IUCN CR v. 2020-2) White-rumped Vultures (*Gyps bengalensis*) near the area of Degray Temple situated at about 9.3 km west of WTG FTN-196.
- A visit and consultation at a cow shelter at Bhadariyaji Mata Temple at Bhadariya located at about 20 km north of Project site confirmed that there is a regular movement of Critically Endangered White-rumped Vultures (*Gyps bengalensis*) and Red-headed Vulture (*Sarcogyps calvus*) in this landscape. The staff and workers at the cow shelter revealed that the Vultures visit in flocks of hundreds of birds to feed upon the cattle carcasses and activity is mostly restricted to winter season.

Figure 5.28 Avifaunal Species observed in the Study Area

	
Egyptian Vulture	Laggar Falcon
	
White-eyed Buzzard	Tawny Eagle
	
Red-naped Ibis	Indian Courser



Little Grebe at Nest



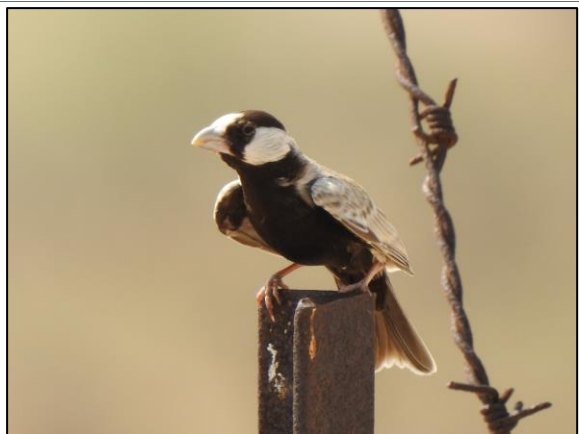
Indian Cormorant



Eurasian Coot



Indian Pond Heron



Black-crowned Sparrow Lark



Rufous-tailed Lark

Table 5.32 Avifaunal Species Reported from the Landscape

SN	Family	Common Name	Scientific Name	Migratory Status	IUCN Status (v 2020-2)	IWPA 1972 Schedule	Source
1	Accipitridae	Black winged Kite	<i>Elanus caeruleus</i>	R	LC	I	PS
2		Cinereous Vulture	<i>Aegypius monachus</i>	M	NT	IV	SS
3		Egyptian Vulture	<i>Neophron percnopterus</i>	R	EN	I	PS
4		Eurasian Griffon	<i>Gyps fulvus</i>	M	LC	IV	SS
5		Eastern Imperial Eagle	<i>Aquila heliaca</i>	M	VU	I	SS
6		Indian Vulture	<i>Gyps indicus</i>	R	CR	I	SS
7		Long legged Buzzard	<i>Buteo rufinus</i>	R	LC	I	SS
8		Red-headed Vulture	<i>Sarcogyps calvus</i>	R	CR	I	SS
9		Shikra	<i>Accipiter badius</i>	R	LC	I	SS
10		Short-toed Snake Eagle	<i>Circaetus gallicus</i>	R	LC	I	SS
11		Steppe Eagle	<i>Aquila nipalensis</i>	M	EN	I	SS
12		Tawny Eagle	<i>Aquila rapax</i>	R	VU	I	PS
13		White-eyed Buzzard	<i>Butastur teesa</i>	R	LC	I	PS
14		White-rumped vulture	<i>Gyps bengalensis</i>	R	CR	I	SS
15	Alaudidae	Ashy crowned Sparrow Lark	<i>Eremopterix griseus</i>	R	LC	IV	PS
16		Black-crowned Sparrow Lark	<i>Eremopterix nigriceps</i>	R	LC	IV	PS
17		Crested Lark	<i>Galerida cristata</i>	R	LC	IV	SS
18		Desert Lark	<i>Ammomanes deserti</i>	R	LC	IV	SS

SN	Family	Common Name	Scientific Name	Migratory Status	IUCN Status (v 2020-2)	IWPA 1972 Schedule	Source
19		Greater Hoopoe-Lark	<i>Alaemon alaudipes</i>	R	LC	IV	SS
20		Indian Bushlark	<i>Mirafra erythroptera</i>	R	LC	IV	SS
21		Rufous Tailed Lark	<i>Ammomanes phoenicura</i>	R	LC	IV	PS
22	Anatidae	Common Teal	<i>Anus crecca</i>	M	LC	IV	SS
23		Indian Pond Heron	<i>Ardeola grayii</i>	R	LC	IV	PS
24		Lesser Whistling Duck	<i>Dendrocygna javanica</i>	M	LC	IV	SS
25		Little Grebe	<i>Tachybaptus ruficollis</i>	R	LC	IV	PS
26		Northern Pintail	<i>Anus acuta</i>	M	LC	IV	SS
27		Northern Shoveler	<i>Anus clypeata</i>	M	LC	IV	SS
28	Apodidae	Asian Palm Swift	<i>Cypsiurus balasiensis</i>	R	LC	IV	SS
29		House Swift	<i>Apus nipalensis</i>	R	LC	IV	SS
30	Ardeidae	Great Egret	<i>Casmerodious albus</i>	R	LC	IV	PS
31		Cattle Egret	<i>Bulbulcus ibis</i>	R	LC	IV	PS
32		Grey Heron	<i>Ardea cinerea</i>	R	LC	IV	SS
33		Purple Heron	<i>Ardea purpurea</i>	R	LC	IV	SS
34	Charadriidae	Common-ringed Plover	<i>Charadrius hiaticula</i>	M	LC	IV	SS
35	Columbidae	Blue Rock Pigeon	<i>Columba livia</i>	R	LC	IV	PS
36		Eurasian Collared Dove	<i>Streptopelia decaocto</i>	R	LC	IV	PS
37		Laughing Dove	<i>Spilopelia senegalensis</i>	R	LC	IV	PS

SN	Family	Common Name	Scientific Name	Migratory Status	IUCN Status (v 2020-2)	IWPA 1972 Schedule	Source
38	Coraciidae	Eurasian Roller	<i>Coracias garrulus</i>	M	LC	IV	SS
39	Corvidae	House Crow	<i>Corvus splendens</i>	R	LC	IV	PS
40	Dicruridae	Black Drongo	<i>Dicrurus macrocercus</i>	R	LC	IV	PS
41	Estrildinae	Indian Silverbill	<i>Lonchura malabarica</i>	R	LC	IV	SS
42	Falconidae	Common Kestrel	<i>Falco tinnunculus</i>	M	LC	IV	SS
43		Laggar Falcon	<i>Falco jugger</i>	R	NT	IV	PS
44	Glareolidae	Indian Courser	<i>Cursorius coromandelicus</i>	R	LC	IV	PS
45	Gruidae	Demoiselle Crane	<i>Anthropoides virgo**</i>	M	LC	IV	SS
46	Laniidae	Long tailed Shrike	<i>Lanius schach</i>	R	LC	IV	SS
47		Southern Grey Shrike	<i>Lanius meridionalis</i>	R	LC	IV	SS
48	Leiothrichidae	Large Grey Babbler	<i>Turdoides malcolmi</i>	R	LC	IV	SS
49	Meropidae	Blue tailed Bee-eater	<i>Merops philippinus</i>	R	LC	IV	SS
50		Blue-cheeked Bee-eater	<i>Merops persicus</i>	R	LC	IV	SS
51		Small Green Bee-eater	<i>Merops orientalis</i>	R	LC	IV	PS
52	Motacillidae	White Wagtail	<i>Motacilla alba</i>	R	LC	IV	SS
53	Muscicapidae	Humes Wheatear	<i>Oenanthe albonigra</i>	R	LC	IV	SS
54		Indian Robin	<i>Saxicoloides fulicatus</i>	R	LC	IV	PS
55		Pied Bush Chat	<i>Saxicola caprata</i>	R	LC	IV	SS
56	Nectariniidae	Purple Sunbird	<i>Nectarinia asiatica</i>	R	LC	IV	PS

SN	Family	Common Name	Scientific Name	Migratory Status	IUCN Status (v 2020-2)	IWPA 1972 Schedule	Source
57	Otididae	Great Indian Bustard	<i>Ardeotis nigriceps</i>	R	CR	I	SS
58	Passeridae	House Sparrow	<i>Passer domesticus</i>	R	LC	IV	PS
59		Chestnut-shouldered Bush-sparrow	<i>Gymnoris xanthocollis</i>	R	LC	IV	PS
60	Phasianidae	Grey Francolin	<i>Francolinus pondicerianus</i>	R	LC	IV	PS
61		Indian peafowl	<i>Pavo cristatus</i>	R	LC	I	PS
62	Pteroclididae	Spotted Sandgrouse	<i>Pterocles senegallus</i>	M	LC	IV	SS
63		Chestnut-bellied Sandgrouse	<i>Pterocles exustus</i>	R	LC	IV	PS
64	Pycnonotidae	Red-vented Bulbul	<i>Pycnonotus cafer</i>	R	LC	IV	PS
65		White-eared Bulbul	<i>Pycnonotus leucotis</i>	R	LC	IV	PS
66	Rallidae	Common Coot	<i>Fulica atra</i>	M	LC	IV	PS
67	Recurvirostridae	Black Winged Stilt	<i>Himantopus himantopus</i>	R	LC	IV	SS
68	Scolopacidae	Common Sandpiper	<i>Actitis hypoleucos</i>	M	LC	IV	PS
69		Green Sandpiper	<i>Tringa ochropus</i>	M	LC	IV	SS
70		Wood Sandpiper	<i>Tringa glareola</i>	M	LC	IV	SS
71	Sternidae	River Tern	<i>Sterna aurantia</i>	R	NT	IV	SS
72		Common Myna	<i>Acridotheres tristis</i>	R	LC	IV	PS
73		Rosy Starling	<i>Pastor roseus</i>	M	LC	IV	SS
74	Sylviidae	Lesser Whitethroat	<i>Sylvia curruca</i>	M	LC	IV	SS
75	Threskiornithidae	Black headed Ibis	<i>Threskiornis melanocephalus</i>	R	NT	IV	SS

SN	Family	Common Name	Scientific Name	Migratory Status	IUCN Status (v 2020-2)	IWPA 1972 Schedule	Source
76		Eurasian Spoonbill	<i>Platalea leucorodia</i>	M	NT	I	SS
77		Red-naped Ibis	<i>Pseudibis papillosa</i>	R	LC	IV	PS
78	Turdidae	Black Redstart	<i>Phoenicurus ochruros</i>	M	LC	IV	SS
79		Desert Wheatear	<i>Oenanthe deserti</i>	M	LC	IV	SS
80	Upupidae	Common Hoopoe	<i>Upupa epops</i>	R	LC	IV	SS

Note: M: Migratory, R: Resident. LC: Least Concern, NT: Near Threatened, VU: Vulnerable, EN: Endangered CR: Critically Endangered, PS: Primary Survey, SS: Secondary Source
Secondary Sources^{30 31 32 33}

Primary sources: Primary survey, Community consultations and ERM's previous experience of working in this landscape

³⁰ Habitat improvement and conservation breeding of the Great Indian Bustard: An Integrated Approach. Annual Progress Report II.

³¹ eBird.com

³² Management Plan of Desert National Park

³³ 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

5.5.5.3 Mammals

The primary survey recorded the presence of three mammalian species in the Study area including Nilgai (*Boselaphus tragocamelus*), Chinkara (*Gazella bennettii*) and Indian Desert Gerbil (*Meriones hurrianae*). A total 18 mammalian species belonging to 11 families have been reported from this region. None of the species is categorised as threatened by IUCN. However, four species viz. Blackbuck (*Antelope cervicapra*), Chinkara (*Gazella bennettii*), Caracal (*Caracal caracal*) and Asiatic Wild Cat (*Felis sylvestris*) are listed under Schedule I of Indian Wildlife (Protection) Act, 1972 and have been accorded the highest degree protection. A list of the species observed and reported is provided in **Table 5.33**.

Table 5.33 Mammalian Species Reported from the Landscape

SN	Family	English Name	Scientific Name	IUCN Status (v 2020-2)	IWAP 1972 Schedule	Source
1	Bovidae	Blackbuck	<i>Antelope cervicapra</i>	LC	I	SS
2		Chinkara	<i>Gazella bennettii</i>	LC	I	PS
3		Nilgai	<i>Boselaphus tragocamelus</i>	LC	III	SS
4	Canidae	Golden Jackal	<i>Canis aureus</i>	LC	II	SS
5		Indian Fox	<i>Vulpes benghalensis</i>	LC	II	SS
6		White footed Desert Fox	<i>Vulpes vulpes</i>	LC	II	SS
7	Emballonuridae	Naked-rumped Tomb Bat	<i>Taphozous nudiventris</i>	LC	V	SS
8	Erinaceidae	Indian Hedgehog	<i>Paraechinus micropus</i>	LC	IV	SS
9	Felidae	Caracal	<i>Caracal caracal</i>	LC	I	SS
10		Asiatic Wild Cat	<i>Felis sylvestris</i>	LC	II	SS
11	Herpestidae	Grey Mongoose	<i>Herpestes edwardsii</i>	LC	II	SS
12	Leporidae	Indian Hare	<i>Lepus nigricollis</i>	LC	IV	SS
13	Muridae	Indian Desert Gerbil	<i>Meriones hurrianae</i>	LC	IV	PS
14	Pteropodidae	Indian Flying Fox	<i>Pteropus giganteus</i>	LC	V	SS
15	Rhinopomatidae	t	<i>Rhinopoma microphyllum</i>	LC	V	SS
16		Lesser Mouse-tailed Bat	<i>Rhinopoma hardwickii</i>	LC	V	SS
17	Soricidae	Asian House Shrew	<i>Suncus murinus</i>	LC	NA	SS
18	Viverridae	Small Indian Civet	<i>Viverricula indica</i>	LC	II	SS

Note: LC: Least Concern, NA: Not Assessed; PS: Primary Survey, SS: Secondary Sources
Secondary sources ³⁴

Primary sources: Primary survey, Community consultations and ERM's previous experience of working in this landscape

³⁴ Management Plan of Desert National Park

Figure 5.29 Mammalian Species and Signs observed in the Study Area



Chinkara



Nilgai

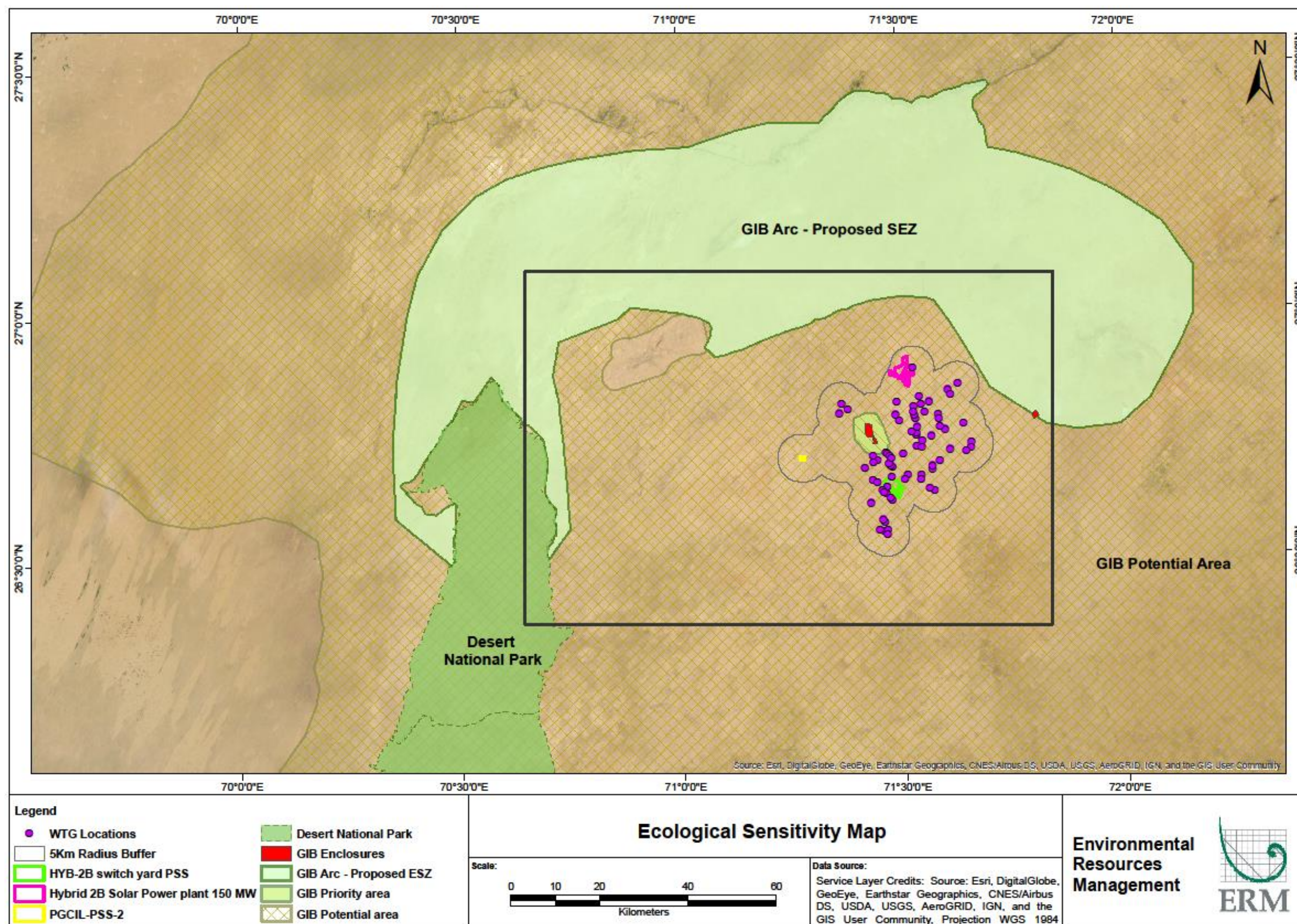


Burrows of Indian Desert Gerbil

5.5.6 Ecologically Significant Areas

There are no Protected Areas (PA) or Important Bird Area (IBA) within 5 km radius of the Project site. However, Desert National Park is situated at a distance of 25.1 km west of the Project site. The areas of ecological significance around the Project site are presented in **Figure 5.30**.

Figure 5.30 Ecological Sensitivities in the Landscape



5.5.6.1 Desert National Park

Desert National Park (DNP) is a Protected Area and an Important Bird Area situated in the western region of Rajasthan state. The area of DNP is 3162 km² and falls within Jaisalmer and Barmer districts. The PA was established to protect the flora and fauna of the Thar Desert and more specifically with the purpose of protecting Critically Endangered (IUCN CR v 2020-2) Great Indian Bustard (*Ardeotis nigriceps*). It is considered to be the most important site for long-term survival of this species.

In addition, the area is very important for Vultures as it harbours five Vulture species³⁵ including three Critically Endangered (IUCN CR v 2020-2) species viz. White-rumped Vulture (*Gyps bengalensis*), Long-billed Vulture (*Gyps indicus*) and Red-headed Vulture (*Aegypius calvus*) and Endangered (IUCN EN v 2020-2) Egyptian Vulture (*Neophron percnopterus*). Three Vulnerable (IUCN VU v 2020-2) bird species viz. Greater Spotted Eagle (*Aquila clanga*), Stoliczka's Bushchat (*Saxicola macrorhyncha*) and Macqueen's Bustard (*Chlamydotis macqueeni*) have been reported from this area.

5.5.6.2 GIB Arc and GIB Landscape

As per the Management Plan of Desert National Park, majority of the records of the Great Indian Bustard (GIB) in the state of Rajasthan are spread over a landscape of largely unprotected land forming an arc extending from northern part of Desert National Park up to Ramdevra and Pokhran on the east of the Arc. GIB Arc covers an area of more than 5000 km² and serves as a corridor for the movement of the GIB in the landscape. A total of 26 individuals of GIB have been reported³⁶ from the eastern region of the GIB Arc. During the GIB status assessment undertaken by Wildlife Institute of India in 2017, 65 individuals of GIB were observed in this Thar landscape.

Based on the long-term surveys of GIB movement and presence in Rajasthan, the Wildlife Institute of India has categorised this landscape in GIB Conservation Priority Area and GIB Potential Area³⁷ to target high priority areas for immediate conservation actions³⁸. As presented in the map below, the entire Project site falls within the GIB Potential Area. The GIB Priority Area is largely restricted to north of Project site, however, a small patch of this area falls within the Study area. This patch covers the GIB enclosures present inside the Study area. According to WII's report about, all the power lines have to be underground in GIB Priority area, while in the Potential area, it can be laid with appropriate mitigation measures.

5.5.6.3 GIB Enclosures

Forest Department has identified and fenced a few areas in this landscape such as at Rasla, Guddi, Akal Wood Fossil Park, Loharki, Dursar, Ramdevra, etc. which are potential habitats for GIB and are called as satellites of Desert National Park (DNP) Wildlife Sanctuary³⁶. The consultation with ACF at Jaisalmer confirmed that these enclosures are treated and managed as a part of DNP and are crucial habitats for GIB. Majority of the enclosures are located inside the GIB Arc, however, a few of them such as at Rasla, Guddi, etc. are located in the vicinity of the Project site.

Rasla enclosures (1 and 2) are situated inside the Study area at approximately 2.8 km north of WTG FTN-266 and about 9.2 km southwest of the solar park boundary. While Guddi enclosure is located at

³⁵ 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

³⁶ Management Plan of Desert National Park Wildlife Sanctuary 2017-2027

³⁷ Jhala, Y. V., Dutta, S., Karkarya, T., Awasthi, A. Bipin, C.M. et al. 2020. Habitat improvement and conservation breeding of the Great Indian bustard: and integrated approach. Progress Report April 2018-March 2020. Wildlife Institute of India, Dehradun 248001, India. | TR/2020/03

³⁸ Habitat improvement and conservation breeding of the Great Indian Bustard. Annual Progress Report II. Wildlife Institute of India.

about 15 km east of WTGs FAT-068 and FAT-639. During the primary survey, consultations with the local community were undertaken to confirm the movement and presence of GIB inside these enclosures. The locals residing in nearby locations of Rasla enclosure confirmed the presence of two pairs of GIB in the enclosure on annual basis. Since these habitats are situated on either sides of the Project site and serve as a corridor for GIB's movement, the likelihood of inter-enclosure movement of the species through the Project site cannot be ruled out.

Figure 5.31 GIB Enclosure

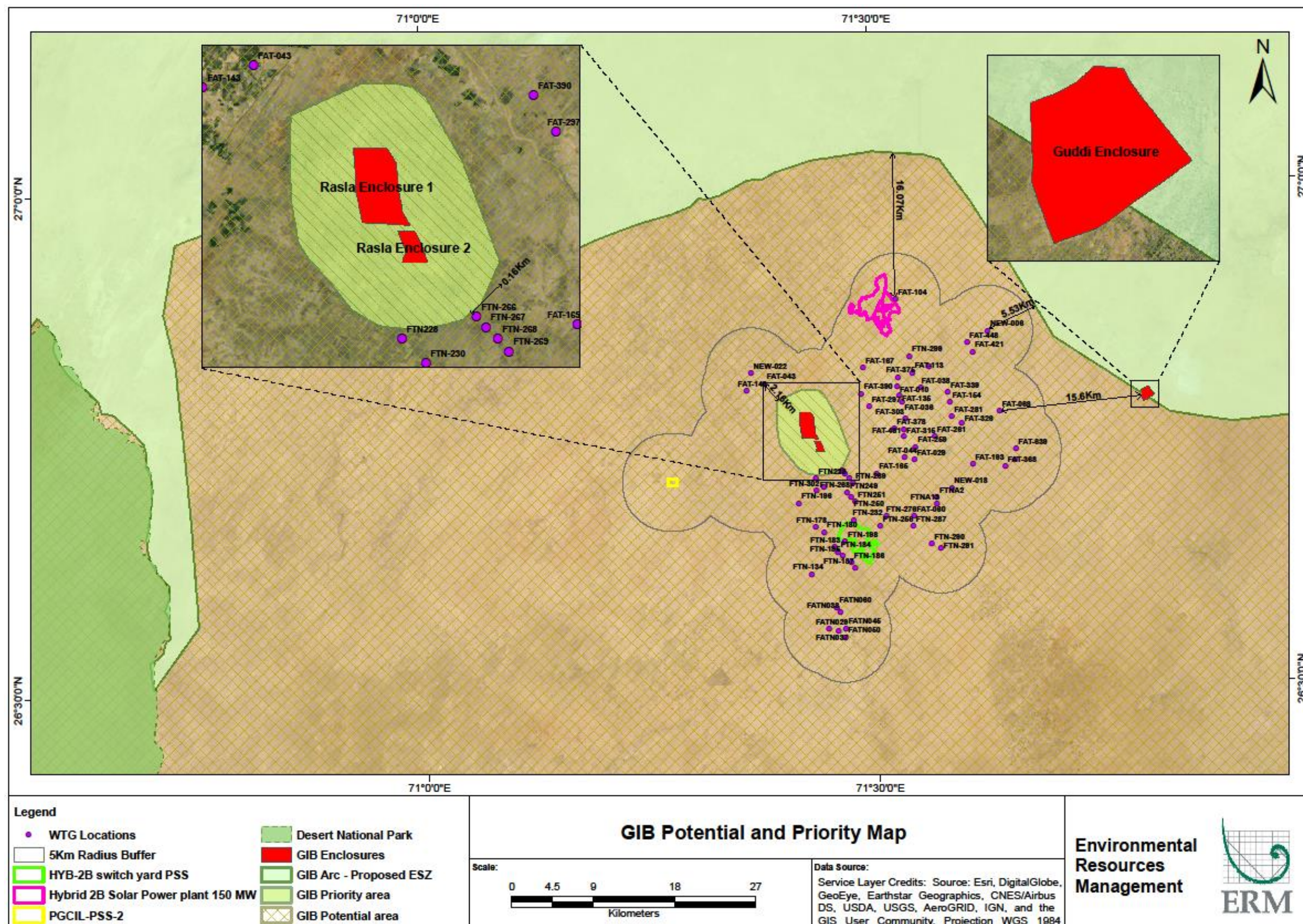


Rasla Enclosure



Guddi Enclosure

Figure 5.32 GIB Priority and Potential Areas



5.5.7 Migratory route

The migratory birds start visiting the wintering grounds in India from the month of September and stay until the month of March. The migration of the birds happens along nine certain migratory flyways globally. Three flyways overlap the Indian mainland and support high concentrations of migratory birds including several threatened species. Two of these flyways viz. Central Asian Flyway and West Asian-East African Flyway overlap each other over western Rajasthan and the Project site falls within this overlap area.

5.5.7.1 Central Asian Flyway

The Central Asian Flyway (CAF) covers huge area of Europe and Asia continents including the boundaries of 29 countries. It connects the breeding grounds in northern Russia and wintering grounds in the southern Asia. CAF supports about 307 species, which also include several species that undertake regular, seasonal movements within the Indian subcontinent³⁹. About 20 globally threatened and 10 Near Threatened (IUCN NT) species use this flyway for the annual movements.

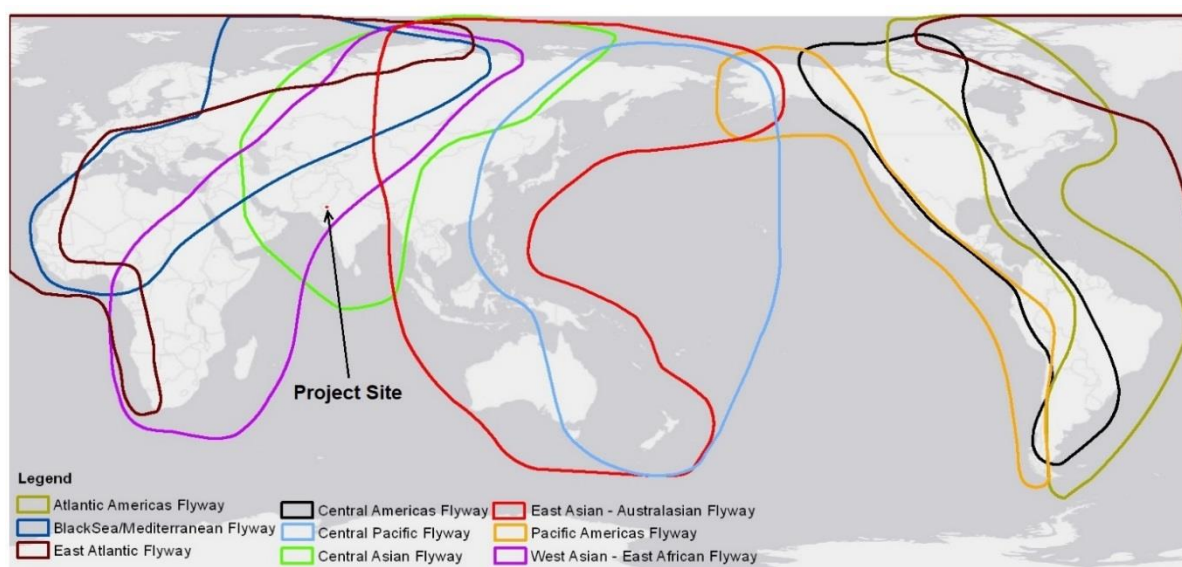
5.5.7.2 West Asian-East African Flyway

Through these routes, many species of birds migrate annually between mid-Palearctic breeding grounds in Asia and non-breeding sites in eastern and southern Africa and overlaps the boundaries of 64 countries. It also supports the movement of about 20 globally threatened and 13 Near Threatened (IUCN NT) species.

The review of secondary resources revealed that more than 22 migratory species are found in this landscape including congregatory Common Crane, Demoiselle Crane, and migratory raptor species such as Steppe Eagle, Cinereous Vulture, Eurasian Griffon and Eastern Imperial Eagle, etc.

The presence of conservation-significant and IUCN threatened species within the Project area has been assessed through the consultations and primary survey. However, the detailed assessment of site-specific impacts of the Project should be based on the long term wildlife monitoring and strict implementation of the suggested mitigation measures.

Figure 5.33 Migratory Flyways of the World



Map Source: Wetlands International

³⁹ Birdlife International, Central Asian Flyway Factsheet

Table 5.34 Habitat Impact Assessment Criteria

Habitat Sensitivity/ Value		Magnitude of Effect on Baseline Habitats			
		Negligible	Small	Medium	Large
		Effect is within the normal range of variation	Affects only a small area of habitat, such that there is no loss of viability/ function of the habitat	Affects part of the habitat but does not threaten the long-term viability/ function of the habitat	Affects the entire habitat, or a significant portion of it, and the long-term viability/ function of the habitat is threatened.
Negligible	Habitats with negligible interest for biodiversity.	Negligible	Negligible	Negligible	Negligible
Low	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.	Negligible	Negligible	Minor	Moderate
Medium	Habitats within nationally designated or recognised 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 congregatory species, and low value habitats used by species of medium value.	Negligible	Minor	Moderate	Major
High	Habitats within internationally designated or recognised 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 congregatory species, highly threatened and/or unique ecosystems, areas associated with key evolutionary species, and low or medium value habitats used by high value species.	Negligible	Moderate	Major	Critical

Table 5.35 Species Impact Assessment Criteria

Baseline Species Sensitivity/ Value		Magnitude of Effect on Baseline Habitats			
		Negligible	Small	Medium	Large
		Effect is within the normal range of variation for the population of the species	Effect does not cause a substantial change in the population of the species or other species dependent on it	Effect causes a substantial change in abundance and/or reduction in distribution of a population over one, or more generations, but does not threatened the long term viability/ function of that population dependent on it.	Affects entire population, or a significant part of it causing a substantial decline in abundance and/or change in and recovery of the population (or another dependent on it) is not possible either at all, or within several generations due to natural recruitment (reproduction, immigration from unaffected areas).
Negligible	Species with no specific value or importance attached to them.	Negligible	Negligible	Negligible	Negligible
Low	Species and sub-species of LC on the IUCN Red List, or not meeting criteria for medium or high value.	Negligible	Negligible	Minor	Moderate
Medium	Species on IUCN Red List as VU, NT, or DD, species protected under national legislation, nationally restricted range species, nationally important numbers of migratory, or congregatory species, species not meeting criteria for high value, and species vital to the survival of a medium value species.	Negligible	Minor	Moderate	Major
High	Species on IUCN Red List as CR, or 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 km ²), internationally important numbers of migratory, or congregatory species, key evolutionary species, and species vital to the survival of a high value species.	Negligible	Moderate	Major	Critical

6. STAKEHOLDER ENGAGEMENT

The disclosure of project information and consultations with stakeholders has been increasingly emphasised by project finance institutions and government regulatory bodies. A brief overview of the requirements of public disclosure and stakeholder consultation applicable to this project is provided in table below.

Table 6.1 Overview of Disclosure and Stakeholder Consultation Requirements

Institution/ Regulatory Body	Reference Regulation/ Standard	Requirements
IFC	PS-1	<ul style="list-style-type: none"> ■ In keeping with this PS, community engagement is to be undertaken with the impacted communities and must be free of external manipulation, interference, or coercion, and intimidation. ■ Furthermore, in situations where an impacted community may be subject to risks or adverse impacts from a project, the proponent must undertake a process of consultation to provide the affected communities with an opportunity to express their views on the project risks, impacts, and mitigation measures, as well as allow the proponents to consider and respond to them. ■ <i>Informed participation:</i> For projects with significant adverse impacts on affected communities, the consultation process must ensure that free, prior and informed consultation with affected communities occurs and that processes exist to facilitate participation by those affected. ■ Apart from such a consultation process, the project proponents are also to establish a Grievance Redressal Mechanism, which will allow the affected communities' concerns and grievances about the project proponent's environmental and social performance to be received and allow for steps to be taken to resolve the same ■ <i>Broader stakeholder engagement:</i> The proponent must identify and engage with stakeholders that are not directly affected by the Project but those that have established relationships with local communities and/or interest in the Project – local government, civil society organisations, etc. – and establish a dialogue.

6.1 Stakeholder Identification and Categorization

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/ organization's actions, objectives, and policies”. Stakeholders thus vary in terms of degree of interest, influence and control they have over the project. While those stakeholders who have a direct impact on or are directly impacted by the project are known as **Primary Stakeholders**, those who have an indirect impact or are indirectly impacted are known as **Secondary Stakeholders**. Keeping in mind the nature of the project and its setting, the stakeholders have been identified and listed in the Table 6.2: Stakeholder Group Categorization below.

Table 6.2: Stakeholder Group Categorization

Stakeholder Groups	Primary Stakeholders	Secondary Stakeholders
Community	<ul style="list-style-type: none"> ■ Land lessors; ■ Local Labourers; ■ Migrant contract labours; ■ Local community from the project villages and nearby areas; ■ Patta holders (i.e. ~10% HHs in each village from every community); ■ Agricultural labours; ■ Potential unskilled labours to be engaged for the construction phase of the project; ■ Any encroacher or Squatter on the project land parcels 	<ul style="list-style-type: none"> ■ Vulnerable Social Groups (i.e. women headed households, handicapped and households of SCT & ST community) from project villages and surrounding areas; ■ Opinion Holders; and ■ Community leaders
Institutional Stakeholders	<ul style="list-style-type: none"> ■ Project investors ■ Developers & EPC contractors; ■ Gram Panchayats (GPs) <ul style="list-style-type: none"> - Madhopura & - Sanawara Gram Panchayats ■ Zila Panchayat/ Janpad Panchayat of Pokhran and Fatehpur; ■ Tehsil Officials, 	<ul style="list-style-type: none"> ■ Village Institutions (schools, health centres); ■ Local Political Groups, i.e. both ruling and opposition parties at Gram Panchayat level, tehsil level & District level; ■ Civil Society/ Local NGOs
Government Bodies/ Regulatory Authorities	<ul style="list-style-type: none"> ■ District Administration ■ Regulatory Authorities <ul style="list-style-type: none"> - Rajasthan Renewable Energy Corporation Ltd. - Rajasthan Pollution Control Board; - Central Pollution Control Board (CPCB) - Ministry of Environment Forest and Climate Change (MoEFCC) - Local Fire Authority; - Water Resource Department, Jaisalmer, Rajasthan - Directorate of Civil Aviation; Government of Rajasthan (DCA) - Ministry of Road Transport and Highways 	

	<ul style="list-style-type: none"> - State Transport Authority; - District Collector and Revenue Department; - Block Development Officer & Patwari - Central Electrical Authority through C.E(P&D) Jaisalmer; - Department of Telegraph – Communication, Govt. of Rajasthan; - Department of Panchayat Raj, Rajasthan; - Ministry of Labour & Employment, Govt. of Rajasthan; - Wildlife Warden, State Forest Department; - District and State Forest Department, MoEFCC. 	
Other Groups		<ul style="list-style-type: none"> ■ Media; ■ Other solar/ wind projects in the area;

6.2 Stakeholder Mapping

“Stakeholder mapping” is a process of examining the relative influence that different individuals and groups have over a 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; and
- Gauge their influence on the Project.

Based on such an understanding, the stakeholders are categorised 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 updated Stakeholder analysis also helps to integrate the impacts and risk identified in the project designing and during the implementation stages to help company better addresses the associated impacts with the project.

Table 6.3 Stakeholder Significance and Engagement Requirement

Magnitude of Influence/ Impact	Category	Likelihood of Influence on/ by Stakeholder		
		Low	Medium	High
	Negligible	Negligible	Negligible	Negligible
	Small/ Low	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Urgent
	Large/ High	Moderate	Urgent	Urgent

6.3 Stakeholder analysis

The table below provides the profile of the key stakeholders who might have certain direct or indirect impact. These stakeholders have also been classified in accordance with the level of influence they might have over the project as well as their priority to the project proponent in terms of importance. 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:** This 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;
- **Negligible Influence:** This signifies a negligible or no influence of stakeholder on the project or project on the stakeholder, both in terms of decision-making and participation for/ during the project cycle.

The intermediary categories of “low to medium” or “medium to high” implies, that their influence will could vary in that particular range, subject to its context, specific conditions and responses for the project from 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 the 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, project proponent is advised to consider this stakeholder mapping as a live document that should be revised in a timely manner, to make it comprehensive for any given time-period.

Figure 6.1 Stakeholder Consultations undertaken in the area



Source: ERM Site visit July 2020

Table 6.4 Stakeholder Analysis

Relevant Stakeholders	Profile	Concerns and Expectations from the project	Influence of Stakeholder on Project	Influence of Project on Stakeholder	Influence Rating
Primary Stakeholders					
Land Lessors	The land being taken and to be taken, on lease for the project is private land	<ul style="list-style-type: none"> ■ The major concern of the land lessors from the project is to get timely payment of their lease amount, and ■ Also, that of accessing employment opportunities that the project will generate, both in construction & operational stage. 	<ul style="list-style-type: none"> ■ The stakeholder groups' influence on the project pertains to the smooth functioning of the project and the timely completion of the project activities. 	<ul style="list-style-type: none"> ■ It was informed that M/s Dalweer Enterprises Pvt. Ltd., M/s Prem Singh and M/s Lakh Singh have been engaged as aggregators for the project and are carrying out land lease process under the ambit of law, i.e. mutual negotiations and sale-deed agreement; ■ The level of impact of leasing of land would be negligible, as the land lease would not lead to any landlessness, secondary land lease will be only carried out after landowner's consent, in addition to it, the payment of lease amount would be on the prevailing market rate. ■ The land losers may also be benefitted by means of the local employment opportunities that will be generated for which they will be reportedly be provided preference. ■ Also, it was understood by consultation that local community and especially land lessors (whoever were consulted) are aware of land lease process, prevailing circle rate & market rate, developer etc.. People/ community added that, there are few renewable projects in 	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
				<p>the area, e.g of Suzlon, Inox etc.; who are either in their operational stage or in land procurement stage. Reportedly, few of the people have also sold their land for some of the wind projects in the vicinity.</p> <ul style="list-style-type: none"> ■ The consultations with landowners revealed that the land would be leased at a rate of INR 21,000/ acre/ annum. The lease rent offered approximately 15-25-percent of the prevailing market rate. ■ The identified landowners informed that they are willing to lease out their land due to the low productivity of the agricultural land, dependency on monsoons and lack of irrigation facilities. Landowners informed that that the lease amount will be a regular income for their family. 	
Local Community	<p>The Solar plant and WTGs will be located on private land and in close proximity to agricultural fields and villages and hence the local community forms an important stakeholder group. There are 18 villages in the core area (lying within a radius of 2 km from solar plant and WTGs) and 16 villages in the buffer zone (within 5 km radius from Solar park and WTGs).</p>	<ul style="list-style-type: none"> ■ The expectations and concern of this group from the project is to, <ul style="list-style-type: none"> ○ Receive benefits from the project in terms of employment and development of infrastructure and the community; ○ To get employment opportunities from the proposed hybrid project; and 	<ul style="list-style-type: none"> ■ As per consultations, no community level consultations were held with villagers, where they were informed about the upcoming project in their area and it's impact over. Rather only identified landowners were consulted directly by aggregators, engaged by Adani, where an amount was quoted for a lease 	<ul style="list-style-type: none"> ■ As per consultation with site team of Adani, the project will generate huge employment opportunities for local communities in construction phase which will also continue to operational phase of the project; ■ The CSR activities can play the crucial role in the development of the community through economic opportunities and CSR 	<p>Influence of Stakeholder: High/Medium</p> <p>Influence of Project: High/Medium</p>

Relevant Stakeholders	Profile	Concerns and Expectations from the project	Influence of Stakeholder on Project	Influence of Project on Stakeholder	Influence Rating
	<p>The population residing in the Aol is 35, 259 individuals out of which nearly 9.87 percent population belongs to Scheduled Caste and a mere 4.29 percent to Scheduled Tribe. The residents of study area will be primary impacted by the project and in turn have a higher probability to affect the project the most. The community has a livestock-agriculture-commons economy where cultivators, animal rearing and agricultural labours form a major proportion, followed by casual workers. The industrial development in the Aol is very low.</p>	<ul style="list-style-type: none"> ○ To get benefited by the CSR activities of the company in the villages, i.e. CSR activities like, skill development, training, education related facilities etc.; 	<p>and a consent was taken from landowners;</p> <ul style="list-style-type: none"> ■ Landowners informed ERM team that agricultural land, used for only seasonal cropping will be given on lease for both solar & wind projects; The lease amount offered to land lessors is INR 21,000/acre/annum with escalation rate of 5 percent in every two years. The offered amount is non-negotiable, however the lease agreement will be carried out only after MoU/ consent is signed with them;; ■ Land sellers are selling their land because there the lands are agriculturally less productive and they can use money for paying off debts or meeting household expenses; 	<p>projects. The CSR activities could also be need-based in it's approach.</p>	
Vulnerable Groups	<ul style="list-style-type: none"> ■ This stakeholder group comprises of ST & SC Communities in the study area. As indicated, SCs account for 9.87% of the total population in the Study area and 4.29% of ST in the study area. ■ Apart from this, vulnerable community will also 	<ul style="list-style-type: none"> ■ The key expectation and concerns of the group from the project include: <ul style="list-style-type: none"> - Receiving benefits from the project in terms of economic opportunities and development programmes; - Access to the economic opportunities and 	<ul style="list-style-type: none"> ■ The group may or may not have a strong influence on the project depending upon the nature of the impact. The stakeholder group will have a negligible impact on the project. However it will certainly have the impacts as other local communities in the area; 	<ul style="list-style-type: none"> ■ In view of the poor social and economic conditions of the Vulnerable Communities, the project Proponent may have to provide engagement avenues to its members. 	<p>Influence of Stakeholder: Low</p> <p>Influence of Project High/ Medium</p>

Relevant Stakeholders	Profile	Concerns and Expectations from the project	Influence of Stakeholder on Project	Influence of Project on Stakeholder	Influence Rating
	<p>comprise of any household headed by women, any land-owner/ person who is handicapped, old-aged etc.</p> <ul style="list-style-type: none"> During consultations held by ERM team in core villages villages, people from different communities were consulted, where their dependence on their land parcels were understood. 	<p>development programmes because of their status in the society; and</p> <ul style="list-style-type: none"> Minimal disturbance to the community in regards to access issues, pollution and influx of migrant workers. 			
Opinion Holder and Community Leaders	<p>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</p>	<ul style="list-style-type: none"> The expectations and concerns of this group from the project: <ul style="list-style-type: none"> 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 Minimal disturbance to the community in regards to access issues, pollution, sound of moving Wind Turbines, and influx of migrant workers 	<ul style="list-style-type: none"> This group, though powerful enough to affect the functioning of the Project in their vicinity; and This stakeholder group may play an important role in the public opinion formation, implementation of the CSR activities planned by the project 	<p>These groups due to their social status, may already have access to a number of economic benefits from the other Projects, and thus may not be completely dependent upon the Project for access to development opportunities</p>	<p>Influence of Stakeholder: Medium</p> <p>Influence of Project: Medium</p>
Local Gram Panchayats Consultations undertaken at Madhopura &	<ul style="list-style-type: none"> The Panchayat is the lowest level of local governance and consists of one or more revenue villages. This body of local governance was accorded 	<ul style="list-style-type: none"> Key concern is of the nature of minimal livelihood impacts, if any, due to the project purpose. Key expectation will include: local employment 	<ul style="list-style-type: none"> GPs play an important role in overall mobilization and shaping the perception and opinions of the people in the project area; 	<ul style="list-style-type: none"> Consultations revealed that the project is expected to have a positive impact over this stakeholder group through extending support in community development activities and by 	<p>Influence of Stakeholder: High</p> <p>Influence of Project: Medium</p>

Relevant Stakeholders	Profile	Concerns and Expectations from the project	Influence of Stakeholder on Project	Influence of Project on Stakeholder	Influence Rating
Sanawara Gram Panchayats	<p>with a number of responsibilities and powers as part of the 73rd Amendment to the Constitution.</p> <ul style="list-style-type: none"> As part of this, most of the rural development schemes and funds for central schemes are channelled through this body of governance. In addition, it is the Panchayat, who is bestowed with the decision- making authority for economic development and social justice. Thus in order for the smooth and proper functioning of the project, the Consent of the Panchayat is imperative. 	<p>generation and support through adequate CSR activities;</p> <ul style="list-style-type: none"> Some potential areas for CSR intervention as indicated by the community and gram panchayats include: <ul style="list-style-type: none"> Skill development & employment opportunities; Road improvement; Support to local schools in form of training, infrastructure, books etc. ; Health camps; Watershed development 	<ul style="list-style-type: none"> They play a role even in demanding community development works for social welfare purpose. Consultation with GP has also been made for permissions regarding traffic flow, road diversions, if any etc. 	<p>strengthening their role in this entire process of facilitation;</p> <ul style="list-style-type: none"> The panchayats also expect increase in local employment and thus leading to income generation in the area. 	
Regulatory Authorities	<ul style="list-style-type: none"> The primary authority for renewable energy (both solar & wind power) is RRECL; The office of District Industries Commissioner regulates the Industrialization at the District Level. Power evacuation/grid connectivity authority; This stakeholder group also comprises of central, state and district level regulatory authorities. These authorities influence the project in terms of establishing 	<ul style="list-style-type: none"> The key expectations of the regulatory authorities is ensuring that the project proponent meets all the statutory compliances and that the project operations are undertaken as per the conditions put forth by the authorities and after having obtained all the necessary permits; 	<ul style="list-style-type: none"> The project has ensured compliance with the relevant guidelines and policy recommendations as per the State Govt. The project needs permission and coordination with the DIC for local infrastructure and other supports required for smooth industrial operation 	<p>The influence of the project on the stakeholders pertains to the role the project will play a vital role in the development of the Project</p>	<p>Influence of Stakeholder: High</p> <p>Influence of Project: Low</p>

Relevant Stakeholders	Profile	Concerns and Expectations from the project	Influence of Stakeholder on Project	Influence of Project on Stakeholder	Influence Rating
	policy, granting permits and approvals for the project, monitoring and enforcing compliance with the applicable rules and regulations;				
District/ Taluka Administration	<ul style="list-style-type: none"> Government bodies at three levels would administer the project area: at the district level, at the block/ taluka level and at the Panchayat level in each village/or cluster of villages. The local administration in this regard refers to the district and block level administration comprising of the offices of the Taluka Development Officer, District Collectors, and Revenue officer etc. The revenue department would be responsible for registration of land lease, mutation, updating and records and transfer of land. The revenue department (sub registrar) would be responsible for documentation/ registration of land lease (i.e. Both Govt. & Pvt. land), mutation, updating and records. 	<ul style="list-style-type: none"> The overall opinion of the local authorities is positive towards the project owing to the fact that, the entire land for both the projects (solar & wind) would be taken on lease and secondly, that the project may create some local employment and other opportunities in the form of local contractors, hiring local vehicles, dependence on local products/goods etc. The key concern would however remain that the project operations are carried out smoothly with minimal negative impact on the local community. 	<ul style="list-style-type: none"> The construction phase will require a number of permissions and support from the local administration. The procedural complication can cause significant project delay. The land-matters can give rise to unnecessary litigations (especially pertaining to lack of records or encroachment issues in case of access roads etc.). 	<ul style="list-style-type: none"> The project is expected to have a positive influence over the local administration by extending support through these authorities or by collaborating to undertake any community development activities. 	<p>Influence of Stakeholder: High</p> <p>Influence of Project: Low</p>
Developers, EPC	Adani is the Developer, which will appoint EPC contractor	<ul style="list-style-type: none"> The major concern of these stakeholders are, smooth functioning of the 	<ul style="list-style-type: none"> The contractors and sub-contractors play an important role during 	<ul style="list-style-type: none"> The project is still in pre-construction phase. 	Influence of Stakeholder: High

Relevant Stakeholders	Profile	Concerns and Expectations from the project	Influence of Stakeholder on Project	Influence of Project on Stakeholder	Influence Rating
Contractors and Sub-contractors	during construction phase and O&M Contractor for the project and will be responsible for construction, operation and maintenance of the project. M/s Dalweer Enetrprises, M/s Prem Singh & M/s Lakh Singh have been engaged as aggregators for land identification, consultation with private landowners' liasioning with local community and facilitating MoU and Lease agreements with private landowners.	<ul style="list-style-type: none"> project without any litigation or community conflict; Timely payment of their agreed contract amount from developers; 	the project construction phase.	<ul style="list-style-type: none"> Civil construction work will absorb some amount of local people during the construction phase of the project. Migrant workforce, as reported, will be employed for specific semi-skilled tasks under civil works. Operation phase will involve very few locals to be employed, i.e. security guards etc. 	Influence of Project: High
Contractworkers	This group is comprised of skilled and semi-skilled workers, that would be involved in the project on a contract basis. This group is most likely to comprise of skilled & semi-skilled workers involved in the construction work of the project, access roads construction. Also, there would be semi-skilled workers, possibly engaged from nearby villages/ communities as supervisors and security guards for construction sites, such as, at WTG locations, PSS, batching plant, site office etc.	<p>The primary concerns and expectations of the stakeholder group pertaining to the project is as follows:</p> <ul style="list-style-type: none"> 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; and safety at work. 	<ul style="list-style-type: none"> 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 	<p>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</p>	<p>Influence of Stakeholder: Medium</p> <p>Influence of Project: High</p>
Secondary Stakeholders					
Village Institutions	This stakeholder group is comprised of health and education institutions at the	The main concerns and expectations of the group from the project pertain to:	The influence of the group on the project pertains to the role of the played by these	The influence of the project on the group pertains to the role of the	Influence of Stakeholder: Low

Relevant Stakeholders	Profile	Concerns and Expectations from the project	Influence of Stakeholder on Project	Influence of Project on Stakeholder	Influence Rating
	village level. The institutions in the immediate vicinity of the project are the primary schools in the villages	<ul style="list-style-type: none"> ■ 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. 	institutions in the opinion formation and implementation of community development programmes and CSR activities	project in the development of these institutions	Influence of Project: Medium
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	<p>The key expectations and concerns of the group from the project include:</p> <ul style="list-style-type: none"> ■ 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	<p>Influence of Stakeholder: Medium</p> <p>Influence of Project: Low</p>
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.	<p>The main expectations and concerns of the stakeholder group from the project include:</p> <ul style="list-style-type: none"> ■ Compliance to the regulatory requirements for the project; ■ Project's role in the development of the area; and 	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 wind energy in the state	<p>Influence of Stakeholder: Medium</p> <p>Influence of Project: Low</p>

Relevant Stakeholders	Profile	Concerns and Expectations from the project	Influence of Stakeholder on Project	Influence of Project on Stakeholder	Influence Rating
		<ul style="list-style-type: none"> 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.	<p>The main expectations and concerns of the stakeholder from the project include:</p> <ul style="list-style-type: none"> 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; and Timely disclosure of information in regards to the project activities; Creating no rucus among local community and authority by developers; Leading to no community un-rest or any kind of conflict among people and land lessors. 	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 limited due to the nature of the project activities	<p>Influence of Stakeholder: Low</p> <p>Influence of Project: Low</p>
Other Project Developers and Investors	This stakeholder group is comprised of companies involved in development and financing of renewable projects in the area. This group includes companies such as Suzlon, Orange, etc.	<p>The main expectations and concerns of the stakeholder from the project include:</p> <ul style="list-style-type: none"> Project's role in the development of the area and the formulation of public opinion towards renewable energy The creation of undue expectations from other projects due to project activities 	The influence of the stakeholder group on the project is likely to pertain to the development of public opinion towards renewable energy projects in the area	The influence of the project on the stakeholders pertains to the role the project will play in the development of renewable energy in the state and the formulation of public opinion towards renewable energy	<p>Influence of Stakeholder: Low</p> <p>Influence of Project: Low</p>

6.3.1 Engagement Process Pre-Impact Assessment

According to the discussions undertaken with the local community and the project team, it is understood that the engagement by the project proponent with the local community was restricted to negotiations with landowners. These negotiations through the land aggregator were undertaken with the individual landowners, with the help of the intermediaries in the area. According to the consultation with the local community, these meetings provided a basic understanding of the project and the purpose of the land procurement.

6.3.2 Engagement as Part of the Impact Assessment

This sub section provides an understanding of the engagement activities undertaken as part of the ESIA process.

6.3.3 Key feedback received during stakeholder consultation process

The key concerns and expectations that were raised during the stakeholder consultation process have been summarised below:

- **Key feedback received from local community of Madhopura and Sanawada village regarding project :** It was informed during the consultation with the community that there is a drastic shift from agriculture based economy to non-agriculture based economy due to lack of irrigation facilities and decline in crop yield. There was a positive outlook towards the solar projects in the area. Although the area has witnessed development of various solar and wind projects in the past 5-10 years, the community desired more such projects in the vicinity. They expect to receive benefits from the project in terms of employment and development of infrastructure and the overall community. In addition they also demanded preference to the local community in contractor and employment opportunities from the project.
- **Key feedback received from land sellers who were consulted during the ERM site visit:** It was informed that the sellers are willing to leasing out their land due to the low productivity of the agricultural land, dependency on monsoons and lack of irrigation facilities. The compensation received after leasing out their land will be used for livelihood earning and starting of alternative livelihood option then farming. The major concern of the stakeholder group till now is related to availability of employment opportunities that the project will generate.

Community Development activities: The local communities were of the opinion that apart from the economic opportunities, the local community should also benefit from the project in terms of community development activities. Some of the key areas for development activities identified included medical infrastructure, access to middle and higher schools, and trainings for youth within the village. This can be done by collaborating with local NGOs working on these areas.

7. IMPACT ASSESSMENT AND MITIGATION MEASURES

7.1 Introduction

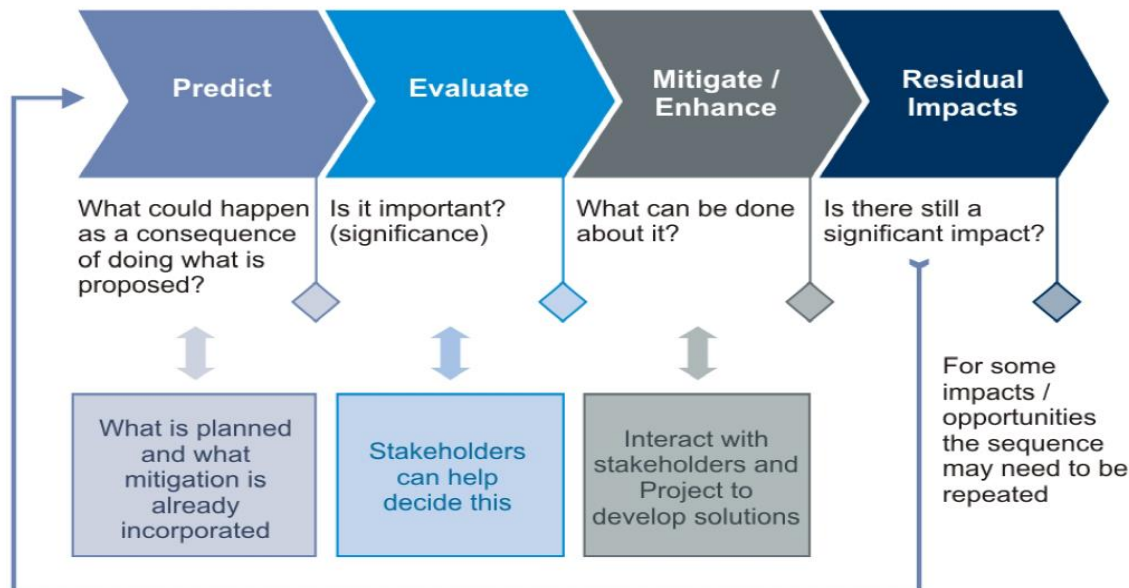
This section assesses the manner in which the Project will interact with elements of the physical, ecological or social environment to produce impacts to resources/ receptors. It has been organized as per the operational and decommissioning phases of the project life cycle to understand the risks and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

7.2 Impact assessment methodology

Impact identification and assessment starts with scoping and continues through the remainder of the Impact Assessment (IA) Process. The principal IA steps are summarized in **Figure 7.1** and comprises of the following:

- **Impact prediction:** to determine what could potentially happen to resources/receptors as a consequence of the projects and its associated activities.
- **Impact evaluation:** to evaluate the significance of the predicted impacts by considering their magnitude and likelihood of occurrence, and the sensitivity, value and/or importance of the affected resource/receptor.
- **Mitigation and enhancement:** to identify appropriate and justified measures to mitigate negative impacts and enhance positive impacts.
- **Residual impact evaluation:** to evaluate the significance of impacts assuming effective implementation of mitigation and enhancement measures.

Figure 7.1: Impact Assessment Process



Source: ERM India

7.2.1 Prediction of impacts

Prediction of impacts was carried out with an objective to determine what is likely to happen to the environment as a consequence of the Project and its associated activities. From the potentially significant interactions identified in scoping, the impacts to the various resources/receptors were elaborated and evaluated.

7.2.2 Evaluation of impacts

Each impact was described in terms of its various relevant characteristics (e.g., type, scale, duration, frequency, extent). The terminology used to describe impact characteristics is as shown in **Table 7.1**.

Table 7.1: Impact Characteristic Terminology

Characteristic	Definition	Designation
Type	A descriptor indicating the relationship of the impact to the project (in terms of cause and effect)	Direct Indirect Induced
Extent	The “reach” of the impact (e.g., confined to a small area around the Project Footprint, projected for several kilometres, etc.)	Local National Global
Duration	The time period over which a resource/receptor is affected.	Temporary Short-term Long-term Permanent
Scale	The size of the impact (e.g., the size of the area damaged or impacted, the fraction of a resource that is lost or affected, etc.)	[no fixed designations; intended to be a numerical value or a qualitative description of “intensity”]
Frequency	A measure of the constancy or periodicity of the impact.	[no fixed designations; intended to be a numerical value or a qualitative description]

The definitions for the type designations are given in **Table 7.2**. Definitions for the other designations are resource/receptor-specific.

Table 7.2 Impact Type Definitions

Type	Definition
Direct	Impacts that result from a direct interaction between the Project and a resource/receptor
Indirect	Impacts that follow on from the direct interactions between the Project and its environment as a result of subsequent interactions within the environment
Induced	Impacts that result from other activities (which are not part of the Project) that happen as a consequence of the Project.

The above characteristics and definitions apply to planned and unplanned events. An additional characteristic that pertains only to unplanned events is likelihood. The likelihood of an unplanned event occurring was designated using a qualitative scale, as described in the table below

Table 7.3 Definitions of Likelihood Designations

Likelihood	Definition
Unlikely	The event is unlikely but may occur at some time during normal operating conditions (probability less than 20%)

Likelihood	Definition
Possible	The event is likely to occur at some time during normal operating conditions (probability greater than 20% and less than 50%)
Likely	The event will occur during normal operating conditions (probability greater than 50%)

Once an impact's characteristics were defined, each impact was assigned a 'magnitude'. Magnitude is typically a function of a combination (depending on the resource/receptor in question) of the following impact characteristics:

- Extent
- Duration
- Scale
- Frequency

In case of unplanned events only, magnitude incorporates the 'likelihood' factor discussed above.

Magnitude essentially describes the intensity of the change that was predicted to occur in the resource/receptor as a result of the impact. As discussed above, the magnitude designations themselves are universally consistent, but the descriptions for these designations vary on a resource/receptor-by-resource/receptor basis. The universal magnitude designations are:

- Positive
- Negligible
- Small
- Medium
- Large

In the case of a positive impact, no magnitude designation (aside from 'positive') was assigned. It was considered sufficient for the purpose of the IA to indicate that the Project was expected to result in a positive impact, without characterising the exact degree of positive change likely to occur.

In the case of impacts resulting from unplanned events, the same resource/ receptor-specific approach to concluding a magnitude designation was followed, but the 'likelihood' factor was considered, together with the other impact characteristics, when assigning a magnitude designation.

In addition to characterising the magnitude of impact, the other principal impact evaluation step was definition of the sensitivity/ vulnerability/ importance of the impacted resource/receptor. There are a range of factors that was taken into account when defining the sensitivity/ vulnerability/ importance of the resource/receptor, which may be physical, biological, cultural or human. Other factors were also considered when characterising sensitivity/ vulnerability/importance, such as legal protection, government policy, stakeholder views and economic value. The sensitivity/ vulnerability/importance designations used herein for all resources/receptors are:

- Low
- Medium
- High

Once magnitude of impact and sensitivity/ vulnerability/ importance of resource/ receptor have been characterised, the significance was assigned for each impact. Impact significance is designated using the matrix shown in **Table 7.4**.

Table 7.4: Impact Significance

		Sensitivity/Vulnerability/importance of Resource/Receptor		
		Low	Medium	High
Magnitude of Impact	Negligible	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

The matrix applies universally to all resources/receptors, and all impacts to these resources/receptors, as the resource/receptor-specific considerations are factored into the assignment of magnitude and sensitivity/ vulnerability/ importance designations that enter into the matrix. provides a context of what the various impact significance ratings imply

Box 7.1 Context of Impact Significance

An impact of **negligible** significance is one where a resource/ receptor (including people) will essentially not be affected in any way by a particular activity or the predicted effect is deemed to be 'imperceptible' or is indistinguishable from natural background variations.

An impact of **minor** significance is one where a resource/ receptor will experience a noticeable effect, but the impact magnitude is sufficiently small and/or the resource/receptor is of low sensitivity/ vulnerability/ importance. In either case, the magnitude should be well within applicable standards/ guidelines.

An impact of **moderate** significance has an impact magnitude that is within applicable standards/guidelines, but falls somewhere in the range from a threshold below which the impact is minor, up to a level that might be just short of breaching a legal limit. Clearly, to design an activity so that its effects only just avoid breaking a law and/or cause a major impact is not best practice. The emphasis for moderate impacts is therefore on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that impacts of moderate significance have to be reduced to minor, but that moderate impacts are being managed effectively and efficiently.

An impact of **major** significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. An aim of IA is to get to a position where the Project does not have any major residual impacts, certainly not ones that would endure into the long-term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (i.e. ALARP has been applied). An example might be the visual impact of a facility. It is then the function of regulators and stakeholders to weigh such negative factors against the positive ones, such as employment, in coming to a decision on the Project.

It is important to note that impact prediction and evaluation takes into account any embedded controls (i.e., physical or procedural controls that are already planned as part of the Project design, regardless of the results of the IA Process).

7.2.3 Identification of Mitigation and Enhancement Measures

Once the significance of an impact has been characterised, the next step was to evaluate what mitigation and enhancement measures are warranted. For the purposes of this IA, ERM adopted the following Mitigation Hierarchy:

- **Avoid at Source, Reduce at Source:** avoiding or reducing at source through the design of the Project.
- **Abate on Site:** add something to the design to abate the impact.
- **Abate at Receptor:** if an impact cannot be abated on-site then control measures can be implemented off-site.
- **Repair or Remedy:** some impacts involve unavoidable damage to a resource (e.g. agricultural land and forestry due to creating access, work camps or materials storage areas) and these impacts can be addressed through repair, restoration or reinstatement measures.
- **Compensate in Kind, Compensate Through Other Means:** where other mitigation approaches are not possible or fully effective, then compensation for loss, damage and disturbance might be appropriate (e.g., planting to replace damaged vegetation, financial compensation for damaged crops or providing community facilities for loss of fisheries, access, recreation and amenity space).

The priority in mitigation was to first apply mitigation measures to the source of the impact (i.e., to avoid or reduce the magnitude of the impact from the associated Project activity), and then to address the resultant effect to the resource/receptor via abatement or compensatory measures or offsets (i.e., to reduce the significance of the effect once all reasonably practicable mitigations have been applied to reduce the impact magnitude).

7.2.4 Management and Monitoring

The final stage in the IA Process is the definition of the basic management and monitoring measures that are needed to identify whether: a) impacts or their associated Project components remain in conformance with applicable standards/ guidelines; and b) mitigation measures are effectively addressing impacts and compensatory measures and offsets are reducing effects to the extent predicted. This is covered in **Section 8** under Environmental and Social Management Plan (ESMP).

7.3 Impact Assessment Criteria

For the purpose of this assessment the following sections define the criteria against which the impacts associated with the 600 MW proposed hybrid project have been assessed. The impact assessment criteria are general criteria and not specifically associated with the project. Interactions that are likely to lead to significant impacts, as identified during the scoping exercise and baseline conditions (**Section 5**) are presented in **Table 7.5**.

Table 7.5: Interactions identified that are likely to result in significant impacts

Resource/Receptor	Potentially Significant Impacts
Land Use	<ul style="list-style-type: none"> ■ Permanent changes in land use due to installation of PV Modules, Central Monitoring Station, Switching Yard, access roads. ■ Temporary changes in land use due to temporary site office and material storage yard.
Topography and drainage	<ul style="list-style-type: none"> ■ Alteration of topography and micro drainage channel due to construction of project site approach road.
Soil Environment	<ul style="list-style-type: none"> ■ Decrease of soil quality due to loss of vegetation cover; ■ Soil erosion during monsoon season and windy periods;

Resource/Receptor	Potentially Significant Impacts
	<ul style="list-style-type: none"> ■ Sedimentation into nearby water bodies due to soil erosion and run-off; ■ Storage and handling of hazardous materials (e.g., fuel and lubricant) and waste generated from operation of construction equipment and machinery and their maintenance may lead to soil contamination due to leaks/ spillage; and ■ Impact on soil and land environment due to improper management of domestic solid waste generated.
Ambient Air Quality	<ul style="list-style-type: none"> ■ Fugitive dust emissions due to movement of machinery and vehicles; ■ Fugitive emission due to operation of pile drivers; and ■ Air emissions due to operations of DG sets and machinery.
Water Environment	<ul style="list-style-type: none"> ■ Usage of surface water for construction activities and cleaning of PV modules; ■ Surface and ground water contamination due to improper disposal of sewage at site; and ■ Surface and ground water contamination due to spillage of oil, lubricant and hazardous waste.
Ambient Noise Quality	<ul style="list-style-type: none"> ■ Noise generation due to movement of vehicles and machineries; ■ Noise generation due to operation of pile drivers; and ■ Noise generation due to operation of DG set.
Occupational Health and Safety	<ul style="list-style-type: none"> ■ Occupational health hazards due to dust and noise pollution; ■ Safety risk due to wrong handling of construction machinery, working at heights; and ■ Exposure of workers to electromagnetic field (EMF) while working in proximity to charged electric power lines during operation and maintenance.

7.3.1 Assessment Criteria for Change in Land Use

For the assessment of land use, the sensitivity and magnitude criteria is outlined in **Table 7.6** and **Table 7.7** respectively.

Table 7.6: Sensitivity Assessment Criteria for Land Use

Land Use Sensitivity	Criteria
Low	The Project footprint will be present in wasteland with no human settlement
Medium	The Project will be present in agricultural land or combination of agricultural land and wasteland etc.
High	The Project will be present in any forest land, or national park or of national Importance covered by international and/or national designation.

Table 7.7: Criteria for Impact Magnitude for Assessment on Land Use

Magnitude	Criteria
Negligible	An imperceptible, barely or rarely perceptible change in land use characteristics. The change may be short term.
Small	A subtle change in land use character over a wide area of a more noticeable change either over a restricted area or infrequently perceived. The change may be short term.
Medium	A noticeable change in land use character, frequently perceived or continuous and over a wide area; or a clearly evident change over a restricted area that may be infrequently perceived. The change may be medium to long term and may not be reversible.

Magnitude	Criteria
Large	A clearly evident, frequently perceived and continuous change in land use characteristics affecting an extensive area. The change may be long term and would not be reversible.

7.3.2 Assessment Criteria for Impact on Topography and Drainage

For the purpose of assessment of impacts on topography and drainage of the area, sensitivity and magnitude criteria have been outlined in **Table 7.8** and **Table 7.9** respectively.

Table 7.8: Sensitivity Assessment Criteria for Topography

Topography and Drainage Sensitivity	Criteria
Low	Flat topography
Medium	Undulating topography
High	Hilly area

Table 7.9: Criteria for Impact Magnitude for Assessment of Impacts on Topography and Drainage

Magnitude	Criteria
Negligible	An imperceptible, barely or rarely perceptible change in topographical characteristics. The change may be short term.
Small	A subtle change in topography character over a wide area of a more noticeable change either over a restricted area or infrequently perceived. The change may be short term to long term and is reversible.
Medium	A noticeable change in topographic character, frequently perceived or continuous and over a wide area; or a clearly evident change over a restricted area that may be infrequently perceived. The change may be medium to long term and may not be reversible.
Large	A clearly evident, frequently perceived and continuous change in topographic characteristics affecting an extensive area. The change may be long term and would not be reversible.

7.3.3 Assessment Criteria for Impact on Soil Environment

7.3.3.1 Project Phases and Associated Activities

For impact assessment, the following phases of the Project cycles were considered for potential impacts on the soil environment. The phase wise project activities that may impact the environment are described below.

Construction phase

- Strengthening of access roads;
- Vegetarian clearance and top soil removal;
- Storage of oil and lubricants onsite;
- Heavy vehicle movement across unpaved roads;
- Digging for WTG and solar PV module foundations and electrical poles

- Storage of construction materials;
- General building/construction activities with regards to the site office and the SCADA room to monitor optimal WTG and solar PV performance.
- Disposal of different type of waste generated from the temporary project site

Operation and Maintenance Phase

- Storage of oil and lubricants onsite;
- Disposal of municipal solid waste and waste water from site office; and
- Storage of waste materials onsite

Decommissioning phase

- Removal of WTGs and Solar PV modules;
- Removal of infrastructure from soil surfaces;
- Heavy vehicle movement across unpaved roads; and
- Restoration of the project

7.3.3.2 Criteria

For the assessment of soil quality, the sensitivity and magnitude criteria outlined in **Table 7.10** and **Table 7.11** respectively have been used.

Table 7.10: Sensitivity Assessment Criteria for Soil quality (compaction, erosion and contamination)

Sensitivity Criteria	Contributing Criteria	
	Environmental	Social
Soil Quality related criteria as compaction, erosion and contamination	The extent to which the soil and quality plays an ecosystem role in terms of supporting biodiversity. This includes its role as in supporting a lifecycle stage	The extent to which the soil a quality provides a use (agricultural use, fishing) to the local communities and businesses, or is important in terms of national resource protection objectives, targets and legislation
Low	<ul style="list-style-type: none"> ■ The soil quality does not support diverse habitat or populations and/or supports habitat or population of low quality. 	<ul style="list-style-type: none"> ■ The soil quality has little or no role in provisioning of services as agricultural uses for the local community.
Medium	<ul style="list-style-type: none"> ■ The soil quality supports diverse habitat or population of flora and fauna and supports habitats commonly available in the Project Aol. 	<ul style="list-style-type: none"> ■ The soil has local importance in terms of provisioning services as agricultural services but there is ample capacity and / or adequate opportunity for alternative sources of comparable quality, i.e. ready availability across the Aol
High	<ul style="list-style-type: none"> ■ The soil quality supports economically important or biologically unique species or provides essential habitat for such species. 	<ul style="list-style-type: none"> ■ The soil is wholly relied upon locally, with no suitable technically or economically feasible alternatives, or

Sensitivity Criteria	Contributing Criteria	
		is important at a regional level for provisioning services.

Table 7.11: Criteria for Impact Magnitude for Assessment of Impact to Soil

Magnitude Criteria	Negligible	Small	Medium	Large
Soil compaction, erosion and contamination	<ul style="list-style-type: none"> Qualitative-No perceptible or readily measurable change from baseline conditions Scale- Localized area as Particular activity areas Time-Short duration (few days) or one time as temporary 	<ul style="list-style-type: none"> Perceptible change from baseline conditions but likely to easily revert back to earlier stage with mitigation Scale- Project site, activity areas and immediate vicinity not impacting any sensitive receptor Short term-Only during particular activities or phase of the project lifecycle as civil works or construction phase (~10-12 months) 	<ul style="list-style-type: none"> Clearly evident (e.g. perceptible and readily measurable) change from baseline conditions and/or likely take time to revert back to earlier stage with mitigation Scale- Project site, activity areas and immediate vicinity impacting sensitive receptor/s Long term-Spread across several phases of the project lifecycle (few years) 	<ul style="list-style-type: none"> Major (e.g. order of magnitude) change in comparison to baseline conditions and/or likely difficult or may not to revert back to earlier stage with mitigation Scale- Regional or international; Permanent change

7.3.4 Assessment Criteria for Impact on Water Environment

The impacts of proposed project on water environment are assessed with respect to following:

- Decreased water availability from the water resources of the area due to consumption of water for carrying out project activities such as module cleaning during operation phase; and
- Water quality being affected due to wastewater release and spills/leaks from project activities.

For the assessment of water quality, the sensitivity and magnitude criteria outlined in the respective tables below.

Table 7.12: Sensitivity Assessment Criteria for Water Resources (Surface water and Ground water)

Sensitivity Criteria	Contributing Criteria	
	Environment	Social
Water Resources - Surface water and ground water	The extent to which the water resource plays an ecosystem or amenity role in terms of supporting biodiversity either	The extent to which the water resource provides or could provide a use (drinking water, agricultural uses, washing and other domestic or industrial, use as waterways) to the local communities and

Sensitivity Criteria	Contributing Criteria	
(quality/quantity related criteria)	directly or indirectly, particularly with respect to dependent ecosystems.	businesses, or is important in terms of national resource protection objectives, targets and legislation.
Low	The water resource does not support diverse aquatic habitat or populations, or supports aquatic habitat or population that is of low quality.	The water resource has little or no role in terms of provisioning services as agricultural water source, other domestic uses as washing, bathing, industrial use and waterways for the local community.
		The groundwater resource is not currently abstracted and used in the vicinity of the Project, but is of sufficient quality and yield to be used for that purpose in the future (and there is a reasonable potential for future use).
Medium	The water resource supports diverse populations of flora and / or fauna but available in the surface water bodies in the region.	The surface water resources have local importance in terms of provisioning services but there is ample capacity and / or adequate opportunity for alternative sources of comparable quality.
		The groundwater resource is an important water supply, and is currently used, but there is capacity and / or adequate opportunity for alternative sources of comparable quality.
High	The water resource supports economically important or biologically unique aquatic species or provides essential habitat for such species	The surface water resources are wholly relied upon locally, with no suitable technically or economically feasible alternatives, or is important at a regional or transboundary watershed level for provisioning services
		The groundwater resource is wholly relied upon locally, with no suitable technically or economically feasible alternatives, or is important at a regional or national level for water supply or contribution to groundwater dependent ecosystems (e.g. transboundary rivers).

Table 7.13: Criteria for Impact Magnitude for Assessment of Impact to Surface and Ground water Resources)

Magnitude Criteria	Negligible	Small	Medium	Large
General Criteria	No perceptible or readily measurable change from baseline conditions.	Perceptible change from baseline conditions but likely to be within applicable norms	Clearly evident (e.g. perceptible and readily measurable) change from baseline conditions and / or likely to approach and even	Major changes in comparison to baseline conditions and / or likely to regularly or continually exceed

Magnitude Criteria	Negligible	Small	Medium	Large
		and standards for mode of use.	occasionally exceed applicable norms and standards for mode of use.	applicable norms and standards for mode of use.
Water Quantity	There is likely to be negligible (less than 1% of lean season flow) or no consumption of surface water by the Project at any time	The Project will consume surface water, but the amounts abstracted are likely to be relatively small in comparison to the resource available at the time of use (i.e. taking into account seasonal fluctuation)	The Project will consume surface water, and the amounts abstracted are likely to be significant in comparison to the resource available at the time of use (i.e. taking into account seasonal fluctuation)	The Project will consume surface water, and the amounts abstracted are likely to be very significant in comparison to the resource available at the time of use (i.e. taking into account seasonal fluctuation)
	There is likely to be negligible or no abstraction, use of or discharge to the groundwater by the Project at any time.	The Project will consume groundwater or deliver discharge to groundwater, but the amounts abstracted / discharged are likely to be relatively small in comparison to the resource available at the time of use (i.e. taking into account seasonal fluctuation).	The Project will consume groundwater or discharge to groundwater, and the amounts abstracted / discharged are likely to be significant in comparison to the resource available at the time of use (i.e. taking into account seasonal fluctuation).	The Project will consume groundwater or discharge to groundwater, and the amounts abstracted / discharged are likely to be very significant in comparison to the resource available at the time of use (i.e. taking into account seasonal fluctuation).
Water Quality	Discharges are expected to be well within statutory limits	Discharges are expected to be within statutory limits	Occasional breach(es) of statutory discharge limits (limited periods) expected	Repeated breaches of statutory discharge limits (over extended periods) expected
	Abstractions from or discharge to aquifer(s) are unlikely to cause water quality issues.	Groundwater quality be within ambient levels or allowable criteria or may exceed for 1-2 parameters which is common occurrence due to geological regime of the area.	Groundwater quality exceeds ambient levels or allowable criteria for key parameters. Abstraction or discharge to aquifer(s) are expected to cause potential localized effects on groundwater	Groundwater quality exceeds ambient levels or allowable criteria. Abstractions or discharge to aquifer(s) are expected to cause potentially severe

Magnitude Criteria	Negligible	Small	Medium	Large
		Abstraction or discharge to aquifer(s) may cause small but local changes in water quality in the aquifer system. These can be considered potential short-term localized effects on groundwater quality which is likely to return to equilibrium conditions within a short (months) timeframe.	quality which are likely to be fairly long lasting and / or give rise to indirect ecological and / or socio-economic impacts.	effects on groundwater quality which are likely to be long-lasting (e.g. years or permanent) and / or give rise to indirect ecological and / or socio-economic impacts.

7.3.5 Assessment Criteria for Impact on Air quality

The impact assessment with respect to air quality of the study area has been undertaken for the project activities described below:

- Construction activities including site preparation, construction of solar PV modules and WTG foundation, erection of internal and external transmission line, construction of Pooling Substation;
- Transportation of Solar modules, WTG components, construction material, construction machinery and personnel;
- Operation of DG sets for emergency power backup;
- Operation and maintenance activities during operation phase; and
- Decommissioning activities.

7.3.5.1 Criteria

The air quality impacts associated with the construction activities have been assessed qualitatively, using professional judgement and based on past experience from similar projects.

Table 7.14: Sensitivity Criteria for Air quality

Sensitivity Criteria	Contributing Criteria	
	Human Receptors	Ecological Receptors
Low	Locations where human exposure is transient. ⁴⁰	Locally designated sites; and/or areas of specific ecological interest, not subject to statutory protection (for example, as defined by the project ecology team).

⁴⁰ As per the NAAQS and World Bank/IFC guidelines, there are no standards that apply to short –term exposure, e.g. one or two hours, but there is still a risk of health impacts, albeit less certain.

Sensitivity Criteria	Contributing Criteria	
Medium	Few Receptors (settlements) within 500 m of project activity area as roads, batching plant, WTG s etc.	Nationally designated sites.
High	Densely populated receptors (settlements) within 500 m of project activity area as roads, batching plant, WTG s etc.	Internationally designated sites.

Table 7.15: Criteria for Impact Magnitude for Assessment of Impact to Air Quality

Magnitude Criteria	Negligible	Small	Medium	Large
Air Quality	<ul style="list-style-type: none"> Soil type with large grain size (e.g. sand); and/or No emissions/dust generation due to Project across all phases 	<ul style="list-style-type: none"> Soil type with large grain size (e.g. sand); and/or Limited emissions/dust generations for short duration 	<ul style="list-style-type: none"> Moderately dusty soil type (e.g. silt); and/or Dust generation and emissions from Projects for long duration 	<ul style="list-style-type: none"> Potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size); and Significant process emissions from Project for the entire Project cycle.

7.3.6 Assessment Criteria for Impact on Ambient noise

The assessment with respect to ambient noise quality of the study area has been done for the following project activities:

- Construction activities including site preparation, piling work, access road widening, construction of ancillary facilities;
- Transportation of construction materials, machinery and personnel
- Operation of wind Turbines;
- Operation of DG sets; and
- Demolition activities during decommissioning phase.

The ambient noise levels have been assessed with respect to Noise Pollution (Regulation and Control) Rules, 2000 and WHO Guidelines as shown in **Table 7.16** and **Table 7.17** respectively.

Table 7.16 Ambient noise quality standards

Area Code	Category of Area	Limits in dB(A) L_{eq}^*	
		Day Time	Night Time
(A)	Industrial Area	75	70
(B)	Commercial Area	65	55

Area Code	Category of Area	Limits in dB(A) L_{eq} *	
		Day Time	Night Time
(C)	Residential Area	55	45
(D)	Silence Zone	50	40

Note:

1. Day time shall mean from 6.00 a.m. and 10.00 p.m.
2. Night time shall mean from 10.00 p.m. and 6.00 a.m.
3. Silence zone is an area comprising not less than 100 metres around hospitals, educational institutions, courts, religious places or any other area which is declared as such by the competent authority.
4. Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.

* dB(A) L_{eq} denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing. A "decibel" is a unit in which noise is measured. "A", in dB (A) L_{eq} , denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of the human ear. L_{eq} : It is energy mean of the noise level over a specified period

Table 7.17: Noise Emission Criteria

Location	Noise Level Limit (dB(A))	
	Daytime (0700 – 2200 hrs)	Night-time (2200 – 0700 hrs)
Industrial; commercial	70	70
Residential; institutional; educational	55	45

Source: Guidelines values are for noise levels measured out of doors. Source: Guidelines for Community Noise, World Health Organisation (WHO), 1999.

The above standards have been utilized to create a sensitivity criteria for ambient noise and criteria for impact magnitude for assessment of impact to ambient noise

Table 7.18: Sensitivity criteria for ambient noise

Sensitivity Criteria	Contributing Criteria	
	Human Receptors	Ecological Receptors
Low	Industrial Use	Locally designated sites; and/or areas of specific ecological interest, not subject to statutory protection (for example, as defined by the project ecology team).
Medium	Residential and Recreational place	Nationally designated sites.
High	Educational/ Religious/ Medical Facilities	Internationally designated sites.

Table 7.19: Criteria for impact magnitude for assessment of impact to ambient noise

Magnitude Criteria	Negligible	Small	Medium	Large
Noise Quality	Predicted noise levels are at or less than 3 dB (A) above the relevant limits / thresholds.	Predicted noise levels are 3 to less than 5 dB (A) above the relevant limits / thresholds.	Predicted noise levels are between 5 and 10 dB (A) above the relevant limits / thresholds.	Predicted noise levels are more than 10 dB (A) above the relevant limits / thresholds.

Magnitude Criteria	Negligible	Small	Medium	Large
	Short term exposure (Few hours in a day and not continuous)		Medium Term Exposure (1 to 6 months)	Long term exposure (> 6 months)

7.3.7 Assessment Criteria for socio-economic impacts

The socio-economic assessment would be carried out on the given below criteria for all the phases of the project:

- Loss of access to cultivated land;
- Potential loss of livelihoods;
- Labour Influx;
- Cultural environment;
- Employment opportunities;
- Impact on local public infrastructure; and
- Retrenchment and loss of employment.

For the assessment of social impacts, the magnitude and sensitivity criteria outlined in **Table 7.20** and **Table 7.21** respectively have been used. The social impacts associated with the construction, operations and decommissioning stages have been assessed qualitatively and in some cases quantitatively (subject to availability of data), using professional judgement and based on past experience from similar projects.

Table 7.20: Impact magnitude for local communities

Category	Extent / Duration / Scale / Frequency
Large	Change dominates over baseline conditions. Affects the majority of the area or population in the area of influence and/or persists over many years. The impact may be experienced over a regional or national area.
Medium	Clearly evident difference from baseline conditions. Tendency is that impact affects a substantial area or number of people and/or is of medium duration. Frequency may be occasional and impact may potentially be regional in scale.
Small	Perceptible difference from baseline conditions. Tendency is that impact is local, rare and affects a small proportion of receptors and is of a short duration.
Negligible	Change remains within the range commonly experienced within the household or community.

Table 7.21: Receptor sensitivity for local communities

Category	Rationale
High	Profound or multiple levels of vulnerability that undermine the ability to adapt to changes brought by the Project.
Medium	Some but few areas of vulnerability; but still retaining an ability to at least in part adapt to change brought by the Project.
Low	Minimal vulnerability; consequently with a high ability to adapt to changes brought by the Project and opportunities associated with it.

Based on this understanding of magnitude and sensitivity, the significance of impacts will be assessed, as depicted in the table below.

Table 7.21: Impact significance matrix

Receptor Sensitivity	Impact Magnitude			
	<i>Negligible</i>	<i>Small</i>	<i>Medium</i>	<i>Large</i>
Low	Negligible	Negligible	Minor	Moderate
Medium	Negligible	Minor	Moderate	Major
High	Negligible	Moderate	Major	Critical

7.3.8 Assessment Criteria for ecological impacts

ERM Impact Assessment standard defines sensitivity of ecological receptors by determining the resource sensitivity for species and habitat separately. The habitat and species impact assessment criteria are given in **Table 7.22** and **Table 7.23** respectively.

Table 7.22 Habitat Impact Assessment Criteria

Habitat Sensitivity/ Value		Magnitude of Effect on Baseline Habitats			
		Negligible	Small	Medium	Large
		Effect is within the normal range of variation	Affects only a small area of habitat, such that there is no loss of viability/ function of the habitat	Affects part of the habitat but does not threaten the long-term viability/ function of the habitat	Affects the entire habitat, or a significant portion of it, and the long-term viability/ function of the habitat is threatened.
Negligible	Habitats with negligible interest for biodiversity.	Negligible	Negligible	Negligible	Negligible
Low	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.	Negligible	Negligible	Minor	Moderate
Medium	Habitats within nationally designated or recognised 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 congregatory species, and low value habitats used by species of medium value.	Negligible	Minor	Moderate	Major
High	Habitats within internationally designated or recognised 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 congregatory species, highly threatened and/or unique ecosystems, areas associated with key evolutionary species, and low or medium value habitats used by high value species.	Negligible	Moderate	Major	Critical

Table 7.23 Species Impact Assessment Criteria

Baseline Species Sensitivity/ Value		Magnitude of Effect on Baseline Habitats			
		Negligible	Small	Medium	Large
		Effect is within the normal range of variation for the population of the species	Effect does not cause a substantial change in the population of the species or other species dependent on it	Effect causes a substantial change in abundance and/or reduction in distribution of a population over one, or more generations, but does not threaten the long term viability/function of that population dependent on it.	Affects entire population, or a significant part of it causing a substantial decline in abundance and/or change in and recovery of the population (or another dependent on it) is not possible either at all, or within several generations due to natural recruitment (reproduction, immigration from unaffected areas).
Negligible	Species with no specific value or importance attached to them.	Negligible	Negligible	Negligible	Negligible
Low	Species and sub-species of LC on the IUCN Red List, or not meeting criteria for medium or high value.	Negligible	Negligible	Minor	Moderate
Medium	Species on IUCN Red List as VU, NT, or DD, species protected under national legislation, nationally restricted range species, nationally important numbers of migratory, or congregatory species, species not meeting criteria for high value, and species vital to the survival of a medium value species.	Negligible	Minor	Moderate	Major
High	Species on IUCN Red List as CR, or 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 km ²), internationally important numbers of migratory, or congregatory species, key evolutionary species, and species vital to the survival of a high value species.	Negligible	Moderate	Major	Critical

7.4 Impact Assessment- Construction Phase

7.4.1 Change in land use

7.4.1.1 Impact Magnitude

Based on review of the land use in the Project Aol, it was observed that majority of land use-land cover includes shrub/waste land (83.54%) followed by agricultural land (11.53%) and gravel waste land (4.93%). The landuse pattern of the Project Aol has been shown in map (refer **Figure 5.2**).

As observed during ERM site visit and discussion with site team, both WTGs and solar power plant will be located on private shrub/waste land, agricultural land and gravel waste land. Additionally, the external transmission line connecting the pooling substation will pass through shrub/waste land, and agricultural land. There is no major dependency for grazing on the land leased for the project. Since, majority of the land is shrub/waste land where no agricultural activities are taking place, thus, receptor sensitivity is assessed as **low**

Furthermore, it is understood that pooling substation, storage yard and site office will be developed on private shrub/waste land. The project activities such as strengthening the access road, installation of solar modules and WTGs and proposed internal and external transmission towers are expected to alter the land use of the area throughout the project life cycle.

Structures, albeit of temporary nature, which will support project activities during the construction stage such as storage yards, etc. will have an impact on the immediate vicinity of the construction area. The construction phase is expected to last approximately 10-12 months, following which the temporary structures will be dismantled from their respective locations with the returning of land to its acceptable pre-construction state. However, site access roads, internal roads, transmission lines and permanent structures such as WTGs, solar modules, site office and the pooling substation will remain until the end of the Project life cycle (i.e. 25 years). Hence, the change in land use due to project development has been classified as **medium**

7.4.1.2 Embedded built in controls

The impacts during the construction activity are envisaged to be of a short duration as the construction phase will be about 10-12 months. Additionally, the EPC contractors will be instructed to avoid any unnecessary disturbance to nearby surrounding features or land parcels. Further, construction activities will be restricted to the footprint area of the Project components and remaining area to be kept undisturbed to the extent possible.

Post completion of the construction work, the areas utilised for storage of material and other temporary structures are expected to be restored to their near original state.

7.4.1.3 Significance of impact

The overall impact significance has been assessed to be **minor**

7.4.1.4 Additional mitigation measures

The following mitigation measures should be implemented to minimize potential impacts on land use during the construction phase:

- Construction activity should be restricted to designated area;
- Waste should not be allowed to litter in and around the Project area;
- On completion of the construction activities, land used for temporary facilities will be restored to the extent possible and handed; and
- The land use around the permanent project facilities will not be disturbed

7.4.1.5 Residual impact significance

The residual impact significance will remain **minor** as changes in land use will be for long term for majority of the project component (installation of PV modules, WTGs, access roads, central monitoring station, switching yard).

Impact	Change in land use							
Impact Nature	Negative		Positive		Neutral			
Impact Type	Direct		Indirect		Induced			
Impact Duration	Temporary	Short-term		Long-term		Permanent		
Impact Extent	Local		Regional		Transboundary			
Impact Scale	Limited to Project footprint							
Impact Magnitude	Positive	Negligible		Small		Medium	Large	
Resource /Receptor Sensitivity	Low		Medium			High		
Impact Significance	Negligible		Minor		Moderate		Major	
	Significance of impact is assessed as Minor							
Residual Magnitude	Positive	Negligible		Small		Medium		Large
Residual Impact Significance	Negligible		Minor		Moderate		Major	
	Significance of residual impact is assessed as minor							

7.4.2 Impact on topography and drainage

7.4.2.1 Impacts

The Project area exhibits flat topography with minor undulations. Two small rivers (Sukhri Nadi and Ghughri Nadi) pass through the proposed project site. Few small water channels observed within the Project area were mostly dry throughout the year except for monsoon season. Since the proposed project, along with the access road, is mostly on a flat terrain the receptor sensitivity has been assessed to be **low**.

The topography may be altered slightly due to the strengthening of approach roads, excavation work at the WTG sites and solar site, internal and external transmission line locations and PSS and SCADA. Clearing and levelling of land would be done prior to any civil work, although these changes are envisaged to be small and restricted to the immediate vicinity of the Project components. The impact magnitude has therefore been assessed as **small** considering the footprint of the Project

7.4.2.2 Embedded built in controls

The EPC contractor at site will be instructed to avoid any unnecessary changes in the topography. Appropriate number of cross drainage channels will be provided during access road construction to maintain flow in existing natural water channels

7.4.2.3 Significance of impact

The impact significance is therefore envisaged to be **minor**.

7.4.2.4 Additional mitigation measures

- Levelling and grading operations should be undertaken with minimal disturbance to the existing contour thereby maintaining the general slope of the site; and
- Disruption/alteration of micro-watershed drainage pattern should be minimized to the extent possible

7.4.2.5 Residual impact significance

The residual impact significance will be reduced to **negligible** after implementing above mentioned mitigation measures.

Impact	Change in topography and drainage							
Impact Nature	Negative		Positive		Neutral			
Impact Type	Direct		Indirect		Induced			
Impact Duration	Temporary	Short-term		Long-term		Permanent		
Impact Extent	Local		Regional		Transboundary			
Impact Scale	Limited to project site and access road							
Impact Magnitude	Positive	Negligible		Small		Medium	Large	
Resource /Receptor Sensitivity	Low		Medium			High		
Impact Significance	Negligible		Minor		Moderate		Major	
	Significance of impact is considered Minor .							
Residual Magnitude	Positive	Negligible		Small		Medium		Large
Residual Impact Significance	Negligible		Minor		Moderate		Major	
	Residual of impact is considered Negligible							

7.4.3 Impact on soil environment

7.4.3.1 Soil Compaction and Erosion

Soil compaction and erosion has been considered for construction phase and decommissioning only. In the operation phase, soil compaction and erosion may occur due to vehicular movement, which only happens during the occasional maintenance activities and will be within the access road developed and land foot print leased already during the construction phase. **Soil compaction and erosion for operation phase has therefore been assessed to be negligible.**

Impact Magnitude

During the construction phase, the top soil will be susceptible to soil erosion to some extent due to site clearance activities. The region is characterised by red desertic soil and sandy soil which is loose in nature and thus soil erosion can occur easily in the Project area. The scale of site clearance will be small at WTG footprint, but since there are 72 turbines in the project the scale of site clearance will be moderate. At different parcels of land and in solar plant area and the pooling substations, excavated loose soil would be susceptible to erosion. The removal of stabilised top soil would result in slope destabilisation and increase in soil erosion.

As for soil compaction, the strengthening of internal access roads and excavation and collection of soil will lead to soil compaction, thus increasing surface run-off and decreasing the percolation rate of the soil. However, since the Project is being developed in a drought prone area the impacts arising from soil compaction will be minimal.

Therefore, the overall resource/receptor sensitivity is assessed as **low to medium** and the impact magnitude is assessed to be **small to medium**.

Embedded built in controls

- Using existing roads to access the site to the extent possible;
- Construction materials and wastes will be stored in designated areas;
- Stripping of topsoil shall not be conducted earlier than required; (vegetation cover will be maintained for as long as possible) in order to prevent the erosion (wind and water) of soil;

- Topography shall be restored to the extent possible and re-vegetated to prevent soil erosion to the extent possible.

Significance of impact

Based on the above, after incorporating the embedded control the impact significance is envisaged to be **minor to moderate** and is likely to impact the project footprint area during the construction phase.

Additional mitigation measures

- Top soil that has been stripped should be stored for landscaping of the site;
- The stock piles of the soil should be kept moist to avoid wind erosion of the soil;
- Soil to be ploughed in compacted area after completion of the construction work;
- Revegetation of the construction boundaries using fast growing local vegetation;
- As a best practice, site clearance, piling, excavation and access road strengthening will not be carried out during the monsoon season to minimize erosion and run-off.
- Site to be restored at the end.

Residual impact significance

The significance of residual impacts will be **negligible to minor** taking into account the additional recommended mitigation measures.

Impact	Soil Erosion and Compaction						
Impact Nature	Negative		Positive		Neutral		
Impact Type	Direct		Indirect		Induced		
Impact Duration	Temporary	Short-term		Long-term	Permanent		
Impact Extent	Local		Regional		Transboundary		
Impact Scale	Limited to Project area (specifically construction areas of the Project)						
Impact Magnitude	Positive	Negligible		Small	Medium	Large	
Resource /Receptor Sensitivity	Low		Medium		High		
Impact Significance	Negligible		Minor		Moderate		Major
	Significance of impact is assessed as minor to moderate						
Residual Magnitude	Positive	Negligible		Small		Medium	Large
Residual Impact Significance	Negligible		Minor		Moderate		Major
	Significance of impact is assessed as negligible to minor						

7.4.3.2 Impact on land and soil contamination due to improper waste disposal

Impact Magnitude

General construction waste generated onsite will comprise of surplus or off-specification materials such as concrete, wooden pallets, steel cuttings/filings, packaging paper or plastic, wood, metals etc. Municipal domestic wastes consisting of food waste, plastic, glass, aluminium cans and waste paper will also be generated by the construction workforce at any canteen facility/ rest area, which shall be constructed for them. Considering the large footprint of the project, moderate quantity of waste generated during construction phase will be hazardous and may include used oil, hydraulic fluids, waste fuel, grease and waste oil containing rags. If improperly managed, solid and hazardous waste could create negative impacts on land. Additionally, soil contamination during the construction phase may result from leaks and spills of oil, lubricants, or fuel from heavy equipment, improper handling of chemical/fuel storage and wastewater. Such spills could have a long-term impact on soil quality.

Therefore, the receptor sensitivity is assessed to be **high** and impact magnitude are assessed as **medium to large**

Embedded/in-built controls

- The construction contractors will have control over the amount and types of waste (hazardous and non- hazardous) produced at the site;
- Workers will be strictly instructed against random disposal of any waste generated from the construction activity;
- Construction contractor will ensure that no unauthorized dumping of used oil and other hazardous wastes is undertaken at the site.
- Hazardous waste will be disposed through authorised vendor only.
- The sewage generated onsite shall be treated and disposed through septic tanks and soak pits as per specifications given in IS 2470: 1995 (Part I and II); Significance of Impact

Based on the above the impact after incorporating the embedded control the impact significance is envisaged to be **moderate to major**.

Additional Mitigation Measures

- Municipal domestic waste generated at site to be segregated onsite and ensure proper collection and handover to local municipal body/ local authority for further disposal;
- Ensure hazardous waste containers are properly labelled and stored onsite provided with impervious surface, shed and secondary containment system;
- The construction contractor should ensure daily collection and periodic (weekly) disposal of construction waste generated debris, concrete, metal cuttings wastes as per the Construction and Demolition Waste Management rules 2016;
- It is to be ensured that hazardous waste is not stored for more than 90 days
- Use of spill control kits to contain and clean minor spills and leaks.
- Unloading and loading protocols should be prepared for diesel, oil and used oil respectively and workers trained to prevent/contain spills and leaks.

After implementation of mitigation measures, significance of impacts is envisaged to reduce to **minor to moderate**

Residual Impact Significance

Impact	On land due to improper waste disposal				
Impact Nature	Negative		Positive		Neutral
Impact Type	Direct		Indirect		Induced
Impact Duration	Temporary	Short-term	Long-term		Permanent
Impact Extent	Local		Regional		Transboundary
Impact Scale	Limited to Project area				
Likelihood	Likely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource /Receptor Sensitivity	Low		Medium		High
Impact Significance	Negligible	Minor		Moderate	Major
	Significance of impact is assessed to be moderate to major				
Residual Magnitude	Positive	Negligible	Small	Medium	Large

Residual Impact Significance	Negligible	Minor	Moderate	Major
	Significance of residual impact is assessed to be minor to moderate-			

7.4.4 Impact on Water Environment

7.4.4.1 Impact on Water Availability

Impact Magnitude

Water is a prime requirement for the execution of civil works, especially with regard to preparation of raw materials like concrete etc. for civil works associated with the Project (i.e. WTG foundation solar PV module installation, casting, construction of proposed site office, SCADA room).

Source of water for the construction phase will be from IGNP canal, it can be sourced from Mohangarh pumping station. Based on estimates shared by AGE(7)L & AGE(9)L, approximately 145 KLD water will be required during peak time of construction phase for civil work and approximately 315 KLD water will be required for domestic purpose.

The project IGNP canal is used for irrigation purpose, drinking purpose and also used by other power producers for sourcing water (Refer **Section 5.3.7.1**). Therefore, the receptor sensitivity is assessed to be **high**. However, since the construction phase of the Project will almost a year (~ 10-12 months), therefore, magnitude of impact is assessed as **large**.

Embedded built in controls

Water tankers will be utilised to fulfil supply requirements for all purposes, including construction work and site office

Significance of Impact

The significance of impact is assessed to be **major**.

Additional Mitigation Measures

- Construction labour deputed onsite to be sensitised about water conservation and encouraged for optimal use of water;
- Regular inspection for identification of water leakages and preventing wastage of water from water supply tankers is necessary for efficient utilisation of water;
- Blending of low quality water with fresh water for construction uses to ensure efficient use of natural resource;
- Recycling/reusing to the extent possible;
- Prepare and implement water conservation scheme e.g., rainwater harvesting at the project site.

Residual Impact Significance

The significance of impact is envisaged to be **moderate** on implementation of mitigation measures

Impact	Water availability during construction phase				
Impact Nature	Negative		Positive		Neutral
Impact Type	Direct		Indirect		Induced
Impact Duration	Temporary	Short-term		Long-term	
Impact Extent	Local		Regional		Transboundary
Impact Scale	Limited to Project footprint area				
Impact Magnitude	Positive	Negligible	Small	Medium	Large

Resource /Receptor Sensitivity	Low		Medium		High	
Impact Significance	Negligible	Minor		Moderate		Major
	Significance of impact is assessed as major					
Residual Magnitude	Positive	Negligible		Small	Medium	Large
Residual Impact Significance	Negligible	Minor		Moderate		Major
	Significance of residual impact is assessed as moderate					

7.4.4.2 Impact on Water Quality

Impact Magnitude

There is a potential for contamination of surface and groundwater resources resulting from improper management of sewage at project site office or other accidental spills/leaks at the storage areas.

The soil type of the area is red desertic soil and sandy soil. This type of soil usually has high percolation (measured in the range of 1 to 8 inches or more per hour) into the subsoil and subsequently the ground water. Therefore, the receptor sensitivity is assessed to be **medium**.

Furthermore, accidental spillage of chemical and fuel may easily contaminate the ground water. Therefore, the spillage of chemicals and fuel may cause changes in the ground water quality during construction activities (i.e. 10-12months). Therefore, the magnitude of impact on water quality is assessed to be **medium** as well.

Embedded/in-built controls

- Provision of septic tank and soak pits onsite for treatment and disposal of sewage, thereby minimizing the impacts of wastewater discharge. Planning of toilets, soak pits and septic tanks, waste collection areas will be away from natural drainage channels;
- Provision for impervious storage area, especially for fuel & lubricant, hazardous waste, etc. will be made onsite;

Significance of Impact

The overall significance of impact is assessed to be **moderate**.

Additional Mitigation Measures

- Hire/engage licensed contractors for management and disposal of waste and sludge;
- Labourers should be given training towards proactive use of designated areas/bins for waste disposal and encouraged for use of toilets. Open defecation and random disposal of sewage should be strictly restricted; and
- Spill/ leakage clearance plan to be adopted for immediate cleaning of spills and leakages.

Residual Impact Significance

The significance of impact is envisaged to be **minor** on implementation of mitigation measures.

Impact	Water quality during construction phase				
Impact Nature	Negative		Positive		Neutral
Impact Type	Direct		Indirect		Induced
Impact Duration	Temporary	Short-term		Long-term	Permanent
Impact Extent	Local		Regional		Transboundary
Impact Scale	Limited to WTG footprint, construction areas & associated facilities				

Frequency	Construction phase				
Likelihood	Likely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource /Receptor Sensitivity	Low		Medium		High
Impact Significance	Negligible	Minor		Moderate	Major
	Significance of impact is assessed to be moderate				
Residual Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor		Moderate	Major
	Significance of residual impact is assessed to be minor				

7.4.5 Impact on air quality

Impacts

Air quality will largely get impacted from the following sources during the construction phase:

- Fugitive dust emissions from site clearing, excavation work, cutting and levelling work at wind and solar sites and access/ internal roads, stacking of soils, handling of construction material, transportation of material, emission due to movement of vehicles and heavy construction machinery etc.;
- Vehicular emissions due to traffic movement on site and on access roads;
- Exhaust emissions from construction machineries, other heavy equipment like bull dozers, excavators, and compactors; and
- Emissions from emergency power diesel generator required during construction activity.

The hybrid Project is spread across a larger area ~4240 acres (area required for transmission towers and the PSS have not been include in the area mentioned). The air quality impacts would be confined to 500 m of the construction activity area includes material storage area, villages located near to access routes etc. and will not have any long term impact on the ambient air quality of the area. However, the Project study area is characterised by presence of loose sandy soil and is prone to soil erosion, coupled with the fact that construction activities will involve increase in the number of vehicles entering the region. State Highways will be utilised along with village roads for transportation of construction materials. Villages along the state highways and village roads in the Project AoI will be impacted due to increased emissions. Therefore, the receptor sensitivity is assessed as **medium**

Since the construction related activities will last for almost a year (i.e. 10-12 months), the impact magnitude is assessed to be **medium**.

Negligible impacts are envisaged during operational phase of the Project with respect to impact on air quality since the Project is a renewable energy Project which does not lead to air emissions. As for impacts due to vehicular emissions and fugitive dust emissions, they are assessed to be limited considering vehicles will use upgraded approach roads (thus nullifying the impacts arising from fugitive dust) and during maintenance activities which will planned to occur only a few time a year.

Embedded built in controls

- Preventive measures such as storage of construction material in sheds, covering of construction materials during transportation will be undertaken, for reducing dust as part of the embedded controls;
- Minimizing of stockpiling by coordinating excavations, spreading, re-grading and compaction activities;

- Proper maintenance of engines and use of vehicles with Pollution under Control (PUC) Certificate.

Significance of impact

The impact on air quality will be local and short-term, restricted to the construction period. The overall impacts are envisaged to be **moderate**.

Additional mitigation measures

- Speed of vehicles on site will be limited to 10-15km/h which will help in minimizing fugitive dust emissions due to vehicular movement;
- Emissions from the emergency D.G. set and other stationary machines will be controlled by ensuring that the engines are always properly tuned and maintained;
- Cease or phase down work if excess fugitive dust is observed. Investigate the source of dust and ensure proper suppression measures;
- Idling of vehicles and equipment must be prevented.

Residual impact significance

The residual impact due to the Project on air quality is envisaged to be **minor**.

Impact	Air Quality during construction phase						
Impact Nature	Negative		Positive		Neutral		
Impact Type	Direct		Indirect		Induced		
Impact Duration	Temporary	Short-term		Long-term	Permanent		
Impact Extent	Local		Regional		Transboundary		
Impact Scale	Limited to Project area and immediate vicinity						
Impact Magnitude	Positive	Negligible		Small	Medium	Large	
Resource /Receptor Sensitivity	Low		Medium		High		
Impact Significance	Negligible		Minor		Moderate		Major
	Significance of impact is assessed to be moderate						
Residual Magnitude	Positive	Negligible		Small		Medium	Large
Residual Impact Significance	Negligible		Minor		Moderate		Major
	Significance of residual impact is assessed to be minor						

7.4.6 Impact on Ambient Noise

Impacts

The project is located in rural setting and therefore prescribes to CPCB and WHO standards set for residential areas (Day time $L_{eq} = 55$).

The list of project activities that might result in noise impacts is given below:

- Noise from heavy vehicular traffic movement;
- Noise from increased workforce and construction/demolition;
- Noise from cranes, drillers, bulldozers, excavators, etc.; and
- Noise from D.G. sets.

Construction work is expected to last for approximately 10-12 months and construction activities will be restricted to daytime. Noise generation from select construction equipment and machinery utilized in the construction of a hybrid project are presented in **Table 7.24**. Specific information about types, quantities, and operating schedules of the construction equipment was not available at the time of assessment and therefore, assumptions have made regarding the type, number and Sound Power Levels (SPLs) of construction equipment, based on similar projects and publicly available data. It has been assumed that only one of each type of equipment will be on-site during any day or night period. Re-assessment of noise levels may be required if the actual construction equipment inventory and SPL vary from the assumed list.

Table 7.24 Assumed construction equipment sound pressure level inventory

Construction Equipment	Average Noise Level at 50 feet (dB A)
Bulldozer	82
Backhoe	78
Loaders	79
Vibratory roller	102
Fuel truck	85
Cranes	81
Dump truck	76
Grader	85
Compressors	78
Generators	85
Rock drill	81
Grader	85
Concrete mixer truck	79
Concrete pump truck	81
Scraper	85

Source: The SPLs of the construction equipment have been taken from FHWA noise specification 721.560⁴¹ and ERM's internal database

Settlements located within 500 m of proposed project will most likely be affected by increasing noise levels because of proximity to the project site. The receptor sensitivity is therefore considered as **medium**.

Impact magnitude is considered to be **large** considering the construction period of the project to last for approximately 10-12 months.

Embedded built in controls

Normal working hours of the contractor to be defined (preferable 8 am to 6pm). If work needs to be undertaken outside these hours, it should be limited to activities which do not generate noise

Significance of impact

The overall impact significance is assessed to be **moderate**.

⁴¹ Construction Noise Handbook. FHWA-HEP-06-15; DOTVNTSC-FHWA-06-02; NTIS No. PB2006-109102. Final Report August 2006 (updated 5/20/2010). <http://www.fhwa.dot.gov/environment/noise/construction_noise/handbook

Additional mitigation measures

- Only well-maintained equipment should be operated on-site;
- If it is noticed that any particular equipment is generating too much noise then lubricating moving parts, tightening loose parts and replacing worn out components should be carried out to bring down the noise and placing such machinery far away from the households as possible;
- Limit the number of heavy vehicles required for the Project to only those that are necessary
- Machinery and construction equipment that may be in intermittent use should be shut down or throttled down during non-work periods; and
- Minimal use of vehicle horns and heavy engine breaking in the area needs to be encouraged

Residual impact significance

After implementation of mitigation measures, the significance of residual impacts will be **minor to moderate**.

Impact	Noise generation during construction phase				
Impact Nature	Negative		Positive		Neutral
Impact Type	Direct		Indirect		Induced
Impact Duration	Temporary	Short-term	Long-term		Permanent
Impact Extent	Local		Regional		Transboundary
Impact Scale	Limited to Project footprint area and surrounding communities				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource /Receptor Sensitivity	Low		Medium		High
Impact Significance	Negligible	Minor		Major	
	Significance of impact is assessed to be moderate				
Residual Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor		Major	
	Significance of residual impact is assessed to be minor to moderate				

7.4.7 Impact on Occupational Health and Safety

Impacts

The 600 MW Hybrid project comprises of two projects of 300 MW solar with 75MW wind each. This project would required a large workforce for construction and operation of the asset; with such a large number of engaged work force the number of potential affected workforce and impacts are also anticipated to be large. The Occupational health and safety needs to be monitored for several activities anticipated for the Project:

- Working at height during erection of WTGs, transmission towers and establishment of transmission lines;
- Working in confined spaces within the WTGs and pooling substation;
- Working with rotating machinery including the batching plant, rollers and layers; and
- Working with live electrical components – transmission towers, lines and WTG internal electrical parts.

The Project site also needs to implement proper measures for fire safety, public accessibility, falling objects, structural safety and any emergencies.

Note: The occupational health and safety concerns mentioned above would be consistent across the Project life cycle and therefore the impacts would be similar in nature.

Embedded built in controls

- All construction activities should be carried out during daytime hours and vigilance should be maintained for any potential accidents;
- Personal Protective Equipment (PPEs) including safety shoes, helmet, goggles, ear muffs and face masks;
- Structural integrity should be checked before undertaking any work; and
- Electrical and maintenance work should not be carried out during poor weather and during lightning strikes.

Significance of impact

AREPGL is a company that has a large portfolio of under operational constructed and operated wind farms respectively and already have a Health and Safety procedures in place, which shall be implemented at this site also. AREPGL has developed SOPs for OHS as part of their detailed ESMS. The SOPs on OHS include these given components:

- On recognition and Reporting of Incidents, Illness and Safety Hazards;
- On personal protective equipment;
- On training and Development;
- On Emergency and Response Plan,
- On transportation safety and handling hazardous materials

In addition, there is a training calendar developed at corporate level, according to which trainings are conducted periodically at AREPGL's project sites. Reportedly, the same would be followed at AGE9L & AGE7L site as well. The impact significance on occupational health and safety is therefore assessed as **minor**.

Additional mitigation measures

- All workers direct, in-direct and third party workers, engaged during construction and operational stage of the project, should be provided with training on Health and Safety policies and with appropriate refresher courses throughout the life cycle of the Project;
- The adequate permitting system should be implemented to ensure that cranes and lifting equipment is operated by trained and authorized persons only;
- Appropriate safety harnesses and lowering/raising tools should be used for working at heights;
- Safe drinking water supply should be provided for the workers;;
- An up-to-date first aid box should be provided at all construction sites and a trained person should be appointed to manage it;
- All equipment should be turned off and checked when not in use; and
- A safety or emergency management plan should be in place to account for natural disasters, accidents and any emergencies. The nearest hospital, ambulance, fire station and police station should be identified in the implemented emergency management plan.

Residual impact significance

Upon implementation of additional mitigation measures, the residual impact significance is envisaged to be **minor** to **negligible**.

Impact	Occupational Health & Safety during construction phase						
Impact Nature	Negative		Positive		Neutral		
Impact Type	Direct		Indirect		Induced		
Impact Duration	Temporary	Short-term		Long-term	Permanent		
Impact Extent	Local		Regional		Transboundary		
Impact Scale	Limited to Project footprint area and surrounding communities						
Frequency	Construction phase						
Likelihood	Likely						
Impact Magnitude	Positive	Negligible		Small	Medium	Large	
Resource /Receptor Sensitivity	Low		Medium		High		
Impact Significance	Negligible		Minor		Moderate		Major
	Significance of impact is assessed to be minor						
Residual Magnitude	Positive	Negligible		Small		Medium	Large
Residual Impact Significance	Negligible		Minor		Moderate		Major
	Significance of residual impact is assessed to be minor to negligible .						

7.4.8 Impact on Community Health and Safety

Impacts

The given hybrid project is spread across 34 Aol villages, which has a huge population of 35, 259 people. Out of these 34 Aol villages, 18 are Core zone villages. The receptors for impacts on community health and safety include the local community within the study area who may be present in the proximity of asset and project activities.

The major community health & safety risks include life and fire safety, public accessibility and management of emergencies etc. Project activities such as, usage of heavy machineries, movement of heavy vehicles during construction work, presence of migrant labour and related health issues and risks (i.e. safety issues with women) and live transmission power lines. Further, the movement of material and personnel via the access roads may sometimes lead to road accidents and cause damage to human life or livestock. In addition, there could be incidents of blade throw; however, the chances of it are very negligible.

The wastewater generated at the time of module cleaning also pose a severe threat to the crops in the nearby agricultural fields; also if this wastewater is not managed properly could lead to stagnation and foul smell in the site surroundings.

The specific receptors may include those living in the immediate settlements from respective WTG locations and solar sites, graziers and their animals, agricultural workers working in the nearby land parcels (both as agricultural labour or sharecropper/ cultivator), users of common access roads (i.e. both project staff, workers and nearby community). In addition, the impact over community's health and safety will escalate with the cumulative impact of other wind plants of Suzlon, Inox in the site proximity.

Possible sources of impacts to community health and safety at present, considering the O&M phase activities like oiling and any other remaining construction activities, workers and staff mobility etc. are as follows:

- Accidents on village access roads by sub-contractors for oiling and other operational activities. Accidents may also be caused by blade throw or fire in the proximity of WTG footprint locations or settlements.

Community discontent arising due to lack of their grievances/ demands being addressed. Based on consultation with local community it was identified that local community has expectation of being engaged as construction labour and security guards during construction and operational phase. Any discontent among community on their engagement in project may lead to agitation or negativity among local community

Embedded built in controls

The project proponent has adopted the following embedded controls to avoid any health and safety impacts to the community:

- The project will identify sensitive receptors in 300 meters of its WTG locations and avoid any settlements, roads, and other sensitive locations where human and animal movement may occur, i.e. waterbodies, forest areas, etc.

In addition to it, it was informed that AREPGL have a health and safety policy in place. The AREPGL policy will be applicable to all activities being undertaken as part of the project, including the appointed contractors and sub-contractors activities. AREPGL will have a safety supervisor on site who will be responsible for daily monitoring of the project activities and the transportation related risk. AREPGL will also be involved in monitoring of the project activities to ensure that the requirements of their health and safety standards are met.

Significance of impact

The overall impact significance of the community health and safety during the construction phase is assessed **as minor**.

Additional mitigation measures

In addition to the embedded measures, the following risk mitigation measures are suggested to minimize the risks/hazards of construction activities onsite:

- 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;
- As part of stakeholder engagement, the project will also propagate health awareness amongst the community, including setting up of health camps,
- The traffic movement for the project in the area will be regulated to ensure road and pedestrian (including livestock) safety
- The workers (both regular and contractual) on the project will be provided with trainings on the Health and Safety policy in place, and their role in the same and refresher courses will be provided throughout the life of the project;
- Put in place a grievance mechanism to allow for the workers and community members to report any concern or grievance related to project activities; and
- In addition, it shall be ensured that all the sensitive receptors are well identified and precautionary measures are duly taken.

7.4.8.1 Residual impact significance

The significance of impact will be reduced to **minor** on implementation of mitigation measures.

Impact	Social and Community Health and Safety						
Impact Nature	Negative	Positive		Neutral			
Impact Type	Direct	Indirect		Induced			
Impact Duration	Temporary	Short-term	Long-term		Permanent		
Impact Extent	Local		Regional	International			
Impact Scale	Limited to Project Footprint area						
Frequency	Project lifecycle						
Likelihood	Possible						
Impact Magnitude	Positive	Negligible	Small		Medium	Large	
Resource/Receptor Sensitivity	Low		Medium		High		
Impact Significance	Negligible	Minor		Moderate		Major	
	Significance of impact is considered Minor						
Residual Impact Magnitude	Positive	Negligible		Small		Medium	Large
Residual Impact Significance	Negligible	Minor		Moderate		Major	
	Significance of Residual Impacts is considered Minor						

7.4.9 Migrant Labours and Related Impacts

Impacts

There will be migrant workers and employees (semi-skilled/ skilled/ highly skilled) working for project activities such as substation/ transformer installation, tower erection, civil foundation works, electrical works, installation of solar panels, solar modules amongst others.

These migrant labourers will be contracted during the construction phase; as there is lack of required skill base (especially in undertaking the steel work for WTG foundation, installation of solar panels and solar modules etc.) in the local area. The migrant labourers will be employed particularly in civil works. The local labourers will also be employed, based on their skill-set and requirement, such as, they may be engaged through sub-contractors for module cleaning, grass cutting, as security guards etc., as and when required.

The in-migration of a number of labourers might have following impacts on the nearby community & resources:

- Additional demand on resources, such as food supply, water and sanitation facilities etc.;
- Spread of contagious diseases and communicable diseases such as STDs and HIV/AIDS;
- Cases of violence against women where safety gets affected by external community in their proximity;
- Conflict with local cultures, values and religious/societal sentiments could arise between project engaged staff/ labourers and local community.

Currently, at the time of ERM's site visit, no migrants workers were engaged as the project is still in it's planning and land procurement stage and thus no construction activity had started for the project.

Embedded Control

It was informed by site team of AREPGL that, to ensure compliance to labour laws, the work order will contain details on the safety and labour law compliance requirements; which would be prerequisite for sub-contractors to comply with.

In addition, AGE(7)L & AGE(9)L as a part of its sub-contractor agreements will require each contractor to have an EHS plan in place, as well as procedures for monitoring of the EHS performance of contractors and their workers.

Impact Significance

The in-migration of workers from outside the area will result in increased risk of conflict and social unrest due to cultural differences between the labourers and local community. Similarly, the in-migration may also lead to spread of communicable diseases due to contact and interaction among the labourer and the local community. Moreover, lack of proper sanitation or waste management facilities may also result in outbreak and transmission diseases. The in-migration will also result in increased pressure on basic facility such as water etc. Such pressure and demand may lead to inflation and increased prices of food items and basic commodities. As this impact is restricted to the construction phase the impact, hence the magnitude of impact has been assessed as **minor**.

Additional Mitigation Measures

The recommended measures to mitigate the impacts related to the in-migrant labours include:

- A formal “code of conduct” in order to ensure that labours are engaged on the basis of contract labour licences, national and state regulations and no forced or child labours are engaged;
- Quarterly health screening of all the employed labourers at the project site by the contractor/sub-contractor;
- Maintenance of hygiene of the labour camp;
- Provision of floor mats/mattresses and ensuring electricity connection for even one light and fan;
- Providing recreational facilities to the labourers on their off-days;
- Providing the local community of an understanding of the project activities and the possible health and safety risks associated with the same;
- Avoiding presence of unsanitary conditions and better facilities in the campsite, such as safe drinking water, proper waste collection and disposal system, etc.
- All Project personnel will be required to respect local cultural traditions and religious festivals, funerals and other traditional events. Induction training for all personnel will include appropriate cultural awareness training.

Residual Impact Significance

After implementation of mitigation measures, the significance of residual impacts will be reduced to **Negligible**.

Impact	Impact on In-migration			
Impact Nature	Negative	Positive		Neutral
Impact Type	Direct	Indirect		Induced
Impact Duration	Short Term	Medium Term		Long Term
Impact Extent	Local	Regional		National
Impact Scale	Low			
Impact Magnitude	Positive	Small	Medium	Large

Resource/ Receptor Sensitivity	Low		Medium		High	
Impact Significance	Negligible	Minor		Moderate	Major	
	Significance of impact is considered minor					
Residual Impact Magnitude	Positive	Negligible		Small	Medium	Large
Vulnerability/ Sensitivity of Social Receptors	The receptor vulnerability is low as the local community are predominantly engaged in cultivation and do not possess the required skill set to undertake construction work. However, local community may be engaged during construction phase as third party contractor and also labours by these third parties, i.e. for water supply, as drivers, etc. also in case of local labours meeting the requirements of skill sets required, they will not be refrained from any opportunity. Furthermore, during consultations with the local community, it was gauged that there had been no reported conflicts pertaining to migrant labourers in the area for other ongoing projects of Suzlon and Inox in the area. The accommodation as informed would be provided with adequate facilities with particular attention to water, cooking and sanitation requirements, however aspects such as electricity, ventilation, floor mats/mattresses require additional attention.					
Residual Impact	Negligible		Minor		Moderate	Major
	Negligible					

7.4.10 Impact on landholding and agricultural income

Impacts

The total private land required for upcoming solar-wind hybrid project is ~4240 Acres; out of which 3900 Acres is required for solar site and rest 340 Acres for 72 WTG locations. As per Adani's land team and aggregators such as, M/s Dalweer Ent. Pvt. Ltd., M/s Prem Singh, M/s Lakh Singh, engaged for land leasing, it was informed that majority of the land identified/ or being lease is dry scrubland with some agriculture taking place sporadically. The same was observed during site visit by ERM team.

Consultation with land aggregators and landowners revealed that the land is being/ will be leased out for a period of 29 year and 11 month at a rate of INR 21,000/ acre/ annum or INR 8400/ Bigha/ annum, with an escalation rate of 5 percent in every two year.

As per consultation with site land team of Adani, 3900 Acres of land identified for solar plants is located in village Sanawara. The "Lease-Deed" agreement has not been carried out for 3900 Acres of land; while MoU has been signed with all the identified landowners. No advance/ token amount has been given for the same. Similarly, 340 Acres of Private land has been identified under Pokhran and Fatehgarh tehsils. As informed by land team, 22 "Lease- Deed" agreements have been carried out until date. The process of lease agreement started in December 2019 and is expected to be completed by November 2020.

The identified land parcels do not have any structures on them and the identified landowners informed that they have more land available for agriculture, the land leasing will not affect their livelihood; rather it will increase their annual income. They further added that, the agriculture is entirely depended on rainwater in the area. There are very less irrigation sources in the village due to which the productivity of land has reduced over a decade. The lease amount will be a fix source of income for them and this will improve their status of living. Further, there were no encroachers or non-titleholders with recognizable usage rights on the procured land parcels, hence informal rights have not been impacted due to the project.

Dependence of local community on agriculture land

As reported during the consultation, due to lack of irrigation facilities and dependence on rainfall, considerable section of the working population, working as agricultural labourers in the study area has reduced. Reportedly, none of the land owner consulted and the local community in the area practice sharecropping. Majority of the households are working as other works and cultivators. Therefore, sale of land is not expected to have significant impact on the agriculture labourers.

Based on the above analysis, after implementing the embedded controls, the impact magnitude is assessed to be **moderate**

- To the extent possible, the project should ensure that no landowner is rendered landless due to the land leasing for the project.

Additional employment opportunities may also be created for the local youth by the project

Significance of Impact

The overall impact significance of the land procured during the construction phase is assessed as **minor**.

Additional Mitigation Measures

Considering that the leasing out of land will have only a minor implication on the financial condition of the land lessor, the following additional measures may be recommended to minimise this impact:

- Providing preference to members of the families who have leased out the land to the project for livelihood opportunities during Construction and operation phase; and
- Procuring resources from the local sources so as to induce more employment in the supply chain.

Residual Impact Significance

After implementation of mitigation measures, the significance of residual impacts will be reduced to **Negligible**.

Impact Nature	Negative		Positive		Neutral
Impact Type	Direct		Indirect		Induced
Impact Duration	Temporary	Short-term	Long-term		Permanent
Impact Extent	Local		Regional		International
Impact Scale	Limited to habitation within the study area and land sellers.				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low		Medium		High
Impact Significance	Negligible	Minor	Moderate		Major
	Significance of impact is considered to be Minor				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Major
	Significance of impact is considered Negligible to Minor .				

7.4.11 Impact on Employment Opportunities

The average Work Participation Ratio (WPR) in the AoI villages is 43.07 percent. The casual labourers are in a higher proportion than other and agriculture labour in the AoI. The higher presence of casual workers mostly due to low productivity of land. The receptors for impacts on livelihood profile

and economic opportunities include the land owners and local community within the study area. According to the information available, the land requirement for the project is mostly comprised of private land.

The construction phase activities of the project including construction of access road, civil works, foundation activities, site clearance and security will involve semi-skilled and unskilled workers. According to the information available, the preference will be given to the local workers to be employed as a contractual workforce.

As discussed in the social baseline, the main livelihood profile in the study area is other workers who are involved working in local housing construction work, Graphite mines, small entrepreneurs and some owned petty shops. Based on the discussions with the local community, it is understood that the establishment of the solar and wind power project in the area has resulted in a shift of preferences of the local community from agriculture and livestock rearing for income. With the locals, preferring to be employed by the solar & wind power projects during the construction and operation phase, as drivers and security personnel. This is primarily resultant from the uncertainties and fluctuations associated with agriculture and the relative stability in income expected from wind power projects and other non-farm based livelihoods. It is also important to note that the main source of non-farm based income in the area, apart from renewable power projects is casual labour, with no other major projects or industries located in the area. The renewable power projects have thus resulted in an increased exposure of the local community to the non-farm sector. The project is also likely to create a number of indirect economic opportunities in terms of hiring of tractors and cars, setting up of petty shops etc.

The local community is likely to benefit from the economic opportunities to be created from the following:

- Civil works during construction phase including, construction of WTGs mounting area, foundation for solar panels, transformer yard, internal roads, and transmission line,
- Self-employment options for individuals possessing vocational or technical training skills like electricians, welders, fitters etc; and

Contracting opportunities for locals possessing tractors, dumper trucks or other vehicles which would be needed to carry away excavated soil and other material. Creation of indirect employment for local community through establishing small shops like tea stalls, supply of intermediate raw materials, repair outlets, hardware stores etc. However, these are likely to be temporary.

Embedded built in controls

As gathered information from consultations with the project team, a significant segment of labour requirement during the construction phase will be sourced locally. However, this employment is likely only for the construction phase of the project, as during the operations phase, only two security guard will be hired for one WTG and for group of security personnel for solar plant.

Significance of Impact

The impacts have been assessed as **positive** due to employment opportunities for locals.

Additional Mitigation Measures

The project is recommended to have the following additional mitigation measures in place:

- Depending upon the skill requirement, the local community should be given preference for employment, especially in semi-skilled and unskilled work;
- The sourcing of local labour wherever possible should be made obligatory for the sub-contractors and in all major procurement activities;
- Preference should be given to the vulnerable population in the AoI; and

- The project proponent will establish a mechanism to audit subcontractors and suppliers with respect to compliance of utilizing local labour and resources.

Residual impact significance

The significance of the residual impact is envisaged to be **positive** on implementation of mitigation measures

Impact	Economic Opportunity Water availability during construction phase					
Impact Nature	Negative		Positive		Neutral	
Impact Type	Direct		Indirect		Induced	
Impact Duration	Temporary	Short-term		Long-term	Permanent	
Impact Extent	Local		Regional		International	
Impact Scale	Limited to Project Footprintfootprint area					
Frequency	Construction Phase of the Project					
Likelihood	Likely					
Impact Magnitude	Positive	Negligible		small	Medium	Large
Resource/Receptor Sensitivity	Low		Medium		High	
Impact Significance	Negligible	Minor		Moderate		Major
	Significance of impact is considered to be Positive					

7.4.12 Labour Rights and Welfare

Impact

The projects will employ skilled, semi-skilled and unskilled workers, across the project lifecycle, which will include contractual and regular employees and local and migrant workers. The regular skilled workers are likely to be comprised of migrant workers, from different districts and states in the country, depending upon the need for technical expertise.

Embedded built in controls

As reported AGE(7)L & AGE(9)L, also as part of its sub-contractor agreements requires each contractor to have an EHS plan in place, as well as procedures for monitoring of the EHS performance of contractors and their workers.

Significance of Impact

The overall impact significance of the labour rights and welfare during the operation phase is assessed **as minor**.

The following additional mitigation measures are suggested in order to ensure compliance with labour laws/provisions as per the industry best practices:

- The labour accommodation facility for contractual workers and as well as for regular employees should meet the requirements of the applicable reference framework in terms of space per worker, water and sanitation facilities, first aid, lighting and ventilation etc. and regular monitoring should be undertaken to ensure compliance through the project lifecycle;
- Both AGE(7)L & AGE(9)L shall ensure a monthly monitoring and regular auditing mechanism for monitoring the sub-contractors and suppliers with respect to compliance to the applicable

reference framework, in terms of resources, migrant workers, child labour and forced labour, health and safety, payment of wages etc.; and

- Establish a grievance redressal mechanism in place, to allow for the employees and workers to report any concern or grievance related to work activities

Residual Impact Significance

The significance of impact would be reduced to **minor** on implementation of mitigation measures.

Impact	Labour Rights and Welfare					
Impact Nature	Negative	Positive		Neutral		
Impact Type	Direct	Indirect		Induced		
Impact Duration	Temporary	Short-term	Long-term		Permanent	
Impact Extent	Local		Regional	International		
Impact Scale	The project will follow the additional mitigation measures as suggested above in order to ensure compliance with labour laws/provisions as per the industry best practices					
Frequency	Project life cycle					
Likelihood	Possible					
Impact Magnitude	Positive	Negligible	small	Medium	Large	
Resource/Receptor Sensitivity	Low		Medium		High	
Impact Significance	Negligible	Minor		Moderate	Major	
	Significance of impact is considered to be Moderate					
Residual Impact Magnitude	Positive	Negligible	Small		Medium	Large
Residual Impact Significance	Negligible	Minor		Moderate		Major
	Significance of Residual Impacts is considered Minor					

7.4.13 Ecological Impacts

The impacts from the construction phase of the Project on the ecology of the area have been assessed with respect to following activities:

- Removal of vegetation from open scrubland for the solar infrastructure, WTG foundation construction and ancillary facilities;
- Laying of access and internal roads for the project.

7.4.13.1 Impacts due to Vegetation Clearance

The site preparation activities will require clearance of vegetation which leads to direct impact (vegetation loss) on the habitat and species. Although the project site is situated mostly in open scrub and grassland the clearance of vegetation for various activities such as excavation for the erection of WTGs and construction of ancillary facilities, construction of solar plant infrastructure, storage yards, access/internal roads, will cause loss of habitat and loss of connectivity of wildlife. This will directly affect the floral diversity and will lead to habitat loss and habitat disturbances to faunal species that the area harbours. It may affect the availability of nesting habitat, breeding sites, foraging resources and perching habitat for the wildlife in the area. The installation of wind farms in this landscape has

resulted in the fragmentation of the GIB population and destroyed the rich grasslands crucial for these birds⁴².

Embedded built in controls

- Labourers will be provided training about do's and don'ts when encountering wildlife;
- Strict no hunting, poaching or trapping of wildlife policy should be implemented and enforced through contractual obligations;
- Vegetation clearance will be planned in the phase manner and confined to the areas required to prevent excessive disturbance, anthropogenic and vehicular movement throughout the entire wind farm and Solar Project area at any given time; and
- Clearance of old mature trees or continuous scrubs should be avoided when planning the solar park and wind farm components
- Minimize chances of introduction of Invasive species in the area by adopting good industry practices by using the local resources and washing to tyres of the transportation vehicles

Significance of impact

Vegetation clearance will lead to loss of habitat and degradation for 80 avifaunal species associated with this habitat, 18 mammalian species and about 8 herpetofaunal species. The species dependent on this habitat include IUCN (v. 2019-2) Critically Endangered, Endangered, Vulnerable, Near Threatened and Schedule I (WPA 1972) species.

There is a likelihood of presence of IUCN Critically Endangered (CR v 2020-2) Great Indian Bustard and CR Vulture species including White-rumped Vulture, Indian Vulture and Red-headed Vulture in this area. Also due to the presence of Endangered (IUCN EN v 2020-2) Egyptian Vulture (*Neophron percnopterus*) and likely presence of Steppe Eagle (*Aquila nipalensis*) in this area, the resource sensitivity is **High** for habitat and species. Also some of these species use the vegetation in this area for roosting purpose and may use for nesting as well. Hence the impacts may cause a significant and irreversible change in the population of some these species and therefore the impact magnitude has been deemed **High**. The impact significance is, thus, deemed as **Critical**.

Additional mitigation measures

The following mitigation measures may reduce the impact significance on the habitat and species:

- Vegetation disturbance and clearance should be restricted to the Project activity area only;
- Large old trees should be completely avoided and the project infrastructure if needs to be modified in such avoidance should be exercised;
- During vegetation clearance exercise the important sites such as avifauna and other wildlife's roosting and breeding sites, etc. should be avoided;
- Vegetation clearance in the scrubland should be minimised by optimization of internal road, power evacuation line and avoiding construction of ancillary facility, storage, labour camps;
- Unnecessary disturbance of neighbouring vegetation due to off-road vehicular movement, fuel wood procurement, needless expansion of labour camp and destruction of floral resources should be prohibited;
- Top soil that is disturbed should be stored separately for later restoration of the habitat;
- Local plant/grass species should be seeded in disturbed areas during monsoon season;

⁴² Management Plan of Desert National Park Wildlife Sanctuary, 2017-2027.

- Simultaneous revegetation with native species on outskirts of Project activity area should be practiced for areas that are determined to have loose or unstable soil to avoid erosion;
- Additional areas in consultation with State Forest Department should be identified where native species plantation can be undertaken on an annual basis and increase the habitat value of the area.
- Prior to vegetation clearance and construction activities, old mature trees should be identified through a survey and options of avoidance should be explored.

Residual impact significance

The direct and indirect impacts of the vegetation clearance activity are limited to the construction phase of the Project for wind farm. The vegetation can recover to some extent post construction. With the proper implementation of the mitigation measures, significance of the residual impact may reduce to **Moderate** for habitat and species.

Impact	Vegetation Clearance						
Impact Nature	Negative		Positive		Neutral		
Impact Type	Direct		Indirect		Induced		
Impact Duration	Temporary	Short-term		Long-term	Permanent		
Impact Extent	Local		Regional		Transboundary		
Impact Scale	Limited to construction area and immediate surrounding						
Frequency	Construction phase						
Likelihood	Likely						
Impact Magnitude	Positive	Negligible		Small	Medium	Large	
Resource /Receptor Sensitivity	Low		Medium		High		
Impact Significance	Negligible		Moderate		Major		Critical
	Significance of impact is considered Critical for habitats and species						
Residual Magnitude	Positive	Negligible		Small		Medium	Large
Residual Impact Significance	Negligible		Moderate		Major		Critical
	Significance of impact is considered Moderate for habitats and species						

7.4.13.2 Impacts due to lying of approach roads

Approach roads are constructed to connect the WTGs and Solar project with the main access roads in the area. These are used during construction phase as well as in operational phase for maintenance activities. Following ecological concerns should be considered during the construction of approach roads.

- Vegetation loss, Habitat continuity
- Roadkills
- Habitat disturbance

Embedded built in controls

- Avoidance of vegetation clusters;
- Approach road construction with minimum clearance of vegetation with proper use of the open barren spaces present on site;
- Avoid potential or preferred habitats for reptilian, mammalian and bird species such as areas with large grasses, etc.;

- Avoid ground roosting sites and burrowed holes;
- Consult locals on areas where mammal activities are highest and these areas should be avoided for approach road construction;
- Whenever feasible, existing village or tractor roads should be upgraded, to create an approach road minimizing the disturbances on local flora and fauna

Significance of Impact

The significance of the impact has been assessed for scrubland, grazing land and agricultural land including the species of mammals, birds and burrowing animals associated with these habitats. The habitats in this landscape may support mammalian species such as Golden Jackal, Bengal Fox, Desert Fox etc. Among the burrowing animals, the most susceptible species to approach roads are lizard species, snake and Bengal Fox. All these species along with ground roosting birds such as Larks, Francolins, Lapwings are likely to be impacted due to construction of approach roads.

Due to likely presence of Critically Endangered (IUCN CR) Great Indian Bustard in the Study area, the habitat and species sensitivity is deemed **High**.

It affects relatively smaller part of the habitat if the total Project area is compared with the area of approach roads. Thus the impacts may not be long term to affect the viability of the habitat, impact magnitude is considered **Medium**.

The overall impact significance has been assessed as **Major** for habitats and species.

Additional mitigation measures

The following mitigation measures will further reduce the impact significance on the habitat and species:

- The construction of roads for the Project should be carried out in a phased manner by focusing on clusters of WTGs at a given time to allow impacted fauna to adjust to the disturbed areas;
- Construction and transportation activities should be avoided during high animal activity duration such as at night (6:00 pm to 6:00 am) and if possible times of high activity during dawn (6:00 am to 7:30 am) and dusk (5:00 pm to 6:00 pm) should also be avoided;
- Anti-poaching and hunting policy should be strictly enforced under contractual obligations;
- Number of routes should be minimized for construction and transportation;
- Speed limit of vehicles on these roads should be kept to 10-15 km/hr to avoid road kill;
- When grasses or small shrubs are removed for access road construction, replanting of native species should be implemented after the construction phase
- Consultations should be carried out with the locals to avoid areas where grazing activities are intense;
- The approach roads should be planned on the basis of land use/ land cover map ;
- As a second step this plan should be shared with the local villagers within which the roads are planned. This would help in avoiding the areas of significance to the villagers;
- The planned road if passing through an intact continuous natural habitat, then a circuitous route bypassing it should be considered;
- At sites where natural vegetation is removed, then compensation in the form of restoration of the adjoining degraded patches, according to the type, the funding for which should be given by the developers; and

- Since these roads need to be maintained until the life of the project, locals from the nearby village through which, the roads area passing, should be employed/kept on wages for maintaining the same. This would improve the livelihood of a family.

Residual impact significance

Proper implementation of suggested mitigation measures and in-built controls can reduce the impacts of approach roads to some extent and the significance of the residual impact may reduce to **Negligible** for habitat and species.

Impact	Approach roads						
Impact Nature	Negative		Positive		Neutral		
Impact Type	Direct		Indirect		Induced		
Impact Duration	Temporary	Short-term		Long-term	Permanent		
Impact Extent	Local		Regional		Transboundary		
Impact Scale	Limited to approach roads and construction areas						
Frequency	Construction phase						
Likelihood	Likely						
Impact Magnitude	Positive	Negligible		Small	Medium	Large	
Resource /Receptor Sensitivity	Low		Medium		High		
Impact Significance	Negligible		Moderate		Major		Critical
	Significance of impact is considered Major for habitats and species						
Residual Magnitude	Positive	Negligible		Small	Medium		Large
Residual Impact Significance	Negligible		Minor		Moderate		Major
	Significance of impact is considered Negligible for habitats and species						

7.4.13.3 Impacts due to Construction Activities

The excavation and construction activities may have an impact on the burrowing species. Activities such as laying of transmission lines, construction of access roads, establishing solar infrastructure, etc. may cause the disturbance of soil layers affecting burrowing and ground roosting species in the area. Increased vehicular movement will result in the disturbance to wildlife and may lead to increased risk of road-kill. The noise from construction activities and vehicular movement may result in increased time spent in an alert mode for faunal species resulting in energy loss for normal activities such as breeding and foraging.

Embedded built in controls

- Avoid large grasses or small shrubs which could be a preferred habitat for reptilian, mammalian and bird species;
- Avoid ground roosting sites and previously burrowed holes when possible;
- Whenever possible, existing village or tractor roads should be upgraded to create an approach road which will minimize the disturbances on local flora and fauna

Significance of impact

The significance of impact has been assessed for open scrub and grassland in the Project area along with the species such Bengal Fox (*Vulpes bengalensis*), Desert Fox (*Vulpes vulpes*), Grey Mongoose (*Herpestes edwardsii*) Caracal (*Caracal caracal*), Asiatic Wild Cat (*Felis sylvestris*) and other related herpetofaunal and avifaunal species.

Some of the burrowing mammalian species, ground roosting bird species and Herpetofauna species including snakes and lizards may be directly and indirectly affected due to excavation and disturbed soil layers. These activities may also have a direct impact on the floral species of the area.

Due to the presence of Schedule I species in the area, the habitat and species sensitivity is deemed **Medium**. However, the impacts described above will be limited to the duration of construction phase only. The species using this habitat may temporarily shift to the neighbouring landscape during the construction activities. And, since the distribution of these is widespread, it is unlikely to cause a significant and irreversible change in populations of ground dwelling species. Thus, the impact magnitude has been deemed **Small** and impact significance is considered **Minor**.

Additional mitigation measures

- Construction and transportation activities should be avoided at night (6:00 pm to 6:00 am) and should particularly avoid high activity areas like tree clusters or water bodies during dawn (6:00 am to 7:30 am) and dusk (5:00 pm to 6:00 pm) to minimize the road kill;
- Hazardous materials should not be stored near natural drainage channels;
- Simultaneous revegetation of native species should be practiced on outskirts of Project activity area for areas that have loose or unstable soil to avoid erosion and sedimentation;
- Efforts should be made to minimize construction noise and the use of noise barriers should be considered for high noise levels;
- Waste materials should be cleared in a timely manner and the use of artificial lights should be minimized so as to not attract wildlife;
- Good housekeeping should be followed for construction activities, waste packaging material should be properly disposed;
- Proper sanitation facilities should be provided at the labour camps;
- Labour movement should be restricted between construction camps and construction sites and should not be allowed to venture in natural areas where no construction activity is planned;
- Vehicle movement should be restricted in areas and times where wildlife is most active;
- Strict prohibition on use of fuel wood and shrubs from nearby areas as kitchen fuel.
- Anti-poaching, trapping and hunting policy among employees and contractors should be strictly enforced; and
- General awareness regarding fauna should be enhanced through trainings, posters, etc. among the staff and labourers.

Residual impact significance

The implementation of suggested mitigation measures can reduce the impacts of construction activities to some extent and the significance of the residual impact may reduce to **Negligible** for habitat and species.

Impact	Construction Activities			
Impact Nature	Negative		Positive	Neutral
Impact Type	Direct		Indirect	Induced
Impact Duration	Temporary	Short-term	Long-term	Permanent
Impact Extent	Local		Regional	Transboundary
Impact Scale	Limited to construction area and immediate surrounding			
Frequency	Construction phase			
Likelihood	Likely			

Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource /Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Major	Critical	
	Significance of impact is considered Minor for habitats and species				
Residual Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Major	Critical	
	Significance of impact is considered Negligible for habitats and species				

7.5 Impact assessment – Operations and maintenance phase

7.5.1 Impact on soil environment

The operational phase of the project will have limited impacts on soil in the form of waste generation and soil contamination due to accidental spillages/ leakages.

7.5.1.1 Impact on land due to improper waste disposal

Impact Magnitude

During operation phase, the waste generated from Project will include domestic solid wastes at SCADA building and substation and hazardous wastes like waste oil from DG sets and transformers, and oil containing jutes and rags. The quantity of hazardous waste generated will be much lesser than the quantity generated during the construction stage. Therefore, the receptor sensitivity and impact magnitude is assessed as **low and small**.

The hazardous waste generated will have to be through an approved vendors (which is yet to be identified) in accordance with Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, as amended. The hazardous wastes will be stored onsite at separate designated covered area provided with impervious flooring and oil spill control kit will be used for cleaning small spills and leaks. During operation phase, the quantity of municipal waste and hazardous waste generated is less and probability of the hazardous waste generation is only during maintenance work and therefore occasional. The waste generated would be routed through proper collection and containment.

Significance of impact

Based on the above the impact after incorporating the embedded control the impact significance is envisaged to be **minor**

Additional mitigation measures

As the embedded controls are sufficient to address the impact no mitigation measures are deemed necessary.

Impact	Impact on land due to improper waste disposal				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	Transboundary		
Impact Scale	Limited to Project area				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource /Receptor Sensitivity	Low	Medium	High		

Impact Significance	Negligible	Minor	Moderate	Major
	Significance of impact is assessed to be minor			

7.5.1.2 Soil Contamination due to Leaks/Spills during operation and maintenance phase

Impact Magnitude

There are chances of spillage of oil during maintenance work such as lubricating oils from gearbox systems, hydraulic systems of the turbine, transformers etc. The accidental spillages at oil/lubricants and hazardous waste from transportation vehicles during maintenance work may cause contamination of soil and ground water. There is a likelihood of spillage to occur at an area that is designated for storage of WTG spares and solar modules, components and maintenance material that would comprise of oils for the above mentioned activities, especially during handling and decanting operations. Therefore, the receptor sensitivity is assessed to be **medium**.

The probability of the impact is only during maintenance activities and therefore occasional. In case of accidental spillage, the impacts will be confined to the Project land parcels within the working and storage area. Therefore, the impact magnitude is considered **medium**.

Embedded built in controls

- Oil/ lubricants will be stored on impervious floor in the storage area having secondary containment;
- Use of spill control kits to contain and clean minor spills and leaks during O&M activities; and
- The guidelines and procedures shall be prepared and followed for immediate clean-up actions following any spillages.

Significance of impact

Based on the above the impact after incorporating the embedded control the impact significance is envisaged to be **moderate**.

Additional mitigation measures

- The sewage generated onsite will be treated and disposed through septic tanks and soak pits;
- Transportation vehicles and equipment should undergo regular maintenance to avoid any oil leakage; and
- Any unloading and loading protocol should be prepared for diesel, oil and used oil respectively and workers trained to prevent spills and leaks.

Residual impact significance

The significance of impact is envisaged to be **minor**, after implementation of mitigation measures.

Impact	Soil contamination due to leaks/spills			
Impact Nature	Negative		Positive	Neutral
Impact Type	Direct		Indirect	Induced
Impact Duration	Temporary	Short-term	Long-term	Permanent
Impact Extent	Local		Regional	Transboundary
Impact Scale	Limited to sola plant and WTG locations and Pooling substation and areas earmarked for storage yard, components and maintenance material that would comprise of oil, etc.			
Likelihood	Likely			

Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource /Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is assessed to be moderate				
Residual Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of residual impact is assessed to be minor				

7.5.2 Impact on water environment

7.5.2.1 Impact on Water Availability

Impact Magnitude

During O&M phase, water will be primarily required at the solar plant for module cleaning. As mentioned in **Section 2.5.3.2**) the Project intends to implement both dry cleaning and wet module cleaning at site. Reportedly, there will be 24 module cleaning cycle per year comprising of 16 cycles of dry cleaning and 8 cycles of wet cleaning (2 dry cleaning followed by 1 wet cleaning) Water for operation phase will be sourced from IGNP canal.

As per secondary research it is understood that the Indira Gandhi Nahar Department has reserved 0.87 MAF (1200 cusec) of water for drinking, energy projects, and other industries. It is understood that Water Resources Department will allocate required quantity of water from IGNP canal/ the nearest available source for cleaning of solar panels and auxiliary consumption for Solar PV Power Plants subject to the availability of water. Power Producer is expected to intimate estimated water requirement to RREC along with source of water, which AGE(7)L & AGE(9)L is yet to complete.

Approximately 10,642 KL water will be required per year for wet module cleaning (Refer **Section 2.5.3.2**). For domestic purpose approximately 5.4 KLD water will be required considering 40 manpower deployed at site during operation phase.

Since the Project is considering wet module cleaning as well as dry module cleaning. Furthermore, there will be only 16 dry cleaning cycles and only 8 wet cleaning cycles per year therefore, receptor sensitivity and impact magnitude is assessed to be **medium**.

Embedded built in controls

As reported, AGE(7)L & AGE(9)L, intends to implement dry module cleaning mechanism as well as wet module cleaning at the site to minimise the water consumption requirement for module cleaning during operation phase.

Significance of impact

The overall significance of impacts on water availability due to operational activities is envisaged to be **moderate**.

Additional mitigation measures

- Optimising water usage in the SCADA building by application of water conservation measures such as sensor based taps, low flush urinals etc.;
- Records of daily water consumption to be maintained;
- Regular inspection for identification of water leakages and preventing wastage of water
- Recycling/reusing to the extent possible

- Feasibility of constructing rain water harvesting system at site should be checked;

Residual impact significance

The residual impact significance is envisaged to be **minor** upon application of embedded controls and additional mitigation measures

Impact	Water availability during operational phase							
Impact Nature	Negative		Positive		Neutral			
Impact Type	Direct		Indirect		Induced			
Impact Duration	Temporary	Short-term		Long-term		Permanent		
Impact Extent	Local		Regional		Transboundary			
Impact Scale	Limited to Project area							
Impact Magnitude	Positive	Negligible		Small		Medium	Large	
Resource /Receptor Sensitivity	Low		Medium			High		
Impact Significance	Negligible		Minor		Moderate		Major	
	Impact significance is assessed to be moderate							
Residual Magnitude	Positive	Negligible		Small		Medium		Large
Residual Impact Significance	Negligible		Minor		Moderate		Major	
	Residual impact significance is assessed to be minor							

7.5.2.2 Impact on Water Quality

Impact Magnitude

During operation phase, wastewater generation is expected to be from solar module cleaning. Additionally, sewage would be generated from substation and SCADA building, these will be of almost negligible quantity.

Therefore, the receptor/resource sensitivity, which may be the groundwater and nearby surface water body, is assessed as **medium** as a two small rivers are found to pass from the project area with multiple small dendritic and sub dendritic channels present within the project area. The rivers have little flow and water round the year whereas the dendritic and sub dendritic channels are seasonal and are filled in the monsoon season, hence the impact magnitude is assessed to be **small**.

Embedded built in controls

- The drainage and sewerage system will be provided for the collection and treatment of wastewater at the SCADA building and substation areas;
- Waste water from solar module cleaning will be percolated into ground for ground water recharge.
- The waste water generated from the site will not be allowed to reach the canal flowing from between the two land parcels of 250MW.

Significance of impact

The overall significance of impacts on water quality due to operational activities is envisaged to be **minor**.

Additional mitigation measures

As the impact is sufficiently addressed by the embedded controls the requirement of additional mitigation measures is not foreseen for this impact.

Residual impact significance

The significance of the residual impacts is envisaged to be **minor**.

Impact	Water quality during operational phase						
Impact Nature	Negative		Positive		Neutral		
Impact Type	Direct		Indirect		Induced		
Impact Duration	Temporary	Short-term		Long-term		Permanent	
Impact Extent	Local		Regional		Transboundary		
Impact Scale	Limited to SCADA office and solar plant						
Impact Magnitude	Positive	Negligible		Small		Medium	Large
Resource /Receptor Sensitivity	Low		Medium			High	
Impact Significance	Negligible		Minor		Moderate		Major
	Impact significance is assessed to be minor						

7.5.3 Impact Due to Noise

There will be no noise generated from the solar power plant during operation phase. However, the emanation of noise from the operation of WTGs is of the following two types: (a) mechanical noise, from interaction of turbine components; and (b) aerodynamic noise, produced by the flow of air over blades. Mechanical sounds originate from the relative motion of mechanical components and the dynamic response among them. Sources of such sounds include:

- Gearbox
- Generator
- Yaw drives
- Cooling fans
- Auxiliary equipment (e.g. hydraulics)

Aerodynamic sound is typically the largest component of wind turbine acoustic emissions. It originates from the flow of air around the blades. Aerodynamic sound generally increases with rotor speed.

Receptors

A total of 77 receptors are considered in the noise study present within 500 m of the WTGs are considered as noise sensitive receptors in this study⁴³. The details of the receptors with noise levels at a wind speed of 6m/s and 8m/s respectively (structures and settlements within 500 metres of the proposed WTG locations) have been presented in **Table 7.25 & Table 7.26**.

The project proponent proposes to install 72 WTGs of Suzlon S120model with a rated capacity of 2.1 MW each and rotor diameter of 120 m. The hub height will be 140 m. The noise generation from the turbines have been taken into consideration during strong wind conditions (with wind velocity 6m/s and 8 m/s at 10 m height) for the noise assessment to consider worst case scenario. Based on the available information from the turbine manufacturer, noise generation details have been presented in subsequent sections.

Embedded built in controls

- Regular maintenance of WTGs; and

⁴³ It must be noted that sensitive receptors (abstract structures) identified in the list of buffer locations have been considered for modelling purposes.

- Periodic monitoring of noise near to the sources of generation to ensure compliance with design specification.Regular maintenance of WTGs.
- Half yearly monitoring of ambient noise levels (during day and night time) at identified residential receptors and residential school for determination of actual impact due to operation of WTGs.
- Air tight windows and doors can be provided in the house to reduce noise level during night time. To facilitate air movement within concrete structures, fans and other ventilation structures to be provided.

Table 7.25 Noise levels at noise sensitive receptors during operation phase with wind speed at 6m/s and all receptors downwind

Code	Receptor Type	Nearest WTG location	Distance between receptor and WTG location	Baseline Noise		Noise generated by the WTGs	Noise Level at Receptors, Leq dB(A)		Additional Exposure due to WTG		Applicable Standard as per Land use dB(A)*#	
				Leq day ⁴⁴	Leq night ⁴⁵		Leq day	Leq night	Day	Night	Leq day	Leq night
A	STLMNT1	FTN-298	327.82	54.58	52.07	36.2	54.64	52.18	0.06	0.11	55	45
B	STLMNT2	FTN-299	331.46	54.58	52.07	36.1	54.64	52.18	0.06	0.11	55	45
C	STLMNT3	FAT-368	500.00	51.41	47.07	32.2	51.46	47.21	0.05	0.14	55	45
D	STLMNT4	FAT-368	557.70	51.41	47.07	31.1	51.45	47.18	0.04	0.11	55	45
E	STLMNT5	New-18	562.74	49.01	45.37	30.9	49.08	45.52	0.07	0.15	55	45
F	STLMNT7	FAT-143	251.80	54.58	52.07	38.1	54.68	52.24	0.10	0.17	55	45
G	STLMNT8	FAT-143	272.88	54.58	52.07	37.7	54.67	52.23	0.09	0.16	55	45
H	STLMNT9	FAT-044	178.88	49.01	45.37	40.5	49.58	46.59	0.57	1.22	55	45
I	STLMNT10	FAT-029	429.92	49.01	45.37	34.1	49.15	45.68	0.14	0.31	55	45
J	STLMNT11	FATNO50	368.87	55.55	54.06	35.3	55.59	54.12	0.04	0.06	55	45
K	STLMNT12	FTN-276	522.89	55.55	54.06	32.4	55.57	54.09	0.02	0.03	55	45
L	STLMNT13	FTN-266	525.09	49.01	45.37	32.5	49.11	45.59	0.10	0.22	55	45
M	STLMNT14	FAT-261	265.89	51.41	47.07	37.6	51.59	47.53	0.18	0.46	55	45
N	STLMNT15	FAT-261	368.38	51.41	47.07	35.1	51.51	47.34	0.10	0.27	55	45
O	STLMNT16	FTNA2	339.22	49.01	45.37	36.7	49.26	45.92	0.25	0.55	55	45
P	STLMNT17	FTN232	507.04	55.55	54.06	32	55.57	54.09	0.02	0.03	55	45
Q	STLMNT18	FTN232	434.38	55.55	54.06	33.8	55.58	54.10	0.03	0.04	55	45
R	STLMNT19	FAT-113	478.35	54.58	52.07	33.3	54.61	52.13	0.03	0.06	55	45
S	STLMNT20	FTN134	496.60	55.55	54.06	32	55.57	54.09	0.02	0.03	55	45
T	STLMNT21	FTN-185 & FTN-184	377.99 & 491.00	55.55	54.06	37	55.61	54.14	0.06	0.08	55	45
U	STLMNT22	FTN-185	319.08	55.55	54.06	37.8	55.62	54.16	0.07	0.10	55	45
V	STLMNT23	FTN-291	454.13	55.55	54.06	33.1	55.57	54.09	0.02	0.03	55	45
X	STLMNT25	FAT-339	204.91	54.58	52.07	39.4	54.71	52.30	0.13	0.23	55	45
Y	STLMNT26	FAT-281	282.52	51.41	47.07	37.4	51.58	47.51	0.17	0.44	55	45
Z	STLMNT27	FTN-290	493.00	55.55	54.06	32.5	55.57	54.09	0.02	0.03	55	45
AA	STLMNT28	FTN-256	400.00	55.55	54.06	34.3	55.58	54.11	0.03	0.05	55	45
AB	STR1	FTN-298	490.94	54.58	52.07	32.4	54.61	52.12	0.03	0.05	55	45
AC	STR2	FTN-298	491.00	54.58	52.07	32.5	54.61	52.12	0.03	0.05	55	45
AD	STR3	FTN-298	370.76	54.58	52.07	35.1	54.63	52.16	0.05	0.09	55	45
AE	STR4	NEW-006	395.72	54.58	52.07	34.2	54.62	52.14	0.04	0.07	55	45
AF	STR6	FAT-639	415.56	51.41	47.07	33.9	51.49	47.27	0.08	0.20	55	45
AG	STR7	FAT-639	204.36	51.41	47.07	39.5	51.68	47.77	0.27	0.70	55	45
AH	STR8	FAT-193	75.22	49.01	45.37	43.9	50.18	47.71	1.17	2.34	55	45
AI	STR9	FAT-193	482.94	49.01	45.37	32.3	49.10	45.58	0.09	0.21	55	45
AJ	STR16	FAT-448	413.66	54.58	52.07	33.9	54.62	52.14	0.04	0.07	55	45
AK	STR17	FAT-143	174.50	54.58	52.07	40.3	54.74	52.35	0.16	0.28	55	45
AL	STR18	FAT-43	201.26	54.58	52.07	39.4	54.71	52.30	0.13	0.23	55	45
AM	STR19	New-022	346.17	54.58	52.07	35.5	54.63	52.16	0.05	0.09	55	45
AN	STR20	New-022	381.48	54.58	52.07	34.5	54.62	52.15	0.04	0.08	55	45

⁴⁴ Leq day has been predicted with average temperature of 38°C and clouded sky

⁴⁵ Leq night has been predicted with average temperature of 29°C and high wind speeds

* IFC/WB EHS Guidelines: Noise Management dated April 30, 2007 gives, Noise level guidelines for Residential; institutional and educational receptors in daytime (07:22:00) and night time (22:00-7:00) as 55 and 45 one hour Leq dB(A) respectively. For industrial and commercial receptors it is 70 one hour Leq dB(A) for both night and day time

Noise standards notified by the MoEF vide gazette notification dated 14 February 2000 as amended in January 2010 based on the A weighted equivalent noise level (Leq) for residential areas

Code	Receptor Type	Nearest WTG location	Distance between receptor and WTG location	Baseline Noise		Noise generated by the WTGs	Noise Level at Receptors, L_{eq} dB(A)		Additional Exposure due to WTG		Applicable Standard as per Land use dB(A)*, #	
				Leq day ⁴⁴	Leq night ⁴⁵		Leq day	Leq night	Day	Night	Leq day	Leq night
AO	STR21	FAT-421	287.90	54.58	52.07	37.1	54.66	52.21	0.08	0.14	55	45
AP	STR22	FAT-315	581.18	51.41	47.07	32.4	51.46	47.22	0.05	0.15	55	45
AQ	STR23	FAT-378	583.17	51.41	47.07	32.8	51.47	47.23	0.06	0.16	55	45
AR	STR24	FAT-378	594.00	51.41	47.07	32.6	51.47	47.22	0.06	0.15	55	45
AS	STR25	FAT-036	509.75	51.41	47.07	33.8	51.48	47.27	0.07	0.20	55	45
AT	STR26	FAT-259	312.68	49.01	45.37	36.4	49.24	45.89	0.23	0.52	55	45
AU	STR27	FAT-259	199.94	49.01	45.37	39.4	49.46	46.35	0.45	0.98	55	45
AV	STR28	FAT-044	382.58	49.01	45.37	33.1	49.12	45.62	0.11	0.25	55	45
AW	STR29	FAT-044	463.55	49.01	45.37	35.1	49.18	45.76	0.17	0.39	55	45
AX	STR30	FAT-029	345.20	49.01	45.37	35.9	49.22	45.83	0.21	0.46	55	45
AY	STR31	FAT-165	478.20	49.01	45.37	32.4	49.10	45.58	0.09	0.21	55	45
AZ	STR32	FAT-165	348.33	49.01	45.37	35.5	49.20	45.80	0.19	0.43	55	45
BA	STR33	FAT-165	352.81	49.01	45.37	33.1	49.12	45.62	0.11	0.25	55	45
BB	STR34	FATNO33	366.47	55.55	54.06	35.6	55.59	54.12	0.04	0.06	55	45
BC	STR35	FATNO50	390.95	55.55	54.06	34.6	55.58	54.11	0.03	0.05	55	45
BD	STR36	FAT-038	517.15	54.58	52.07	32	54.60	52.11	0.02	0.04	55	45
BE	STR37	FTN134	471.26	55.55	54.06	32.3	55.57	54.09	0.02	0.03	55	45
BF	STR38	FTN134	238.43	55.55	54.06	38.5	55.63	54.18	0.08	0.12	55	45
BG	STR39	FTN-185	303.89	55.55	54.06	37.1	55.61	54.15	0.06	0.09	55	45
BH	STR40	FTN-185	312.53	55.55	54.06	37.4	55.62	54.15	0.07	0.09	55	45
BI	STR41	FTN-291	360.11	55.55	54.06	35.2	55.59	54.12	0.04	0.06	55	45
BJ	STR42	FTN-291	418.81	55.55	54.06	34.3	55.58	54.11	0.03	0.05	55	45
BK	STR43	FTN187	430.29	55.55	54.06	33.6	55.58	54.10	0.03	0.04	55	45
BL	STR44	FAT-339	298.00	54.58	52.07	37.2	54.66	52.21	0.08	0.14	55	45
BM	STR45	FAT-154	475.56	54.58	52.07	32.9	54.61	52.12	0.03	0.05	55	45
BN	STR46	FAT-154	371.36	54.58	52.07	35.1	54.63	52.16	0.05	0.09	55	45
BO	STR47	FAT-154	451.42	54.58	52.07	33.4	54.61	52.13	0.03	0.06	55	45
BP	STR48	FAT-154	418.28	54.58	52.07	34.2	54.62	52.14	0.04	0.07	55	45
BQ	STR49	FTN-269	188.51	49.01	45.37	40.3	49.56	46.55	0.55	1.18	55	45
BR	STR50	FTN-269	202.41	49.01	45.37	39.8	49.50	46.43	0.49	1.06	55	45
BS	STR51	FTN-269	289.95	49.01	45.37	37.5	49.31	46.03	0.30	0.66	55	45
BT	STR52	FTN-269	387.39	49.01	45.37	35.6	49.20	45.81	0.19	0.44	55	45
BU	STR53	FTN180	211.76	55.55	54.06	39	55.65	54.19	0.10	0.13	55	45
BV	STR54	FTN180	261.82	55.55	54.06	37.9	55.62	54.16	0.07	0.10	55	45
BW	STR55	FTN180	376.58	55.55	54.06	35.3	55.59	54.12	0.04	0.06	55	45
BX	STR56	FTN-198	380.0	55.55	54.06	34.8	55.59	54.11	0.04	0.05	55	45

Note: Colour coding used to represent exceedance from applicable standards is as follows:

	> 10 dB(A)		5 dB(A) < x < 3 dB(A)
	10 dB(A) < x < 5 dB(A)		< 3 dB(A)

Table 7.26 Noise levels at noise sensitive receptors during operation phase with wind speed at 8m/s and all receptors downwind

Code	Receptor Type	Nearest WTG location	Distance between receptor and WTG location	Baseline Noise		Noise generated by the WTG (dB)	Noise Level at Receptors, L_{eq} dB(A)		Additional Exposure due to WTG		Applicable Standard as per Land use dB(A)*, #	
				Leq day ⁴⁶	Leq night ⁴⁷		Leq day	Leq night	Leq day	Leq night	Leq day	Leq night
A	STLMNT1	FTN-298	327.82	54.58	52.07	39.2	54.70	52.29	0.12	0.22	55	45
B	STLMNT2	FTN-299	331.46	54.58	52.07	39.1	54.70	52.28	0.12	0.21	55	45
C	STLMNT3	FAT-368	500.00	51.41	47.07	35.3	51.52	47.35	0.11	0.28	55	45
D	STLMNT4	FAT-368	557.70	51.41	47.07	34.1	51.49	47.28	0.08	0.21	55	45
E	STLMNT5	New-18	562.74	49.01	45.37	33.9	49.14	45.67	0.13	0.30	55	45
F	STLMNT7	FAT-143	251.80	54.58	52.07	41	54.77	52.40	0.19	0.33	55	45
G	STLMNT8	FAT-143	272.88	54.58	52.07	40.7	54.75	52.38	0.17	0.31	55	45
H	STLMNT9	FAT-044	178.88	49.01	45.37	43.5	50.09	47.55	1.08	2.18	55	45
I	STLMNT10	FAT-029	429.92	49.01	45.37	37.1	49.28	45.97	0.27	0.60	55	45
J	STLMNT11	FATNO50	368.87	55.55	54.06	38.3	55.63	54.17	0.08	0.11	55	45
K	STLMNT12	FTN-276	522.89	55.55	54.06	35.4	55.59	54.12	0.04	0.06	55	45
L	STLMNT13	FTN-266	525.09	49.01	45.37	35.5	49.20	45.80	0.19	0.43	55	45
M	STLMNT14	FAT-261	265.89	51.41	47.07	40.6	51.76	47.95	0.35	0.88	55	45
N	STLMNT15	FAT-261	368.38	51.41	47.07	38.1	51.61	47.59	0.20	0.52	55	45
O	STLMNT16	FTNA2	339.22	49.01	45.37	39.7	49.49	46.41	0.48	1.04	55	45
P	STLMNT17	FTN232	507.04	55.55	54.06	35	55.59	54.11	0.04	0.05	55	45
Q	STLMNT18	FTN232	434.38	55.55	54.06	36.8	55.61	54.14	0.06	0.08	55	45
R	STLMNT19	FAT-113	478.35	54.58	52.07	36.3	54.64	52.18	0.06	0.11	55	45
S	STLMNT20	FTN134	496.60	55.55	54.06	35	55.59	54.11	0.04	0.05	55	45
T	STLMNT21	FTN-185 & FTN-184	377.99 & 491.00	55.55	54.06	40	55.67	54.23	0.12	0.17	55	45
U	STLMNT22	FTN-185	319.08	55.55	54.06	40.8	55.69	54.26	0.14	0.20	55	45
V	STLMNT23	FTN-291	454.13	55.55	54.06	36.1	55.60	54.13	0.05	0.07	55	45
X	STLMNT25	FAT-339	204.91	54.58	52.07	42.4	54.84	52.51	0.26	0.44	55	45
Y	STLMNT26	FAT-281	282.52	51.41	47.07	40.4	51.74	47.92	0.33	0.85	55	45
Z	STLMNT27	FTN-290	493.00	55.55	54.06	35.5	55.59	54.12	0.04	0.06	55	45
AA	STLMNT28	FTN-256	400.00	55.55	54.06	37.3	55.61	54.15	0.06	0.09	55	45
AB	STR1	FTN-298	490.94	54.58	52.07	35.5	54.63	52.16	0.05	0.09	55	45
AC	STR2	FTN-298	491.00	54.58	52.07	35.5	54.63	52.16	0.05	0.09	55	45
AD	STR3	FTN-298	370.76	54.58	52.07	38.1	54.68	52.24	0.10	0.17	55	45
AE	STR4	NEW-006	395.72	54.58	52.07	37.2	54.66	52.21	0.08	0.14	55	45
AF	STR6	FAT-639	415.56	51.41	47.07	36.9	51.56	47.47	0.15	0.40	55	45
AG	STR7	FAT-639	204.36	51.41	47.07	42.5	51.94	48.37	0.53	1.30	55	45
AH	STR8	FAT-193	75.22	49.01	45.37	46.9	51.09	49.21	2.08	3.84	55	45
AI	STR9	FAT-193	482.94	49.01	45.37	35.3	49.19	45.78	0.18	0.41	55	45
AJ	STR16	FAT-448	413.66	54.58	52.07	36.9	54.65	52.20	0.07	0.13	55	45
AK	STR17	FAT-143	174.50	54.58	52.07	43.3	54.89	52.61	0.31	0.54	55	45
AL	STR18	FAT-43	201.26	54.58	52.07	42.3	54.83	52.51	0.25	0.44	55	45
AM	STR19	New-022	346.17	54.58	52.07	38.5	54.69	52.26	0.11	0.19	55	45

⁴⁶ Leq day has been predicted with average temperature of 38°C and clouded sky

⁴⁷ Leq night has been predicted with average temperature of 29°C and high wind speeds

* IFC/WB EHS Guidelines: Noise Management dated April 30, 2007 gives, Noise level guidelines for Residential; institutional and educational receptors in daytime (07:22:00) and night time (22:00-7:00) as 55 and 45 one hour Leq dB(A) respectively. For industrial and commercial receptors it is 70 one hour Leq dB(A) for both night and day time

Noise standards notified by the MoEF vide gazette notification dated 14 February 2000 as amended in January 2010 based on the A weighted equivalent noise level (Leq) for residential areas

Code	Receptor Type	Nearest WTG location	Distance between receptor and WTG location	Baseline Noise		Noise generated by the WTG (dB)	Noise Level at Receptors, L _{eq} dB(A)		Additional Exposure due to WTG		Applicable Standard as per Land use dB(A)*, #	
				Leq day ⁴⁶	Leq night ⁴⁷		Leq day	Leq night	Leq day	Leq night	Leq day	Leq night
AN	STR20	New-022	381.48	54.58	52.07	37.5	54.66	52.22	0.08	0.15	55	45
AO	STR21	FAT-421	287.90	54.58	52.07	40	54.73	52.33	0.15	0.26	55	45
AP	STR22	FAT-315	581.18	51.41	47.07	35.4	51.52	47.36	0.11	0.29	55	45
AQ	STR23	FAT-378	583.17	51.41	47.07	35.8	51.53	47.38	0.12	0.31	55	45
AR	STR24	FAT-378	594.00	51.41	47.07	35.6	51.52	47.37	0.11	0.30	55	45
AS	STR25	FAT-036	509.75	51.41	47.07	36.8	51.56	47.46	0.15	0.39	55	45
AT	STR26	FAT-259	312.68	49.01	45.37	39.4	49.46	46.35	0.45	0.98	55	45
AU	STR27	FAT-259	199.94	49.01	45.37	42.4	49.87	47.14	0.86	1.77	55	45
AV	STR28	FAT-044	382.58	49.01	45.37	36.2	49.23	45.87	0.22	0.50	55	45
AW	STR29	FAT-044	463.55	49.01	45.37	38.1	49.35	46.12	0.34	0.75	55	45
AX	STR30	FAT-029	345.20	49.01	45.37	38.9	49.41	46.25	0.40	0.88	55	45
AY	STR31	FAT-165	478.20	49.01	45.37	35.4	49.20	45.79	0.19	0.42	55	45
AZ	STR32	FAT-165	348.33	49.01	45.37	38.5	49.38	46.18	0.37	0.81	55	45
BA	STR33	FAT-165	352.81	49.01	45.37	36.1	49.23	45.86	0.22	0.49	55	45
BB	STR34	FATNO33	366.47	55.55	54.06	38.6	55.64	54.18	0.09	0.12	55	45
BC	STR35	FATNO50	390.95	55.55	54.06	37.6	55.62	54.16	0.07	0.10	55	45
BD	STR36	FAT-038	517.15	54.58	52.07	35.1	54.63	52.16	0.05	0.09	55	45
BE	STR37	FTN134	471.26	55.55	54.06	35.4	55.59	54.12	0.04	0.06	55	45
BF	STR38	FTN134	238.43	55.55	54.06	41.5	55.72	54.29	0.17	0.23	55	45
BG	STR39	FTN-185	303.89	55.55	54.06	40.1	55.67	54.23	0.12	0.17	55	45
BH	STR40	FTN-185	312.53	55.55	54.06	40.4	55.68	54.24	0.13	0.18	55	45
BI	STR41	FTN-291	360.11	55.55	54.06	38.2	55.63	54.17	0.08	0.11	55	45
BJ	STR42	FTN-291	418.81	55.55	54.06	37.3	55.61	54.15	0.06	0.09	55	45
BK	STR43	FTN187	430.29	55.55	54.06	36.6	55.60	54.14	0.05	0.08	55	45
BL	STR44	FAT-339	298.00	54.58	52.07	40.2	54.74	52.34	0.16	0.27	55	45
BM	STR45	FAT-154	475.56	54.58	52.07	36	54.64	52.18	0.06	0.11	55	45
BN	STR46	FAT-154	371.36	54.58	52.07	38.1	54.68	52.24	0.10	0.17	55	45
BO	STR47	FAT-154	451.42	54.58	52.07	36.5	54.65	52.19	0.07	0.12	55	45
BP	STR48	FAT-154	418.28	54.58	52.07	37.2	54.66	52.21	0.08	0.14	55	45
BQ	STR49	FTN-269	188.51	49.01	45.37	43.3	50.04	47.47	1.03	2.10	55	45
BR	STR50	FTN-269	202.41	49.01	45.37	42.8	49.94	47.28	0.93	1.91	55	45
BS	STR51	FTN-269	289.95	49.01	45.37	40.5	49.58	46.59	0.57	1.22	55	45
BT	STR52	FTN-269	387.39	49.01	45.37	38.6	49.39	46.20	0.38	0.83	55	45
BU	STR53	FTN180	211.76	55.55	54.06	42	55.74	54.32	0.19	0.26	55	45
BV	STR54	FTN180	261.82	55.55	54.06	40.9	55.70	54.26	0.15	0.20	55	45
BW	STR55	FTN180	376.58	55.55	54.06	38.3	55.63	54.17	0.08	0.11	55	45
BX	STR56	FTN-198	380.0	55.55	54.06	37.8	55.62	54.16	0.07	0.10	55	45

Note: Colour coding represent exceedance from applicable standards

> 10 dB(A)	10 dB(A) < x < 5	5 dB(A) < x < 3 dB(A)	< 3 dB(A)
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Figure 7.2 Noise Levels of the receptors in the the wind farm at wind speed of 6m/s

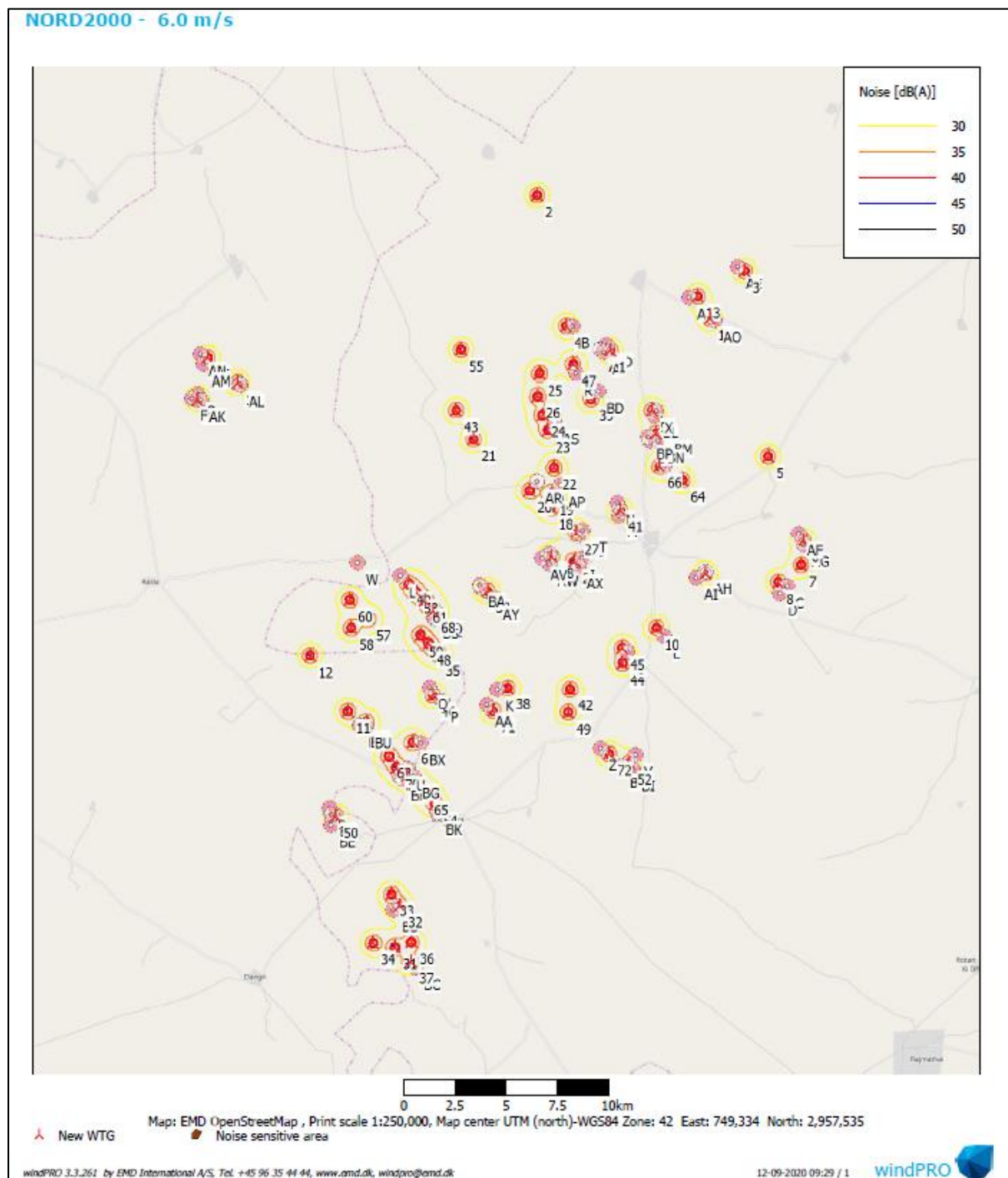
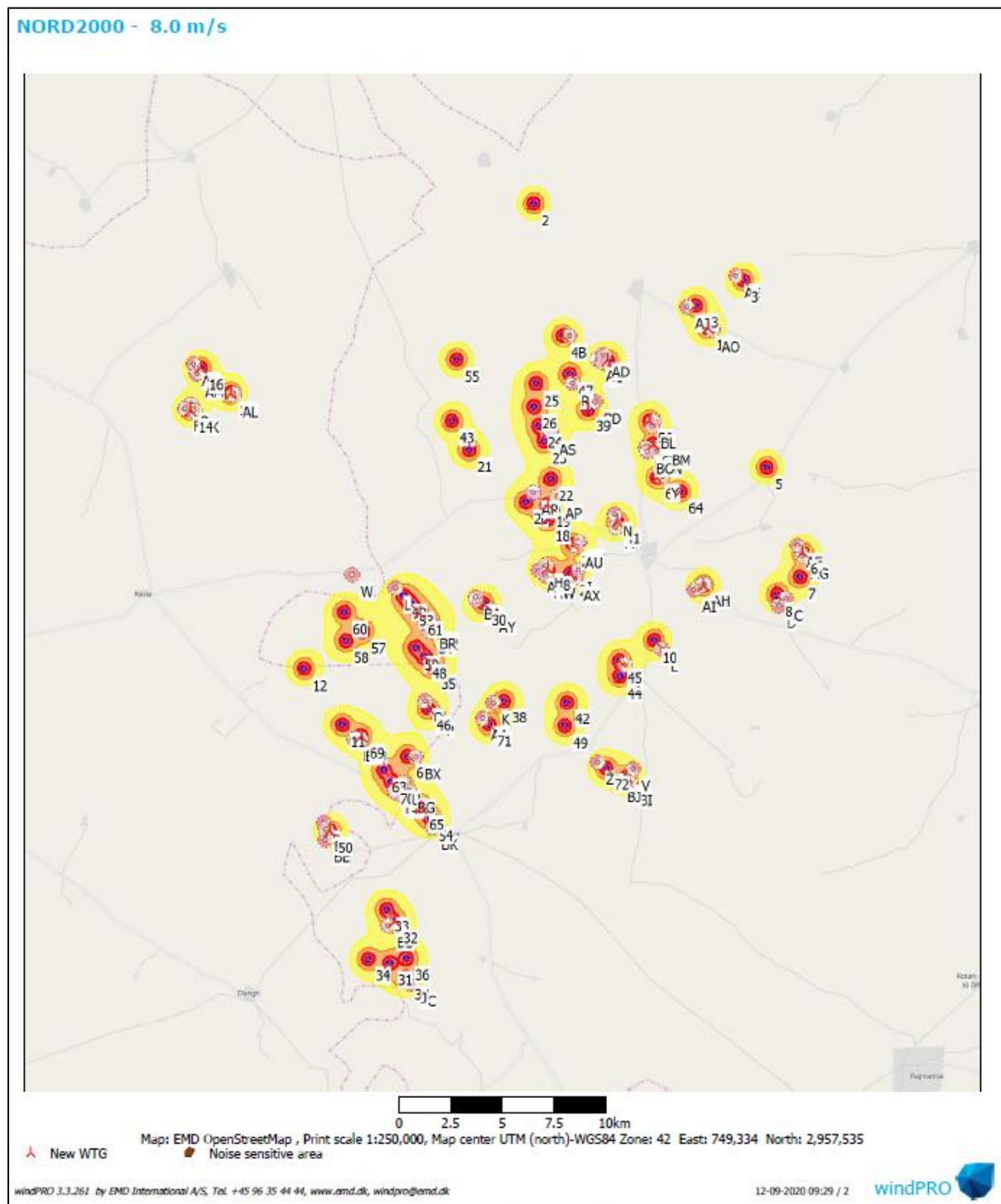


Figure 7.3 Noise Levels of the receptors in the the wind farm at wind speed of 8m/s



Significance of Impact

It is evident from that overall noise levels (background + predicted) due to operation of WTGs at most of the receptors are exceeding the noise standards during the day time as well as night time at wind speed of 6m/s as well as for 8m/s. The baseline noise levels during the day as well night are found to be on a higher side, which can be attributed to the presence of other wind turbines in the vicinity as well as due to high wind speeds during the monitoring period, impact will be assessed on the additional noise added in the baseline levels due to operation of the turbines. Since the turbines are

adding an additional exposure ranging from 0.02db to 2.34db at wind speed of 6m/s whereas additional exposure at a wind speed of 8m/s ranges from 0.02-3.84db. Since the additional exposure on identified receptors due to operation of WTGs during daytime as well as night time are mostly less than 1 dB, but since the ambient noise levels during the night time are exceeding the prescribed limits approximately by 7-10Db, the impact magnitude is considered to be **moderate**.

At a wind speed of 6m/s (Day Time/ Night Time)

- Small impact magnitude (Additional exposure of less than 1dB) : 71 Nos. of WTG/ 68 Nos. of WTG
- Medium impact magnitude (Additional exposure of 1.00-1.50dB) : 1 Nos. of WTG/ 3 Nos. of WTG
- Large impact magnitude (Additional exposure of 1.50-2.00dB) : None / None
- Very Large impact magnitude (Additional exposure of 2.00dB and above) : None/ 1 Nos. of WTG

At a wind speed of 8m/s (Day Time)

- Small impact magnitude (Additional exposure of less than 1dB) : 69 Nos. of WTG/ 65 Nos. of WTG
- Medium impact magnitude (Additional exposure of 1.00-1.50dB) : 2 Nos. of WTG/ 2 Nos. of WTG
- Large impact magnitude (Additional exposure of 1.50-2.00dB) : None / 2 Nos. of WTG
- Very Large impact magnitude (Additional exposure of 2.00dB and above) : 1 Nos. of WTG / 3 Nos. of WTG

7.5.3.2 Residual impact significance

The significance of the residual impacts is envisaged to be **moderate**.

Impact	Noise generation from operation of the solar plant						
Impact Nature	Negative		Positive		Neutral		
Impact Type	Direct		Indirect		Induced		
Impact Duration	Temporary	Short-term		Long-term	Permanent		
Impact Extent	Local		Regional		Transboundary		
Impact Scale	Limited to wind power plant						
Impact Magnitude	Positive	Negligible		Small	Medium	Large	
Resource /Receptor Sensitivity	Low		Medium		High		
Impact Significance	Negligible		Minor		Moderate		Major
	Significance of impact is considered as moderate						

7.5.4 Impact Due to Shadow Flicker

Shadow flicker is a term used to describe the pattern of alternating light intensity observed when the rotating blades of a wind turbine cast a shadow on a receptor under certain wind and light conditions. Shadow flicker occurs under a limited range of conditions when the sun passes behind the hub of a wind turbine and casts an intermittent shadow over neighbouring properties.

7.5.4.1 Regulations pertaining to Shadow Flicker

Indian energy planning and environmental policies and legislations contains no specific shadow flicker requirements and recommendations. The Ministry of New and Renewable Energy (MNRE) has

published guidelines for development of onshore wind power projects in October 2016, which specifies certain specific requirements for micro-siting of the projects and includes:

- Developer(s) shall maintain a distance of $HH + \frac{1}{2} RD + RD + 5m$ (Hub Height+ Half Rotor Diameter +5 meters) from Public Roads, railway tracks, highways, buildings, public institutions and EHV lines.
- Developer(s) shall not site wind turbines within 300 m of any dwelling for the mitigation of noise.

In order to ensure health and safety of people working/residing near the wind power installations the National Institute of Wind Energy (NIWE) will prescribe criteria for noise and shadow flicker in consultation with stakeholders.

Shadow flicker has been elaborated upon in the EHS guidelines for wind energy, by the International Finance Corporation (IFC), dated August 7, 2015 (48). They are as follows:

Shadow flicker occurs when the sun passes behind the wind turbine and casts a shadow. As the rotor blades rotate, shadows pass over the same point causing an effect termed shadow flicker. Shadow flicker may become a problem when potentially sensitive receptors (e.g., residential properties, workplaces, learning and/or health care spaces/facilities) are located nearby, or have a specific orientation to the wind energy facility.

Potential shadow flicker issues are likely to be more important in higher latitudes, where the sun is lower in the sky and therefore casts longer shadows that will extend the radius within which potentially significant shadow flicker impact will be experienced.

Where there are nearby receptors, commercially available software can be used to model shadow flicker in order to identify the distance to which potential shadow flicker effects may extend. The same software can typically also be used to predict the duration and timing of shadow flicker occurrence under real weather conditions at specific receptors located within the zone of potential shadow flicker impact.

If it is not possible to locate the wind energy facility/turbines such that neighbouring receptors experience no shadow flicker effects, it is recommended that the predicted duration of shadow flicker effects experienced at a sensitive receptor not exceed 30 hours per year and 30 minutes per day on the worst affected day, based on a worst-case scenario

7.5.4.2 Occurrence of Shadow Flicker in regards to wind farms

Shadow flicker is most pronounced at sunrise and sunset when shadows are the longest, and at high wind speeds (faster rotating blades leading to faster flicker). There is anecdotal evidence internationally that shadow flicker could lead to stress and headaches. There is also a fear that shadow flicker, especially in the range of 2.5-50 Hertz (2.5-50 cycles per second) could lead to seizures in epileptics and may also scare away livestock.

An analysis of those conditions that may lead to shadow flicker and the location of potential sensitive receptors (residential and community properties) is provided in this section. The timing and duration of this effect can be theoretically calculated from the geometry of the wind turbines, their orientation relative to nearby houses and the latitude of the potential site, using specialised software such as WindPro 3.1. The results provide the total number of hours in a year when a theoretical shadow flicker will occur. However, the actual shadow flicker could be substantially lower compared to theoretical values because shadow flicker does not occur where there is vegetation or other obstructions between the turbines and the shadow receptors; if windows facing a turbine are fitted with blinds or shutters; or if the sun is not shining brightly enough to cause shadows.

(48) EHS guidelines for wind energy, August 7, 2015.

http://www.ifc.org/wps/wcm/connect/2c410700497a7933b04cf1ef20a40540/FINAL_Aug+2015_Wind+Energy_EHS+Guideline.pdf?MOD=AJPERES. Accessed 05/12/2017

It should be noted that the theoretical calculations done by WindPro does take into account the reduction in shadow flicker due to topographic features, however, it does not take into account the reduction in shadow flicker due to these onsite factors i.e. vegetation. Simple geometry relating to the position of the sun and the angle of the turbine blades can also eliminate or significantly reduce the effects of shadow flicker. In addition, shadow flicker will only occur inside the properties where the flicker is occurring through openings (e.g. window, door).

Weather conditions at the site, such as bright sunshine, will greatly enhance the occurrence and intensity of shadow flicker, whereas cloud density, haze or fog will cause a reduction. Receptors further away from the turbines which may have experienced a shadow flicker effect under bright sunshine conditions will, as a result of these weather conditions, experience either no effect or one which is greatly reduced in intensity.

The distance between receptors and turbines has a large effect on the intensity of shadow flicker. Shadow flicker intensity can be defined as the difference in brightness between the presence and absence of a shadow at any given location. This study does not examine variations in intensity but rather the occurrence in number of hours shadow flicker may occur, whether or not this is clearly distinct or barely noticeable. The assessment assumes a conservative worst case of bright sunshine conditions in all periods when flicker may occur.

Considering all of the above points, the likelihood of shadow flicker occurring is greatest when the circumstances listed below exist simultaneously.

- The receptor is at a position which is between 130° clockwise⁴⁹ and anti-clockwise from north and located within 10 turbine rotor diameter of the wind turbine (~1000m).
- The sun is shining and visible in the sky in line with the monthly mean sun-shine hours at nearby location.
- The wind speeds are between 3 m/s and 22 m/s and the turbine is therefore in operation.
- The turbine blades are perpendicular to the line between the sun and the observer or receptor most of time as per reported wind mast data.

Due to lack of data regarding epilepsy rates in India and operation levels below of 1 Hz for modern turbines, seizures caused by shadow flicker are considered to be extremely unlikely. The turbines (proposed to be used in this Project) being considered operate at a frequency outside the range where negative health effects may result (50). Potential effects on people are likely to be limited to nuisance.

7.5.4.3 Considerations and assumptions for the study

Weather conditions at the site, such as bright sunshine, will greatly enhance the occurrence and intensity of shadow flicker, whereas cloud density, haze or fog will cause a reduction. Receptors further away from the turbines which may have experienced a shadow flicker effect under bright sunshine conditions will, as a result of these weather conditions, experience either no effect or one which is greatly reduced in intensity. The distance between receptors and turbines has a large effect on the intensity of shadow flicker. Shadow flicker intensity can be defined as the difference in brightness between the presence and absence of a shadow at any given location. This study does

⁴⁹ It is acknowledged by this assessment however that India is at a lower latitude than the European countries and therefore angles of shadow flicker may be narrower.

⁵⁰ See Health and Safety Executive/Local Authority Enforcement Liaison Committee (HELA) circular, entitled 'Disco Lights and Flicker Sensitive Epilepsy' (available at <http://www.hse.gov.uk/lau/lacs/51-1.htm>). It provides medical details on flicker frequencies likely to give rise to epileptic effects. It states 'In 1971 the Greater London Council banned the use of flicker rates greater than 8 fps but to be effective the above figures show that any advice on restriction of flicker rate has to limit the frequency to below 5 fps.'

not examine variations in intensity but rather the occurrence in number of hours shadow flicker may occur, whether or not this is clearly distinct or barely noticeable. The assessment assumes a conservative worst case of bright sunshine conditions in all periods when flicker may occur as well as a real case scenario based on average sunshine hours in a year in Jaisalmer.

Considering all of the above points, the likelihood of shadow flicker occurring is greatest when the circumstances listed below exist simultaneously.

- The receptor is at a position which is between 130° clockwise ⁽⁵¹⁾ and anticlockwise from north and located within 10 times turbine rotor diameters of the wind turbine.
- The sun is shining and visible in the sky in line with the monthly mean sun-shine hours at nearby location.
- The wind speeds are between 3 m/s and 18 m/s and the turbine is therefore in operation.
- The turbine blades are perpendicular to the line between the sun and the observer or receptor most of time.

Due to lack of data regarding epilepsy rates in India and operation levels below of 1 Hz for modern turbines, seizures caused by shadow flicker are considered to be extremely unlikely. The turbines (proposed to be used in this Project) being considered operate at a frequency outside the range where negative health effects may result ⁽⁵²⁾. Potential effects on people are likely to be limited to nuisance.

7.5.4.4 Standard for shadow flicker

In the Indian context, at present, there is neither regulation nor decided level of shadow flicker identified as causing a significant effect ⁽⁵³⁾. Therefore, IFC EHS Guidelines for Wind Energy dated August 7, 2015 ⁽⁵⁴⁾ have been followed, which clearly states that if it is not possible to locate the wind energy facility/turbines such that neighbouring receptors experience no shadow flicker effects, it is recommended that the predicted duration of shadow flicker effects experienced at a sensitive receptor not exceed **30 hours per year and 30 minutes per day** on the worst affected day, based on a worst-case scenario.

7.5.4.5 The Model- WindPro Shadow

SHADOW is the WindPro calculation module that calculates how often and in which intervals a specific neighbour or area will be affected by shadows generated by one or more WTGs. These calculations are worst-case scenarios (astronomical maximum shadow, i.e. calculations which are solely based on the positions of the sun relative to the WTG). Shadow impact may occur when the blades of a WTG pass through the sun's rays seen from a specific spot (e.g. a window in an adjacent settlement). If the weather is overcast or calm, or if the wind direction forces the rotor plane of the WTG to stand parallel with the line between the sun and the neighbour, the WTG will not produce shadow impacts, but the impact will still appear in the calculations. In other words, the calculation is a

⁵¹ It is acknowledged by this assessment however that India is at lower latitude than the European countries and therefore angles of shadow flicker may be narrower

(52) See Health and Safety Executive/Local Authority Enforcement Liaison Committee (HELA) circular, entitled 'Disco Lights and Flicker Sensitive Epilepsy' (available at <http://www.hse.gov.uk/lau/lacs/51-1.htm>). It provides medical details on flicker frequencies likely to give rise to epileptic effects. It states: 'In 1971 the Greater London Council banned the use of flicker rates greater than 8 fps but to be effective the above figures show that any advice on restriction of flicker rate has to limit the frequency to below 5 fps.'

(53) Assumption based upon review of the MNRE website and Onshore Wind Energy Policy.

(54) EHS guidelines for wind energy, August 7, 2015.

http://www.ifc.org/wps/wcm/connect/2c410700497a7933b04cf1ef20a40540/FINAL_Aug+2015_Wind+Energy_EHS+Guideline.pdf?MOD=AJPERES. Accessed 05/12/2017

worst-case scenario, which represents the maximum potential risk of shadow impact. A calendar can be printed for any specific point of observation, which indicates the exact days, and time periods where shadow impact may occur.

Apart from calculating the potential shadow impact at a given neighbour, a map rendering the iso-lines of the shadow impact can also be printed. This printout will render the amount of shadow impact for any spot within the project area.

The calculation of the potential shadow impact at a given shadow receptor is carried out simulating the situation. The position of the sun relative to the WTG rotor disk and the resulting shadow is calculated in steps of 1 minute throughout a complete year. If the shadow of the rotor disk (which in the calculation is assumed solid) at any time casts a shadow reflection on the window, which has been defined as a shadow receptor object, then this step will be registered as 1 minute of potential shadow impact. The following information is required:

- The position of the WTGs (x, y, z coordinates)
- The hub height and rotor diameter of the WTGs
- The position of the shadow receptor object (x, y, z coordinates)
- The size of the window and its orientation, both directional (relative to south) and tilt (angle of window plane to the horizontal).
- The geographic position (latitude and longitude) together with time zone and daylight saving time information.
- A simulation model, which holds information about the earth's orbit and rotation relative to the sun.

7.5.4.6 Assessment Methodology and Modelling

Input Data

Shadow flicker calculations have been made using windPRO 3.3.732 SP 3 software. The model used in this analysis is very conservative and assumes the following conditions:

- The mean monthly sunshine hours have been taken from the India Meteorological Department (IMD) station at Jaisalmer covering the data period (1969 – 1993)⁵⁵;
- There are no trees, or vegetation on the surface which may obscure the line of sight between shadow receptor and turbine;
- The sun can be represented as a single point;
- Flicker is ignored if sun is less than 3° above horizon (due to atmospheric diffusion/ low radiation/ sheltering);
- Structures and Settlements identified within 1.22km around the wind turbine locations are considered as shadow receptors, as.

The following data inputs were used in this study:

- A digital elevation model of the site (National Aeronautics and Space Administration (NASA) Shuttle Radar Topography Mission (SRTM) Data at 30 m resolution);
- Latitude and longitude at centre of the site used to calculate the position of the sun (calculated in GIS using UTM co-ordinates);
- Average monthly sun-shine hours recorded;

(1) ⁵⁵ Available in WindPro database of climatological data

- Turbine locations – coordinates (provided by the Client);
- Turbine rotor diameter for project turbines i.e. 120 m
- Height to bottom of Turbine hub for project turbines is 127 m;
- Tilt angle of the 'window' (always assumed vertical);
- Shadow receptors contain on openings measuring 1 m by 1 m facing towards the closest wind turbines; and
- Height above ground level of the 'window' 1 m.

Receptors

The maximum horizontal distance between a receptor affected by shadow flicker and turbine location for example has been identified as being equal to the diameter of the turbine multiplied by ten. In this instance, turbine rotor diameter is 120 m; and therefore an area envelope of 1220m from the nearest turbine is used in shadow flicker analyses.

Table 7.27 and Figure 7.3 presents all the of 153 receptor (75 Structures⁵⁶ & 78 Settlements⁵⁷) within the area envelope of 1220m, identified as being within the study area of the wind farm (falling under different villages).

7.5.4.7 Shadow Flicker Analysis

Calculated shadow flicker at each identified shadow receptor due to the proposed windfarm is presented in **Table 7.27**. Shadow main results and shadow graphical calendar illustrate the times of the year at each of the receptors in the analysis where theoretical shadow flicker was predicted to occur.

⁵⁶ Structure is considered a standalone house with a second house minimum at a distance of more than 100-150m

⁵⁷ A cluster of houses, with a minimum of 5-10 houses in the vicinity

Table 7.27 Results of shadow hours at identified receptors

S.NO	Receptor ID	Structure/ Settlement ID	Receptor Location		Nearest WTG	Degrees from (south clock-wise)	Worst Case Scenario			Real Case Scenario Shadow hours per year [h/year]
			Easting	Northing			Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	
1	A	STLMNT1	754,399	2,968,804	FTN-298	0.0	6:26	30	0:18	2:39
2	B	STLMNT2	752,840	2,970,036	FTN-299	32.3	110:42	117	1:15	33:23
3	C	STLMNT3	763,589	2,957,589	FAT-368	65.1	0:00	0	0:00	0:00
4	D	STLMNT4	763,229	2,957,268	FAT-368	-204.5	0:00	0	0:00	0:00
5	E	STLMNT5	757,600	2,955,056	New-18	-237.5	2:32	19	0:11	1:01
6	F	STLMNT7	734,298	2,966,166	FAT-143	-39.1	173:50	159	1:28	50:57
7	G	STLMNT8	734,549	2,966,423	FAT-143	0.0	0:00	0	0:00	0:00
8	H	STLMNT9	751,927	2,958,978	FAT-044	0.0	261:37	142	2:05	132:49
9	I	STLMNT10	753,515	2,958,758	FAT-029	68.7	69:54	108	1:00	26:29
10	J	STLMNT11	745,842	2,938,865	FATNO50	-262.8	61:36	71	1:05	13:45
11	K	STLMNT12	749,497	2,952,288	FTN-276	-79.1	75:33	122	0:53	22:28
12	L	STLMNT13	744,678	2,957,747	FTN-266	-42.9	0:00	0	0:00	0:00
13	M	STLMNT14	755,256	2,960,906	FAT-261	-147.0	0:00	0	0:00	0:00
14	N	STLMNT15	755,186	2,961,499	FAT-261	-22.3	0:00	0	0:00	0:00
15	O	STLMNT16	755,840	2,954,254	FTNA2	-245.2	0:00	0	0:00	0:00
16	P	STLMNT17	746,817	2,951,719	FTN232	-250.6	0:00	0	0:00	0:00
17	Q	STLMNT18	746,163	2,952,329	FTN232	-27.4	0:00	0	0:00	0:00
18	R	STLMNT19	753,066	2,967,747	FAT-113	-210.6	7:46	47	0:14	3:03
19	S	STLMNT20	741,417	2,946,351	FTN134	-48.8	0:00	0	0:00	0:00
20	T	STLMNT21	744,810	2,947,941	FTN-185 & FTN-184	-97.0	136:37	160	1:10	41:11
21	U	STLMNT22	745,177	2,948,347	FTN-185	0.0	2:12	18	0:11	0:41
22	V	STLMNT23	756,320	2,949,223	FTN-291	26.0	7:36	28	0:21	2:26
23	W	STLMNT25	757,004	2,966,038	FAT-339	0.0	46:30	70	1:10	12:21
24	X	STLMNT26	757,487	2,963,378	FAT-281	32.3	127:10	122	1:22	40:48
25	Y	STLMNT27	754,619	2,949,537	FTN-290	-32.2	94:31	96	1:17	35:40
26	Z	STLMNT28	749,003	2,951,513	FTN-256	-31.8	78:48	84	1:08	33:22
27	AA	STLMNT29	746,136	2,940,964	FATNO45	33.2	0:00	0	0:00	0:00
28	AB	STLMNT30	746,105	2,939,350	FATNO50 & FATNO45	-219.0	62:16	133	0:41	26:21
29	AC	STLMNT31	746,414	2,938,290	FATNO50	-238.2	0:00	0	0:00	0:00
30	AD	STLMNT32	744,410	2,943,434	FATNO60	0.0	0:00	0	0:00	0:00

S.NO	Receptor ID	Structure/ Settlement ID	Receptor Location		Nearest WTG	Degrees from (south clock-wise)	Worst Case Scenario			Real Case Scenario Shadow hours per year [h/year]
			Eastings	Northings			Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	
31	AE	STLMNT33	747,298	2,946,018	FTN-187	-245.5	0:00	0	0:00	0:00
32	AF	STLMNT34	744,996	2,946,871	FTN-185 & FTN-186	-152.8	19:18	67	0:25	6:04
33	AG	STLMNT35	745,715	2,947,677	FTN-185 & FTN-186	-238.0	0:00	0	0:00	0:00
34	AH	STLMNT36	744,355	2,947,316	FTN-185 & FTN-184	-132.3	5:56	39	0:15	1:55
35	AI	STLMNT37	745,934	2,948,869	FTN-198	-225.8	12:39	53	0:21	4:46
36	AJ	STLMNT38	746,114	2,949,061	FTN-198	-242.0	10:35	53	0:18	4:10
37	AK	STLMNT39	746036	2,949,379	FTN-198	-260.4	29:39	73	0:37	6:55
38	AL	STLMNT40	741,794	2,944,937	FTN-134	-166.3	0:00	0	0:00	0:00
39	AM	STLMNT41	740,727	2,945,513	FTN-134	-110.4	20:46	55	0:27	6:14
40	AN	STLMNT42	742,462	2,945,366	FTN-134	-253.7	0:00	0	0:00	0:00
41	AO	STLMNT43	742,833	2,949,710	FTN-180	-147.5	13:04	48	0:19	4:26
42	AP	STLMNT44	747,165	2,951,910	FTN-232	81.2	20:19	46	0:34	6:09
43	AQ	STLMNT45	748,725	2,950,384	FTN-256	-136.2	0:00	0	0:00	0:00
44	AR	STLMNT46	749,890	2,950,388	FTN-256	-227.5	0:00	0	0:00	0:00
45	AS	STLMNT47	748,640	2,951,921	FTN-256	-22.9	10:51	42	0:20	3:18
46	AT	STLMNT48	749,762	2,953,435	FTN-276	-5.5	0:00	0	0:00	0:00
47	AU	STLMNT49	754,005	2,949,602	FTN-290	-52.0	16:15	52	0:27	5:10
48	AV	STLMNT50	756,358	2,953,144	FTNA13	104.3	0:00	0	0:00	0:00
49	AW	STLMNT51	756,518	2,953,456	FTNA13	-251.2	26:11	69	0:31	6:25
50	AX	STLMNT52	756,635	2,954,144	FTNA13 & FTNA2	51.0	32:21	97	0:26	9:59
51	AY	STLMNT53	749,068	2,956,394	FAT-165	-175.4	0:00	0	0:00	0:00
52	AZ	STLMNT54	749,564	2,956,224	FAT-165	-230.7	0:00	0	0:00	0:00
53	BA	STLMNT55	749,402	2,958,079	FAT-165	26.0	0:00	0	0:00	0:00
54	BB	STLMNT56	746,794	2,954,822	FTN-250, FTN249 & FTN251	45.3	42:26	102	0:37	17:02
55	BC	STLMNT57	763,050	2,956,914	FAT-368	-180.4	0:00	0	0:00	0:00
56	BD	STLMNT58	763,848	2,957,702	FAT-368	88.4	30:45	62	0:39	8:06
57	BE	STLMNT60	758,883	2,958,568	FAT-193	-51.1	37:00	68	0:38	13:26
58	BF	STLMNT61	759,981	2,957,310	FAT-193	-196.4	0:00	0	0:00	0:00
59	BG	STLMNT62	759,235	2,957,060	FAT-193	-144.2	0:00	0	0:00	0:00

S.NO	Receptor ID	Structure/ Settlement ID	Receptor Location		Nearest WTG	Degrees from (south clock-wise)	Worst Case Scenario			Real Case Scenario Shadow hours per year [h/year]
			Eastings	Northing			Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	
60	BH	STLMNT63	760,094	2,958,632	FAT-193	0.0	0:00	0	0:00	0:00
61	BI	STLMNT64	759,460	2,959,206	FAT-193	0.0	0:00	0	0:00	0:00
62	BJ	STLMNT66	756,044	2,961,572	FAT-261	51.7	42:38	90	0:36	19:18
63	BK	STLMNT67	757,756	2,962,384	FAT-326 & FAT-281	-103.3	5:08	22	0:18	1:40
64	BL	STLMNT68	755,980	2,963,383	FAT-281	-65.9	9:48	44	0:23	3:08
65	BM	STLMNT69	755,767	2,966,052	FAT-339	-61.2	11:55	35	0:27	3:52
66	BN	STLMNT70	757,423	2,966,870	FAT-339	23.1	0:00	0	0:00	0:00
67	BO	STLMNT71	753,928	2,958,701	FAT-029	64.7	21:46	62	0:33	7:14
68	BP	STLMNT72	753,883	2,958,150	FAT-029	-252.2	6:19	38	0:13	1:27
69	BQ	STLMNT73	754,326	2,959,817	FAT-259	93.3	11:58	37	0:25	3:05
70	BR	STLMNT74	754,050	2,960,518	FAT-259	41.9	36:30	103	0:30	15:47
71	BS	STLMNT75	752,850	2,963,601	FAT-303	37.6	34:37	90	0:32	15:32
72	BT	STLMNT76	752,050	2,964,225	FAT-036 & FAT-303	-211.5	0:00	0	0:00	0:00
73	BU	STLMNT77	752,652	2,964,474	FAT-036	-247.9	0:00	0	0:00	0:00
74	BV	STLMNT78	754,175	2,965,660	FAT-038	-198.7	0:00	0	0:00	0:00
75	BW	STLMNT79	754,810	2,966,160	FAT-038	-251.8	28:53	70	0:28	6:26
76	BX	STLMNT80	754,295	2,967,369	FAT-038	28.9	0:00	0	0:00	0:00
77	BY	STLMNT81	754,918	2,967,688	FTN-298	28.4	2:47	21	0:11	0:41
78	BZ	STLMNT82	752,836	2,970,712	FTN-299	12.4	0:00	0	0:00	0:00
79	CA	STR1	754,222	2,968,903	FTN-298	0.0	54:41	129	0:53	19:23
80	CB	STR2	754,227	2,968,937	FTN-298	0.0	63:43	126	0:53	22:05
81	CC	STR3	754,484	2,969,156	FTN-298	0.0	34:52	48	1:02	16:26
82	CD	STR4	760,828	2,973,033	NEW-006	-54.7	83:03	99	1:05	25:32
83	CE	STR6	764,093	2,960,194	FAT-639	-17.8	0:00	0	0:00	0:00
84	CF	STR7	764,370	2,959,656	FAT-639	-153.0	0:00	0	0:00	0:00
85	CG	STR8	759,603	2,958,223	FAT-193	-17.6	301:25	194	2:38	141:11
86	CH	STR9	759,132	2,957,926	FAT-193	-107.8	0:00	0	0:00	0:00
87	CI	STR16	758,505	2,971,524	FAT-448	-90.3	111:31	144	1:04	32:55
88	CJ	STR17	734,731	2,966,151	FAT-143	24.4	258:46	166	1:45	72:24
89	CK	STR18	736,686	2,966,907	FAT-43	50.0	82:26	92	1:23	18:14
90	CL	STR19	734,856	2,967,846	New-022	-151.6	9:46	48	0:16	3:17
91	CM	STR20	759,793	2,970,443	New-022	73.9	122:19	102	1:26	29:14

S.NO	Receptor ID	Structure/ Settlement ID	Receptor Location		Nearest WTG	Degrees from (south clock-wise)	Worst Case Scenario			Real Case Scenario Shadow hours per year [h/year]
			Eastings	Northing			Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	
92	CN	STR21	734,669	2,968,301	FAT-421	-36.8	86:38	100	1:07	25:49
93	CO	STR22	752,362	2,962,322	FAT-315	16.4	6:55	34	0:18	2:47
94	CP	STR23	751,287	2,962,452	FAT-378	34.1	0:00	0	0:00	0:00
95	CQ	STR24	751,230	2,962,497	FAT-378	25.0	0:00	0	0:00	0:00
96	CR	STR25	752,043	2,965,382	FAT-036	32.0	0:00	0	0:00	0:00
97	CS	STR26	753,506	2,960,109	FAT-259	0.0	98:07	103	1:15	35:47
98	CT	STR27	753,394	2,959,938	FAT-259	43.2	80:52	72	1:23	17:38
99	CU	STR28	751,563	2,958,724	FAT-044	-70.6	104:35	154	0:58	31:10
100	CV	STR29	751,946	2,958,453	FAT-044	-141.3	10:07	33	0:24	3:06
101	CW	STR30	753,332	2,958,357	FAT-029	-233.0	16:53	65	0:21	3:49
102	CX	STR31	749,255	2,956,762	FAT-165	-239.6	0:00	0	0:00	0:00
103	CY	STR32	748,582	2,957,227	FAT-165	-59.4	93:24	101	1:12	27:31
104	CZ	STR33	748,534	2,957,359	FAT-165	-39.7	91:23	102	1:02	35:22
105	DA	STR34	744,624	2,941,502	FATNO33	-104.3	0:00	0	0:00	0:00
106	DB	STR35	745,757	2,938,698	FATNO50	-226.9	0:00	0	0:00	0:00
107	DC	STR36	754,140	2,966,927	FAT-038	20.1	0:00	0	0:00	0:00
108	DD	STR37	741,492	2,945,548	FTN134	-136.4	0:00	0	0:00	0:00
109	DE	STR38	741,506	2,946,042	FTN134	-62.8	159:57	133	1:34	45:25
110	DF	STR39	745,483	2,948,002	FTN-185	-261.3	166:25	154	1:18	45:03
111	DG	STR40	744,937	2,947,830	FTN-185	-110.1	19:06	58	0:23	6:31
112	DH	STR41	756,226	2,948,545	FTN-291	-220.5	0:00	0	0:00	0:00
113	DI	STR42	755,654	2,948,696	FTN-291	-88.3	65:26	77	1:02	19:19
114	DJ	STR43	746,692	2,946,233	FTN187	-190.7	0:00	0	0:00	0:00
115	DK	STR44	756,903	2,965,791	FAT-339	-164.1	0:00	0	0:00	0:00
116	DL	STR45	757,481	2,965,008	FAT-154	87.7	50:34	71	0:54	17:25
117	DM	STR46	757,145	2,964,583	FAT-154	-186.5	0:00	0	0:00	0:00
118	DN	STR47	756,731	2,964,574	FAT-154	-145.1	0:00	0	0:00	0:00
119	DO	STR48	756,620	2,964,778	FAT-154	-104.0	69:10	79	1:03	20:25
120	DP	STR49	746,453	2,955,988	FTN-269	95.2	50:04	55	1:09	11:26
121	DQ	STR50	746,401	2,955,901	FTN-269	-218.6	0:00	0	0:00	0:00
122	DR	STR51	746,365	2,955,785	FTN-269	-211.7	0:00	0	0:00	0:00
123	DS	STR52	746,337	2,955,683	FTN-269	-210.7	0:00	0	0:00	0:00
124	DT	STR53	743,111	2,950,355	FTN180	-175.3	0:00	0	0:00	0:00

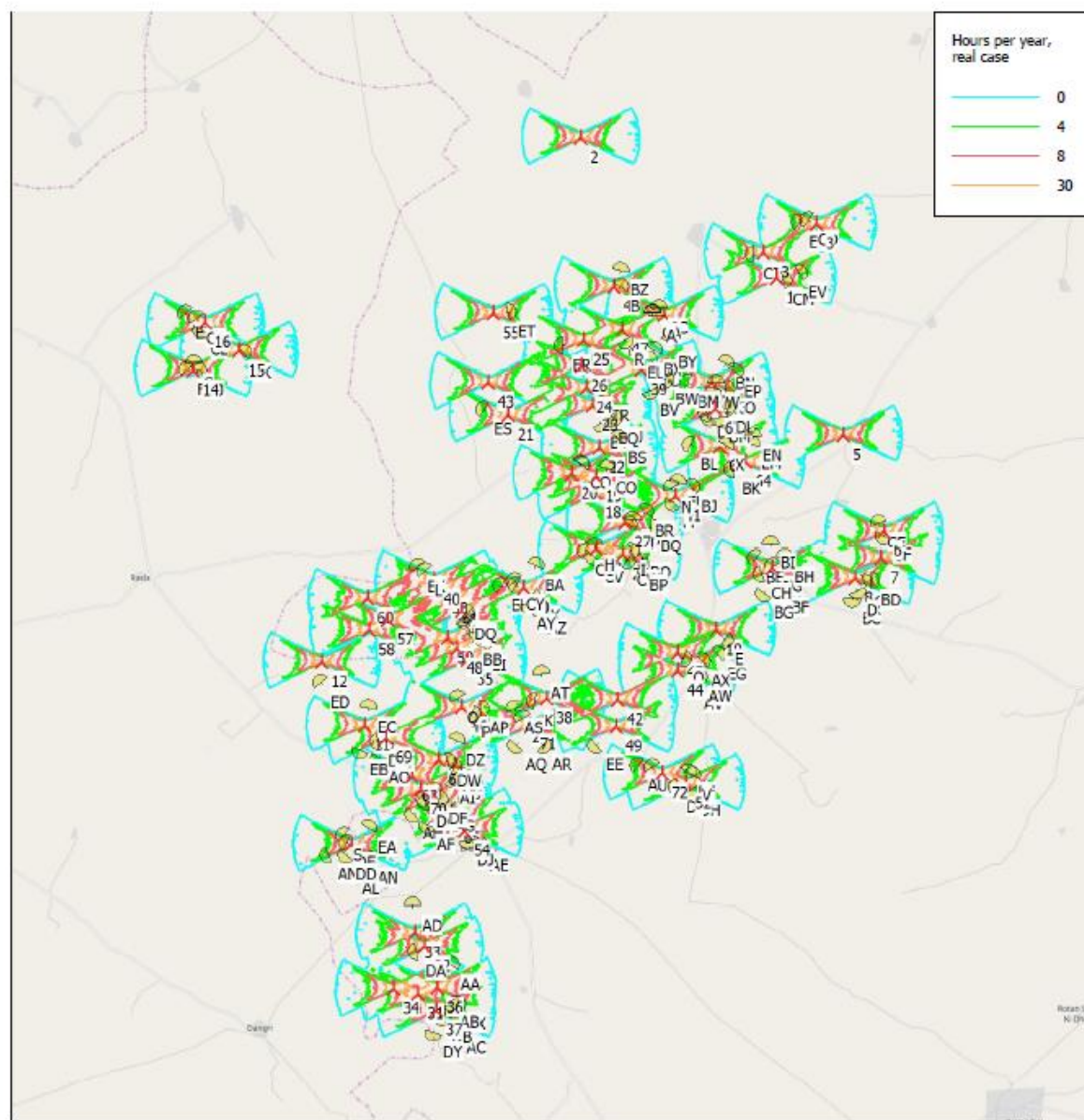
S.NO	Receptor ID	Structure/ Settlement ID	Receptor Location		Nearest WTG	Degrees from (south clock-wise)	Worst Case Scenario			Real Case Scenario Shadow hours per year [h/year]
			Eastings	Northing			Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	
125	DU	STR54	742,945	2,950,376	FTN180	-121.5	0:00	0	0:00	0:00
126	DV	STR55	742,783	2,950,403	FTN180	-108.4	0:00	0	0:00	0:00
127	DW	STR56	745,790	2,949,594	FTN-198	74.1	126:21	178	1:07	34:35
128	DX	STR57	746,390	2,939,302	FATNO50 & FATN045	35.3	21:50	69	0:30	7:54
129	DY	STR58	745,396	2,938,062	FATNO50	-159.0	0:00	0	0:00	0:00
130	DZ	STR59	746,157	2,950,495	FTN-198	26.6	0:00	0	0:00	0:00
131	EA	STR60	742,408	2,946,696	FTN-134	29.6	0:00	0	0:00	0:00
132	EB	STR61	742,028	2,950,003	FTN-178	-153.0	3:37	38	0:09	1:09
133	EC	STR62	742,329	2,951,836	FTN-178	9.0	0:00	0	0:00	0:00
134	ED	STR63	740,278	2,952,891	FTN-196	-40.8	0:00	0	0:00	0:00
135	EE	STR64	752,176	2,950,439	FTN-287	-129.5	0:00	0	0:00	0:00
136	EF	STR65	756,146	2,949,333	FTN-291	30.4	9:54	31	0:25	3:16
137	EG	STR66	757,279	2,954,430	NEW-018	48.4	9:27	48	0:16	3:31
138	EH	STR67	747,970	2,957,200	FAT-165	-59.8	14:01	37	0:29	4:30
139	EI	STR68	747,180	2,954,595	FTN-250 & FTN-251	43.8	17:19	60	0:25	5:18
140	EJ	STR69	746,898	2,954,983	FTN-250 & FTN-251	37.7	37:37	93	0:31	16:21
141	EK	STR70	744,346	2,957,905	FTN-266	-34.1	0:00	0	0:00	0:00
142	EL	STR71	755,426	2,961,771	FAT-261	16.3	0:00	0	0:00	0:00
143	EM	STR72	758,580	2,963,493	FAT-326	17.7	6:37	25	0:20	2:15
144	EN	STR73	758,642	2,963,821	FAT-326	4.4	6:34	28	0:19	2:40
145	EO	STR74	757,465	2,965,791	FAT-339	90.6	24:18	51	0:35	5:13
146	EP	STR75	757,803	2,966,514	FAT-339	37.5	14:38	44	0:26	6:10
147	EQ	STR76	752,444	2,964,420	FAT-036	-231.5	0:00	0	0:00	0:00
148	ER	STR77	750,391	2,967,466	FAT-375 & FAT-010	-89.7	24:25	60	0:32	7:25
149	ES	STR78	747,058	2,964,711	FAT-390 & FAT-297	-60.2	11:55	34	0:27	3:58
150	ET	STR79	748,014	2,968,834	FAT-167	75.1	31:11	55	0:43	10:22
151	EU	STR80	753,594	2,967,209	FAT-038	-15.0	0:00	0	0:00	0:00
152	EV	STR81	760,471	2,970,798	FAT-421	58.9	13:53	38	0:28	5:33
153	EW	STR82	760,468	2,972,929	NEW-006	-56.8	23:21	48	0:38	7:25
154	EX	STR83	734,190	2,968,510	NEW-022	-40.0	22:39	56	0:32	6:58

*The results have been incorporated from modelling results based on confirmed 72 locations.
(Figures highlighted represent greater than 30 hours per year of shadow flicker in worst and real case scenario)
Note: Colour coding used to represent exceedance from applicable standards is as follows:

Shadow hours per year	Max. shadow hours per day
> 120 hr/year	01:30 hr/day
120 hr/year < x < 60 hr/year	01:30 hr/day < x < 01:00 hr/day
60 hr/year < x < 30 hr/year	01:00 hr/day < x < 0:30 hr/day
< 30 hr/year	< 00:30 hr/day

Table 7.4 Wind turbines and shadow receptors of the wind farm

SHADOW - Map



Map: EMD OpenStreetMap , Print scale 1:250,000, Map center UTM (north)-WGS84 Zone: 42 East: 749,550 North: 2,957,460
 New WTG
 Shadow receptor
 Flicker map level: Elevation Grid Data Object: ESIA_600 MW_ADANI_RAJASTHAN_EMDGrid_0.wpg (1)

7.5.4.8 Impact Assessment

Given the guidelines of 30 hours or less per year is considered to be acceptable, the operation of the wind farm theoretically results in shadow flicker impacts that could be considered as significant for the purposes of this study. The results show that in case of theoretical shadow flickers impact scenario, shadow flicker impact at 55 receptors occurs for more than 120 hr/yr, at 51 receptors shadow flickers impact occurs between 120 hr/yr and 60 hr/yr, and at 33 receptors the shadow flicker impact occurs between 60 hr/yr and 30 hr/yr. All other receptors will have shadow flicker less than 30:00 hr/year.

Additionally in real case scenario as shown in **Table 7.27**, two (02) receptors will have shadow flicker impact for more than 120 hr/ yr (highlighted in red). one (01) receptor will have shadow flicker impact between 120 hr/yr and 60 hr/yr (highlighted in dark yellow) and thirteen (13) receptors will have shadow flicker impact between 60 hr/yr and 30 hr/yr (highlighted in light yellow). All the other receptors will have shadow flicker less than 30:00 hr/year in real case scenario.

It is relevant to emphasise that predicted hours of shadow flicker effects with certain assumptions. Assumptions made during the analysis include optimal meteorological, natural light and geometrical conditions for the generation of shadow flicker. The assessment does not account for trees or other obstructions that intervene between receptor and turbine during times when effects may occur. The assessment calculation is therefore an over estimation in the probability of effects. It should also be noted that for shadow effects to occur, properties need to be occupied, with blinds or curtains open and views to the wind turbine unobstructed.

Considering the above scenario, impact magnitude is assessed to be **large** for 2 receptors **medium** for 1 receptors, **small** for 13 receptors and **negligible** for 137 receptors.

7.5.4.9 Mitigation Measures

There needs to be close monitoring through engagement with residents during the operation phase where there are predicted impacts from shadow flicker. The likelihood of direct line of sight to the location of a turbine location can be assessed visually and the potential for using screening like higher fencing and planting trees can be explored at problem locations. The use of curtains can also be explored at the individual residences. If these prove effective and the impacts mitigated, the shutting down of turbines during certain environmental conditions, which meet the physical requirements for theoretical shadow flicker to occur, will not be required.

Should the impact of shadow flicker be identified and the mitigation measures proposed above prove ineffective, further analysis can be carried out to identify the exact timings and conditions under which shadow flicker occurs and a technical solution sought. This is likely to involve pre-programming the turbine with dates and times when shadow flicker can cause a nuisance for nearby receptors. A photosensitive cell can be used to monitor sunlight and the turbine could potentially then be shut down, when the strength of the sun, wind speed and the angle and position of the sub combines to cause a flicker nuisance.

7.5.4.10 Residual Impact Significance

The results of the windPro shadow flicker assessment show a real case estimate with certain assumptions and the mitigation measures above will be implemented for the identified properties that experiences shadow flicker.

Residual impacts following the application of required mitigation measures, as discussed above, is likely to result in minor to negligible impacts.

Impact	Shadow Flickering during Operation Phase – real case scenario		
Impact Nature	Negative	Positive	Neutral
Impact Type	Direct	Indirect	Induced

Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	Transboundary		
Impact Scale	Within 500 m from the WTGs on the receptors in the NE-SE and NW-SW direction of the WTGs				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
	Impact magnitude varies based on distance of receptors from the WTGs and their orientation. Out of the 153 receptors identified in the study, impact magnitude: ■ Large impact (>120 hr/year): 2 ■ Medium impact (60 < x < 129hr/year): 1 ■ Small impact (30 < x < 60 hr/year): 13 ■ Negligible impact (<30 hr/year): 137				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource /Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Major for 2 receptor, moderate impact for 1 receptor, minor impact for 13 receptors, and negligible for 137 receptors				
Residual Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	The residual magnitude post implementation of mitigation measures is envisaged to be minor				

7.5.5 Impact on economy and employment

7.5.5.1 Impacts

The average Work Participation Ratio (WPR) in the AoI villages is 43.07 percent. The casual labourers are in a higher proportion than other and agriculture labour in the AoI. The higher presence of casual workers mostly due to low productivity of land. The receptors for impacts on livelihood profile and economic opportunities include the landowners and local community within the study area. According to the information available, the land requirement for the project is mostly comprised of private land.

Community consultations and observations made during the site visit suggest that the existing scenario of the agriculture in the study area is not capable enough to meet requirements of the people who are solely dependent upon it; especially due to water availability and growing population.

As per the Detailed Project Report, the project would employ skilled, semi-skilled and unskilled labourers during the construction phase of the project. The locally procured services will include maintenance work of the facility, 24-hour security, bush and undergrowth cleaning and housekeeping activities.

7.5.5.2 Embedded built in controls

- Depending upon the skill requirement, the local community should be given preference for employment, especially in semi-skilled and unskilled work. Especially as a security personnel for WTGs;
- The sourcing of local labour wherever possible should be made obligatory for the sub-contractors and in all major procurement activities;
- Preference should be given to the vulnerable population in the AoI; and
- The project proponent will establish a mechanism to audit subcontractors and suppliers with respect to compliance of utilizing local labour and resources.

7.5.5.3 Significance of impact

The impacts due to employment opportunities for locals have been assessed as **positive**.

7.5.5.4 Additional mitigation measures

While, the significance of the impact on economy and employment opportunities during the operations phase is understood to be positive, the following measures should be put in place to ensure that the local community receives maximum benefit from the presence of the project:

- Preference should be provided to local labour or suppliers to pass on maximum economic benefit locally; and
- Preference should be provided to the vulnerable population in the Aol.

7.5.5.5 Residual impact significance

The significance of the residual impact will be **positive**.

The significance of the residual impact will be positive .					
Impact	Employment Opportunities				
Impact Nature	Negative	Positive		Neutral	
Impact Type	Direct	Indirect		Induced	
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local		Regional	International	
Impact Scale	In Project villages and nearby area in Aol				
Frequency	Operational Phase of the Project				
Likelihood	Likely				
Impact Magnitude	Positive	Negligible	small	Medium	Large
Resource/Receptor Sensitivity	Low	Medium		High	
Impact Significance	Negligible	Minor		Moderate	Major
	Significance of impact is considered to be Positive				

7.5.6 Labour Rights and Welfare

7.5.6.1 Impact

The projects will employ skilled, semi-skilled and unskilled workers, across the project lifecycle, which will include contract and regular employees and local and migrant workers. The regular skilled workers are likely to be comprised of migrant workers, from different districts and states in the country, depending upon the need for technical expertise.

7.5.6.2 Embedded built in controls

As informed during consultations with site team of AGE(7)L & AGE(9)L, the companies as part of its sub-contractor agreements, shall require each contractor to have an EHS plan in place, as well as procedures for monitoring of the EHS performance of contractors and their workers.

7.5.6.3 Significance of Impact

The overall impact significance of the labour rights and welfare during the operation phase is assessed as **moderate**.

7.5.6.4 Additional Mitigation Measures

The following additional mitigation measures are suggested in order to ensure compliance with labour laws/ provisions as per the best industry practices:

- The labour accommodation facility for contract workers and as well as for regular employees should meet the requirements of the applicable reference framework in terms of space per worker, water and sanitation facilities, first aid, lighting and ventilation etc. and regular monitoring should be undertaken to ensure compliance through the project lifecycle;
- Both AGE(7)L & AGE(9)L shall ensure a monthly monitoring and regular auditing mechanism for monitoring the sub-contractors and suppliers with respect to compliance to the applicable reference framework, in terms of resources, migrant workers, child labour and forced labour, health and safety, payment of wages etc.; and
- Establish a grievance redressal mechanism in place, to allow for the employees and workers to report any concern or grievance related to work activities

7.5.6.5 Residual Impact Significance

The significance of impact will be reduced to **minor** on implementation of mitigation measures

Impact	Labour Rights and Welfare						
Impact Nature	Negative	Positive		Neutral			
Impact Type	Direct	Indirect		Induced			
Impact Duration	Temporary	Short-term	Long-term		Permanent		
Impact Extent	Local		Regional	International			
Impact Scale	The project will follow the additional mitigation measures as suggested above in order to ensure compliance with labour laws/provisions as per the industry best practices						
Frequency	Project life cycle						
Likelihood	Possible						
Impact Magnitude	Positive	Negligible	small		Medium	Large	
Resource/Receptor Sensitivity	Low		Medium		High		
Impact Significance	Negligible	Minor		Moderate		Major	
	Significance of impact is considered to be Moderate						
Residual Impact Magnitude	Positive	Negligible		Small		Medium	Large
Residual Impact Significance	Negligible	Minor		Moderate		Major	
	Significance of Residual Impacts is considered Minor						

7.5.7 Ecological impacts

The impacts in operational and maintenance phase are restricted to the electrical hazards from transmission line laying including potential of collision and electrocution of roosting and nesting fauna and collision risk with operating wind turbine blades.

The impacts of the operational wind farm on local ecology have been assessed with respect to the following activities:

- Collision and electrical hazards from transmission lines and towers:
 - Electrical hazards to birds; and

- Risk of collision with transmission lines.
- Operating wind turbine blades:
 - Collision risk to bird and bat species
 - Avoidance behaviour by birds leading to increased energy expenditure
 - Barrier effects that lead to connectivity issues and access to resources.
 - Effects of air pressure changes due to blade movement (Barotrauma affecting bats)

7.5.7.1 Hazards associated with turbine blade rotation

The rotating turbine blades are one of the major risks for soaring bird species and bats present in and around the wind farm area. Also, the turbines may cause birds to change their behaviour such as flight deviation, alternate resource utilization, and displacement from the wind farm area, changing flight heights, etc. This avoidance behaviour can affect the energy expenditure of the birds and can lead to decrease energy reserves for foraging, hunting, socializing and breeding. It may also lead to loss of foraging resources, habitats and migration pathways.

During the local movement, the migratory bird species may fly into the high risk zone (Rotor swept area) of the turbines resulting in the increased risk of collision with turbines in the vicinity of important bird habitats. The GIB habitat (Rasla GIB Enclosure) is located at a distance of 2.8 km from WTG FTN-266 and four individuals on annual basis are reported to be present in this habitat.

Embedded built in controls

- Avoiding the siting of WTGs in the areas close to or within Great Indian Bustard habitat
- Avoiding dense clustering of the WTGs in a particular area
- Maintaining a minimum setback distance of 500m from the GIB enclosures and all the seasonal water bodies in the landscape

Significance of impact

The Project site (WTG locations) is located outside the GIB Priority Area identified by the Wildlife Institute of India (WII). However the entire site fall within the GIB Potential Area identified by WII. Furthermore, 13 species protected under Schedule I of Indian Wildlife Protection Act 1972 have been reported from this landscape.

The significance of impact has been assessed for Critically Endangered (IUCN CR, v 2020-2) Great Indian Bustard (*Ardeotis nigriceps*), White-rumped Vulture (*Gyps bengalensis*), Indian Vulture (*Gyps Indicus*) and Red-headed Vulture (*Sarcogyps calvus*) and Endangered (IUCN EN v 2020-2) species such as Steppe Eagle (*Aquila nipalensis*), Egyptian Vulture (*Neophron percnopterus*), other susceptible raptor species including *Eastern Imperial Eagle (Aquila heliaca)*, *Tawny Eagle (Aquila rapax)*, *Short-toed Snake Eagle (Circaetus gallicus)*, listed under Schedule I of Indian Wildlife Protection Act, 1972. The species sensitivity has thus been assessed as **High**. And the magnitude has been assessed as **Medium**.

The overall impact significance has, thus, been assessed as **Major**.

Additional mitigation measures

The following mitigation measures will further reduce the impact significance on avifaunal species.

- A detailed and long term monitoring of bird and bat species (covering migratory as well as breeding season) within the Project study area should be undertaken for at least two years which may help understand the presence of threatened species inside the Project area and their

movement. This will further help in assessing the site specific impacts and updating the mitigations measures;

- Cattle Carcass Management should be implemented as a precautionary measure due to vulture presence in the area in consultation of local authorities, Forest Department and local villagers;
- Bird carcass monitoring should be commissioned in operation and maintenance phase, in which all bird carcasses found in the wind farm should be recorded and photographed with details about the distance from the closest wind turbine generator and the name of the wind turbine generator for at least two years;
- The habitats visited by bird species of conservation significance should be identified and a minimum distance of 1000 m is recommended to maintain from such habitats. It includes resting/roosting and feeding sites of birds;
- Periodic bird mortality counts should be undertaken for the first two years of the wind farm operation to determine if there is any risk of CR and EN and migratory bird species collision from the wind farm. The mitigation measures should be revised based on the results of the monitoring;
- Waste materials should not be left lying around and should be cleared immediately so as to not attract birds near the WTG blades;
- The tower and blade tips should be marked with orange colour for better visibility of the WTGs.

Residual impact significance

Proper implementation of suggested mitigation measures and in-built controls can reduce the impacts to some extent and the significance of the residual impact may reduce to **Moderate**.

Impact	Bird and bat collision with wind turbine							
Impact Nature	Negative		Positive		Neutral			
Impact Type	Direct		Indirect		Induced			
Impact Duration	Temporary	Short-term		Long-term		Permanent		
Impact Extent	Local		Regional		Transboundary			
Impact Scale	Limited to core zone of the wind farm as well as a displacement radius of 1 km for birds that are showing avoidance behaviour							
Impact Magnitude	Positive	Negligible		Small		Medium	Large	
Resource /Receptor Sensitivity	Low			Medium		High		
Impact Significance	Negligible		Moderate		Major		Critical	
	Significance of impact is considered Major							
Residual Magnitude	Positive	Negligible		Small		Medium		Large
Residual Impact Significance	Negligible		Moderate		Major		Critical	
	Significance of impact can be reduced to Moderate for habitats and species							

7.5.7.2 Collision and Electrical hazards from Transmission Infrastructure

It has been observed globally that several avifaunal species utilize the transmission lines and transmission towers for roosting, nesting or using the height of the manmade structures as a lookout for predators. All these structures have electrical components and therefore electrocution risk for these species needs to be assessed.

The Project site is situated close to GIB habitat and there are sighting records of the species from the GIB enclosure areas falling inside the study area and the eastern part of GIB Arc which falls on immediate north of the Project site. There is a likelihood of GIB and CR Vulture species inside the Project area. These species may face a risk of collision or electrocution with the transmission lines.

Embedded built in controls

- During transmission line siting, important bird habitats (such as water bodies, dense vegetation areas and grasslands) should be identified and avoided and maximum possible distance should be maintained from such habitats preferred by bird species;
- The 33 kV feeder transmission poles should be raised with suspended insulators in order to reduce the electrocution of avifaunal species;
- At each location where the conductor is crossing over a transmission pole, the conductor should be insulated at pole crossover 1.5 m on either sides;
- For high-voltage transmission lines such as 220 kV, a distance of greater than 2.6 m should be maintained between the phase conductors. The maximum wing span of the largest bird species, the White-rumped Vulture is 2.1 m, and will greatly reduce mortality through electrocutions;
- Bird Spike guards/Perch receptors (Broom Type) should be installed on 33kv line to prevent birds from perching and subsequent electrocution;
- Bird diverters should be installed on 33 kV and 220 kV transmission lines in all the areas.

Significance of impact

The species, which are susceptible to electrocution and collision, are raptors. 14 raptor species including three Critically Endangered Vultures and Endangered Eagle species have been reported from this landscape.

Several Schedule I (IWPA 1972) species such as Indian Peafowl (*Pavo cristatus*), Eastern Imperial Eagle (*Aquila heliaca*), Egyptian Vulture (*Neophron percnopterus*), Long legged Buzzard (*Buteo rufinus*), Shikra (*Accipiter badius*), Short-toed Snake Eagle (*Circaetus gallicus*), Steppe Eagle (*Aquila nipalensis*), Tawny Eagle (*Aquila rapax*), White-eyed Buzzard (*Butastur teesa*) have been reported from this landscape and may experience mortality due to electrocution.

The significance of impact has been assessed for Critically Endangered (IUCN CR v 2020-2) Great Indian Bustard (*Ardeotis nigriceps*), White-rumped Vulture (*Gyps bengalensis*), Indian Vulture (*Gyps Indicus*) and Red-headed Vulture (*Sarcogyps calvus*) and Endangered (IUCN EN v 2020-2) species such as Steppe Eagle (*Aquila nipalensis*), Egyptian Vulture (*Neophron percnopterus*) and Schedule I, IWPA 1972) in the wind farm area. The IBA situated on the west supports the highest population of Great Indian Bustard and boundary of proposed ESZ of GIB Arc is situated at a distance of 5.9 km from the north-eastern WTG NEW-006. Also, the 220 kV transmission line route passes from about 2.9 km of Rasla enclosure. Thus, the species and habitat sensitivity has been assessed as **High**. Since the collisions with transmission lines and electrocution may significantly impact the populations of species of conservation significance likely to be visiting the landscape, the impact magnitude has been assessed as **Large**.

The overall impact significance has, thus, been assessed as **Critical**.



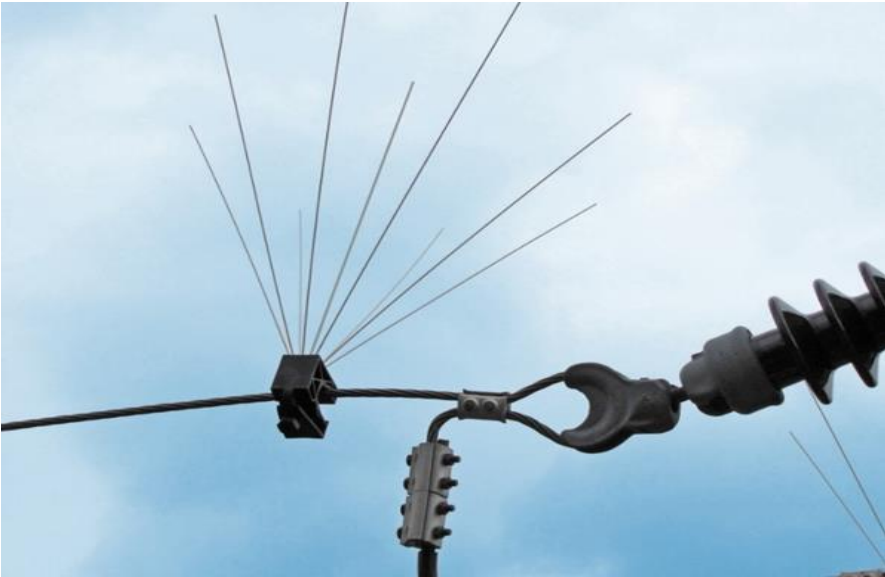
Additional mitigation measures

- Long term monitoring of entire transmission lines should be commissioned to understand the movement of migratory species and areas with the presence of EN, CR species such as GIB and Vultures in this landscape. This will help identify the high risk areas of the transmission line stretch and the mitigation measures can be revised based on the outcomes of the study;
- An assessment for critical habitat against the IFC Performance Standard 6 (Biodiversity Conservation and Sustainable Management of Living Natural Resources) should be undertaken for the areas transmission line alignment and the wind farm and solar park;
- Records of feeder trips due to bird electrocution should be maintained with feeder number, bird species, time of electrocution, location, etc. These should be shared with an expert ornithologist

for identification of the species. These will be the areas of high concern and focus for further mitigation;

- Regular checking of the vacuums or holes in the towers should be done to avoid nesting by any of the birds;
- Use of plastic insulator caps or tubing of conductor at the electricity poles crossover should be considered
- The siting of 33kv line should be avoided in the areas of high bird activity, such as grasslands, waterbodies, etc.
- Bird diverters should be used to mark the overhead cables and three phase lines of high voltage or 220 kV transmission line. As several species such as Cranes migrate at night, fluorescent diverters which glow at night should be used. Several models can be used however, an examples of those from Indo divert has been provided in **Figure 7.5**.

Figure 7.5: Bird Diverter, insulators and perch rejecter

	
<p>Bird Diverter from Indodivert</p>	<p>Insulation of conductors at Pole Crossovers</p>
	
<p>Broom type perch rejecter</p>	

Residual impact significance

Proper implementation of suggested mitigation measures and in-built controls may reduce the impacts to some extent and the significance of the residual impact may reduce to **Major**. However, complete cessation of mortality may not be expected and this may affect small and recovering populations of CR species in the landscape.

Impact	Collision and electrocution hazards from transmission infrastructure						
Impact Nature	Negative		Positive		Neutral		
Impact Type	Direct		Indirect		Induced		
Impact Duration	Temporary	Short-term		Long-term	Permanent		
Impact Extent	Local		Regional		Transboundary		
Impact Scale	Limited to the electrical components of wind farm and internal and external transmission lines and transmission towers						
Frequency	Operation phase						
Likelihood	Likely						
Impact Magnitude	Positive	Negligible		Small	Medium	Large	
Resource /Receptor Sensitivity	Low		Medium		High		
Impact Significance	Negligible		Moderate		Major		Critical
	Significance of impact is considered Critical						
Residual Magnitude	Positive	Negligible		Small		Medium	Large
Residual Impact Significance	Negligible		Moderate		Major		Critical
	Significance of impact can reduced to Major						

7.6 Impact assessment – Decommissioning phase

7.6.1 Impact on soil environment

7.6.1.1 Impacts

The decommissioning activities will cause following impacts on soil:

- Soil compaction due to the increased vehicular and workforce movement, dismantling and storage of WTG and solar components on the adjacent land, removal of internal electric lines/ poles etc.
- Waste will be generated in form of dismantled WTG and solar modules and demolition debris from WTG and solar foundations, storage yard and substation complex. Electric components such as transformers, insulators, wires will be generated. The waste will be mainly of inert nature;
- The possibility of soil contamination during decommissioning phase is very less though may occur due to leakage from machinery and transportation vehicles and during collection of remaining oil/ lubricants.

7.6.1.2 Embedded built in controls

- The decommissioning of the wind farm will be carried out in a planned manner;
- During decommissioning phase, the quantity of waste generated will be high. The waste will be routed through proper collection, storage and disposal. The waste will be evaluated for its recycling/ reuse/ scrap value and disposed of, accordingly;
- Detailed decommissioning plan will be developed prior to the activity and implemented as per the site conditions.

7.6.1.3 Significance of impact

The overall significance of impacts on soil environment due to decommissioning activities is envisaged to be **minor**.

7.6.1.4 Additional mitigation measures

Following mitigation measures are proposed to reduce the impacts of wind farm decommissioning activities on soil environment:

- The vehicular movement during decommissioning activities should be restricted to the designated route path;
- The demolition/ dismantling waste should not be left over in whole project area and to be collected and stored at designated area only for further segregation and disposal.

7.6.1.5 Residual impact significance

The significance of impact will vary from **minor to negligible** on implementation of mitigation measures.

Impact	Soil and land environment during decommissioning phase					
Impact Nature	Negative		Positive		Neutral	
Impact Type	Direct		Indirect		Induced	
Impact Duration	Temporary	Short-term		Long-term	Permanent	
Impact Extent	Local		Regional		Transboundary	
Impact Scale	Limited to Project area					
Impact Magnitude	Positive	Negligible	Small		Medium	Large

Resource /Receptor Sensitivity	Low		Medium		High		
Impact Significance	Negligible	Minor		Moderate		Major	
	Impact significance is assessed to be minor						
Residual Magnitude	Positive	Negligible		Small		Medium	Large
Residual Impact Significance	Negligible		Minor		Moderate		Major
	Significance of residual impact is assessed to be minor to negligible						

7.6.2 Impact on water environment

7.6.2.1 Impacts

Water during the decommissioning phase will be consumed by labourers and will be required for civil work. The water demand is expected to be met through procurement of water tankers. Also, there is a potential for contamination of groundwater and surface water resources resulting from improper management of sewage and accidental spills/leaks at the storage areas. Therefore, the receptor sensitivity is assessed to be **medium**. However, since the decommissioning activity will last for short period of time, the impact magnitude is assessed to be **small**.

7.6.2.2 Embedded built in controls

- The provisions of septic tank and soak pits will be provided onsite for treatment and disposal of sewage, thereby minimizing the impacts of wastewater discharge. Planning of toilets, soak pits and septic tanks, waste collection areas should be away from natural drainage channels;
- Use of licensed contractors for management and disposal of waste and sludge;
- Spill/ leakage clearance plan to be adopted for immediate cleaning of spills and leakages;
- Water tankers with proper permissions will be utilized for water sourcing.

7.6.2.3 Significance of impact

The overall impact significance is assessed to be **minor**

7.6.2.4 Additional mitigation measures

- Ensure proper cover and stacking of loose construction material to prevent surface runoff and contamination of receiving water body;
- Labourers will be given training towards proactive use of designated areas/bins for waste disposal and encouraged for use of toilets. Open defecation and random disposal of sewage shall be strictly restricted;
- Construction labour deputed onsite to be sensitised about water conservation and encouraged for optimal use of water;
- Regular inspection for identification of water leakages and preventing wastage of water from water supply tankers.
- Recycling/reusing to the extent possible

7.6.2.5 Residual impact significance

The residual impact significance is envisaged to be **negligible** upon application of embedded controls and additional mitigation measures.

Impact	Impact on water environment during decommissioning phase		
Impact Nature	Negative	Positive	Neutral

Impact Type	Direct		Indirect		Induced	
Impact Duration	Temporary	Short-term		Long-term		Permanent
Impact Extent	Local		Regional			Transboundary
Impact Scale	Limited to Project Area					
Impact Magnitude	Positive	Negligible		Small	Medium	Large
Resource /Receptor Sensitivity	Low		Medium			High
Impact Significance	Negligible	Minor		Moderate		Major
	Significance of impact is considered minor					
Residual Magnitude	Positive	Negligible		Small	Medium	Large
Residual Impact Significance	Negligible	Minor		Moderate		Major
	Significance of impact is considered negligible					

7.6.3 Impact on air quality

7.6.3.1 Impacts

The decommissioning activities will have limited impact on the air quality of the area and will be mainly in form of dust emissions due to demolition of office building. The increased vehicular movement for transportation of dismantled WTGs, solar panels, demolition debris, and scrap materials will also generate fugitive dust emissions. Therefore, the receptor sensitivity is assessed to be **medium**. However, considering the decommission phase will last for a short term, the impact magnitude is assessed to be **small**.

7.6.3.2 Embedded built in controls

- Emissions from the emergency DG set and other stationary machines will be controlled by ensuring that the engines are always properly tuned and maintained;
- Minimize stockpiling by coordinating excavations, spreading, re-grading and compaction activities;
- Speed of vehicles on site will be limited to 10-15km/hr which will help in minimizing fugitive dust emissions due to vehicular movement; and
- Idling of vehicles and equipment will be prevented.

7.6.3.3 Significance of impact

The impact on air quality during decommissioning phase of the Project is assessed to be **moderate**.

7.6.3.4 Additional mitigation measures

The following mitigation measures are proposed to reduce impact significance on air quality for the decommissioning phase:

- Barricading the demolition areas;
- Cease or phase down work if excess fugitive dust is observed, investigate source and take suppression measures;
- Proper maintenance of engines and use of vehicles with Pollution Under Control (PUC) Certificate;

7.6.3.5 Residual impact significance

Upon application of additional mitigation measures, residual impact due to the Project on air quality will be **minor**.

Impact	Air quality during decommissioning phase							
Impact Nature	Negative		Positive		Neutral			
Impact Type	Direct		Indirect		Induced			
Impact Duration	Temporary	Short-term		Long-term		Permanent		
Impact Extent	Local		Regional		Transboundary			
Impact Scale	Project area and immediate vicinity							
Impact Magnitude	Positive	Negligible		Small		Medium	Large	
Resource /Receptor Sensitivity	Low		Medium			High		
Impact Significance	Negligible		Minor		Moderate		Major	
	Significance of impact is assessed to be moderate							
Residual Magnitude	Positive	Negligible		Small		Medium		Large
Residual Impact Significance	Negligible		Minor		Moderate		Major	
	Significance of residual impact is assessed to be minor							

7.6.4 Impact on ambient noise

7.6.4.1 Impacts

During decommissioning phase of the project, noise will generate from movement of vehicles carrying dismantled structure and equipment. Therefore the receptor sensitivity is assessed to be **low to medium**.

Impact magnitude is considered to be **small** considering the decommissioning period to last for small duration.

7.6.4.2 Embedded built in controls

Normal working hours of the contractor to be defined (preferable 8 am to 6pm). If work needs to be undertaken outside these hours, it should be limited to activities which do not generate noise.

7.6.4.3 Significance of impact

The overall impact significance is envisaged to be **negligible to minor**.

7.6.4.4 Additional mitigation measures

- Only well-maintained equipment should be operated on-site;
- If it is noticed that any particular equipment is generating too much noise then lubricating moving parts, tightening loose parts and replacing worn out components should be carried out to bring down the noise and placing such machinery far away from the households as possible;
- Machinery and equipment that may be in intermittent use should be shut down or throttled down during non-work periods; and
- Minimal use of vehicle horns and heavy engine breaking in the area needs to be encouraged

7.6.4.5 Residual impact significance

Significance of residual impact is assessed to be **negligible** upon incorporation of the above mentioned mitigation measures

Impact	Ambient Noise Levels –Decommissioning Phase		
Impact Nature	Negative	Positive	Neutral
Impact Type	Direct	Indirect	Induced

Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	Transboundary		
Impact Scale	Project area and vicinity				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource /Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered to be minor .				
Residual Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered negligible .				

7.6.5 Impact on Economy and employment

7.6.5.1 Impacts

The major social impacts associated with the decommissioning phase are linked to the loss of jobs and associated income. This has implications for the households who are directly affected, including their families. However, the impacts are likely to be limited due to relatively small number of permanent employees (mainly security guards) who will be affected. Other associated impacts would be:

- Improper disposal of construction waste and debris from deconstruction of storage area, etc. will lead to contamination of soil and discontentment with the immediate villages in the local surrounding communities; and
- Impact magnitude is considered to be **small** considering the decommissioning period to last for small duration.

7.6.5.2 Additional Mitigation Measures

The decommissioning phase will require removal of machinery, workers and other temporary structures. The mitigation measures for decommissioning shall include the following:

- Both AGE(7)L & AGE(9)L shall ensure that retrenchment packages are provided for all staff who stand to lose their jobs when the plant is decommissioned;
- The contractor shall inform the workers and local community about the duration of work;
- Reduction of worker will be done phase wise and corresponding to completion of each activity; and
- All waste generated from demobilisation shall be collected and disposed of at the nearest municipal disposal site.

7.6.5.3 Residual impact significance

The significance of residual impact upon incorporation of the above mentioned mitigation measures is assessed to be **negligible**.

Impact	Impact on Economy and Employment			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Direct	Direct	
Impact Duration	Temporary	Short-Term	Long-term	Permanent
Impact Extent	Local	Regional	International	

Impact Scale	Project area and vicinity				
Frequency	Regular during decommissioning				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low		Medium		High
Impact Significance	Negligible	Minor	Moderate	Major	
Residual Impact	Significance of impact is considered to be minor .				
Magnitude	Positive	Negligible	Small	Medium	Major
Residual Impact Significance	Negligible		Minor	Moderate	Major
	Significance of impact is considered negligible .				

7.7 Cumulative impact assessment

The areas surrounding the project site are characterised by operational wind power plants. Three operational wind power plants were observed within the study area. The details of the wind plants observed within 5-10 km from the site along, with their distance from the proposed project site, are as follows

- A 39.9 MW wind power plant developed by Suzlon and owned by Orange Renewable Power Private Limited is located near Bhainsara Village and other surrounding villages, few of the turbines are located approximately within a distance of 600m-1km from the turbine location of proposed 600MW project ;
- A 100 MW wind power project developed by Siemens Gamesa and owned by National Aluminium Company Limited (NALCO) located approximately 5 kms of the proposed project, few of the turbines are located at a distance of 1.5-2.5 kms from the proposed project. ;
- In addition to the above, AGEL is planning to develop a 390 MW and 700 MW solar and wind hybrid power project located within the 5 km radius of the Proposed 600 MW project.
- There are other upcoming wind power projects to be developed by Renew and Eden Renewables (capacities not known) within 5-10 km of the proposed project site

This section assesses the cumulative impacts the above mention projects will have on the local soil, water, land, air and ambient noise environment.

7.7.1 Environmental Impact

7.7.1.1 Impact Magnitude

The environmental impacts listed below have been considered for cumulative impact assessment.

- Impact on land environment;
- Impact on soil environment;
- Impact on water environment;
- Impact on air environment;
- Impact on ambient noise.

Impact on Land Environment

As mentioned previously in the report, land cover in the Project study area is primarily shrub/waste land followed by agricultural land and gravel waste land. Other operational and upcoming wind power projects were observed towards north, north east and north west directions. There are AGEL's upcoming solar power projects in the area. Therefore, renewable power projects will lead to change in

land use/land cover in the study area. Furthermore, project related activities can potentially lead to land pollution in cases of mismanagement of wastes (solid, wastewater and hazardous) and hazardous materials. With a number of wind turbines installed in the study area already, the chances of land pollution will increase. However, these projects are being developed by companies have an extensive wind power portfolio in India and have experience in managing said projects. Therefore, activities that may lead to pollution and contamination will be carefully undertaken.

Considering the above, the resource sensitivity is assessed to be **medium**. Since the existing and upcoming projects will lead to the agricultural land being converted to industrial land, the impact magnitude is assessed as **medium** as well.

Impact on Soil Environment

Impacts on soil environment have been discussed in previous sections. As mentioned earlier, the region is characterised by desertic and sandy soil which is loose in nature, and thus soil erosion is common in these parts. Since the upcoming projects will require clearance of the vegetation in the area, the amount of soil being eroded can increase. Another major concern in terms of soil environment is soil compaction considering the projects will develop a network of internal access road to provide access to the WTGs and upcoming solar plants through already existing village roads during construction phase and for logistical support. Furthermore, waste generated on site during a particular project's life cycle can lead to increased contamination of the soil if not maintained and managed properly, considering the amount of projects that are operational or being developed in the area. Therefore, the resource sensitivity in the area is assessed to be **medium**.

The impact magnitude is assessed **medium** as well considering the access roads that will lead to soil compaction, increased soil erosion during windy days and the fact that the soil in the project area is sandy in nature with high infiltration capacity. Therefore, oils and lubricants can easily percolate inside the soil in the event of accidental leakage.

Impact on Water Environment

Increased number of wind and solar power projects in the study area of 5 km can lead to increased stress on water resources of the area, especially for solar projects during operation phase. Projects utilising tankers sourcing water from nearby surface water bodies will affect the surface water resources in the area and projects utilising groundwater can lead to groundwater resources in the area being depleted.

With respect to impacts on water quality, the area consists of loose sandy soil with high soil permeability and in cases of leakages and improper waste management practices. Groundwater in the area can be severely impacted. As for leakages impacting the surface water resources, the projects are being developed in an area consisting of drainage channels and water ponds that are seasonally filled (during monsoon season). The local community use these seasonal water bodies and cases of accidental leakages and spills may lead to the surface water bodies being contaminated. Considering all the existing and upcoming wind and solar power projects will consist of proper systems for waste management and leakage/spill management, the resource sensitivity is assessed to be **medium**. The impact magnitude therefore is assessed to be **medium** as well.

Impact on Air Environment

Impact on air quality in the region will arise during the construction as well as decommissioning phases due to the following activities:

- Fugitive emissions from site clearing, excavation work, material handling etc.;
- Fugitive emission from traffic movement;
- Exhaust emission from operation of machineries like pile drivers, vehicles; and
- Point source emission from diesel generator.

The receptors of the above will be the various villages present within the study area of 5 km. The operational projects in the study area will not lead to any adverse impacts on the air quality of the area. Whereas, the construction activities will be for a duration approximately to a year (10-12 months) with air quality improving during the operational phase. Considering the present scenario, in which the existing projects are operational, air quality impacts during the construction phase identified for the proposed 600 MW hybrid project will prevail (receptor sensitivity assessed as **medium** and impact magnitude assessed as **small**). However, the effects of these impacts may increase in case another developer plans to install its project at the same time as AGE(9)L & AGE(7)L.

7.7.1.2 Significance of impact

Taking the above mentioned environmental impacts into consideration, the overall cumulative impact significance is assessed to be **minor to moderate**. The cumulative impact significance will not go beyond moderate for environment impacts since wind and solar power projects have very low dependence on natural resources and are being developed to enhance the renewable energy sources in the country. Considering that the proposed 600 MW wind solar hybrid power project is being developed as per IFC Performance Standards and other Projects are being operated by developers with vast experience in the same sector, mitigation measures and management plans in place for impacts arising due to such projects can easily help mitigate any environmental impacts.

7.7.1.3 Mitigation measures

It is recommended that the proposed 600 MW hybrid Project diligently follows the mitigation measures already in place and additional mitigation measures proposed for all potential environmental impacts in **sections 7.4, 7.5, 7.6** and the environmental and social management plan.

7.7.1.4 Residual impact significance

The implementation of mitigation measures and sound environmental practices will depend upon how a developer goes about ensuring that the natural environment of a region is not disturbed to a point where impacts become irreversible. Based on the aspects discussed for cumulative impacts, it can be concluded that developers within the 5 km of the proposed 600 MW hybrid power project (including AGE(9)L & AGE(7)L) will implement management plans to ensure any potential environmental impact is readily mitigated. Based on said assumption, the overall residual impact significance for cumulative environmental impacts is assessed to be **minor**.

Impact	Cumulative Impact Assessment - Environmental Impacts							
Impact Nature	Negative		Positive		Neutral			
Impact Type	Direct		Indirect		Induced			
Impact Duration	Temporary	Short-term		Long-term		Permanent		
Impact Extent	Local		Regional		Transboundary			
Impact Scale	Limited to the 5 km radius of the proposed hybrid power project							
Impact Magnitude	Positive	Negligible		Small	Medium		Large	
Resource /Receptor Sensitivity	Low		Medium			High		
Impact Significance	Negligible		Minor		Moderate		Major	
	Impact significance is assessed to be moderate to minor							
Residual Magnitude	Positive	Negligible		Small		Medium		Large
Residual Impact Significance	Negligible		Minor		Moderate		Major	
	Residual impact significance is assessed to be minor							

7.7.2 Social Impact

The project is set-up in Pokhran and Fatehgarh tehsil of Jaisalmer district, considering the availability of land, solar radiation and good wind potential and the establishment of many projects. Jaisalmer is fast emerging as the hub for renewable power energy. Due to the above-mentioned factors, the following cumulative impact given below has been envisaged in the Aol:

- Community Health and Safety;
- Employment Opportunity; and
- Impact on Land Holding and Agriculture Land.

The details of each cumulative impacts are delineated below:

7.7.2.1 Community Health and Safety

The receptor for this impact will be the local community during the entire lifecycle of the project. The local community will include locals residing close to the solar plant and WTGs, cultivators whose land is close to the WTGs.

The construction phase activities such as the piling of solar panels and erection of the WTGs, construction of the transmission line and substation and movement of material and personnel may result in impacts on the health and safety of the community. These activities will involve the use of heavy machinery for the transportation of WTGs' part and other material. Furthermore, the movement of material and personnel via the access roads may result in injuries to people or livestock due to accidents.

The operation phase activities will include the accidental impacts-blade throw and Natural Disasters. Any communities lying in close proximity to the WTG are receptors of this type of impact. Blade throw risk for public safety is treated as extremely low as in the event of a failure the blade can reach between 15-100 m from the wind turbine. Furthermore, the live transmission line may result in injuries to the local community.

The decommissioning phase, such as the demolition of WTGs, and movement of heavy material may result in impacts on the health and safety of the community. These activities will involve the use of heavy machinery for the transportation of WTGs' part and other material.

The significance of the Project in the community health and safety is considered to be **Moderate**.

7.7.2.2 Employment Opportunity

Coming of the renewable power project will have **Positive Impact** on the employment opportunity of the local people. The Project infrastructure will create employment opportunity for the local people, who are having limited livelihood opportunity. The local community is likely to benefit from the economic opportunities to be created from the following activities in the Aol:

- Civil works during the construction phase including, construction of piling of solar panels and WTGs mounting area, transformer yard, internal roads, and transmission line,
- Self- employment options for individuals possessing vocational or technical training skills like electricians, welders, fitters etc.; and
- Contracting opportunities for locals possessing tractors, dumper trucks or other vehicles which would be needed to carry away excavated soil and other material. Creation of indirect employment for the local community through establishing small shops like tea stalls, the supply of intermediate raw materials, repair outlets, hardware stores etc. However, these are likely to be temporary.

The projects in the Aol has a positive impact in terms of employment generation for the local people during the entire project lifecycle.

7.7.2.3 Impact on Land Holding and Agriculture Land

The Aol is consists of agricultural land with patches of fallow land. The upcoming hybrid (solar and wind) projects in the Aol and the land lease made by them of the agricultural land will not result in change of land holding and land usage for agriculture. The land leasing is temporary possession of land for the project and will reduce the landholding of the local community in the area. As informed, the land identified for installing both solar plants is 3900 Acres and for 72 WTGs is ~340 acres, which also includes access road and other utilities required for power generation.

WTGs are usually located in a dispersed manner; as a consequence, even the land adjoining the WTG sites is used for carriage and vehicular movement during the construction phase of the project. Thus, the projects establishing in the Aol would result in land fragmentation on temporary basis.

Thus, taking into consideration the argument as mentioned above, the impact of projects is anticipated to be **moderate** in the Aol.

7.7.2.4 Significance of Impact

Community Health and Safety

- **Dust and Noise Discomfort:** Inhabitants residing close to access roads will be affected due to noise and dust generated from vehicular movement during construction phase. However, the access road is a paved road and the dust generation will be minimum.
- **Traffic movement in site approach road:** The construction activities are expected to increase traffic load in the site approach road which may create public safety issues for local residents and school children of nearby primary school. Potential impacts include pedestrian safety issues and safety aspects of slow moving vehicles

Employment Opportunity

During the construction phase, the project is expected to create economic opportunities for the engagement of local unskilled and semi-skilled workers. The wage earnings from the project will supplement their earnings from agriculture or other sources. Furthermore, the project development may also result in the creation of indirect economic opportunities such as for small businesses, contractual workers, structures or vehicles being provided on rent etc. the influx of workers (Semi skilled and skilled) is also likely to raise the wage levels and result in a localized inflation of prices for basic goods and supplies. There may also be a temporary period where demand of consumable may exceed supply.

Land Holding and Agriculture land

The coming of hybrid (solar and wind) projects in the Aol and the land lease made by them of the agricultural land will not result in a change of the titleholders. The land leasing is temporary possession of land for the project and will reduce the landholding of the local community in the area. As informed, the of land identified for installing solar plants is 3900 Acres and for 72 WTGs is ~340 Acres, which also includes access road and other utilities required for power generation.

Taking the above mentioned social impacts into considerations, the overall cumulative impact significance is assessed to be **minor to moderate**.

7.7.2.5 Mitigation Measures

It is recommended that the project diligently follow the mitigation measures already in place and additional mitigation measures proposed for all potential social impacts in **section 7.4, 7.5 and 7.6** and the environmental and social management plan.

7.7.2.6 Residual Impact Significance

The implementation of mitigation measures and sound social practices will depend upon how a developer goes ensuring that the social environment of the AoI is not disturbed to a point where impacts become irreversible. Based on the aspects discussed for cumulative impacts, it can be concluded that developer with the 5 km AoI of the 600 MW hybrid power project will implement management plans to ensure any potential environmental impact is readily mitigated. Based on said assumption, the overall residual impact significance for cumulative social impact is assessed to be **minor**.

Impact	Cumulative Impact Assessment-Social Impacts						
Impact Nature	Negative		Positive		Neutral		
Impact Type			Direct		Direct		
Impact Duration	Temporary	Short-Term		Long-term	Permanent		
Impact Extent	Local		Regional		International		
Impact Scale	Limited to the 5 km radius of the proposed 600 MW hybrid power project						
Frequency	Project Lifecycle						
Impact Magnitude	Positive	Negligible		Small	Medium	Large	
Resource Sensitivity	Low			Medium		High	
Impact Significance	Negligible		Minor		Moderate	Major	
	Significance of impact is considered to be moderate to minor .						
Residual Impact Magnitude	Positive	Negligible		Small		Medium	Major
Residual Impact Significance	Negligible		Minor		Moderate		Major
	Significance of impact is considered minor .						

7.7.3 Ecological Impact

Individually a wind or solar farm may have minor impacts on the ecology of the region; however, presence of multiple projects in an area may increase the impact on avifaunal species by manifolds. Additionally, the Project site falls inside the Central Asian and West Asian-East African Flyways and supports the turnover high numbers of migratory birds in winter. The Project site is situated immediate south of GIB habitat and there is a likelihood of the movement of GIB and Vultures inside the Project site. The existing windfarms and some future projects coming in this landscape may lead to an increased risk to these avifaunal species. Also siting of wind and solar parks in the natural habitats thereby affecting the thorny scrub vegetation and grasslands.

Many raptor species and congregatory species such as Demoiselle Crane have been reported to be regular winter visitors to this landscape. All these species are likely to be affected to a great extent by the wind farms covering this landscape. The associated facilities such as the transmission lines (internal as well as external) will add to the existing risk of collision and electrocution

The cumulative impacts can be effectively managed by

- Improved regional management,
- Carrying out planning of wind/solar power industry in this region and strategic environmental and social assessment/regional environmental assessment of the planning, based on long term specific species and general biodiversity assessments,

- Strengthening mitigation measures for all wind/solar power projects in region

7.7.3.1 Barrier Effect and Avoidance Behaviour

The presence of the turbines may act as a barrier to the movement of the avifauna. Also, the birds may try to avoid entire windfarm area/specific clusters and both of these will force the species to travel longer distances to access the same resources. Both displacement and barrier effects/avoidance will result in energy costs for the concerned species and affecting their ecology, which may ultimately affect their breeding and migration.

8. ENVIRONMENT AND SOCIAL MANAGEMENT PLAN

This section presents the Environmental and Social Management Plan (ESMP) for the 600 MW Hybrid Project. The purpose of this ESMP is to specify the standards and controls required to manage and monitor environmental and social impacts during different phase of project life cycle, i.e. construction, operation and decommissioning phases. 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 to IFC Performance Standards 1 that emphasizes the importance of managing social and environmental performance through the lifecycle of the Project.

8.1 Project level organization structure

Refer **Section 2.5.2.3** for Project level organisation structure.

8.2 Corporate Level E&S Management System at AGEL

AGEL has established an Integrated Management System (IMS) in line with requirements of Quality management system of ISO 9001, and E&S management system in line with IFC PS ISO 14001, and 45001. AGEL has obtained quality management certification (*document dated 12th February 2020 and valid through 11th February 2023*) as per ISO 9001:2015. The scope of the 9001:2015 certification applies to "Development, engineering, procurement, project management and construction of Solar Wind Power Projects and Associated infrastructure through AGEL SPVs".

AGEL has established an Environmental and Social Management System (ESMS) (document updated May 2019) at the corporate level as part of the IMS. As reported, AGEL intends to obtain ISO 14001, and ISO 45001 certification as well.

As per the document ESMS Manual, the ESMS applies to project life cycle and associated activities, which includes three sequential phases:

- Construction and development of renewable energy project and electric power transmission infrastructure;
- Renewable energy project operations; and
- Renewable energy project decommissioning, site restoration and closure.

The ESMS has established E&S requirements concerning a) policy level considerations and commitments, b) management programs/ procedures, c) risk and impact identification, d) organizational competency and capacity, e) emergency preparedness, f) monitoring and supervision of implementation of management measures, and g) stakeholder engagement.

8.2.1 Existing Policies at AGEL

8.2.1.1 EHS Policy

- **Integrated management system policy:** As part of the ESMS, an Integrated Management System Policy has been developed which reflects AGEL's commitment towards green energy and reduction of carbon footprint. The policy was developed on 4th May 2019, which is duly signed by Chief Executive Officer (CEO) of AGEL. The policy commits to adopt of risk based approach to identify and mitigate OHS and other risks, implement effective processes for participation and consultation amongst employees, and implement efficient operations capable of conservation of energy and natural resources whilst minimizing waste generated from their operations.

8.2.1.2 Policy for Social Aspects Associated with AGEL's Projects

- **Human rights and community relations policy:** AGEL has established a Human rights and community relations policy wherein the senior management, i.e. Head of Human resource has committed to upholding of fundamental human rights in line with International Bill of Human Rights and those established in the International Labour Organizations Declaration on Fundamental Principles and Rights at work, and the eight Fundamental Conventions that comprise them. As part of the Policy, AGEL has committed to conduct continuous Human Rights due diligences, respect human rights of employees, and their supply chain. The Policy also outlines commitment towards communities influenced by their projects and assets by a) identifying opportunities to maximize positive impacts, and promoting shared value, and b) recognizing and respecting unique nature of indigenous and tribal people.
- **Land procurement Policy:** AGEL has established a land procurement policy (dated 1st January 2020), wherein it has committed to procure land for its renewable business in line with legal and social compliance. The policy commits to adhering to state level legal requirements for procuring government land, whilst for private land it outlines clear policy for a) type of procurement, b) pre-procurement activity, and public consultation, c) legal due-diligence, d) land related approvals, e) registration process and payment methods, f) post procurement legal compliances, g) conversion of land, and h) community relationship – CSR. As part of the public consultation, the policy commits to ensure that prices offered to the sellers/ leasers be purely based on mutually agreed price. For sale model, AGEL establishes the need for the payment to be higher than the government guideline value, whereas for lease model, the lease rent will be reasonably higher i.e. 2 to 2.5 times than government guideline value. The policy is duly signed by CEO of AGEL.
- **Corporate Social Responsibility (CSR) Policy:** AGEL has established a CSR policy in line with Companies Act, 2013, which encompasses its philosophy and guides its sustained efforts for undertaking and supporting socially useful programs for the welfare and sustainable development of the society. The policy commits to prioritize its CSR activities around four areas of work, which include, a) primary education, b) community health, c) sustainable livelihood, and d) rural infrastructure development.
- **Whistle blower policy:** AGEL has established a whistle blower policy which is in line with 4(2)(B) of SEBI (Listing Obligations and Disclosure Requirements) Regulations, 2015. A code of conduct has been adopted for directors and senior management which lays down the principles and standards that govern the action under the policy. AGEL has also established a vigil mechanism, which governs the whistle blower policy.
- **Other governance practices and policies:** The ethics and governance practices and policies include a) Code of Conduct for Board of Directors and Senior Management, b) Code of Conduct for Employees, and c) Policy on Sexual Harassment of Women at workplace (*in line with The Sexual Harassment of Women at Workplace (Prevention, Prohibition & Redressal) Act, 2013*). The policies (14 statutory policies) established at the corporate level are in line with Companies Act 2013, and SEBI requirements

8.3 EHS Department Roles and responsibilities

Environment, Health and Safety department shall be responsible for monitoring the implementation of the various actions which are to be executed by the agencies specified in the ESMS at the corporate level and ESMP.

In general, the EHS department shall perform the following activities:

- 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

8.4 Inspection monitoring and audit

Inspection and monitoring of the environmental impacts of the Project activities will increase the effectiveness of ESMP. Through the process of inspection and auditing, both AGE(7)L & AGE(9)L will ensure that the conditions stipulated under various permits are followed. The inspections and audits will be done by off role safety officers deployed by AGE(7)L & AGE(9)L (during construction phase), AGEL's EHS department and by external agencies/experts. The entire process of inspections and audits should be documented. The inspection and audit findings are to be implemented by the site head and safety office at site.

8.5 Reporting and documentation

AGE(7)L & AGE(9)L 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 check list, incident record register, training records, and environmental and social performance reports (weekly, monthly, quarterly, half yearly, yearly etc.).

8.5.1 External reporting and communication

EHS head of AGEL and Cluster Safety officer will be responsible for ensuring that communication with regulatory agencies and stakeholders are maintained as per the requirement. All complaints and enquiries are to be appropriately dealt with and records should be maintained in a Complaint/Enquiry Register by the delegated staff of EHS.

8.5.2 Internal reporting and communication

Documentation is an important step in the implementation of the ESMP. AGEL has a formal monitoring and review procedures in place. Key points of the monitoring and review procedure are as below.

- The Monitoring and review procedure mandates AGEL SOP No.1 Document and Record Control procedure to be followed at Site.
- The monitoring and review procedure also mandates development of environmental and social monitoring plan to capture all the specific monitoring needs identified in the site specific documents and final project ESIA/DPR.
- Non-conformances noted in monitoring activities will be resolved through the corrective and preventive action process as prescribed in SOP No. 3. Any EHS non-conformance identified at Site should be brought in immediate attention of Site supervisor who will forward such information to the EHS Manager for evaluation.
- An annual regulatory compliance verification audit will also be conducted by EHS manager for detailed verification of project compliance with applicable regulation.
- After initiation of construction phase, project is required to conduct OHS hazards and risks assessment annually and results of the assessment to be shared at Corporate level as part of performance data required by management review process.
- Internal audits are required to be conducted once in six months by the cluster level EHS coordinator.

8.5.3 Documentation

Documentation is an important step in the implementation of the ESMP, AGE(7)L & AGE(9)L will establish a documentation and record keeping system in keeping with their ESMS, to ensure recording and updating of documents as discussed in 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:

- Master Environment Management System document;
- Legal Register;
- Operation control procedures;
- Work instructions;
- Incident reports;
- Emergency preparedness and response procedures;
- Training records;
- Monitoring reports;
- Auditing reports; and
- Complaints register and issues attended/closed.

8.5.4 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, Site in charge in coordination with personnel delegated EHS will be responsible for making the amendments in the ESMP and seeking approval from the Regional and Corporate heads. The amended ESMP will be communicated to all the staff on the project

8.6 Training programme 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; and
- Aware of the potential risks from the Project activities.

EHS head of EPC contractor and AGE(7)L & AGE(9)L at site will ensure that environmental health and safety induction training and job specific trainings are identified and given to the concerned personnel for construction activities and operation of the hybrid power project.

Also general environmental awareness will be increased among the project's team to encourage the implementation of environmentally sound practices and compliance requirements of the project activities. This will help in minimising 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.

8.7 Management Programs for E&S Aspects at Corporate Level

As part of the ESMS, AGEL has listed out management plans to address E&S risks identified at the projects level during the project life-cycle. The content of the management plan depends, in significant part, on design assumptions and details contained in, and the results associated with, Environmental and Social Impact Assessment (ESIA) study, and/or other modes of E&S related issues and project information, through HIRA, and aspect impact matrix assessments. The list of management plans include the following:

- Occupational Health and Safety Plan;
- Emergency Preparedness and Response Plan;
- Construction Management Plan;
- Waste Management Plan;
- Transportation Management Plan;
- Stakeholder and Community Relation Management Plan;
- Visitor Management Plan;
- Environmental and Social Monitoring Plan; and

In addition to the above plans, the ESMS also presents Standard Operating Procedures (SOP) for its Renewable Energy Projects which are applicable to, and have been adopted by all projects. The SOPs adopted at the project level include the following:

- SOP 01: Document and Record Control;
- SOP 02: Field Inspections;
- SOP 03: Identification of Non Conformances and Respective Action;
- SOP 04: Training and Development;
- SOP 05: Grievance Management;
- SOP 06: Use of Personal Protective Equipment;

- SOP 07: Emergency Preparedness Plan;
- SOP 08: Transportation Safety;
- SOP 09: Handling of Hazardous Materials;
- SOP 10: Recognition and Reporting of Incidents, Illness and Safety Hazards;
- SOP 11: Identification of Legal and Other Requirements;
- SOP 12: Determination of Environmental and Social Aspects and Significant Impacts;
- SOP 13: Management Reviews;
- SOP 14: Water and Waste Water Management;
- SOP 15: Site Security;
- SOP 16: Hazard Identification and Risk Assessment; and
- SOP 17: Archaeological Chance Find

8.8 Environment and Social Management Plan

This section outlines the potential adverse impacts, mitigation measures, monitoring and management responsibilities during construction and operation phases of the Project.

The purpose of ESMP is to:

- Provide an institutional mechanism with well-defined roles and responsibilities for ensuring that measures identified in ESIA designated to mitigation potentially adverse impacts are implemented;
- List all suggested mitigation measures and control technologies, safeguards identified through the ESIA process;
- Provide Project monitoring program for effective implementation of the mitigation measures and ascertain efficacy of the environmental management and risk control systems in place; and
- Assist in ensuring compliance with all relevant legislations at local, state and national level for the Project.

In addition to the SOPs developed at the corporate level, AGE(7)L & AGE(9)L is required to follow the ESMP presented in **Table 8.1** during lifecycle of the 600 MW hybrid project.

Table 8.1: Environment and Social Management Plan

SN.	Environmental/Social Resource	Impacts/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
1.1	Land Use									
1.1.1	<ul style="list-style-type: none"> Strengthening of access road; Site clearance and preparation for WTGs, solar plant, PSS and EHV line; Transient storage of WTG and solar components 	Permanent and temporary changes in land use	Construction	<ul style="list-style-type: none"> On completion of construction activities, land used for temporary facilities should be restored to the extent possible. Waste should not be allowed to litter in and around the Project area 	AGE(7)L & AGE(9)L HSE Team Contractors engaged by AGE(7)L & AGE(9)L	Site inspection	Upon completion of task	AGE(7)L & AGE(9)L and their sub-contractor	AGE(7)L & AGE(9)L EHS personnel	-
1.2	Land and Soil									
1.2.1	<ul style="list-style-type: none"> Land and Soil Construction and Strengthening of access roads; Vehicular movement; and Stripping and stockpiling of soil layers 	Soil compaction and erosion	Construction and Decommissioning	<ul style="list-style-type: none"> Top soil that has been stripped should be stored for landscaping of the site; The stock piles of the soil should be kept moist to avoid wind erosion of the soil; Soil to be ploughed in compacted area after completion of the construction work; Revegetation of the construction boundaries using fast growing local vegetation; As a best practice, site clearance, piling, excavation and access road strengthening will not be carried out during the monsoon season to minimize erosion and run-off. Site to be restored at the end. 	AGE(7)L & AGE(9)L HSE Team Contractors engaged by AGE(7)L & AGE(9)L	Site Inspection	Monthly monitoring	AGE(7)L & AGE(9)L and their sub-contractor	AGE(7)L & AGE(9)L EHS personnel	Report from onsite HSE officer to HSE department of AGEL
1.2.2	Improper management of solid wastes	Soil contamination	Construction Operation Decommissioning	<ul style="list-style-type: none"> Municipal domestic waste generated at site to be segregated onsite The sub-contractors will ensure daily collection and weekly disposal of construction waste generated debris, concrete, metal cuttings wastes, waste/used oil etc. The municipal waste will be routed through proper collection and handover to local municipal body for further disposal 	AGE(7)L & AGE(9)L HSE Team Contractors engaged by AGE(7)L & AGE(9)L	Site Inspection	Monthly monitoring	AGE(7)L & AGE(9)L and their sub-contractor	AGE(7)L & AGE(9)L EHS personnel	Report from onsite HSE officer to HSE department of AGEL

SN.	Environmental/Social Resource	Impacts/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
1.2.3	Improper management of hazardous waste	Soil Contamination	Construction Operation	<ul style="list-style-type: none"> Hazardous waste will be properly labelled, stored onsite at a location provided with impervious surface, shed and secondary containment system as per in accordance to Hazardous Wastes Rules, 2016 Hazardous waste will be disposed routinely through approved vendors and proper records will be maintained of the same It is to be ensured that hazardous waste is not stored for more than 90 days 	AGE(7)L & AGE(9)L HSE Team Contractors engaged by AGE(7)L & AGE(9)L	Site Inspection	Monthly monitoring	AGE(7)L & AGE(9)L and their sub-contractor	AGE(7)L & AGE(9)L EHS personnel	Report from onsite HSE officer to HSE department of AGEL
1.3 Water Resource Availability and Quality										
1.3.1	<ul style="list-style-type: none"> Civil Work; Domestic water for site staff and workers; 	Depletion of water resources	Construction Operation	<ul style="list-style-type: none"> Regular inspection for identification of water leakage and preventing water wastage; Optimum use of water during sprinkling on roads for dust settlement, washing of vehicles, concrete mixing, etc.; Construction Labour deputed onsite to be sensitized about water conservation and encouraged for optimal use of water; For construction uses, the low quality water will be blended with fresh water ; and Recycle and reuse of water to the extent possible 	AGE(7)L & AGE(9)L HSE Team Contractors engaged by AGE(7)L & AGE(9)L	Site Inspection	Monthly monitoring	AGE(7)L & AGE(9)L and their sub-contractor	AGE(7)L & AGE(9)L EHS personnel	Report from onsite HSE officer to HSE department of AGEL

SN.	Environmental/Social Resource	Impacts/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
				<ul style="list-style-type: none"> ■ Prepare and implement water conservation scheme e.g., rainwater harvesting at the project site. 						
1.3.2	<ul style="list-style-type: none"> ■ Storage of hazardous substances and waste onsite; ■ Construction and demolition activities that causes dust and erosion. 	Water contamination	Construction Operation Decommissioning	<ul style="list-style-type: none"> ■ Spill, leakage and clearance plan to be adopted for immediate cleaning of spills and leaks; ■ Use of licensed contractors for management and disposal of waste and sludge; ■ Labourers will be given training towards proactive use of designated areas/bins for waste disposal and encouraged for use of toilets. Open defecation and random disposal of sewage will be strictly restricted. 	AGE(7)L & AGE(9)L HSE Team Contractors engaged by AGE(7)L & AGE(9)L	Site Inspection	Monthly monitoring	AGE(7)L & AGE(9)L and their sub-contractor	AGE(7)L & AGE(9)L EHS personnel	Report from onsite HSE officer to HSE department of AGEL
1.4	Air Quality									
1.4.1	<ul style="list-style-type: none"> ■ Site preparation and excavation of WTG foundation and piling work ■ Access road widening, strengthening and maintenance; ■ Construction of ancillary facilities; ■ Operation of D.G. sets; ■ Vehicular movement; ■ Demolition activities. 	Particulate, fugitive and vehicular emissions	Construction Decommissioning	<ul style="list-style-type: none"> ■ Speed of vehicles on site will be limited to 10-15 km/hr which will help in minimizing fugitive dust emissions due to vehicular movement; ■ Cease or phase down work if excess fugitive dust is observed. Investigate the source of dust and ensure proper suppression measures; ■ Proper maintenance of engines and use of vehicles with Pollution Under Control (PUC) Certificate; and ■ Idling of vehicles and equipment will be prevented ■ Emissions from the emergency DG sets and other stationary machines will be controlled ensuring that the engines are always properly tuned and maintained 	AGE(7)L & AGE(9)L HSE Team Contractors engaged by AGE(7)L & AGE(9)L	Site Inspection Training records Visual	Monthly monitoring	AGE(7)L & AGE(9)L and their sub-contractor	AGE(7)L & AGE(9)L EHS personnel	Report from onsite HSE officer to HSE department of AGEL
1.5	Ambient Noise									
1.5.1	Construction activities Operation of WTGs	Impacts on receptors due to noise during construction and operation phase	Construction and O&M Phase	<ul style="list-style-type: none"> ■ Only well-maintained equipment should be operated on-site; ■ If it is noticed that any particular equipment is 	AGE(7)L & AGE(9)L HSE Team Contractors engaged by AGE(7)L & AGE(9)L	Site Inspection	Monthly monitoring	AGE(7)L & AGE(9)L and their sub-contractor	AGE(7)L & AGE(9)L EHS personnel	Report from onsite HSE officer to HSE department of AGEL

SN.	Environmental/Social Resource	Impacts/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
				<p>generating too much noise then lubricating moving parts, tightening loose parts and replacing worn out components should be carried out to bring down the noise and placing such machinery far away from the households as possible;</p> <ul style="list-style-type: none"> ■ Limit the number of heavy vehicles required for the Project to only those that are necessary ■ Machinery and construction equipment that may be in intermittent use should be shut down or throttled down during non-work periods; and ■ Minimal use of vehicle horns and heavy engine breaking in the area needs to be encouraged 						
1.5.2	Shadow flicker	Impact on receptors due to shadow flicker on the XXX identified as part of the study	Operation Phase	<ul style="list-style-type: none"> ■ There needs to be close monitoring through engagement with residents during the operation phase where there are predicted impacts from shadow flicker. ■ The likelihood of direct line of sight to the location of a turbine location can be assessed visually and the potential for using screening like higher fencing and planting trees can be explored at problem locations. ■ The use of curtains can also be explored at the individual residences. If these prove effective and the impacts mitigated, the shutting down of turbines during certain environmental conditions, which meet the physical requirements for theoretical 	AGE(7)L & AGE(9)L HSE Team	Site Inspection And visual observation	Monthly monitoring	AGE(7)L & AGE(9)L	AGE(7)L & AGE(9)L EHS personnel	Report from onsite HSE officer to HSE department of AGEL

SN.	Environmental/Social Resource	Impacts/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
				<p>shadow flicker to occur, will not be required.</p> <ul style="list-style-type: none"> Should the impact of shadow flicker be identified and the mitigation measures proposed above prove ineffective, further analysis can be carried out to identify the exact timings and conditions under which shadow flicker occurs and a technical solution sought. This is likely to involve pre-programming the turbine with dates and times when shadow flicker can cause a nuisance for nearby receptors. A photosensitive cell can be used to monitor sunlight and the turbine could potentially then be shut down, when the strength of the sun, wind speed and the angle and position of the sub combines to cause a flicker nuisance. 						
1.6	Social									
1.6.1	Impact on Community Health and Safety	The construction phase activities such as the piling of solar panel and erection of the WTGs, construction of the transmission line and substations and movement of material and personnel may result in impacts on the health and safety of the community.	Construction Activity	<ul style="list-style-type: none"> As part of the stakeholder engagement and information disclosure process, the community will be engaged with on a regular basis and will be provided with an understanding of the project activities to be undertaken and the precautions taken for safety The traffic movement for the project in the area will be regulated to ensure road and pedestrian (including livestock) safety The workers (both regular and contractual) on the project will be provided with trainings on the Health and Safety policy in place, and their role in the 	AGE(7)L & AGE(9)L EPC team	Discussion with EPC Visual inspectionDiscussion with EPC Visual inspection	Weekly Monitoring	EHS Manager and EPC EHS Team	AGE(7)L & AGE(9)L EHS Team	Report from EPC EHS team

SN.	Environmental/Social Resource	Impacts/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
				same and refresher courses will be provided throughout the life of the project						
1.6.2	Impacts on land Holding and Agriculture Income	The project may lead to temporary decrease in the land holding of the local land owners	Construction Activity	<ul style="list-style-type: none"> To the extent possible, the project should ensure that no land owner is rendered landless due to the land procurement for the project. For this purpose, post the completion of land procurement for the Project, AGE(7)L & AGE(9)L will undertake an audit of the land procurement process through a third party to ensure that the land procurement process was undertaken on the basis of willing-buyer willing seller arrangements and that no land owner was severely impacted by the same 	AGE(7)L & AGE(9)L Land Team	Discussion with Local community and verification of land owners remaining land documents	Before procurement of land	AGE(7)L & AGE(9)L Land team	AGE(7)L & AGE(9)L Land team	Report from AGE(7)L & AGE(9)L Land Team
				<ul style="list-style-type: none"> Additional employment opportunities may also be created for the local youth by the project 	AGE(7)L & AGE(9)L HR Team	Employment Records	Before Operation and at the time of operation f project	AGE(7)L & AGE(9)L HR team	AGE(7)L & AGE(9)L HR team	Report from AGE(7)L & AGE(9)L HR team
1.6.3	Impact on Employment Opportunities	The construction phase activities of the project including construction of access road, civil works, foundation activities, site clearance and security will result in creation of economic opportunities	Construction Activity	<ul style="list-style-type: none"> Civil works during construction phase including, construction of solar plant, sub-station, WTGs mounting area, transformer yard, internal roads, and transmission line, Self- employment options for individuals possessing vocational or technical training skills like electricians, welders, fitters etc.; and Contracting opportunities for locals possessing tractors, dumper trucks or other vehicles which would be needed to carry away excavated soil and other material. Creation of indirect employment for local community through establishing small shops like 	Project Team/HR Site manager	Site Inspection/Internal audits/document verification	Monthly during construction and quarterly during operation	AGE(7)L & AGE(9)L and appointed contractors	AGE(7)L & AGE(9)L HSE team	Report from Onsite HSE office to HSE department of AGE(7)L & AGE(9)L

SN.	Environmental/Social Resource	Impacts/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
				tea stalls, supply of intermediate raw materials, repair outlets, hardware stores etc. However, these are likely to be temporary						
1.6.4	Accidental Impacts-Blade throw and Natural Disasters	Unforeseen situation can cause the damage to the blades' of WTGs and can cause accident in the nearby vicinity of WTGs	Operation Phase	<ul style="list-style-type: none"> The disaster management cell of the district and the nearest fire-service station should be involved in preparedness for emergency situation; Company should ensure it has adequate third party insurance cover to meet the financial loss to any third party due to such emergencies. 	AGE(7)L & AGE(9)L site HSE team	Site Inspection/Internal audits/document verification	Prepared disaster management plan and available insurance	AGE(7)L & AGE(9)L site HSE team	AGE(7)L & AGE(9)L HSE Team	Report from Onsite HSE office to HSE department of AGE(7)L & AGE(9)L
1.6.5	Occupational Health and Safety	The construction phase activities such as construction of piling of solar panel, sub-station, WTGs, access roads, transmission lines and other project components and maintenance activities in the operations phase are likely to result in a risk on the health and safety of the workers on the project.	Construction and Operation Phase	<ul style="list-style-type: none"> The workers (both regular and contractual) on the project will be provided with trainings on the Health and Safety policy in place, and their role in the same and refresher courses will be provided throughout the life of the project; Establish a grievance redressal mechanism in place, to allow for the employees and workers to report any concern or grievance related to work activities; and Put in place measure to reduce the risk of prevalence of diseases, including screening of workers, undertaking health awareness amongst the workers, implementation of vector control programs, avoiding presence of unsanitary conditions and better facilities in the project site, such as safe drinking water, proper waste collection and disposal etc. 	AGE(7)L & AGE(9)L HSE Team	Site Inspection/Internal audits/document verification/training records	Weekly monitoring	AGE(7)L & AGE(9)L site HSE team	AGE(7)L & AGE(9)L HSE Team	Report from Onsite HSE office to HSE department of AGE(7)L & AGE(9)L
1.6.6	Labour Rights and Welfare	The influx of labour (skilled, semi-skilled and unskilled) may	Construction and Operation Phase	<ul style="list-style-type: none"> The labour accommodation facility for contractual workers 	Project Team/HR Site manager	/Internal audits/document verification	Monthly during construction and	AGE(7)L & AGE(9)L and appointed contractors	AGE(7)L & AGE(9)L HSE team	Report from Onsite HSE office to HSE

SN.	Environmental/Social Resource	Impacts/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
		result in impact on labour rights and welfare		<p>and as well as for regular employees should meet the requirements of the applicable reference framework in terms of space per worker, water and sanitation facilities, first aid, lighting and ventilation etc. and regular monitoring should be undertaken to ensure compliance through the project lifecycle;</p> <ul style="list-style-type: none"> ■ AGE(7)L & AGE(9)L should ensure a monthly monitoring and regular auditing mechanism for monitoring the sub-contractors and suppliers with respect to compliance to the applicable reference framework, in terms of resources, migrant workers, child labour and forced labour, health and safety, payment of wages etc.; and ■ Establish a grievance redressal mechanism in place, to allow for the employees and workers to report any concern or grievance related to work activities 			quarterly during operation			department of AGE(7)L & AGE(9)L
1.6.7	Impact on Indigenous Communities/Vulnerable Groups	The project activities during construction and operations phase may have disproportionate impact on vulnerable groups	Operation Phase	<ul style="list-style-type: none"> ■ Preference to be given to vulnerable groups in employment and contracting opportunities; ■ Undertake a profiling of the various social groups in the study area, to understand the individual needs and concerns of the social groups and identify community development and CSR programmes in accordance to the same; ■ As part of the stakeholder engagement, ensure adequate representation of the SC/ST groups and 	AGE(7)L & AGE(9)L project and CSR team	Study report/CSR report	Monthly reporting	CSR team	AGE(7)L & AGE(9)L CSR team	Report from CSR site team

SN.	Environmental/Social Resource	Impacts/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
				<p>vulnerable groups identified, and undertake specific engagement activities with these groups; and</p> <ul style="list-style-type: none"> ■ Ensure that the grievance management mechanism established is accessible to these groups 						
1.7	Ecology									
1.7.1	Vegetation Clearance	Site Preparation	Construction	<ul style="list-style-type: none"> ■ Vegetation disturbance and clearance should be restricted to the Project activity area only ■ Areas with dense vegetation patches should be avoided during the planning of access/internal roads, storage areas, labour camps and ancillary facilities; ■ Vegetation clearance in the scrubland should be minimised by optimization of internal road, power evacuation line and avoiding construction of ancillary facility, storage, labour camps. ■ Unnecessary disturbance of neighbouring vegetation due to off-road vehicular movement, fuel wood procurement, needless expansion of labour camp and destruction of floral resources should be prohibited; ■ Top soil that is disturbed should be stored separately for restoration of the habitat; ■ Local grass species should be seeded in disturbed areas during monsoon season; ■ Simultaneous revegetation with native species on outskirts of Project activity area should be practiced for areas that are determined to 	EHS Officer	Visual Verification	Duration of the Activity	EPC Sub contractor	HSE	Report from onsite HSE officer to HSE department

SN.	Environmental/Social Resource	Impacts/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
				<ul style="list-style-type: none"> have loose or unstable soil to avoid erosion The land use in and around permanent project facilities should not be disturbed. 						
1.7.2	Laying of Approach Road	Habitat Disturbance and Road Kill	Construction	<ul style="list-style-type: none"> The construction of roads for the Project should be carried out in a phased manner by focusing on clusters of WTGs at a given time to allow impacted fauna to adjust to the disturbed areas; Construction and transportation activities should be avoided at night (6:00 pm to 6:00 am) and if possible times of high activity during dawn (6:00 am to 7:30 am) and dusk (5:00 pm to 6:00 pm) should also be avoided; Anti-poaching and hunting policy should be strictly enforced; Number of routes should be minimized for construction and transportation; Speed limit of vehicles on these roads should be kept to 10-15 km/hr to avoid road kill; When grasses or small shrubs are removed for access road construction, replanting of native species should be implemented after the construction phase Residual impact significance 	EHS Officer	Visual Verification	Duration of the Activity	EPC contractor	HSE	Report from onsite HSE officer to HSE
1.7.3	Operational Wind Turbine	Collision Risk	Operation	<ul style="list-style-type: none"> A detailed and long term monitoring of bird and bat species (covering migratory as well as breeding season) within the Project study area should be undertaken for at least two years which may help understand the presence of threatened species inside the Project area and their movement. This will further 	EHS	Third Party Monitoring Agency	Initial 2 years after Operation of Wind/Solar Farm	HSE	Project Manager	HSE to Project Manager

SN.	Environmental/Social Resource	Impacts/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
				<p>help in assessing the site specific impacts and updating the mitigations measures.</p> <ul style="list-style-type: none">■ Cattle Carcass Management should be implemented as a precautionary measure due to vulture presence in the area in consultation of local authorities, Forest Department and local villagers;■ Bird carcass monitoring should be commissioned in operation and maintenance phase, in which all bird carcasses found in the wind farm should be recorded and photographed with details about the distance from the closest wind turbine generator and the name of the wind turbine generator for at least two years;■ The habitats visited by bird species of conservation significance should be identified and a minimum distance of 1000 m is recommended to maintain from such habitats. It includes resting/roosting and feeding sites of birds;■ Periodic bird mortality counts should be undertaken for the first two years of the wind farm operation to determine if there is any risk of CR and EN and migratory bird species collision from the wind farm. The mitigation measures should be revised based on the results of the monitoring;■ Waste materials should not be left lying around and should be cleared immediately so as to not attract birds near the WTG blades;						

SN.	Environmental/Social Resource	Impacts/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
				<ul style="list-style-type: none"> The tower and blade tips should be marked with orange colour for better visibility of the WTGs. 						
1.7.4	Transmission infrastructure	Collision and Electrocution Risk	Operation	<ul style="list-style-type: none"> Long term monitoring of entire transmission lines should be commissioned to understand the movement of migratory species and areas with the presence of EN, CR species such as GIB and Vultures in this landscape. This will help identify the high risk areas of the transmission line stretch and the mitigation measures can be revised based on the outcomes of the study; An assessment for critical habitat against the IFC Performance Standard 6 (Biodiversity Conservation and Sustainable Management of Living Natural Resources) should be undertaken for the areas transmission line alignment and the wind farm and solar park; Records of feeder trips due to bird electrocution should be maintained with feeder number, bird species, time of electrocution, location, etc. These should be shared with an expert ornithologist for identification of the species. These will be the areas of high concern and focus for further mitigation; Regular checking of the vacuums or holes in the towers should be done to avoid nesting by any of the birds; Use of plastic insulator caps or tubing of conductor at the 	EHS	Third Party Monitoring Agency	Initial 2 years after Operation of Wind/Solar Farm	HSE	Project Manager	HSE to Project Manager

SN.	Environmental/Social Resource	Impacts/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
				<div>electricity poles crossover should be considered</div> <div><div>■</div>The siting of 33kv line should be avoided in the areas of high bird activity, such as grasslands, waterbodies, etc.</div> <div><div>■</div>Bird diverters should be used to mark the overhead cables and three phase lines of high voltage or 220 kV transmission line. As several species such as Cranes migrate at night, fluorescent diverters which glow at night should be used.</div>						

9. IMPACT SUMMARY AND CONCLUSION

9.1 Introduction

This Environmental and Social impact assessment has been conducted to evaluate the impacts associated with the proposed wind and solar hybrid power project of 600 MW capacity. The impact assessment has been conducted in compliance with the Administrative Framework identified herein, including relevant national legislative requirements, international conventions and Enel's corporate requirements.

9.2 Impact Requiring Detailed Assessment

Following a Scoping exercise, this ESIA was focused on interactions between the Project activities and various resources/receptors that could result in significant impacts. The table below presents the outcomes of the comprehensive assessment of identified impacts as a result of the various phases of the Project.

Table 9.1 Impact Assessment Summary

Impact Description	Impact Nature	Significance of Impacts	
		Without Mitigation	With Mitigation
CONSTRUCTION PHASE			
Change in Land Use	Negative	MINOR	MINOR
Topography and Drainage	Negative	MINOR	NEGLIGIBLE
Soil Compaction and Erosion	Negative	MINOR TO MODERATE	NEGLIGIBLE TO MINOR
Soil Contamination	Negative	MODERATE TO MAJOR	MINOR TO MODERATE
Water availability	Negative	MAJOR	MODERATE
Water Quality	Negative	MODERATE	MINOR
Air Quality	Negative	MODERATE	MINOR
Ambient Noise	Negative	MODERATE	MINOR TO MODERATE
Occupational Health and Safety	Negative	MINOR	NEGLIGIBLE TO MINOR
Community Health and Safety	Negative	MINOR	MINOR
In-Migration of workers	Negative	MINOR	NEGLIGIBLE
Landholding & Agricultural Income	Negative	MINOR	NEGLIGIBLE TO MINOR
Labour Rights and Welfare	Negative	MODERATE	MINOR
Employment Opportunity	Positive	POSITIVE	POSITIVE
Vegetation Clearance	Negative	CRTITICAL	MODERATE
Approach Roads	Negative	MAJOR	NEGLIGIBLE
Construction Activities	Negative	MINOR	NEGLIGIBLE
OPERATION AND MAINTENANCE			
Waste Disposal/Generation	Negative	MINOR	MINOR
Soil Contamination	Negative	MODERATE	MINOR
Water Availability	Negative	MODERATE	MINOR
Water Quality	Negative	MINOR	MINOR
Noise Quality	Negative	MODERATE	MODERATE
Shadow Flicker	Negative	MODERATE	MINOR
Labour Rights and Welfare	Negative	MODERATE	MINOR
Wind turbine Bird & bat collision	Negative	MAJOR	MODERATE
Collision and electrocution with TL	Negative	CRITICAL	MAJOR

Impact Description	Impact Nature	Significance of Impacts	
		Without Mitigation	With Mitigation
DECOMMISSIONING PHASE			
Soil Environment	Negative	MINOR	MINOR TO NEGLIGIBLE
Water Environment	Negative	MINOR	NEGLIGIBLE
Air Quality	Negative	MODERATE	MINOR
Ambient Noise	Negative	MINOR	NEGLIGIBLE
Economy and Employment	Negative	MINOR	NEGLIGIBLE
CUMULATIVE IMPACTS			
Environment	Negative	MODERATE TO MINOR	MINOR
Social	Negative	MODERATE TO MINOR	MINOR

9.3 Project categorization

IFC's Environmental and Social Review Procedure Manual ⁽⁵⁸⁾ 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:

- Category A:** Projects with potential significant adverse environmental or social risks and/or impacts that is diverse, irreversible or unprecedented.
- 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.
- Category C:** Projects with minimal or no adverse environmental or social risks and/or impacts.

The proposed Project has been categorized as **Category A** as per the IFC guidelines.

9.3.1 Category Justification

The Project has been assessed as **Category A**. The selection of **Category A** is based on the following reasoning:

- The potential habitats for IUCN v2020-2 categorized Critically Endangered (CR) species such as Great Indian Bustard (GIB) (*Ardeotis nigriceps*), White-rumped Vulture (*Gypes bengalensis*), Indian Vulture (*Gyps indicus*) and Red-headed Vulture (*Sarcogyps calvus*) are likely to be present within and in the areas adjacent to the Project site. The GIB Arc, an area with majority of the movement and records of the GIB, is situated immediate vicinity of the Project site. The proposed ESZ of this arc is located at about 5.9 km east of WTG NEW-006. Also a GIB enclosure, which is a GIB Conservation Priority Area and a part of Desert National Park, is situated within the Study area. The consultations with locals confirmed that the movement of two pairs of GIB in this enclosure on annual basis. Also, since the GIB enclosures are located on either sides of the Project site, there is a possibility of inter-enclosure movement of the bird through the Project site.
- Similarly, three Critically Endangered Vulture species have been reported from the landscape of the Project site including Desert National Park (IBA). Consultations confirmed a regular movement and presence of CR Vulture species in larger number near Bhadariya, 20 km north of Project site. Endangered Egyptian Vultures (*Neophron percnopterus*) were also observed inside the Project

(58) Environmental and Social Review Procedures Manual: Environment, Social and Governance Department (2012):

<http://www.ifc.org/wps/wcm/connect/190d25804886582fb47ef66a6515bb18/ESRP%2BManual.pdf?MOD=AJPERES>. Accessed on 06.09.2016.

area and areas along the route of 220 kV transmission line. The Vultures can fly great distances in search of food and thus their movement in the Project area and the areas along the 220 kV transmission line stretch cannot be ruled out

- The impacts of the wind farm development on all these species in this area are likely to be irreversible. Any planned mitigation can only be suggested based on the long term habitat and species monitoring in the wind farm and solar park and surrounding areas. A detailed Critical Habitat Assessment supported by long term bird and bat monitoring of wind farm along with the transmission line alignment is required to ascertain what level of mitigation measures will be required. The impacts anticipated to the biodiversity specifically bird and bats will likely be adverse (resulting in loss of population of species), irreversible (to the already threatened population of vultures and GIBs) from operating wind turbine blades (collision risk) and the electrical transmission infrastructure (electrocution and collision risk).
- **Unprecedented:** Development of solar power projects and wind farms is occurring in large numbers in the last decade and therefore several such projects are located across India. The proposed Project and its surrounding areas consist of a number of upcoming and operational wind and solar projects (Refer **Section 2.1.1**). Hence, the proposed 600 MW wind-solar hybrid Project can therefore not be considered an unprecedented activity.
- **Limited adverse impacts on the baseline:** Solar and Wind based energy development Projects are less polluting source of energy and thus not likely to lead to any adverse impacts on the baseline environment during the operation phase. In terms of social impacts the land required is composed of private agricultural and culturable, fallow land waste land. The site location of the project does not involve any anticipated settlements and physical displacement.

APPENDIX A WIND TURBINE GENERATOR (WTG) PROFILING

S.N o.	WTG ID	Latitude (Decimal)	Longitude (Decimal)	Nearest village	North	South	East	West	Remarks	Receptor type (within 500 metres)	Receptor ID	Approximate distance from WTG location (metres)	Direction from WTG	Receptor Latitude (Decimal)	Receptor Longitude (Decimal)
1	FTN-298	26.81822153°	71.56269974°	Sanawara	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land		Settlement	STLMNT1	327.82	W	26.81766000°	71.55949200°
										Structure	STR1	490.94	W	26.81857953°	71.55772900°
										Structure	STR2	491.00	W	26.81888576°	71.55778610°
										Structure	STR3	370.76	NW	26.82081716°	71.56041078°
2	FAT-104	26.88652987°	71.52658369°	Sanawara	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Road is passing from NW to SE at 63m from south						
3	NEW-006	26.85309550°	71.62861310°	Naya Sanawara	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land		Structure	STR4	395.72	NW	26.85461500°	71.62499600°
4	FTN-299	26.82902100°	71.54078515°	Sanawara	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Settlement extends over a wide range from North to South on the East of proposed wind turbine at 331.46m / Patch of net sown area is found on the East	Settlement	STLMNT2	331.46	E	26.82905000°	71.54406800°
5	FAT-068	26.77234294°	71.63999928°	Khetasar	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Road is passing from East to South at a distance of 368.4m from proposed turbine						
6	FAT-639	26.735146°	71.657550°	Khetasar	Fallow Lands	Fallow Lands	Barren and Un-culturable Land	Barren and Un-culturable Land	Turbine is proposed in fallow area / Man made pond exist near the structure	Structure	STR6	415.56	NW	26.73820556°	71.65513000°
					Fallow Lands	Fallow Lands	Barren and Un-culturable Land	Barren and Un-culturable Land	Turbine is proposed in fallow area	Structure	STR7	204.36	S	26.73329809°	71.65780224°
7	FAT-667	26.72445934°	71.65629628°	Khetasar	Barren and Un-culturable Land	Fallow Lands	Fallow Lands	Barren and Un-culturable Land	Patches of fallow lands exist at NE along the buffer line						
8	FAT-368	26.71689165°	71.64504803°	Khetasar	Barren and Un-culturable Land	Barren and Un-culturable Land	Fallow Lands	Barren and Un-culturable Land	Man made water ponds exist near to settlement	Settlement	STLMNT3	500.00	SE	26.71480400°	71.64952000°
									Man made water ponds exist near to settlement	Settlement	STLMNT4	557.70	S	26.71197900°	71.64583600°
9	FAT-193	26.72071514°	71.60913433°	Khetasar	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Patch of net area sown is observed in South	Structure	STR8	75.22	NE	26.72126700°	71.60962200°
									Patch of net area sown is observed in South	Structure	STR9	482.94	SW	26.71867073°	71.60482800°
10	New-18	26.69694350°	71.58520495°	Achalpura	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Patch of net area sown is observed in South / HT line passing from East to SW within the buffer / Road is passing from North to South at a distance of 240.6m West from proposed turbine	Settlement	STLMNT5	562.74	SE	26.69307300°	71.58885700°
11	FTN-178	26.66008501°	71.43337278°	Achla	Barren and Un-culturable Land	Barren and Un-culturable Land	Fallow Lands	Barren and Un-culturable Land	A patch of fallow land is seen on the East						
12	FTN-196	26.684705°	71.414832°	Lakhasar	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Road is passing East to West on the North of proposed Wind Turbine / HT line is passing from West to East on the South of proposed Wind Turbine, within the buffer						
13	FAT-448	26.84203783°	71.60545358°	Naya Sanawara	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Net area Sown	Man made water pond exist near the net area sown	Structure	STR16	413.66	W	26.84143639°	71.60132939°
14	FAT-143	26.79725725°	71.35943742°	Dawara	Fallow Lands	Fallow Lands	Fallow Lands	Fallow Lands		Structure	STR17	174.50	E	26.79716115°	71.36125162°
									Identified settlement - is a small group (3 to 4) structures together	Settlement	STLMNT7	251.80	W	26.79736840°	71.35690969°
									Identified settlement - is a small group (3 to 4) structures together	Settlement	STLMNT8	272.88	N	26.79964642°	71.35947523°

S.N o.	WTG ID	Latitude (Decimal)	Longitude (Decimal)	Nearest village	North	South	East	West	Remarks	Receptor type (within 500 metres)	Receptor ID	Approximate distance from WTG location (metres)	Direction from WTG	Receptor Latitude (Decimal)	Receptor Longitude (Decimal)
15	FAT-43	26.80439955°	71.37913535°	Dawara	Fallow Lands	Fallow Lands	Fallow Lands	Fallow Lands	Road is passing from North to South at a distance of 239m East from proposed turbine	Structure	STR18	201.26	SE	26.80365855°	71.38104664°
16	New-022	26.81515667°	71.36458546°	Dawara	Fallow Lands	Fallow Lands	Fallow Lands	Fallow Lands	Road is passing from North to South at a distance of 239m East from proposed turbine	Structure	STR19	346.17	SW	26.81242983°	71.36283381°
									Road is passing from North to South at a distance of 239m East from proposed turbine	Structure	STR20	381.48	NW	26.81656637°	71.36103899°
17	FAT-421	26.83223029°	71.61128391°	Naya Sanawara	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Road is passing from NW to East at a distance of 226m NE from proposed turbine	Structure	STR21	287.90	SE	26.83145130°	71.61405232°
18	FAT-481	26.74977800°	71.53311986°	Sadrasar	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Has overlapping buffer with FAT315 on the North						
19	FAT-315	26.75594681°	71.53330696°	Sadrasar	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Road is passing from West to East at a distance of 190m NE from Proposed turbine	Structure	STR22	581.18	NE	26.75955518°	71.53770867°
20	FAT-378	26.75720846°	71.52278063°	Sadrasar	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Road is passing from West to East at a distance of 190m North from Proposed turbine	Structure	STR23	583.17	NE	26.76092347°	71.52693255°
									Road is passing from West to East at a distance of 190m North from Proposed turbine	Structure	STR24	594.00	NE	26.76133650°	71.52637228°
21	FAT-297	26.77979613°	71.49519973°	Madhopura	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land							
22	FAT-303	26.76722627°	71.53482392°	Sadrasar	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land							
23	FAT-036	26.78375903°	71.53171259°	Madhopura	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Has an overlapping buffer with FAT135 on the North	Structure	STR25	509.75	NE	26.78721487°	71.53511327°
24	FAT-135	26.79025757°	71.52910191°	Madhopura	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Has overlapping buffer with FAT010 on North						
25	FAT-375	26.80841979°	71.52771499°	Madhopura	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land							
26	FAT-010	26.79857526°	71.52669218°	Madhopura	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land							
27	FAT-259	26.73861675°	71.54565603°	Sadrasar	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land		Structure	STR26	312.68	E	26.73939215°	71.54875868°
										Structure	STR27	199.94	SE	26.73787248°	71.54760094°
28	FAT-044	26.72804205°	71.53351231°	Sadrasar	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land		Structure	STR28	382.58	S	26.72724734°	71.52896598°
										Structure	STR29	463.55	W	26.72473670°	71.53275299°
										Settlement	STLMNT9	178.88	N	26.72947527°	71.53267396°
29	FAT-029	26.558623°	71.445929°	Sadrasar	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Scattered settlement	Settlement	STLMNT10	429.92	E	26.72720242°	71.54857988°
										Structure	STR30	345.20	SE	26.72362030°	71.54666137°
30	FAT-165	26.71308106°	71.50198217°	Khuhra	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land		Structure	STR31	478.20	SE	26.70996297°	71.50539405°
										Structure	STR32	348.33	NW	26.71427519°	71.49871965°
										Structure	STR33	352.81	NW	26.71547577°	71.49826659°
31	FATNO37	26.556792°	71.456561°	Amarsar	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Has overlapping buffer with FATNO45 on the East						

S.N o.	WTG ID	Latitude (Decimal)	Longitude (Decimal)	Nearest village	North	South	East	West	Remarks	Receptor type (within 500 metres)	Receptor ID	Approximate distance from WTG location (metres)	Direction from WTG	Receptor Latitude (Decimal)	Receptor Longitude (Decimal)
32	FATNO33	26.57493296°	71.45909872°	Bhainsara	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Has overlapping buffer with FATNO60 on the NW	Structure	STR34	366.47	NW	26.57312412°	71.45592399°
33	FATNO60	26.58013940°	71.45494447°	Bhainsara	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land							
34	FATNO29	26.55810113°	71.44610568°	Amarsar	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land							
35	FTN251	26.68560497°	71.47772427°	Khuhra	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Has overlapping buffer with FAT250 on the NW						
36	FATNO45	26.55906282°	71.46465010°	Bhainsara	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Has overlapping buffer with FATNO37 on the West						
37	FATNO50	26.55034459°	71.46418262°	Amarsar	Barren and Un-culturable Land	Fallow Lands	Barren and Un-culturable Land	Barren and Un-culturable Land	Existing wind turbine (facing South) is at 677.72m East from proposed location	Structure	STLMNT11	368.87	SE	26.54911721°	71.46763614°
									Patches of unmaintained fallow land is observed in the south	Settlement	STR35	390.95	SE	26.54763007°	71.46675000°
38	FTN-276	26.67048304°	71.51200974°	Sadrasar	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land		Settlement	STLMNT12	522.89	W	26.66956208°	71.50693849°
39	FAT-038	26.79731809°	71.55299893°	Sanawara	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Road is passing from North to South at a distance of 239m East from proposed turbine	Structure	STR36	517.15	NE	26.80077243°	71.55650964°
40	FTN-266	26.716276°	71.463273°	Khuhra	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Has overlapping buffer with FTN26 on the SE / Patch of fallow land exist on the West	Settlement	STLMNT13	525.09	NW	26.71965445°	71.45960607°
41	FAT-261	26.74857692°	71.56726616°	Sankara	Barren and Un-culturable Land	Fallow Lands	Net area Sown	Net area Sown	Road is passing along the STLMNT14	Settlement	STLMNT14	265.89	SW	26.74625900°	71.56650263°
										Settlement	STLMNT15	368.38	NW	26.75162636°	71.56591623°
42	FAT-060	26.66986384°	71.54274098°	Achalpura	Barren and Un-culturable Land	Barren and Un-culturable Land	Fallow Lands	Barren and Un-culturable Land							
43	FAT390	26.79245990°	71.48679937°	Madhopura	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land							
44	FTNA13	26.68131962°	71.56853945°	Achalpura	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Has overlapping buffer with FTNA2 on the North						
45	FTNA2	26.68806420°	71.56831903°	Achalpura	Barren and Un-culturable Land	Barren and Un-culturable Land	Fallow Lands	Barren and Un-culturable Land		Settlement	STLMNT16	339.22	SE	26.68615735°	71.57102092°
46	FTN232	26.66703028°	71.47533391°	Achla	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land		Settlement	STLMNT17	507.04	SE	26.66490369°	71.47991408°
										Settlement	STLMNT18	434.38	NW	26.67052167°	71.47347301°
47	FAT-113	26.81228428°	71.54419294°	Sanawara	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land		Settlement	STLMNT19	478.35	SE	26.80836857°	71.54587206°
48	FTN250	26.68982596°	71.47319441°	Khuhra	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land							
49	FTN-287	26.65957601°	71.54177965°	Achalpura	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land							
50	FTN134	26.61387876°	71.42771493°	Amarsar	Fallow Lands	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Existing wind turbine (facing West) is at 554.27m SE from proposed location	Structure	STR37	471.26	SW	26.61015394°	71.42527368°
										Structure	STR38	238.43	W	26.61460807°	71.42551656°
									Settlement extends beyond 496m	Settlement	STLMNT20	496.60	NW	26.61741224°	71.42467656°

S.N o.	WTG ID	Latitude (Decimal)	Longitude (Decimal)	Nearest village	North	South	East	West	Remarks	Receptor type (within 500 metres)	Receptor ID	Approximate distance from WTG location (metres)	Direction from WTG	Receptor Latitude (Decimal)	Receptor Longitude (Decimal)
51	FTN-185	26.63193879°	71.46270836°	Bhainsara	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land		Structure	STR39	303.89	E	26.63160821°	71.46580235°
										Structure	STR40	312.53	SE	26.63015266°	71.46028850°
									Falls in the buffer of FTN185 and FTN184 in West and Se directons respectively	Settlement	STLMNT2_1	377.99	W	26.63117343°	71.45903875°
										Settlement	STLMNT2_2	319.08	N	26.63477484°	71.46280376°
52	FTN-291	26.63742999°	71.57197447°	Motisar	Barren and Un-culturable Land	Barren and Un-culturable Land	Fallow Lands	Barren and Un-culturable Land	Fallow lands are observed only in minor patches	Structure	STR41	360.11	SE	26.63459145°	71.57373826°
										Structure	STR42	418.81	SW	26.63605667°	71.56802789°
										Settlement	STLMNT2_3	454.13	NE	26.64069216°	71.57481419°
53	FTN-267	26.71275056°	71.46675666°	Khuhra	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land							
54	FTN187	26.61925888°	71.47628142°	Bhainsara	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Has overlapping buffer with FTN186 on the NW / Road is running from NW to SE at 87.5m SW to the proposed turbine location	Structure	STR43	430.29	SE	26.61544015°	71.47759438°
55	FAT167	26.81870633°	71.48906194°	Madhopura	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	A patch of fallow land is seen on the East on the buffer border						
56	FAT-339	26.79252305°	71.58303542°	Sanawara	Barren and Un-culturable Land	Barren and Un-culturable Land	Fallow Lands	Barren and Un-culturable Land	STLMNT25 is a scattered settlement on the East in fallow lands around them with man made water ponds	Settlement	STLMNT2_5	204.91	E	26.79223627°	71.58511132°
									Road is running North to South at 217m West from the proposed turbine location	Structure	STR44	298.00	SE	26.79002025°	71.58404905°
57	FTN230	26.70071053°	71.44340891°	Lakhasar	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land							
58	FAT-326	26.76173357°	71.59792871°	Khetasar	Barren and Un-culturable Land	Fallow Lands	Fallow Lands	Net area Sown	Net area sown are in patches						
59	FTN186	26.62427053°	71.47194163°	Bhainsara	Fallow Lands	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Has overlapping buffer with FTN187 on the SE / Road is running from NW to SE at 192.5m SW to the proposed turbine location						
60	FAT-281	26.76786008°	71.58660847°	Sankara	Barren and Un-culturable Land	Fallow Lands	Net area Sown	Fallow Lands	Settlement is encompassed with fallow lands and sown in patches on the buffer border on East	Settlement	STLMNT2_6	282.52	E	26.76815361°	71.58942408°
61	FAT-154	26.78227410°	71.58492457°	Khetasar	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Road is passing from North to South at a distance of 300m West from proposed turbine	Structure	STR45	475.56	E	26.78285087°	71.58968828°
										Structure	STR46	371.36	S	26.77907872°	71.58623142°
										Structure	STR47	451.42	SW	26.77907411°	71.58206837°
										Structure	STR48	418.28	SW	26.78093438°	71.58099178°
62	FTN-269	26.70422606°	71.47538439°	Khuhra	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land		Structure	STR49	188.51	SE	26.70347397°	71.47709469°
										Structure	STR50	202.41	SE	26.70269719°	71.47656057°
										Structure	STR51	289.95	S	26.70166014°	71.47617704°
										Structure	STR52	387.39	S	26.70074699°	71.47587474°
63	FTN180	26.655244°	71.442550°	Achla	Barren and Un-culturable Land	Fallow Lands	Barren and Un-culturable Land	Fallow Lands	Another structure exist behind STR53 in the same line from proposed turbine	Structure	STR53	211.76	S	26.65324571°	71.44245067°
									Two structures exist behind STR54 in the same line from proposed turbine	Structure	STR54	261.82	SW	26.65346238°	71.44078159°
										Structure	STR55	376.58	SW	26.65373202°	71.43915934°

S.N o.	WTG ID	Latitude (Decimal)	Longitude (Decimal)	Nearest village	North	South	East	West	Remarks	Receptor type (within 500 metres)	Receptor ID	Approximate distance from WTG location (metres)	Direction from WTG	Receptor Latitude (Decimal)	Receptor Longitude (Decimal)
64	FTN-184	26.63530573°	71.45743861°	Achla	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Road is passing from West to Se at 279m SW from the proposed turbine	Settlement	STLMNT21	491.00	SE	26.63117343°	71.45903875°
65	FTN-290	26°38'28.63"N	71°33'42.37"E	Motisar	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	A surface water body at 338 m E to the turbine There are around 5-6 group of settlements	Settlement	STLMNT27	493.00000000°	NW	26°38'37.84"N	71°33'28.10"E
66	FTN-268	26°42'31.26"N	71°28'16.54"E	Khuhra	Fallow Lands	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Has Overlapping buffer with FTN-267 in W at a distance of 130m & FTN-269 in E at a distance of 150m						
67	FTN-228	26°42'32.97"N	71°26'3.68"E	Lakhasar	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	GB Priority Area at a distance of 402 m N						
68	FTN-302	26°41'48.13"N	71°26'6.38"E	Lakhasar	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Overlapping buffer with FTN 230 at a distance of 420 m in NE						
69	FTN-183	26°38'25.40"N	71°27'13.18"E	Achla	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Has Overlapping buffer with FTN-183 in SW						
70	FTN-198	26°38'47.09"N	71°27'55.18"E	Achla	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land		Structure	STR56	380.00000000°	W	26°38'45.30"N	71°28'9.10"E
71	FTN-249	26°41'37.53"N	71°28'8.72"E	Achla	Fallow Lands	Barren and Un-culturable Land	Barren and Un-culturable Land	Fallow Lands	Overlapping buffer with FTN250 in SW at a distance of 110m						
72	FTN-256	26°39'36.84"N	71°30'17.51"E	Baiteena	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land	Barren and Un-culturable Land		Settlement	STLMNT28	400.00000000°	NE	26°39'45.57"N	71°30'6.58"E

APPENDIX B PHOTO DOCUMENTATION

Photo-documentation



Photo 1: Approach road for the solar plant located at village Sanwara



Photo 2: HT line crossing from near to the Proposed solar plant location for 600MW



Photo 3: Snapshot of the location within the solar plant



Photo 4: Location of FAT261 within the fenced area. Houses were present across the road

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Photo-documentation



Photo 5: Cluster of houses present across the road within a distance of 500m from the zero point of FAT-261 turbine location



Photo 6: Location of FAT-339 inside the fenced area. 10 houses were observed to be present within the 300m radius of the turbine.



Photo 7: Cattle was observed to be grazing in the near vicinity proposed wind turbine



Photo 8: Location of Turbine FAT-044. 10-12 scattered settlements were observed near to the zero point of the turbine

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Photo-documentation



Photo 9: Consultation being held in project Village



Photo 10: Consultation being held in at the proposed solar plant for the project in village Sanawara



Photo 11: Air Quality Sampler setup at Loona Kalan Village



Photo 12: Sound Level meter setup at Madhupura Village

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Photo-documentation



Photo 13: Agricultural activities been undertaken near to the zero point of the turbine FTN-187



Photo 14: Kutch house was observed to be present in the vicinity of FTN-187



Photo 15: Barren land near to the zero point of Turbine FAT-193



Photo 16: Location of FAT143 within the fencing. The turbine location is situated on fallow land. Agricultural practices was found to be undertaken

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