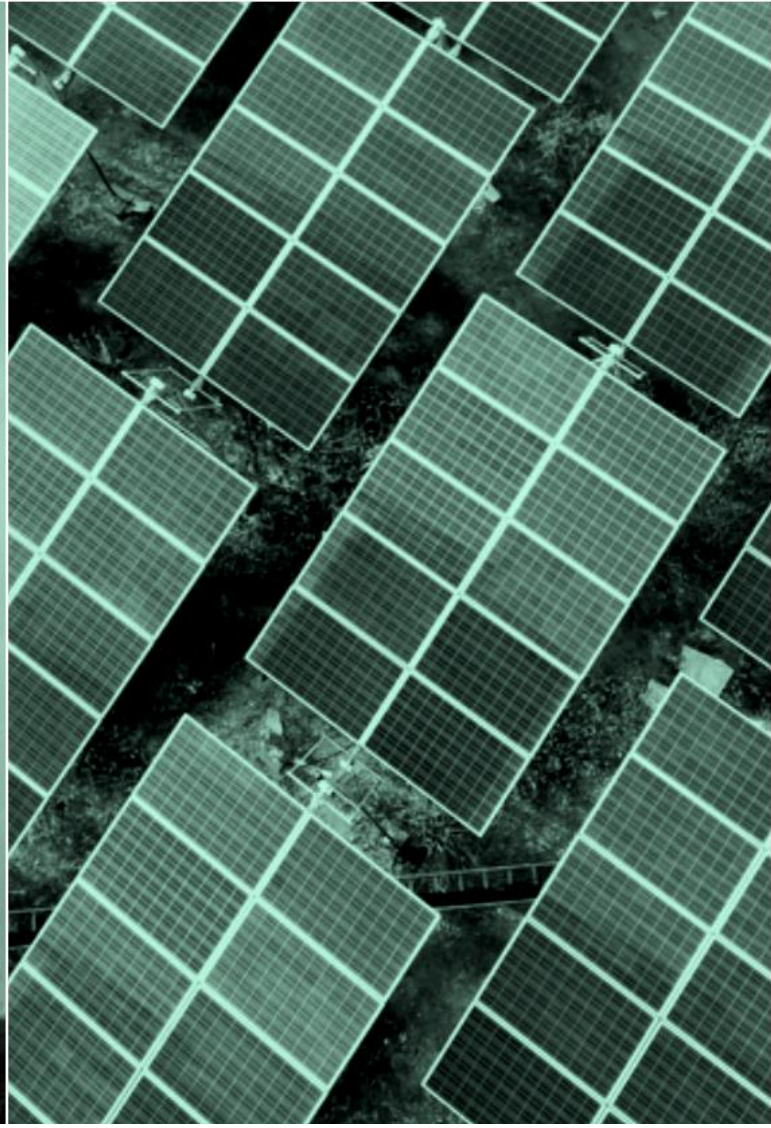

Environment and Social Impact Assessment Report: 390 MW Hybrid Power Project in Fategarh, Rajasthan

Final Report

Adani Green Energy Limited

04 February 2021

Project No.: 0560254

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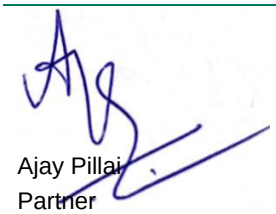

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Acronyms and Abbreviations

Abbreviation	Description
AAQ	Ambient Air Quality
AL	Agricultural Labourers
Amsl	Above mean sea level
AoI	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
ESIA	Environment and Social Impact Assessment
ESMP	Environment and Social Management Plan
ESZ	Eco sensitive Zone
FCCC	Framework Convention on Climate Change

Abbreviation	Description
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
HH	Household
HWA	Hazardous Waste Authorization
IA	Impact Assessment
IFC	International Finance Corporation
ILO	International Labour Organisation
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
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
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

Abbreviation	Description
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
PGCIL	power grid corporation of India
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
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
SDA	State designated agency
SECI	Solar Energy Corporation of India
SEIAA	State Environmental Impact Assessment Authority
SO_2	Sulphur Dioxide
SOP	Standard Operating Procedure
SPS	Safeguard Policy Statement
SPV	Special Purpose Vehicle
TDS	Total Dissolved Solids
TL	Transmission line
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') for undertaking an Environmental and Social Impact Assessment (ESIA) study of a greenfield 390 MW hybrid {wind (101.2 MW) and solar (360 MWac)}, power project (hereinafter referred as the "project"). The proposed 390 MW hybrid power project in being set up in Jaisalmer district of Rajasthan, India; the same is scheduled for Commissioning in May 2021. The project is being developed under the SPV M/s Adani Green Energy Eighteen Limited (AGE (18) L), a 100% subsidiary company of M/s Adani Green Energy Limited.

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 390 MW Solar-Wind Hybrid Power Project is located on land ranging from flat to undulating private shrub/waste land, agricultural land and grvel land across 12 villages under Fatehgarh and Pokhran tehsil of Jaisalmer district in the state of Rajasthan. Elevation at project site ranges from 240 m to 320 m above mean sea level.

As observed during ERM site visit, a dry seasonal water channel of 2 km length and 6 feet deep was observed approximately 5 km from solar site towards east direction. Additionally, a water pond (also known as Noteri Nadi) was observed at Madhopura village (26°45'34.33"N, 71°32'14.53"E) and another water pond was observed at Deg Rai Temple (26°42'29.41"N, 71°19'26.71"E) near Bhimsar village. The Madhopura village pond is located approximately 4 km from the proposed solar plant, whereas Deg Rai Temple water pond is located approximately 900 m from 220 kV external transmission line connecting the pooling substation to the Fatehgarh-2 PGCIL grid substation.

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 69 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 GIB enclosures. Rasla enclosures (1 and 2) are situated inside the Study area at approximately 2.7 km east of WTG FAT-195 and about 5.8 km southwest of the solar park boundary

The land for the hybrid project (land for solar park and for 47 WTGs) comprised of private land. As reported, the Project is in the process of land lease for solar plant and for the internal and external transmission line. However, land leasing process for the WTGs have been completed. The land for the project has been leased out through a process of negotiation with the landowners. The project has engaged Pokhran-based entity named **M/s Riti Energy Private Limited or Riti** to support the land procurement process with the assistance of local support from key intermediaries at the village level.

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 46 operating WTGs with a capacity of 2.2 MW each.

Note: *Currently, 45 WTGs have been finalised and one location from either of two WTGs-FAT-090 or FTN-156 will be finalised at a later stage. Therefore, the WTG profiling and shadow flicker modelling have been undertaken for 47 locations.*

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	☒	This PS aims to assesses the existing social and environmental management systems of AGEL and AGE(18)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. 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. The developer, at the corporate level, has also established an Environmental and Social Management System,that will be implemented in conjuction with the management plan presented in this report.
IFC PS 2 - Labour and Working Conditions	☒	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(18)L as well as any contractors. The project activities will involve hiring of approximately 1000 skilled, semi-skilled and unskilled labourers during the

Description	Applicability	Objectives and Applicability to Project
		construction phase and solar plant staff during the operation 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.
IFC PS 3 - Resource Efficiency and Pollution Prevention	☒	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 AGE(18)L intends to minimize pollution related impacts, what management plans and systems are in place, and what measures it plans to take to conserve and use resources more efficiently. The Project 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.
IFC PS 4 - Community Health, Safety and Security		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. 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

Description	Applicability	Objectives and Applicability to Project
		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.
IFC PS 5 - Land Acquisition and Involuntary Resettlement	☐	**Not Applicable** PS-5 requires project proponents to anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use. 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. Based on the consultations conducted during the site visit, and also based on the understanding of the land lease process implemented onsite, required land for the project is being leased. Apposite consultation are undertaken with land owners to take their consent before finalising the lease. The following condition has been fulfilled: ■ 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 Furthermore, the project has not led to resettlement, physical displacement and economic displacement. Therefore, PS 5 is not applicable to the project.
IFC PS 6 - Biodiversity Conservation and Sustainable Management of Living Natural Resources	☒	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. 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. 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	☐	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

Description	Applicability	Objectives and Applicability to Project
		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. 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. 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. The project does not envisage adverse impacts on communities of Indigenous peoples. Therefore, PS 7 is not applicable to the project.
IFC PS 8 - Cultural Heritage	☐	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. As confirmed during ERM site visit, and based on locations of project related components, no cultural heritage will be affected by the project activities. Based on the site assessment, the project external TL is ~30 km with 30 m RoW. No culturally significant site is being impacted directly. However, Degree Mata Mandir falls ~1 km NE of the proposed TL. It is expected that the access to the temple will not be impacted by the Project. Therefore, PS8 is not applicable to the Project.

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*) and Indian Vulture (*Gyps indicus*) and Red-headed Vulture (*Sarcogyps calvus*) are likely to be present within and in the areas adjacent to the Study area. 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 5.6 km east of WTG FAT-045.Also one 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 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 movemet and presence of CR Vulture species in larger number near Bhadariya, 24 km north of Project site. Endangered Egyptatian Vulture (*Neophron percnopterus*) were also observed inside the Project area. The Vultures can fly great distances in search of food and thus their movement in the wind farm 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);
- **Potentially limited risks/impacts and reversible**: Environmental and social impacts of the Project are anticipated during the operation, construction and decommissioning phase and will encompass changes in land-use, increased noise levels, changes in air quality, use and changes in water availability and quality, occupational health & safety, etc. Most of these impacts are limited to the Project site and their immediate vicinity and can be minimized through application of mitigation measures as proposed in the ESMP;
- **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. Hence, the proposed 390 MW wind-solar hybrid Project can therefore not be considered an unprecedented activity; and
- **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 shrub/waste land, agricultural land and gravel waste land. The site location of the project does not involve any anticipated settlements and physical displacement.

  Additionally, given the guidelines of 30 hours or less per year is considered acceptable, the operation of the wind turbines theoretically results in shadow flicker impact on the structures and settlements present in vicinity. The results show that theoretical shadow flicker impact in real case scenario occur at 1 receptors with higher than 120 shadow hours per year, 1 receptor with shadow impact between 60 hours per year and 30 hours per year and 8 receptors with shadow more than 30 hours per year from a total of 92 receptors identified within the Project area.

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 26th June 2020 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 Meterology:

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. The district experiences extreme heat in summer and cold in winter due to its location in dessert area. Atmosphere in the district is generally dry except during the monsoon period. 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. The primary baseline data was collected for aspects including Ground water quality (4 locations), surface water quality (3 locations), soil quality (4 locations). M/s Netel India Private Limitd, an NABL accredited laboratory, was engaged for collection of baseline information on ambient air quality and ambient noise quality. The primary data was collected in 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 solar plant is proposed to be located at an elevation of 280-290 amsl with elevation increasing from north to south. Similarly, majority of the WTG locations are finalised at an elevation ranging between 250-310 amsl with elevation increasing towards the south. Analysis of digital elevation map for Project shows a trend in elevations ranging from 240-320 metres above mean sea level in south direction which is indicative of flat, yet increasing elevations within the Project AoI, which contributes to undulating nature.

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, gluconitic 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 with few portion of agricultural land and gravel waste that will be converted to non-agricultural land for industrial development.

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.

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.

Soil:

As per the information provided by CGWB in the groundwater brochure for Jaisalmer district (2013), soils of the district 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 µS/cm (S1), 384 µS/cm (S2), 680 µS/cm (S3) and 354 µS/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 limestone[1] 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 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 However, the noise level during night time at all the three locations were observed to be exceeding the prescribed limit. The high noise levels during night time can be attributed to high wind speeds at night time in the area, vehicular movement, presence of settlements and presence of other turbines.

Air quality:

The analysis of results indicated that none of the assessed parameters exceeded the permissible limits of Ambient Air Quality set by the Central Pollution Control Board (CPCB).

[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=7mNDHM7a6lMXQWl3OsFRH0;455611;j3gn6G58v)

Natural desasters:

- *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 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 "AoI" of the project, which is spread across villages spanning two tehsils of Jaisalmer district. The concentration of villages is higher in Pokhran tehsil as compared to Fatehgarh.

The core zone of the AOI comprises of 11 villages while the buffer zone has 14 villages. Village wise predominant land use is as provided in the table below:

Name of the village	Total Geographical Area (in Hectares)	Forest Area (in Hectares)	Area under Non-Agricultural Uses (in	Barren & Un-cultivable Land Area (in Hectares)	Permanent Pastures and Other Grazing Land Area (in Hectares)	Land Under Miscellaneous Tree Crops	Culturable Waste Land Area (in Hectares)	Fallows Land other than Current Fallows Area (in Hectares)	Current Fallows Area (in Hectares)	Agricultural land (in Hectares)
Core Area										
Naya Sanawara	4980	0	15	0	0	0	10	1584	386	2985
Sanawara	8552.04	0	64.04	74	663	0	958	0	2130	4663
Chok	1998	0	83	7	322	0	0	249	111	1226
Khetasar	4623	0	6	19	20	0	58	507	7	4006
Madasar	3352	0	52	2	87	108	261	207	118	2517
Bhainsara	6180.52	0	16.94	937.79	838.7	0	0	2162.9	94.99	2129.2
Motisar	2488	0	8	564	107	0	312	137	89	1271
Madhopura	5996	0	16	20	247	0	1257	1368	23	3065
Rasla	6235.68	0	78.52	2.75	1046.84	0	3569.77	0	0	1537.8
Achla	1215.31	0	12.01	19.51	297.63	0	375.59	0	0	510.57
Balasar	1247.64	0	15.97	10.99	0	0	102.95	584.89	20.89	511.95
% Core Total	**46868.19**	**0**	**0.78%**	**3.53%**	**7.74%**	**0.24%**	**14.73%**	**14.51%**	**6.36%**	**52.11%**

Name of the village	Total Geographical Area (in Hectares)	Forest Area (in Hectares)	Area under Non-Agricultural Uses (in	Barren & Un-cultivable Land Area (in Hectares)	Permanent Pastures and Other Grazing Land Area (in Hectares)	Land Under Miscellaneous Tree Crops	Culturable Waste Land Area (in Hectares)	Fallows Land other than Current Fallows Area (in Hectares)	Current Fallows Area (in Hectares)	Agricultural land (in Hectares)
Buffer Area										
% Buffer Total	**40376.16**	**0**	**4.11%**	**2.32%**	**10.6%**	**0%**	**21.16%**	**8.15%**	**5.25%**	**48.41%**
% AoI Total	87244.35	**0**	**2.32%**	**3**	**9.1%**	**0.12%**	**17.7%**	**11.56%**	**5.8%**	**50.4%**

- The core zone has 2,139 households supporting a population of 12,682 households. The average size of the households is 6 across the core and buffer zone. Out of the total villages in the core area, Madasar village has the highest sex ratio of 943 females per 1000 males;
- The buffer zone comprises of 2,463 households supporting a population of 14,698 individuals. The buffer zone exhibits a sex ratio of 871 females per 1000 males, which is higher than the district figure of 852 females per 1000 males;
- The 100 percent of the population in the AoI falls in the rural category. The SC population in the core and buffer zone distributed to 14.7 percent and 12.12 percent, respectively;
- The AoI is categorized by 47.94 percent working population (main and marginal workers) in the core zone and 38.15 percent working population in the buffer zone. Majority of the working population of the AoI (47.31 percent) comes under “main workers”, i.e., being employed for more than six (6) months in a year. The core zone population nearly 38.15 percent of Main workers, the buffer zone have percentage of 61.85 percent coming under Main workers category. There is a significant ratio of non-working population in the AoI (52.06 percent in the core zone and 60.17 percent in the buffer zone) which includes children, the older people or unemployed youth;
- Witin the study area, the number of the primary schools 27 which is comparatively more in number than the number of secondary schools (6) and senior secondary schools 3 in the AOI and in each village except Achla there is a primary school; and
- 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, is was observed that the potential habitats for IUCN v. 2020-2 categorized Critically Endangered (CR) Great Indian Bustard (GIB) (*Ardeotis nigriceps*) are likely to be 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 devided into GIB Priority Area and GIB Potential Area considering the need of conservation efforts. The Project site (WTG locations) is located outside the GIB Prioriety Area. However the entire site fall within the GIB Potential Area.

The key imapcts 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 reduced to 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 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.

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 staring 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:** Impact on land use is expected to be mainly from clearing of vegetation from land prior to construction activities. The potential for alteration of land use of the proposed site is minor as there is no major dependency for grazing on the land leased for the project and

majority of the land is shrub/waste land where no agricultural activities are taking place. 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 6-8 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.

- **Topography:** The Project area exhibits flat topography with minor undulations. There are no major water bodies that pass though the proposed Project site. The water channels observed within the Project area are mostly dry. Since the proposed project, along with the access road, is mostly on a flat terrain, the impact is assessed to be minor;

  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:** There will be clearance of vegetation that covers the top soil, site levelling and grading during the construction phase. These activities will largely affect the top layers of the soil and loss of top soil quality is envisaged but the effects can be reversed over time.

- **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:** Based on estimates shared by AGE(18)L, approximately 125 KLD water will be required during peak time of construction phase for civil work and approximately 86.40 KLD water will be required for domestic purpose. Source of water for the construction phase will be from IGNP canal from Mohangarh pumping station located 7.2 km from site. 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. The significance of impact is therefore considered to be minor;

- **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 a small period (~6 months); The significance of impact is assessed to be minor;

- **Ambient Noise**: Noise quality in the study area will be impacted in the form of noise from heavy vehicular traffic movement, increased workforce and construction/demolition and from D.G. sets. However, construction work is expected to last for approximately 6-8 months and construction activities will be restricted to daytime. The overall impact significance is expected to be minor.

- **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 communityand 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;

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. Based on the site assessment, the project external TL is ~30 km with 30 m RoW. No culturally significant site is being impacted directly. However, Degree Mata Mandir falls ~1 km NE of the proposed TL. It is expected that the access to the temple will not be impacted by the Project. Therefore, the impact significance is assessed to be minor;
- I**n-migration of workers:** The in-migration of workers from outside the area will resulted and 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 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 implememtation of mitigation measures the imapact 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 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. 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 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. 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 can 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. The hazardous waste generated will be disposed through approved vendors. 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. The significance of impact has been assessed as negligible;
- **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 cycles 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. AGEL has already received access to its other project (700 MW Hybrid power project) proposed in the same region.The impact significance therefore assessed to be minor;
- **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 low and impact magnitude is assessed to be medium. Post implementation of mitigation measures the impact significance is assessed to be negligible;
- **Noise generation:** There will be no noise generated from the solar power plant during operation phase. However, the emanation of noise form 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.

During daytime overall noise levels (background + predicted) due to operation of WTGs at all receptors are within the applicable noise standards except for one receptor. However, during night time the impact magnitude of predicted noise levels due to the operation of WTGs at all identified receptors were found to be exceeding the baseline requirements;

- **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 at one shadow receptor ranging between 60 hr/yr and 120 hr/yr i.e. receptor ID: K with maximum of 98:49 hr/year;
- **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 Infrasctructure:** 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 390 MW hybrid Project.

- A 50.4 MW wind power plant developed by Suzlon and owned by Orange Renewable Power Private Limited located approximately 4 km from the proposed site;
- A 100 MW wind power project developed by Siemens Gamesa and owned by National Aluminium Company Limited (NALCO) located within 5 km of the proposed project;
- A 450 MW wind power plant developed and owned by Caparo Energy (India) Ltd. at Madasar and Lakhasar village located approximately 9 km southwest of the 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 only real matter of concern is that 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 habiats 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 GPCB 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 46 operating WTGs and 1,216,180 solar PV modules to generate 390 MW power through wind and solar 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.

It is important for AGE(18)L to implement the suggested mitigation measure to minimize the impacts over the environment, social and ecological resources in order to mitigate overall impact significance.

The Environmental and Social Management Plan (ESMP) and specific management plans describes mitigation measures for impacts specific to project activities and also discuss implementation mechanism. To conclude, the implementation of ESMP will help AGE(18)L in complying with national/ state regulatory framework as well as to meet IFC / EDF reference framework requirements.

1. INTRODUCTION

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, an integrated business conglomerate in India, for undertaking an Environmental and Social Impact Assessment (ESIA) study of a greenfield 390 MW hybrid {wind (101.2 MW) and solar (360 MWac)}, power project (hereinafter referred as the "project"). The proposed 390 MW hybrid power project in being set up in Jaisalmer district of Rajasthan, India; the same is scheduled for Commissioning in May 2021. The project is being developed under the SPV M/s Adani Green Energy Eighteen Limited (AGE (18) L), a 100% subsidiary company of M/s Adani Green Energy Limited

The power generated from the proposed Solar-Wind Hybrid project will be purchased by Solar Energy Corporation of Indian (SECI) awarded to the Project Company through Competitive bidding process on 'Build, Own, Operate' basis. The tenders were invited for 2500 MW ISTS Connected Wind-Solar Hybrid Power Project Capacity vide Request for Selection (RFS No: SECI/ C&P/ HPD/ 2500MW/ HYB/ T1/ RfS/ 062018) dated 22nd June 2018. Subsequent to the completion of successful bidding process and based on the provisions of RfS terms and conditions, the Project Company has entered into PPA with the Project Company 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

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. 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 390 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 AGEL's review and final ESIA report for relevant environmental agencies and lenders based on AGEL'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

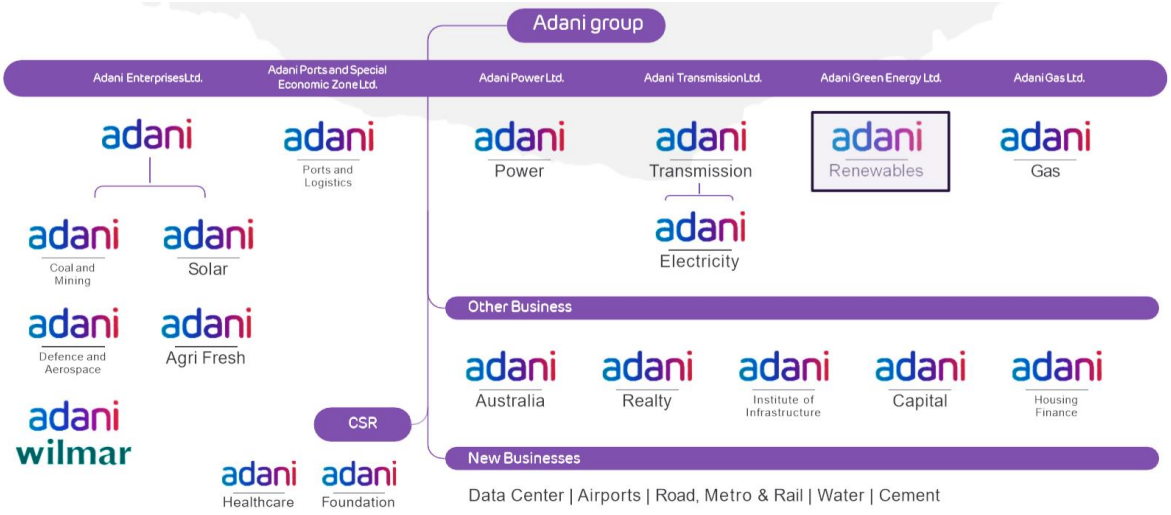
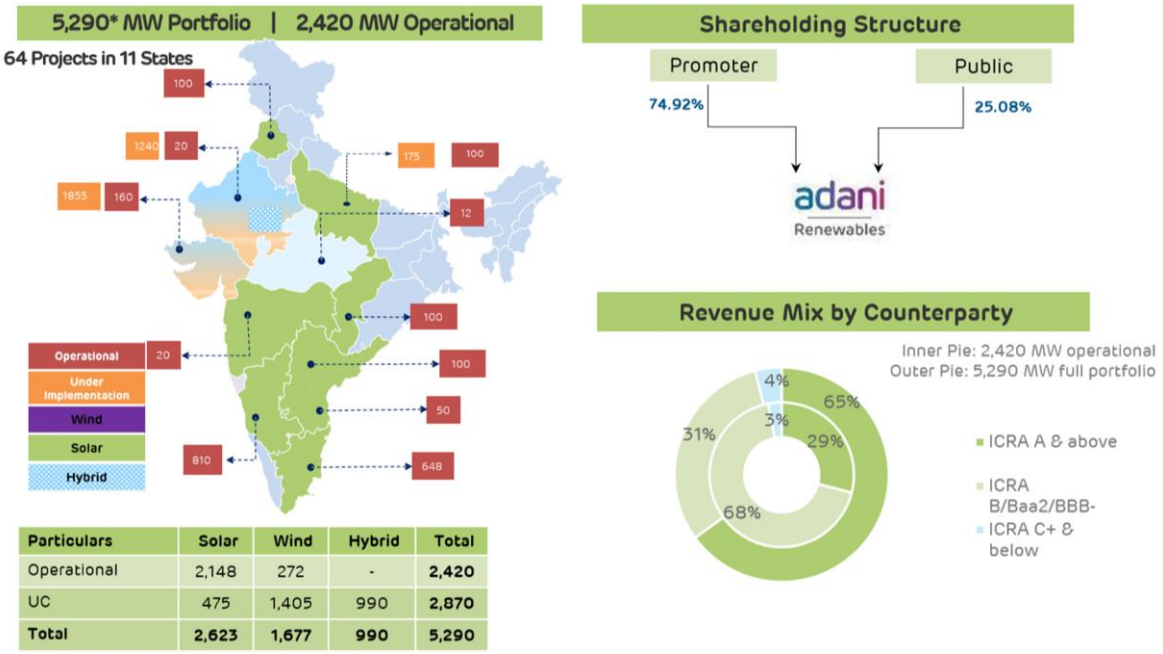


Figure 1.2: AGEL business portfolio



Particulars	Solar	Wind	Hybrid	Total
Operational	2,148	272	-	2,420
UC	475	1,405	990	2,870
Total	2,623	1,677	990	5,290

1.3 Project overview

Table 1.1 provides a brief snapshot and salient features of the proposed 390 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 – 390 MW Hybrid Power Project, Rajasthan

Particulars	Description
Project name	390 MW Solar-Wind Hybrid Power Project
Project Capacity	360.00 MW ac Solar, & 101.20 MW Wind, a total peak hybrid capacity of 390 MW
LOCATION DETAILS	
Location coordinates	26.821143 N, 71.492376 E
Location details	Pokhran tehsil, Jaisalmer district, Rajasthan state, India
Villages covered - Solar	Madhopura
Villages covered - Wind	Madhopura, Sanawara, Naya Sanawara, Chok, Khetasar, Madasar, Rasla, Achla, Bhainsara Motisar, Balasar and Uttam Nagar
LAND RELATED, & CONNECTIVITY DETAILS	
Land type	Solar and Wind Project: Private Land
Land characteristic	Predominantly shrub land with few portion of agricultural land and gravel waste land
Total land required	2126 acres
Mode of land procurement	Lease for 30 years 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

Particulars	Description
Nearest Airport	Jaisalmer
Nearest Sea Port	Mundra 750 km and Kandla 700 km
TECHNICAL SUMMARY – SOLAR	
Solar Capacity	360.00 MW ac
Total blocks	58 blocks each of 6.25 MW
Total number of modules	1,216,180
TECHNICAL SUMMARY – WIND	
Wind Capacity	101.20 MW
WTG capacity	2.2 MW
# of WTGs	46 WTGs divided into four clusters (Cluster 1 – 11 WTGs, Cluster 2 – 12/13* WTGs, Cluster 3 – 12 WTGs, and Cluster 4 – 11/10* WTGs) ** please refer to project status for clarity*
PLANT CONNECTIVITY	
Internal pooling	33 kV for solar, and 33 kV for wind
Transmission Line – Solar and Wind Pooling Substation to ISTS / CTU Substation	Voltage level at 220 kV, double circuit, with TL length ~30 km and 120 towers
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	25th June 2019
PPA date	28th November 2019
PPA effective date	7th November 2019 and valid through 18 months from PPA effective date
PPA COD timeline	May 2021
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	**Planning Phase.** ■ The Project will have 46 operating WTGs with a capacity of 2.2 MW each. Currently, 45 WTGs have been finalised i.e. land has been leased for 45 WTGs and one location from either of two WTGs-FAT-090 or FTN-156 will be finalised at a later stage; **NOTE:** This report has undertaken assessment of 47 WTG locations identified by the project proponent as either of the two WTGs FAT-090 or FTN-156 will be finalised at a later stage. ■ For total 276 acres of land, the lease agreement has been executed. The total land procured for all the WTGs are private land. ■ The land for the solar plant is in the process of finalisation. Out of 1500 acres, lease agreement for 1450 acres of land has been executed, and the remaining 50 acres of land is under process. The total land procured for the solar power plant is private land

Particulars	Description
	■ Internal Transmission Line: The internal transmission line has been devided into four clusters, and tentative route has been identified. However, land survey for the same is yet to be executed, and ROW is yet to be finalised ■ External Transmission Line: Initial route survey of the external transmission line connecting pooling substation in Madhopura village to the Fatehgarh-2 PGCIL grid substation has been completed. However, ground survey for the same is yet to be conducted. As reported by the Project team and as per the initial survey of external transmission line (TL), the land requirement for the TL comprise of private land only.

Source: Detailed Project Report dated June 2020, and site visit conducted June 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 the AGEL. 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;
- 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	Particulars	Description
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 47 WTGs	
Annexure B	Photo Documentation	

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 390 MW Solar-Wind Hybrid Power Project is located on land ranging from flat to undulating private shrub/waste land, agricultural land and grvel land across 12 villages under Fatehgarh and Pokhran tehsil of Jaisalmer district in the state of Rajasthan. Elevation at project site ranges from 240 m to 320 m above mean sea level. The Project lies between the following coordinates:

- Northern most point: 26°53'29.90"N, 71°26'15.44"E
- Southern most point: 26°37'44.21"N, 71°36'54.17"E
- Western most point: 26°45'54.74"N, 71°23'0.58"E
- Eastern most point: 26°50'59.82"N, 71°38'12.22"E

The nearest villages to the Site are Madhopura (towards south-east and east direction at an approximate aerial distance of 4.5 km from wind power plant and 12 km from solar power plant respectively), Neran (towards east and north-east direction at an approximate aerial distance of 1.5 km from wind power plant and 4 km from solar plant respectively), Dawara (towards west and north direction at an approximate aerial distance of 4 km from wind plant and 6 km from solar plant respectively), Rasla (towards south west and south direction at an approximate aerial distance of 8 km from wind plant and 2 km from solar plant respectively) and Keraliya (towards north and north east direction at an approximate aerial distance of 700 m for wind plant and 9 km from solar plant respectively).

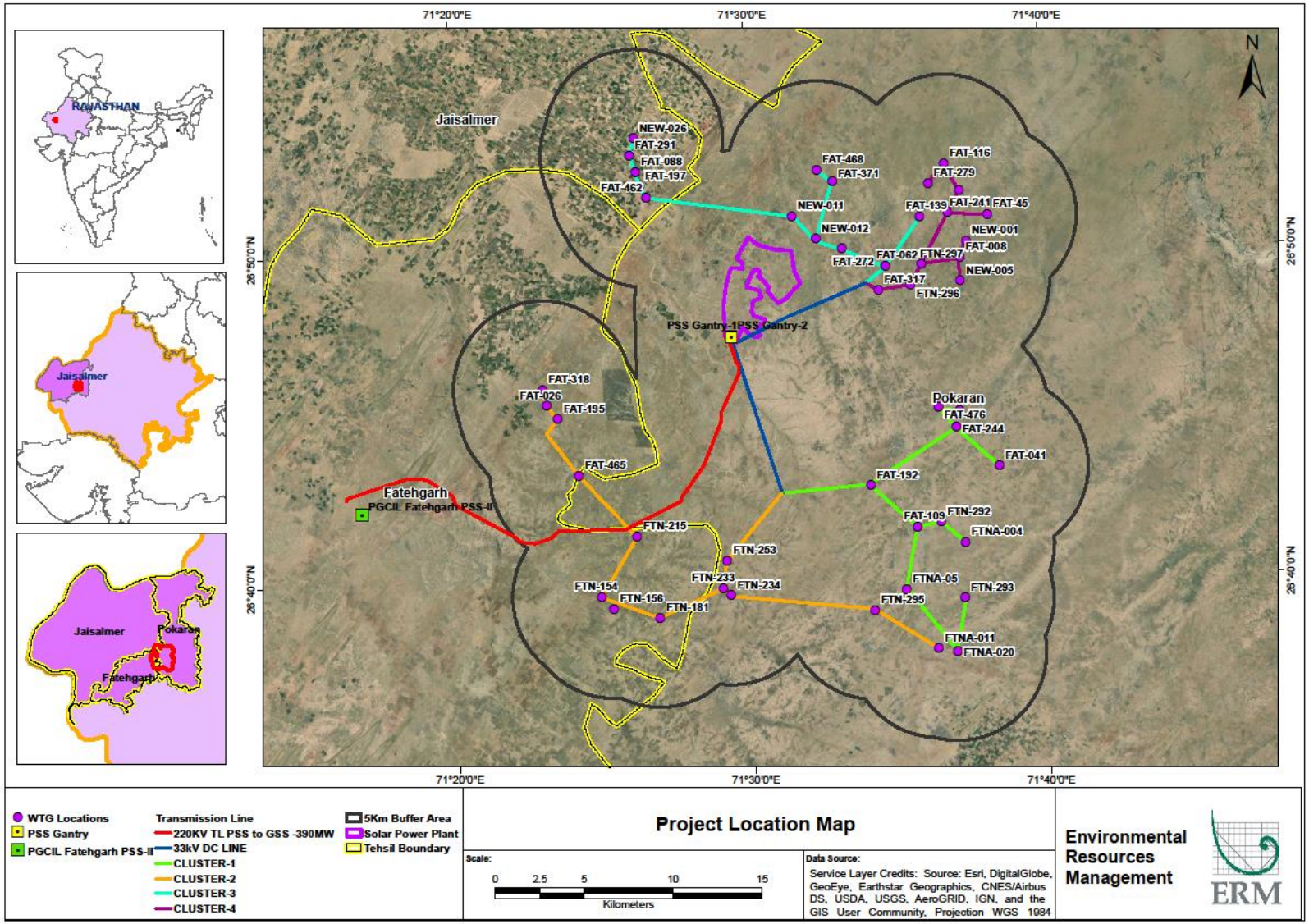
As observed during ERM site visit, a dry seasonal water channel of 2 km length and 6 feet deep was observed approximately 5 km from solar site towards east direction. Based on consultation with local community, it is understood that the water channel remains dry throughout the year and only gets water when there is heavy rain in the area. Additionally, a water pond (also known as Noteri Nadi) was observed at Madhopura village (26°45'34.33"N, 71°32'14.53"E) and another water pond was observed at Deg Rai Temple (26°42'29.41"N, 71°19'26.71"E) near Bhimsar village. The Madhopura village pond is located approximately 4 km from the proposed solar plant, whereas Deg Rai Temple water pond is located approximately 120 m from 220 kV external transmission line connecting the pooling substation to the Fatehgarh-2 PGCIL grid substation. .

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 69 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 GIB enclosures. Rasla enclosures (1 and 2) are situated inside the Study area at approximately 2.7 km east of WTG FAT-195 and about 5.8 km southwest of the solar park boundary (Refer ***Section 5.5.6).***

The project will use the existing gram panchayat road as approach road for the project which is 5 meter wide and approximately 3 km in length. The gram panchayat road gets connected to National Highway (NH)-15 approximately 18 km towards north direction through another village road. Nearest railway station is the Jaisalmer Railway Station located at an approximate distance of 60 km from site. Nearest airport to the site is *Jaisalmer Airport*, located at an approximate distance of 70 km.

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



Source: ERM India

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 50.4 MW wind power plant developed by Suzlon and owned by Orange Renewable Power Private Limited located approximately 4 km from the proposed site;
- A 100 MW wind power project developed by Siemens Gamesa and owned by National Aluminium Company Limited (NALCO) located within 5 km of the proposed project;
- A 450 MW wind power plant developed and owned by Caparo Energy (India) Ltd. at Madasar and Lakhasar village located approximately 9 km southwest of the project site.
- In addition to the above, AGEL is planning to develop a 600 MW and 700 MW solar and wind hybrid power project located within the 5 km and ~15 km radius of the Proposed 390 MW project.
- There are other upcoming wind power projects to be developed by Renew and Eden Renewables (capacities not known) within 10 km of the proposed project site

2.2 Major components of the Hybrid project

The proposed 390 MW hybrid power project is a combination of solar and wind power plant. Out of the total capacity of 390 MW, 360 MWac will be produced by solar power and 101.2 MW will be produced by wind energy. As per the detailed project report, a total number of approx. 1,216,180 solar modules and 46 wind turbines are proposed for the project. The details of major component of solar and wind power project is given below:

2.2.1 360 MWac Solar Power Project

The proposed 290 MW Solar Power Project will include the following components and associated facilities as presented in **Table 2.1.**

Table 2.1: Major components

Component	Manufacturer	Model
PV Modules	LONGi Solar	LR4-72HPH 440M~445M
Inverter	Huawei	SUN2000-185KTL-INH0
ADDITIONAL INFRASTRUCTURE		
Transmission Line and Tower	The Transmission line of 220 KV (double circuit) having 120 towers will transverse a patch of approximately 30 km length from 765 KV/400 KV/200KV Power Grid Corporation India Limited (PGCIL) Fatehgarh-2 Substation to Pooling Substation located within the solar plant.	
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(18)L, 2020

Table 2.2: Technology design parameter

Component	Description
DC Installed capacity	541.20 MWp
AC installed capacity	360MW
No. of installed modules	1,216,180
No. of inverters	Not Finalised
No. of MV transformers	Not Finalised
Transformer (step-up)	33 kV to 220 kV
Mounting structure	Fixed Tilt Module Mounting Structure for the proposed project
Mounting system	Fixed tilt module mounting system

2.2.2 101.2 MW Wind Power Project

AGE(18)L has proposed to install 46 no. of WTGs of Siemens Gamesa make SG2.2-122. 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	Siemens Gamesa	SG 2.2-122
Additional Infrastructure		
External Transmission Line and Tower	Refer ***Table 2.1***	
Internal Transmission Line	The 33 kV internal transmission line connecting the WTGs to the pooling substation has been divided into four clusters, and tentative route has been identified. However, land survey for the same is yet to be executed, and ROW 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	

2.2.3 Power Evacuation Infrastructure for 390 MW Hybrid Power Plant

The proposed 390 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	Pooling substation along with Site office will be located in Madhopura village near Solar Power Area (26.791675° N, 71.493549°E)

Components	Description
Switchyard Ownership	Project Company
Incoming Voltage Level	33 kV
Outgoing Voltage Level	220 kV
Power Transformer Rating	33 kV
Substation Ownership	Project Company
Internal Transmission Line- Connecting WTGs to the Pooling Substation in Madhopura village	
Length of Internal Transmission Line	Yet to be finalised (Land survey yet to be executed)
TL Voltage Level	33 kV
Total no. of Towers	Yet to be finalised (Land survey yet to be executed)
External Transmission Line – Solar and Wind Pooling Substation to ISTS/CTU Substation	
TL Voltage Level	220 kV
Type	Double Circuit
Length	Approx. 30 km
Total no. of Towers	120
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(18)L

2.3 Wind Turbine Profiling

ERM undertook desk-based profiling of the WTG locations shared by AGE(18)L in the form of a google earth (kmz) file. . The Project will have 46 operating WTGs with a capacity of 2.2 MW each. Currently, 47 WTG locations have been identified by AGE(18)L project team, out of which 45 WTGs have been finalised i.e. land has been leased for 45 WTGs. One location from either of two WTGs FAT-090 or FTN-156 will be finalised at a later stage;

Based on the E&S profiling of 47 WTGs, ERM visited 7 WTG locations which consisted of sensitivities within 500 m, such as a road or a structure which has been presented in ***Table 2.4.*** The Photo documentation of the 7 WTG locations visited by ERM and the solar power plant location have been presented in **Appendix B.**

Additionally, WTG profiling of the 47 WTG locations identified by AGE(18)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.	FTN-297	26.82537°	71.59897°	Naya Sanawara	Shrub/waste land	Shrub/waste land	Agricultural land	Shrub/waste land	East: Agricultural land only in patches	Structure	STR 4	630	S	26.82093°	71.60308°
2.	FTN-292	26.69475°	71.60736°	Achalpura	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land		Structure	STR 5	384.4	NE	26.69706°	71.61025°
3.	FTNA-05	26.66084°	71.58696°	Loona Khurd	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land	Settlement is outside the 500 m, but can be considered for shadow flicker The four structures are present in cluster	Structure	STR 13, 39, 40, 41	395.19	SE	26.65878°	71.59025°
4.	FAT-109	26.69242°	71.59379°	Achalpura	Shrub/waste land	Shrub/waste lands	Shrub/waste land	Shrub/waste land		Settlement	STLMNT3	440.63	SW	26.69081°	71.58973°
									The structure identified is a temple used by local community	Structure	STR 49	150 m	W	26.69163°	71.59505°
5.	FAT-139	26.84941°	71.59836°	Naya Sanawara	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land							
6.	FAT-279	26.86607°	71.60363°	Naya Sanawara	Shrub/waste land	Shrub/waste land	Shrub/waste lands	Shrub/waste land							
7.	FAT-244	26.742886°	71.616928°	Khetasar	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land	Two Roads passing North to South at 320 m and 380 m towards West of WTG	Structure	STR 48	210 m	W	26.74213°	71.61498°

Source: ERM Site Visit dated 26 June 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 ***(Current phase of the Project)***	The planning phase activities ideally include: ■ 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. As part of the planning phase, the following activities have been carried out: ■ Identification and finalisation of land area for solar and wind site; ■ Land lease agreement between land owner and AGE(18)L for the 46 wind turbine locations and 1500 acre solar power plant. ■ Route survey assessment for external transmission line connecting pooling substation to PGCIL Fatehgarh 2 grid Substation; ■ Identification and finalisation of locations for pooling substation, storage yards and site office that will support the Project activities; and ■ Finalization of contractors is under process.
Construction	The construction phase activities will include: ■ 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
	■ Turbine testing to verify proper operation of the facility; and ■ Commissioning
Operation and maintenance	The operation and maintenance phase activities will include: ■ 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 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.
Decommissioning	The decommissioning activities include: ■ 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 June 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(18)L Project team. The resource requirements are as elaborated below.

2.5.1 Land Requirement and Procurement Process

This section provides an understanding of the land requirement process and the procedure followed for procurement of the same. This understanding is developed in mind the applicable reference framework, especially the requirement of the IFC PS 5.

2.5.1.1 Land Procurement Methodology

The land for the hybrid project (land for solar park and for 47 WTGs) comprised of private land. This review was carried out based on the consultations undertaken with the project team on the site, land aggregator appointed by the project, land owners, local community and the consultation with Patwari[2]. However, it should be noted that all of the land owners could not be consulted during the site visit as due to unprecedented situation caused by COVID-19 pandemic.

Land Requirement for the Project

As reported, the Project is in the process of land lease for solar plant and for the internal and external transmission line. The land for the project has been leased out through a process of negotiation with the landowners. Based on the discussion with the Project team, land owners and the local community, the land is and will procure based on voluntary land transactions. The project has engaged Pokhran-based entity named **M/s Riti Energy Private Limited** or **Riti** to support the land lease process with the assistance of local support from key intermediaries at the village level.

Reportedly, 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.

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.

[2] It's a government official in the local revenue authority who maintains the ownership record for specific area as well as to undertake the collection of land taxes.

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

Project Component	Total Leased out Land Size (in acres)	Easement Rights (in acres)	Land Category	Comments
Hybrid Project (Solar and Wind power plant)	2160 (as per the estimate given by the land team of AGE(18)L)		Private land	■ **Solar Plant**: The land for the solar plant is the process of finalisation. Out of 1500 acres, for 1450 acres of land the lease agreement has been executed and the remaining 50 acres of land is still in the process. The total land procured for the solar plant is private land ■ **WTGs**: The land for all the 46 WTGs has been finalised. For total 276 acres of land, the lease agreement has been executed. The total land procured for all WTGs is private land ■ **Internal Transmission Line:** The Internal transmission line yet to be finalised ■ **External Transmission Line:** Initial route survey of the external transmission line has been completed. However, the finalisation of route is yet to be conducted. As reported by the Project team and as per the initial survey of external TL, the land requirement for the TL is comprise of private land only. ■ **Access Road:** The project will use the existing gram panchayat road. However, the project might need to reinforce the road for movement of heavy vehicles
Break-up of total land into each component				
Solar Plant	1290	Not Applicable	Private Land	1240 acres from the total land has been leased out and the remaining 50 acres of land is in the process of finalisation and yet to be leased out
WTGs	276	Not Applicable	Private land	6 acres per WTG The land for the 46 operating WTGs has been finalised. For total 276 acre of land the lease agreement has been executed.
Wind Mast	5.5	Not Applicable	Private Land	A common wind mast has been be set-up for all the upcoming project of Adani group
Access Road	NA	Not Applicable	Not Available	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. If the need of private land will arise, the option of land purchase or land lease will be searched out as per the consultation with the land owners. As reported dated June 26, 2020, no land for the access road has been procured by the project. However, 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.
Internal Transmission Line (33 KV)	Yet to be finalised	Not Required[3]	Not Available	The internal TL route yet to be finalised
External Transmission Line (220 kV)	286.6	Yet to Finalised	Pivate Land	Initial survey of the external transmission line has been done, however, the finalisation of route is yet to be done. As reported by the project team, the land requirement for the external TL is comprise of private land only The compensation for easement right for private land will be paid in keeping with the regulations As reported, the total distance from PSS to GSS is 34 Km.
Pooling Sub-Station and site office (PSS)	210	Not Applicable	Private land	The project has already procured the land for pooling sub-station and for the site office. The pooling substation and the site office will be located inside the solar plant

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.

[3] 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.

2.5.1.2 Land Procurement Process

Identification/Procurement of Land

As reported, the Project is in the process of land procurement for solar plant and for the internal and external transmission line. The tentative location of all 47 WTGs has been finalised and the same was made available at the time of the assessment. The land for the project has been leased out through a process of negotiation with the landowners. The land has been leased for a period of 29 years and 11 months.

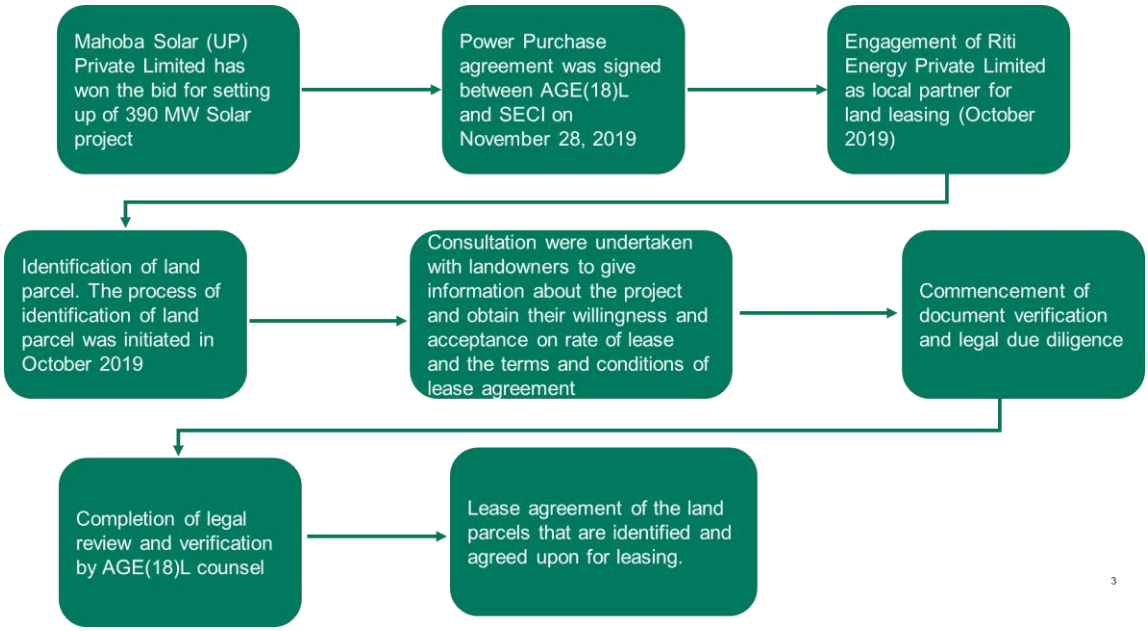
Details of land procurement process

Based on the discussion with the project component and the land owners, the land has been procured on voluntary land transactions basis. Reportedly, the Project has chosen the leasing of land over land purchase, because taking land on leases is an ideal solution for both land owners and Project. In lease agreement, the land owners will receive agreed amount on annual basis instead of lump sump money if they sell their land. This lease amount will become a stable annuity income and plus the land owners retains the right to the land.

The project has engaged Pokhran-based entity named **M/s Riti Energy Private Limited** or **Riti** to support the land procurement process with the assistance of local support from key intermediaries at the village level.

The land leasing process for the project started on October 2019 (first lease agreement was signed) and the process will be completed by November 2019. As reported by the project proponent, and the local community during the consultation, the lease rent was established based on negotiations held with the landowners. 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. As per the lease agreement, the project proponent or the lessee will be solely responsible for the payment of any charges, taxes or levies applicable once the lease agreement is in place.

Figure 2.2: Land procurement process flow of the project



2.5.1.3 Key Points of Lease Agreement

The lease agreement was signed between AGE(18)L and the land owners. The key points of lease agreement is delineated below:

- The tenure of Lease is of 29 years and 11 months;
- Lease rent is INR 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 rate[4] of the land;
- 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;
- 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 hereby 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 reported by the Patwari (government official who maintain land records in the given area), the prevailing market rate of land in the area is **INR 60,000/acre.**

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:

[4] 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.

Table 2.7: Key Sensitivities related to land procurement for project

Sensitivity	Details
Tribal Land/Schedule V Area[5]	The project area does not fall under Schedule V[6] area as defined by the Indian Constitution.
Tribal (Schedule Tribe) Land	According to the information available and the consultation with Patwari, the land identified for the project is comprised of mostly private land, and no tribal land has been procured for 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, 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.
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	Based on the site assessment, the external transmission route is ~ 30 km with 30 m RoW does not impact site of cultural singnificance or cultural heritage sites. However, the external TL runs ~1 km NE of the Deg Rai Mata Mandir. The Project activities are not expected to restrict access to the temple.
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, June 26, 2020

2.5.2 Manpower requirement

The proposed 390 MW hybrid project is in the initial planning phase. Therefore, EPC contractor, manpower requirement for construction and operation phase, labour camp, organizational structure for EHS&S management during the construction phase, etc., are yet to be finalized.

2.5.2.1 Construction phase

As reported by Project representatives during ERM site visit, the peak labour requirement during the construction phase, for site preparation, foundation laying, fencing, cleaning, pilling of solar panel and erection and commissioning of mounting structures, is estimated to be approximately 800-1000 skilled, semi-skilled and unskilled labourers. Reportedly, unskilled and semi-skilled labourers will be sourced from the local labour pool to the extent possible. In case the requirement of semi-skilled

[5] 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.

[6] 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.

labourers isn't met from the local labour pool, then the semi-skilled labourers from other part of Rajasthan or from other state will be considered. As for skilled labourer, they may not be sourced from the local labour pool, but will likely be migrant workers.

2.5.2.2 Operation phase

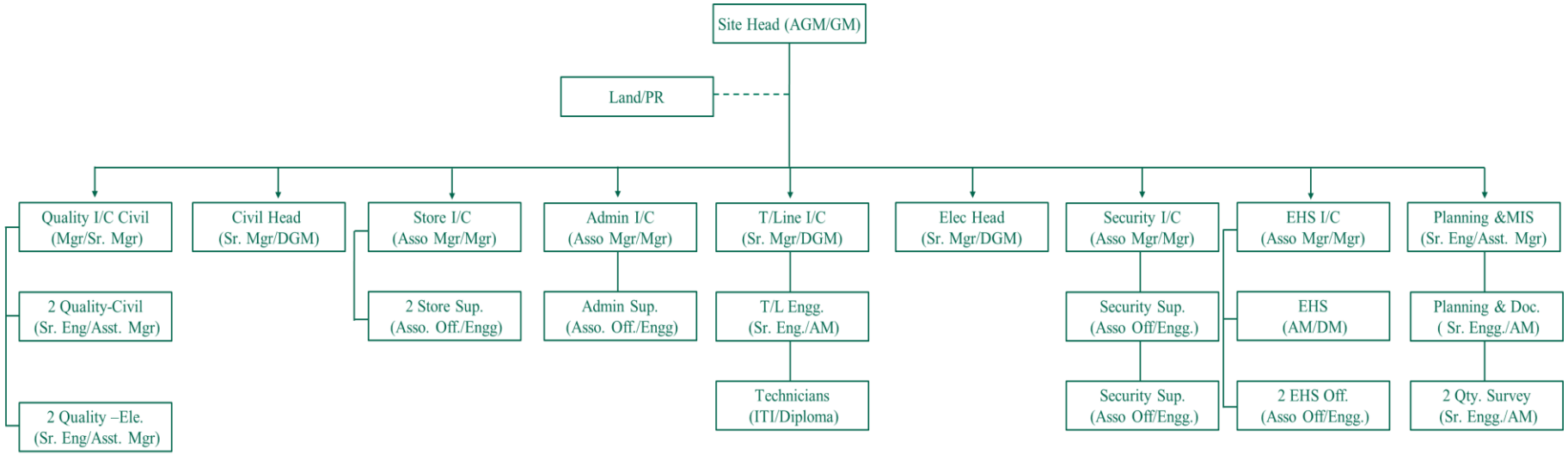
The Project will be supervised by the Project Director. The key Head Office personnel and their reporting requirements has been described below:

- Cluster Head will be responsible for supervising all Project related aspects. Project Development Coordinator, Land Head, Plant Head, Contract Management, Cluster HR head and Cluster Safety head will all report directly to the Cluster Head;
- The Plant 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 AGE(18)L 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;
- Health, Safety & Environment (HSE) Head will be responsible for ensuring of HSE related aspects, such as compliance related aspects and occupational health & safety related aspects, are being strictly adhered to by the Project team.

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: AGEL

Summarization of the organisational structure is as follows:

AGEL Corporate Team

- At the corporate level, the project is under the direct control of CEO-AGEL, CEO leads the construction, operation and management of the project. Furthermore, the CEO-AGEL is further supported by four team which comprise of Project Head, Head of Operation and Maintenance, HR team and Safety Team;
- EHS Head at Cooperate level is responsibility for supervision of EHS aspects associated with Project activities, and operations. Furthermore, EHS Manager is responsible for the administration of AGEL's ESMS management system, and provide management support to the Engineers and the EHS Coordinator as necessary to ensure proper implementation of ESMS planning requirements

AGE(18)L Site Team

- At SPV level, the Project will be headed by the Site head will be responsible for overall construction and Operation and Maintenance of the project. The Site Head will also be responsible for overseeing partnership between AGE(18)L and appointed contractors.
- The Site Head will be further supported by the land team and other teams including quality team, Civil Head, Store Manager, Admin, Electricity, Security, Safety, Planning and transmission line Manager and EHS Head;
- With respect to EHS, 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.
- The EHS Manager at the site level will directly report to the EHS Manager at the corporate level who will further report to the EHS Head at the AGEL Corporate office.

2.5.3 Water resource requirement

AGEL has conducted "water usage reduction feasibility assessment for 390 MW solar power plant in Fatehgarh, Rajasthan" dated 19.03.2020 by an external agency TUV SUD South Asia. Based on the water feasibility report and site observations 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.

The primary source of water for the Project is Indira Gandhi Nahar Pariyojna (IGNP) canal[7]. A stretch of canal passes approximately 7.2 km in east direction in the village of Ghator. 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 water[8]. 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.

[7] 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.

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

Based on discussion with AGE(18)L team, it is understood that source of water for the Project will be through IGNP Canal at Mohangarh Pumping Station.

AGE(18)L has registered the 390 MW Hybrid Project under Rajasthan Wind and Hybrid Energy Policy 2019 vide registration no. H/001/2019 dated 09.07.2020.

Furthermore, AGE(18)L vide no. AGE(18)L/RRECL/390MW/WATER/24072020 dated 24.07.2020 shared request application with RRECL to allocate 0.13 cusec of water from IGNP canal at Mohangarh pumping station.

It is also understood that M/s Adani Renewable Energy Park has obtained an allocation approval from the Dy. Seceretary, RREC to gain access from IGNP for its 1500 MW solar power park. The project has been allocated 0.5 cusec from RREC in line with govt. order no. F.6(6) IGNB/2009 dated 07.09.2010.

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 125 KLD water will be required during peak time of construction phase for civil work. Furthermore, approximately 86.40 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 cycles 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 also 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 1,216,180, therefore approximately, 851 KL water will be required per wash. Considering, 8 cycles per year for wet cleaning, approximately 6810 KL water will be required per year.

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(18)L has proposed to implement 16 cycles of dry module cleaning at 390 MW site in addition to the 8 cycles of wet module cleaning per year. 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

For domestic purpose approximately 5.4 KLD water will be required considering 40 manpower deployed at site during operation phase.

2.5.4 Raw material requirement

2.5.4.1 Construction Phase

Based on Detailed Project Report (DPR) and discussion with site team, the 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. The amount of raw material and equipment required for construction activities are presented in ***Table 2.8.***

Table 2.8: Raw Material and Equipment required for Civil Work

S.No.	Description	Quantity and Unit
Raw Material		
1	Cement	2000 Mt/month
2	Stone	5000 Mt/month
3	Steel	40-50 Mt/month
4	Sand	3500 Mt/month
Equipment Type		
5	Loader cum Mixer	15 nos

Source: AGEL

Solar modules will be obtained from Longi Solar Technology Co. Limited and wind turbines will be supplied by Siemens Gamesa Renewable Energy.

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 40 kVA 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 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). Adani Green Energy Limited (AGEL) has signed an annual rate contract with M/s.TES-AMM (India) Private Limited[9] dated 25.05.2019 for disposal of e-waste and hazardous material across solar and wind power plants of AGEL. As reported by Site representative, agreement with M/s.TES-AMM (India) Private Limited has been signed for the 390 MW solar plant as well for FY-21. However, the agreement was not shared with ERM for review.
- 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 M/s.TES-AMM (India) Private Limited (a Tamil Nadu State Pollution Control Board authorized hazardous waste recycler);
- 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.

[9] M/s.TES-AMM (India) Private Limited is an authorised recycler from Tamil Nadu State Pollution Control Board, and obtained hazardous waste authorisation dated 16 February 2016 which is valid for five years (15 Feb 2021)

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 be operated at project Site.

Based on discussion with AGE(18)L 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 2.9: 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

State/Region	Requirement (MU)	Availability (MU)	Deficit (MU)	Deficit (%)
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/lgbr/lgbr-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 2.10: 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
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 2.11: Advantages and Disadvantages of Various Power Generation Systems

Mode	Disadvantage	Advantage
Thermal Power Plant	■ 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	■ Large scale production potential ■ Moderate gestation period ■ Relatively inexpensive ■ Wider distribution potential
Hydropower Plant	■ Site specific, dependent on reservoir/river etc. ■ Downstream impact on flow ■ Long gestation period ■ Acute and chronic social and ecological impacts	■ GHG emission estimated as low as 1.1gCeq/kWh for run of river projects
Nuclear Power	■ 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.	■ Cheaper power generation ■ GHG emissions as low as 2.5gCeq/kWh
Wind Power	■ Land requirement of about 2.0 to 2.5 acres (1 ha approx.) per MW ■ Site specific (associated to wind pattern) ■ Expensive installation	■ Pollution levels are insignificant ■ Inexpensive power generation ■ Inexhaustible source ■ GHG emissions as low as 2.5gCeq/kWh for the Production Chain
Solar Power	■ Large land requirement ■ Site specific to solar insolation ■ Expensive installation ■ Concrete foundation on larger area	■ Pollution levels are insignificant ■ Inexpensive power generation ■ Inexhaustible source ■ GHG emissions as low as 8.2gCeq/kWh for the Production Chain

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/m^2/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 Charted 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 (Refer Section 0), 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)	The Ministry of Environment and Forests (MoEFCC), Government of India is responsible for the environment management at Union of India level. The specific functions of MoEFCC are as follows: ■ Environmental policy planning; ■ Effective implementation of legislation; ■ Issuing guidelines under EP Act for environment protection; ■ Monitoring and control of pollution through Central Pollution Control Board and State Pollution Control Boards; ■ Environmental clearance for industrial and development projects covered under EIA Notification; ■ Monitoring of compliance conditions stipulated in Environmental clearance through its regional offices; ■ Promotion of environmental education, training and awareness;

Agency	Functions
	■ Forest conservation, development, and wildlife protection; and ■ Protection of Coastal areas. MoEFCC is responsible for the implementation and enforcement of the Environment Protection Act, 1986, and Rules issued under the Act, including the EIA notification. Under sections 3 and 5 of the EP Act, 1986, it retains enormous powers to issue directions in the interests of environment protection.
Central Pollution Control Board	The Central Pollution Control Board (CPCB) has been constituted for the control of water, air and noise pollution, land degradation and hazardous material and waste management. The specific functions of CPCB are as follows: ■ Prevent pollution of streams and wells; ■ Advise the Central Government on matters concerning prevention, control and abatement of water and air pollution; ■ Co-ordinate the activities of SPCB's and provide them with technical and research assistance; ■ Establish and keep under review quality standards for surface and groundwater and for air quality; ■ Planning and execution of national programme for the prevention, control and abatement of pollution through the Water and Air Acts.
Ministry of New and Renewable Energy (MNRE)	■ The Ministry of New and Renewable Energy (MNRE) is the nodal Ministry of the Government of India for all matters relating to new and renewable energy. The broad aim of the Ministry is to develop and deploy new and renewable energy for supplementing the energy requirements of the country. ■ The Ministry facilitate research, design, development, manufacture and deployment of new and renewable energy systems/devices for transportation, portable and stationary applications in rural, urban, industrial and commercial sectors.
Central Electricity Authority (CEA)	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: ■ 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;

Agency	Functions
	■ Advise any State Government, licensees or the generating companies on such matters which shall enable them to operate and maintain the electricity system 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	■ 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)	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 ■ 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	■ 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)	■ 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.

Agency	Functions
Labour Department, Government of Rajasthan	■ 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 promotes welfare of workers in the undertakings falling within the sphere of the State.
Gram Panchayats	■ 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)	The Directorate Industrial Safety and Health Department enforces the provisions of Factories Act 1948 and State Factories Rules and the rules made there under to ensure the safety health and welfare of the workers. It also plays a significant role in regularizing working hours, and working conditions and reducing the accident and dangerous occurrences in the factories, redressal of the grievances of the workers in respect of Safety Health and Welfare through a set of policies and programs developed by both the Central and State Government. Some of the functions of DISH are ■ Eliminating inequality and discrimination in the work place; ■ Enhancing occupational health and safety awareness and compliance in the workplace; ■ Workforce and community participation, to employers, employees, workplaces, communities, businesses and unions; and ■ Providing policy advice and analysis to government on labour and employment related matters.
Rajasthan State Forest Department	■ 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.

Agency	Functions
	■ 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. 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	☒	☒	☒	☒	■ 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	☐	☒	☒	☒	■ Government of Rajasthan	■ Refer to **Section 3.3.1**
Rajasthan Renewable Energy Corporation Limited	☐	☒	☒	☒	■ Government of Rajasthan	AGE(18)L vide no. AGE(18)L/RRECL/390MW/WATER/24072020 dated 24.07.2020 shared application with RREC to allocate 0.13 cusec of water from IGNP canal at Mohangarh pumping station.
Right to Fair Compensation and Transperancy in Land Acquisition, Rehabilitation and Resettlement Act, 2013; National Rehabilitation and Resettlement Policy, 2007; and The Rajasthan Land Acquisition Act, 2014	☐	☐	☐	☐	■ 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 The Air (Prevention And Control Of Pollution) Act, 1981 The Water (Prevention And Control Of Pollution) Act 1974	☐	☒	☒	☒	■ 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)/2015-201610), “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. AGE(18)L had shared Project Execution Intimation letter for development of 390 MW Wind-Solar hybrid project with Rajasthan State Pollution Control Board (RSPCB) vide reference no. AGEEL/RPCB/390 MW ADANI/Madhopura/001 dated 26.05.2020 and received acknowledgement on the same from RSPCB on 27.05.2020
The Noise (Regulation & Control) Rules, 2000 and as amended up to 2010	☒	☒	☒	☐	■ 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(18)L and their contractors will need to abide by the limits prescribed for residential zones.
Ambient Noise Standards	☐	☒	☒	☐	■ RSPCB ■ MoEFCC	■ As the project is in rural/residential set up, noise standards for residential area will be applicable for the project.

[10] 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	☐	☒	☒	☒	■ RSPCB ■ local municipal bodies	■ All bio-degradable, non-biodegradable and domestic hazardous wastes generated from the project will be managed by AGE(18)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	☐	☒	☒	☐	■ RSPCB	■ 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	☐	☒	☒	☐	■ RSPCB	■ 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	☐	☐	☒	☒	■ RSPCB	■ 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	☐	☒	☒	☒	■ RSPCB	■ 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) and reportedly, the project will dispose hazardous waste through M/s.TES-AMM (India) Private Limited (agreement yet to be executed), hence hazardous waste authorization is not applicable for the project
The Factories Act, 1948 and Rajasthan Factories Rules, 1951	☐	☐	☒	☐	■ Deputy Chief Inspector of Factories	■ AGE(18)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; Inter-state Migrant Workers Act, 1979 Contract Labour Act, 1970	☐	☒	☐	☐	■ Labour Department, Government of Rajasthan	■ AGE(18)L will need to comply with the requirements of the regulations.
The Child Labour (Prohibition and Regulation) Act, 1986 Bonded Labour (Abolition) Act 1976 Minimum Wages Act, 1948 Equal Remuneration Act 1976 Workmen's Compensation Act, 1923 Maternity Benefit (Amendment) Act, 2017	☐	☒	☒	☒	■ Labour Department, Government of Rajasthan	■ AGE(18)L and its contractors will need to comply with the requirements of these regulations.
Companies Act, 2013	☐	☒	☒	☐	■ Ministry of Corporate Affairs	■ 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	☐	☒	☒	☒	■ Respective Gram Panchayats	■ The given permission will be required for procuring both Government and Private land ■ Reportedly, AGE(18) L has initiated the process for obtaining gram panchayat NOCs from the respective villages, where the Project falls
International treaties and conventions						

Topic and Reference	Pre-construction	Construction	Operations	Decommissioning	Agency Responsible	Remarks
Conventions on the Conservation of Migratory species of wild animals and migratory species	☒	☒	☒	☒	■ 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 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.	☒	☒	☒	☐	■ MoEFCC, Government of India	--
Forest Conservation Act 1980	☒	☒	☐	☐	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	☒	☒	☒	☐	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	☒	☒	☒	☒	■ 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	☐	☒	☒	☒		
IFC EHS Guidelines for Power Transmission and Distribution, 2007	☐	☒	☒	☒		
IFC Guidelines for Wind Energy Projects	☐	☒	☒	☒		
IFC/WB Air Emissions and Ambient Air Quality Standards	☐	☒	☐	☒		
IFC/WB Guidelines for treated sanitary sewage discharges	☐	☒	☒	☒		
IFC/WB Noise Standards	☐	☒	☒	☒		
Equator Principles, 2020	☐	☒	☒	☒		

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 form 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	☒	This PS aims to assesses the existing social and environmental management systems of AGEL and AGE(18)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. 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. The developer, at the corporate level, has also established an Environmental and Social Management System, that will be implemented in conjuction with the management plan presented in this report.
IFC PS 2 - Labour and Working Conditions	☒	This PS is guided by a number of international conventions and instruments on labour and workers’ rights. It recognises that the

Description	Applicability	Objectives and Applicability to Project
		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(18)L as well as any contractors. The project activities will involve hiring of approximately 1000 skilled, semi-skilled and unskilled labourers during the construction phase and solar plant staff during the operation 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.
IFC PS 3 - Resource Efficiency and Pollution Prevention	☒	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 AGE(18)L intends to minimize pollution related impacts, what management plans and systems are in place, and what measures it plans to take to conserve and use resources more efficiently. The Project 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.
IFC PS 4 - Community Health, Safety and Security		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,

Description	Applicability	Objectives and Applicability to Project
		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. 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.
IFC PS 5 - Land Acquisition and Involuntary Resettlement	☐	**Not Applicable** PS-5 requires project proponents to anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use. 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. Based on the consultations conducted during the site visit, and also based on the understanding of the land lease process implemented onsite, required land for the project is being leased. Apposite consultation are undertaken with land owners to take their consent before finalising the lease. The following condition has been fulfilled: ■ 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 Furthermore, the project has not led to resettlement, physical displacement and economic displacement. Therefore, PS 5 is not applicable to the project.
IFC PS 6 - Biodiversity Conservation and Sustainable Management of Living Natural Resources	☒	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.

Description	Applicability	Objectives and Applicability to Project
		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. 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	☐	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. 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. 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. The project does not envisage adverse impacts on communities of Indigenous peoples. Therefore, PS 7 is not applicable to the project.
IFC PS 8 - Cultural Heritage	☐	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. As confirmed during ERM site visit, no cultural heritage will be affected by the project activities. Based on the site assessment, the project external TL is ~30 km with 30 m RoW. No culturally significant site is being impacted directly. However, Degree Mata Mandir falls ~150 m NE of the proposed TL. The Project is expected to not restrict access to the temple. Therefore, PS8 is not applicable to the Project.

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

Project Activity/ Hazards \ Environmental and Social Resources / Receptors	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	■ 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	■ 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	■ 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	■ Operation of D.G. sets, vehicular movement and construction activities can cause fugitive and point source emission.
Impact on Water Environment	■ 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	■ 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 Madhopura and Sanawada villages, may be disturbed due to higher than anticipated noise.
Ecology	■ 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	■ 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	■ There will be no impact on land-based livelihood 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	■ 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	■ 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	■ 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 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	■ 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	■ According to the Census records and consultations with the local community, the study areas do not report a significant presence of Scheduled Tribe population within the study area. No direct impacts on indigenous people are envisaged. ■ 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; and ■ 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. ■ As per the details given by the Project team, based on the initial survey of External TL, the land requirement for the TL comprise of private land only. However, the RoW of TL doesn't envisage the adverse impact on communities of indigenous people. Therefore, the impact on Indigenous people seems to be negligible.
Demography (Influx and Displacement)	■ 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(18)L and its contractors
Impact on cultural resources and heritage structures	■ 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(18)L also confirmed that the project would not impact any such structure.
Natural/Common Property Resources	■ 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 390 MW solar-wind hybrid power project in Pokhran 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 (AoI) has been identified. This sub section provides an understanding of the AoI 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 twelve villages (Refer ***Table 1.1***).

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 (AoI).

The AoI 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 AoI) 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 AoI 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 AoI is in turn, divided into a core and buffer zone. This division of the AoI 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 26th June 2020 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 AoI.

As part of this site visit, primary data was collected from sensitive spots and other places inside the AoI 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 in 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 bore wells 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, shrub land and gravel waste land within the study area.
Ambient Noise Quality	Three (03)	Once for 24 hours during monitoring period	Ambient noise samples were collected over a 24 hr period near selected WTG location and at solar plant
Ambient air quality	Four (04)	24 hourly, once in a week	Air quality at nearby villages were monitored once in a week

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 below:

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

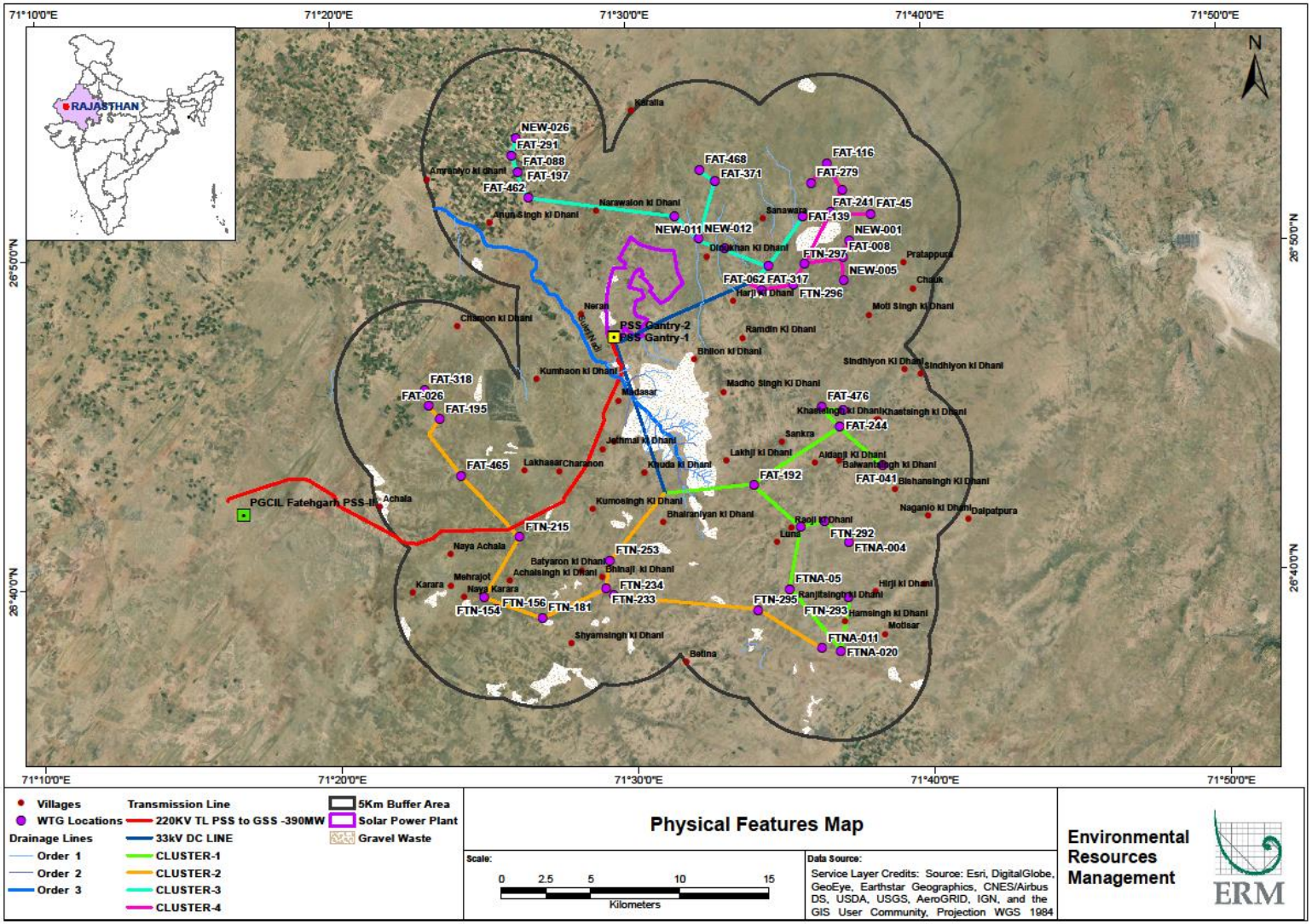
SN.	Attribute	Source of Data Collection
4	Eco-sensitive Areas	Wildlife Institute of India ENVIS Centre on Wildlife and Protected Areas and Birdlife International Website
5	Natural Hazards	Building Materials and Technology Promotion Council of India (BMTPC) Meteorological Department

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 47 WTG locations;
- Other wind power projects developed by Orange and Nalco within the Study area;
- 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

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 AoI. 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 with few portion of agricultural land and gravel waste that will be converted to non-agricultural land for industrial development.

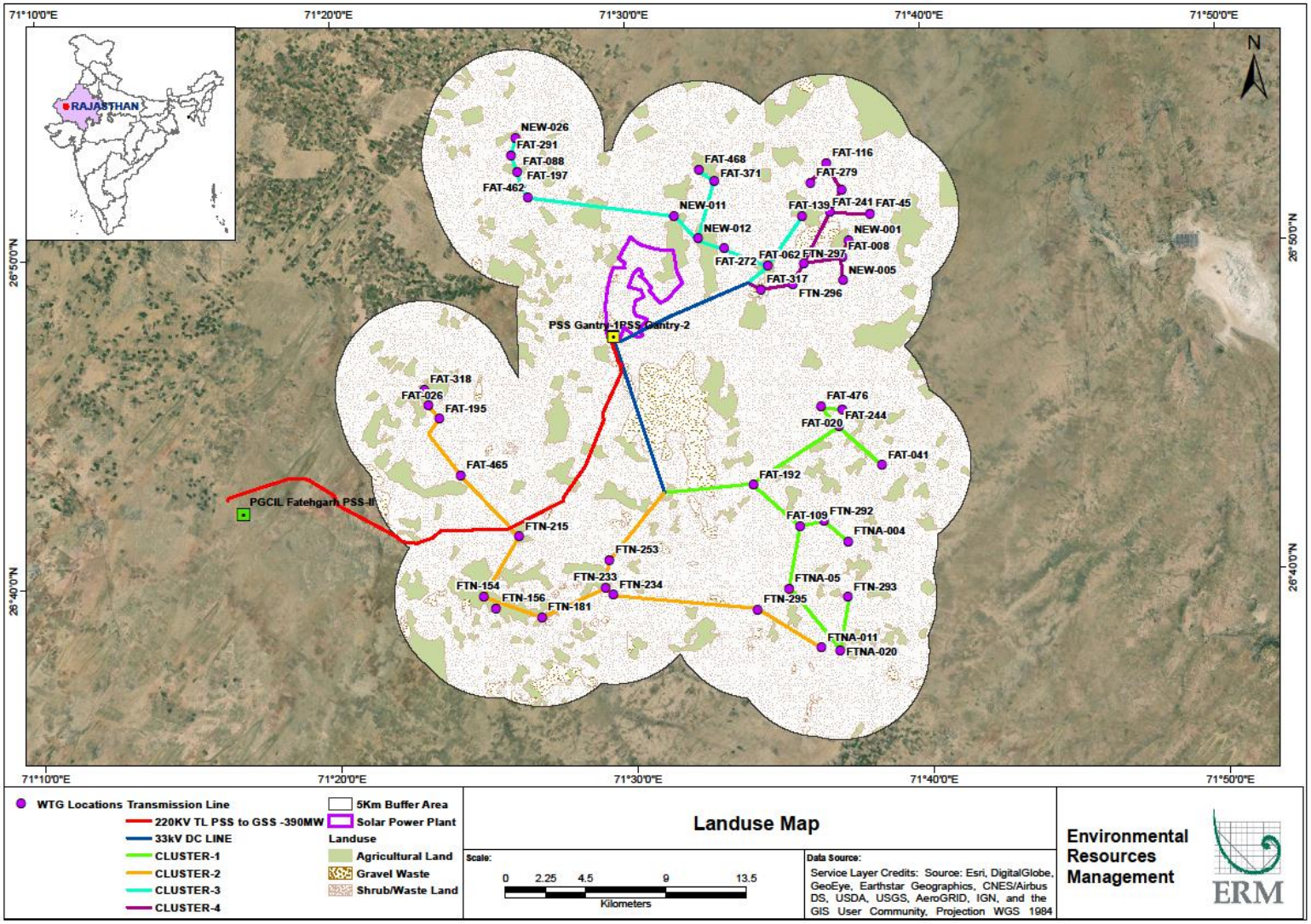
A detailed analysis of the land use and land cover has been presented in ***Table 5.3.*** Map displaying the land use/land cover within the study area is presented as ***Figure 5.2.***

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

Landuse Category	Area SqKM	Percentage
Agricultural Land	130.81	12.58
Gravel Waste Land	40.17	3.86
Shrub/Wate Land	869.11	83.56
Total	**1040.09**	**100.00**

Source: ERM India

Figure 5.2: Land Use and Land Cover of Project AoI

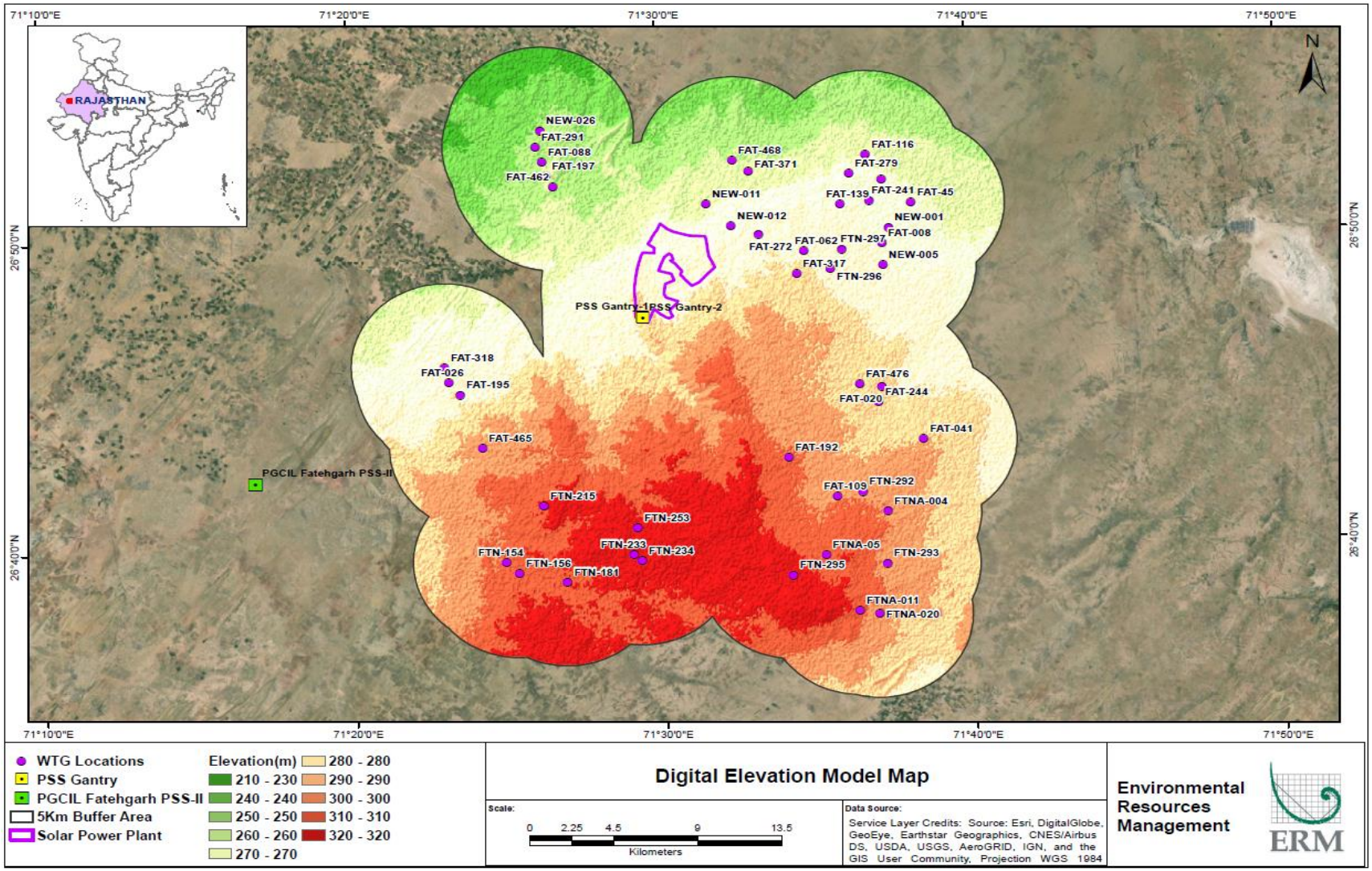


Source: ERM India

5.3.5 Topography

Based on satellite images and ERM site visit, it was observed that the solar plant is proposed to be located at an elevation of 280-290 amsl with elevation increasing from north to south. Similarly, majority of the WTG locations are finalised at an elevation ranging between 250-310 amsl with elevation increasing towards the south. Analysis of digital elevation map (***Figure 5.3)*** for Project shows a trend in elevations ranging from 240-320 metres above mean sea level in south direction which is indicative of flat, yet increasing elevations within the Project AoI, which contributes to undulating nature

Figure 5.3: Digital Elevation Map



Source: ERM India

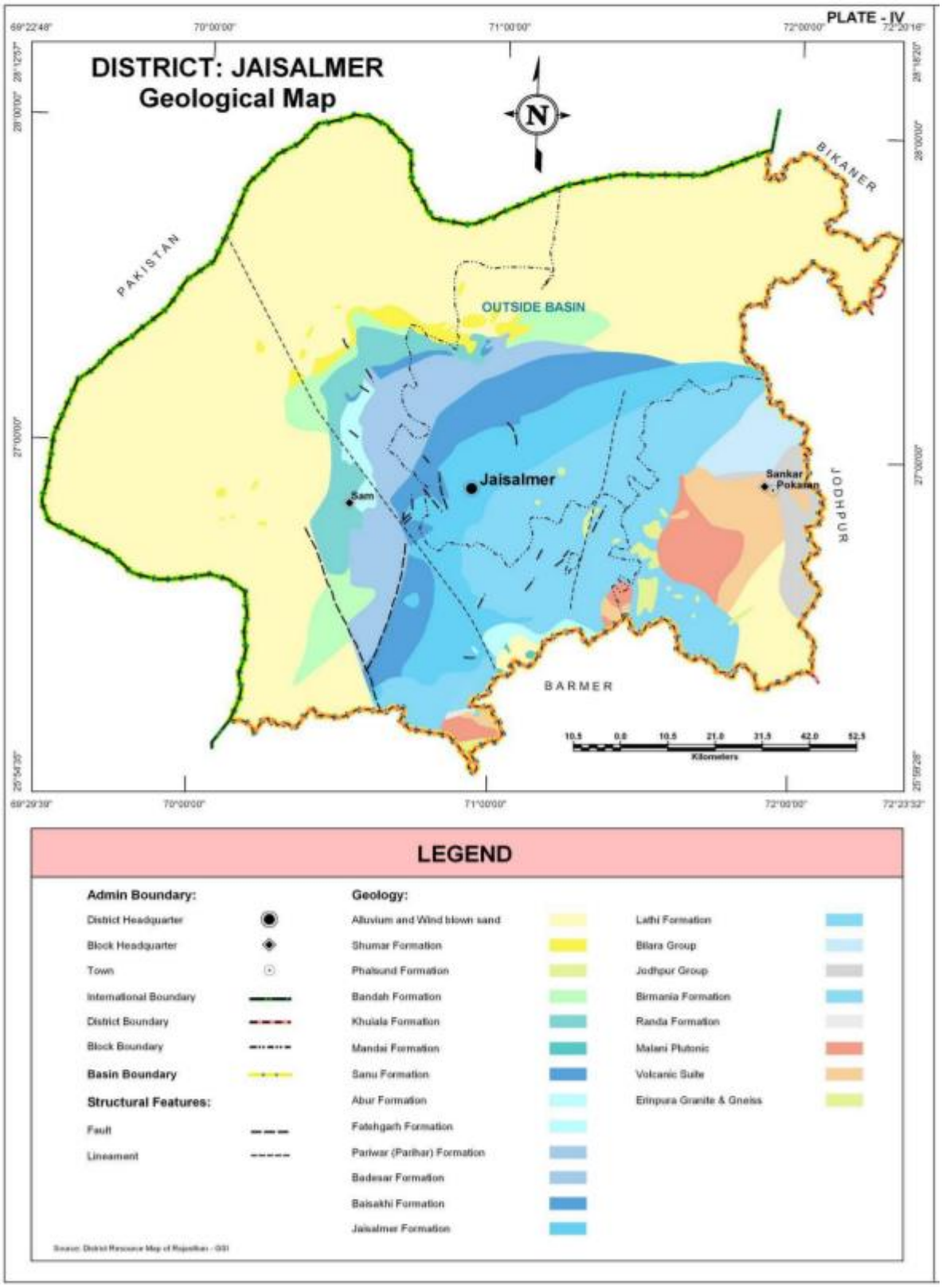
5.3.6 Geology

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, gluconitic 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		
		Birmania 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

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 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. 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 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. At Mohangarh, the main canal ends and further westward extension of canal is known as Sagarmal Gopa branch which takes southward bend near Ramgarh and is called Gadra Road sub branch. Major irrigation in the area is through Nachana Branch System, Sagarmal Gopa Branch System, Shaheed Birbal Shakha System and part of Charanawala Branch System. According to Indira Gandhi Nahar Department, Government of Rajasthan, proposed beneficiary districts from IGNP canal in Rajasthan are Sriganganagar, Hanumangarh, Bikaner, Jaisalmer, Jodhpur, Churu, Jhunjhunu, Sikar, Nagore and Barmer[11].

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.

[11] Jhunjhunu, Sikar, Nagore and Barmer districts can abstract water from IGNP canal only for drinking purpose.

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 activites 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 industries[12]. 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 AG(18)L has already completed. As mentioned earlier, AGE(18)L has submitted a request for obtaining access to 0.13 cusec of water from IGNP from Mohangarh pumping station (ref: vide no. AGE(18)L/ RRECL/ 390MW/ WATER/ 24072020 dated 24.07.2020).

Observations from ERM Site Visit

During ERM site visit, no major river was observed at the Project site except for small village ponds located near villages falling within core and buffer zone. A dry nallah was also observed approximately 5 km from the solar plant. As reported by local community, the nallah remains dry throughout the year and only gets water when there is heavy rainfall in the area. As observed in drainage map below, there are few dendritic to sub dendritic drainage channels passing through the study area. However, the drainage channels remain dry throughout and only receive water during monsoon season. ***Figure 5.4*** presents drainage pattern in the study area.

5.3.7.2 Surface Water Quality Assessment

The surface water quality assessment was done to understand the baseline surface water quality of the study area. The surface water samples were collected from village ponds from selected villages in the study area. A map showing location of water sampling is presented in ***Figure 5.10.*** The details of water sampling locations are presented in ***Table 5.5*** and the results of surface water quality assessment have been presented in ***Table 5.6.***

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 in June 2020

Table 5.6: Surface water analysis of the study area

Parameter	Units	Results		Permissible Limit [13]	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

[12] http://www.water.rajasthan.gov.in/content/water/en/ignd/dataroom/salientfeaturesofIGNP.html#

[13] As per IS 2296 Inland surface Water class C

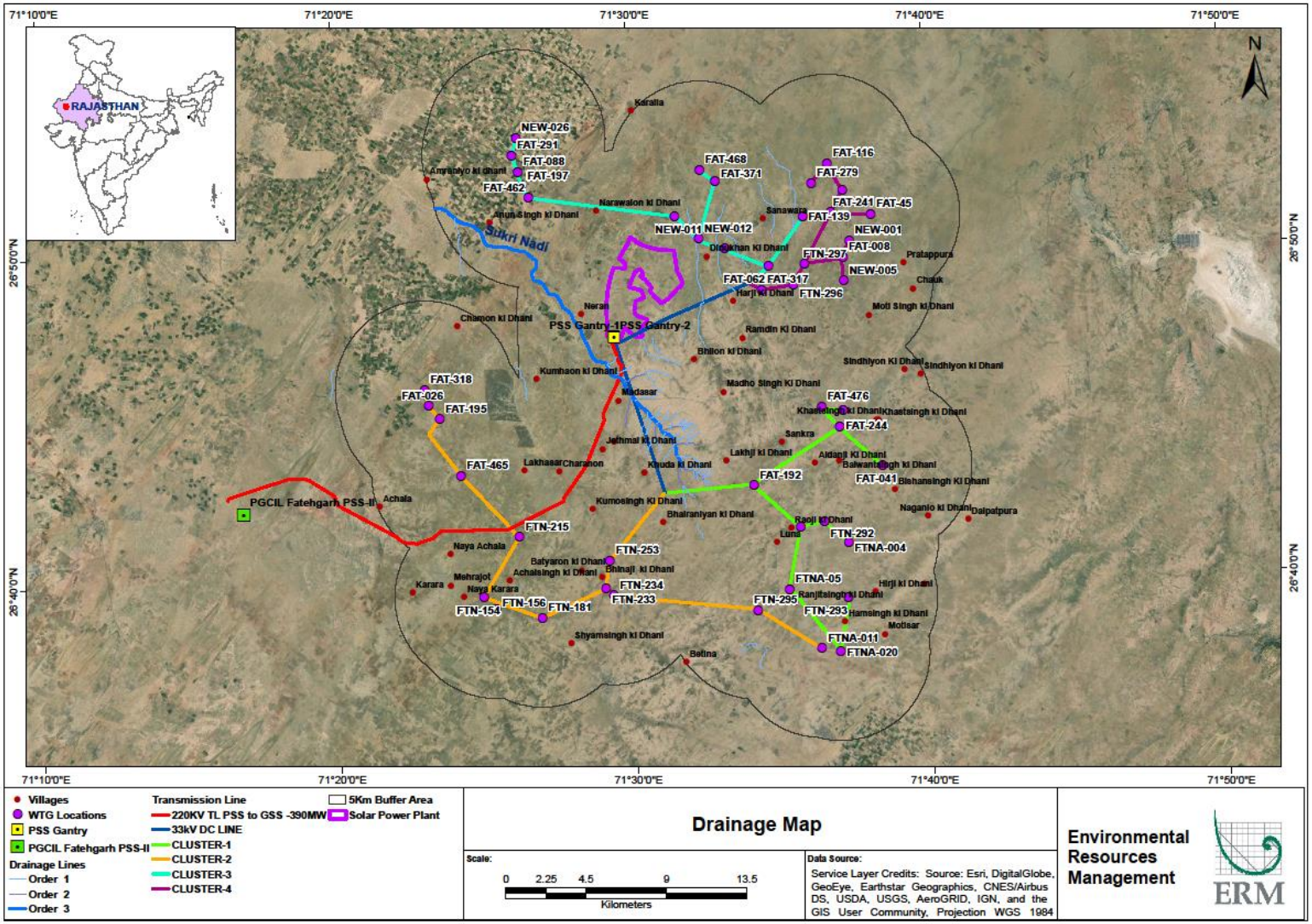
Parameter	Units	Results		Permissible Limit [13]	Test method
		SW 1	SW 2		
Electrical Conductivity	µS/cm	221.0	956.0	_	APHA 23nd Edn,4500H+B
Nitrite	mg/l	BDL (DL-0.02)	BDL (DL-0.02)	_	IS : 3025(P-34)
Nitrate	mg/l	BDL (DL-0.1)	0.8	50.0 Max	IS : 3025(P-34)
Dissolved Oxygen	mg/l	6.8	5.4	4.0 Min	APHA 23nd 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: Primary monitoring, 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 AoI



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.

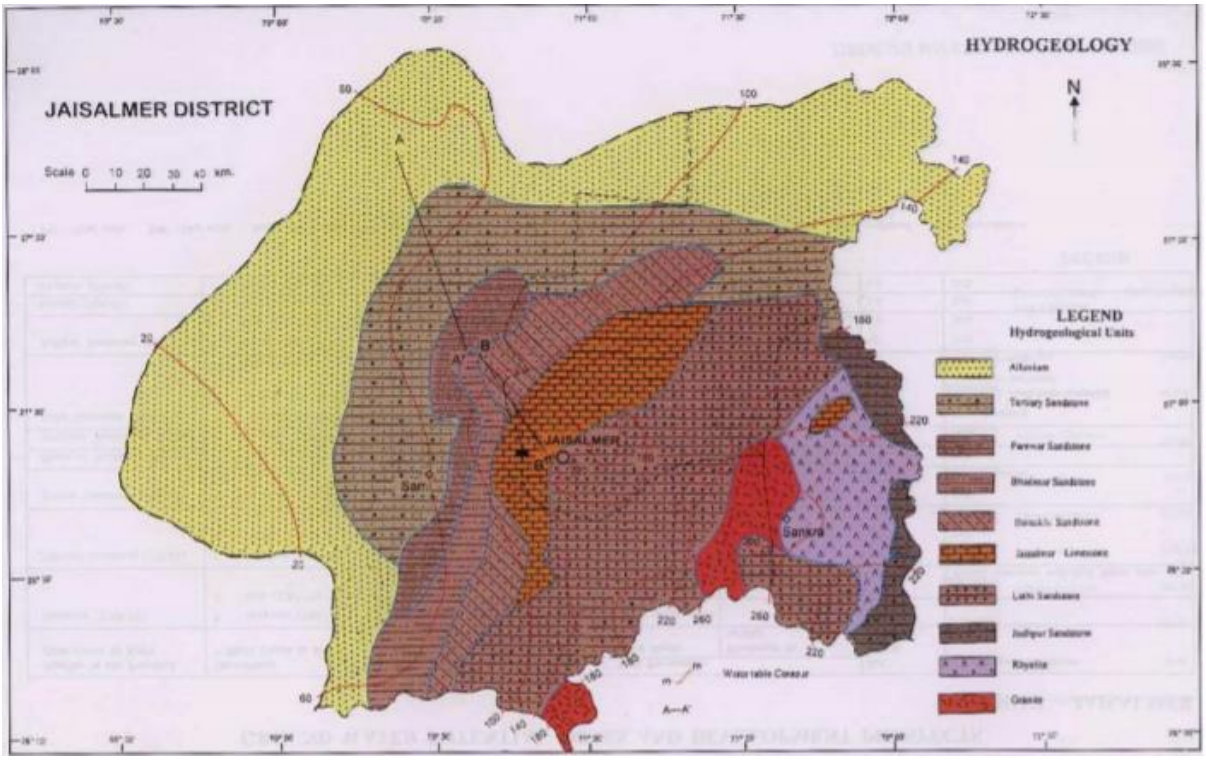
  Lathi sandstone is the most productive aquifer system in the district. Lathi basin covers an area of 7500 sq km, out of which only 3270 sq km area has usable quality of ground water. The ground water in Lathi occurs under perched as well as main water table conditions and under confined condition. The 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



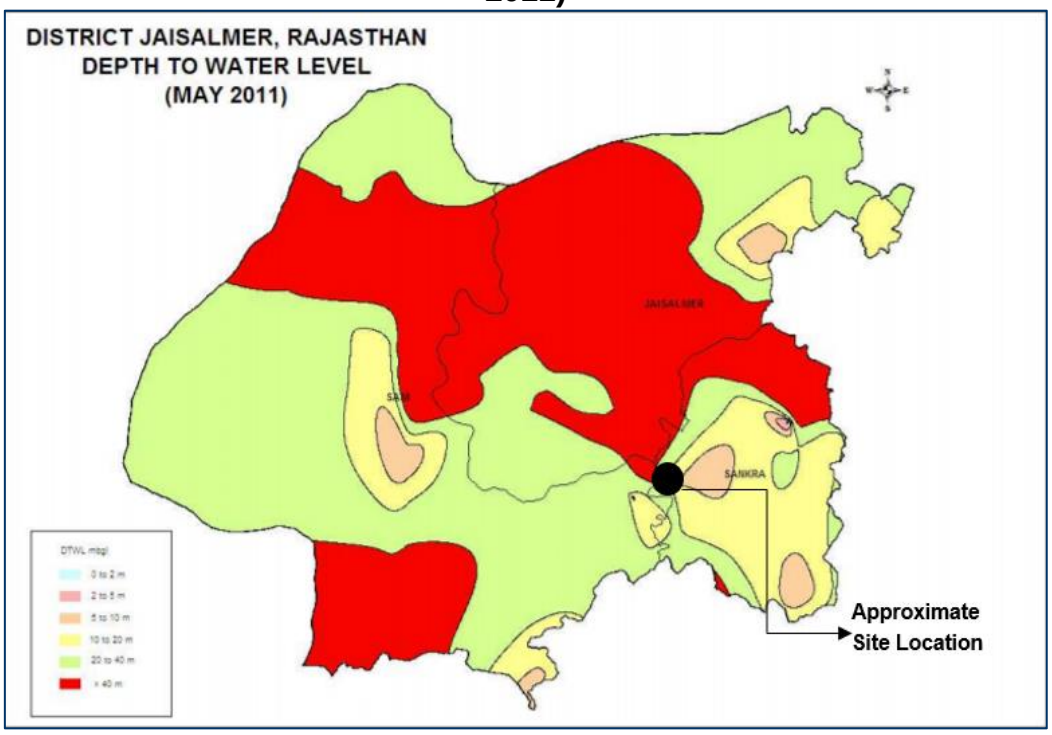
Source: CGWB, Information Brochure for Jaisalmer district, 2013

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.

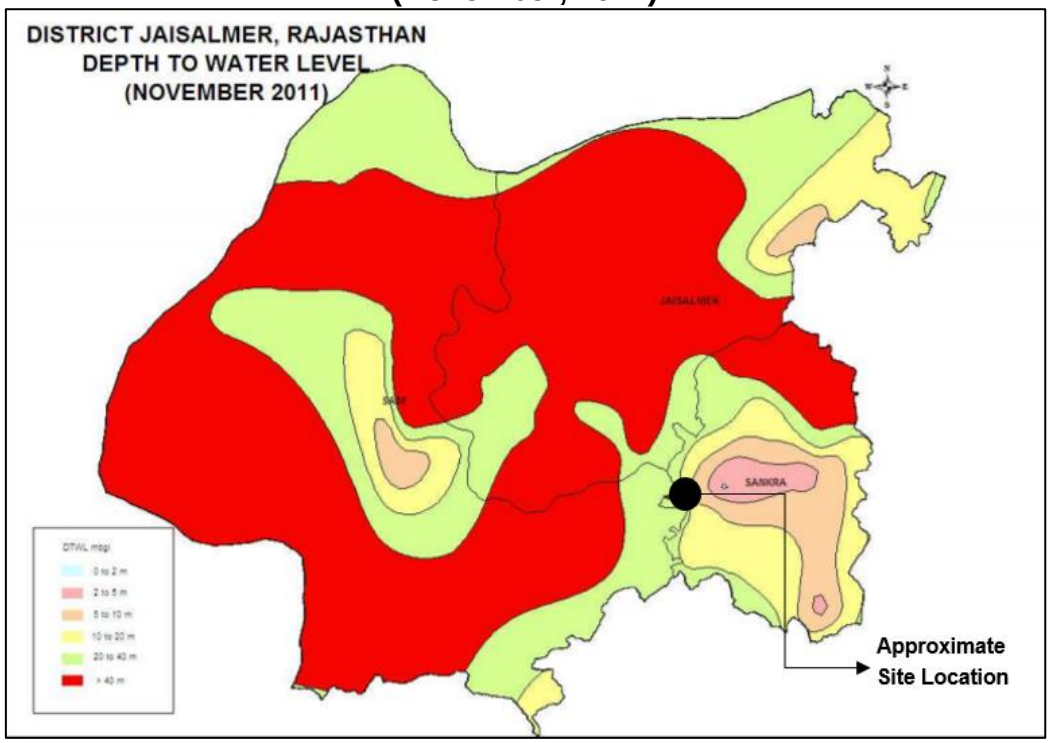
According to the study undertaken by CGWB for Jaisalmer district in 2013, the depth to water level in the district during pre-monsoon (2011) varied largely from 1.85 to 108.86 mbgl. Over a major part of the district, water levels are deeper (more than 20 m). Water levels more than 40 m were recorded in northern and southern parts of the district. As per 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)

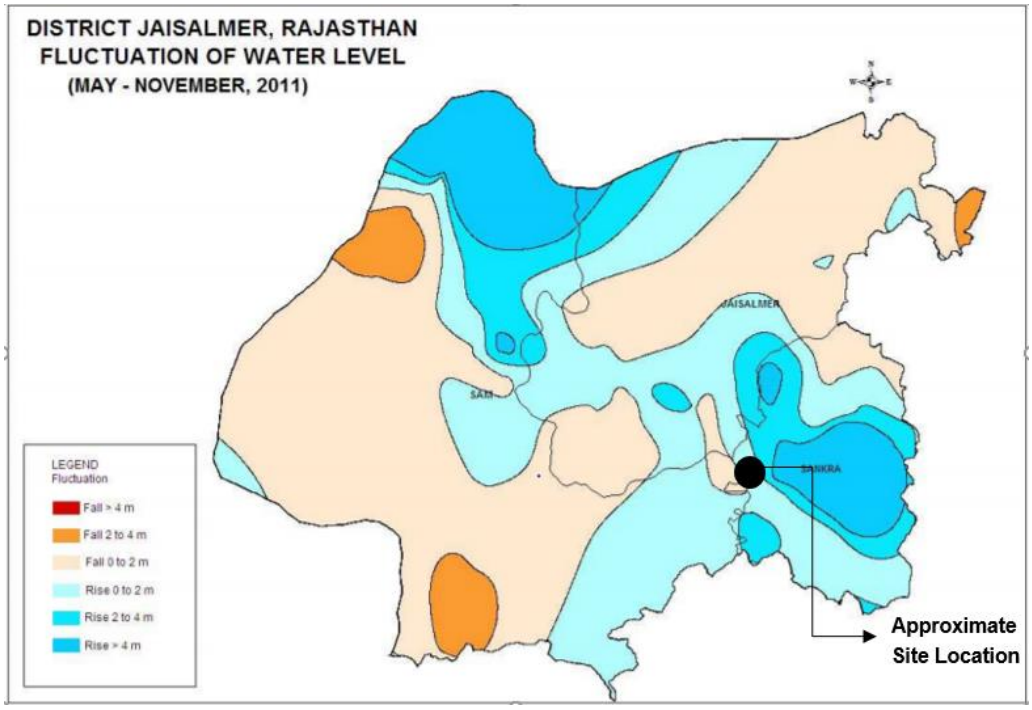


Source: Central Ground Water Brochure, Jaisalmer District, 2013

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. 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 µS/cm at 25°C at Khuiyala to 9800 µS/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 µS/cm at 25°C.

Groundwater Quality Assessment

The groundwater quality assessment was done to understand the baseline groundwater quality of the study area. The groundwater samples were collected from bore wells from selected villages in the study area. A map showing location of water sampling is presented in Figue 5.9. The details of water sampling locations are presented in ***Table 5.7*** and the results of ground water quality assessment have been presented in ***Table 5.8***: ***.***

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	Proposed Solar Power Plant in Madhopura Village	N 26°48'08.62" E 71°29'21.58"	

Source: ERM Monitoring conducted in 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 (Dl-0.1)	BDL (Dl-0.1)	BDL (Dl-0.1)	BDL (Dl-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: Primary monitoring, 2020 by avon lab,

** 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 limestone[14] 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 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.

[14] 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=7mNDHM7a6lMXQWl3OsFRH0;455611;j3gn6G58v)

- **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 four (04) locations in June 2020. Soil sampling locations are shown in Table 5.9. Soil analysis and results have been 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)
12.	Arsenic	mg/kg	1.07	1.85	2.45	3.51

S. No.	Parameters	Units	S1	S2	S3	S4
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: Avon Food Labs Private Limited

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 0.81-1.00: sufficient >1.0 more than sufficient
4	Nitrogen (kg/ha)	Up to 50 very less

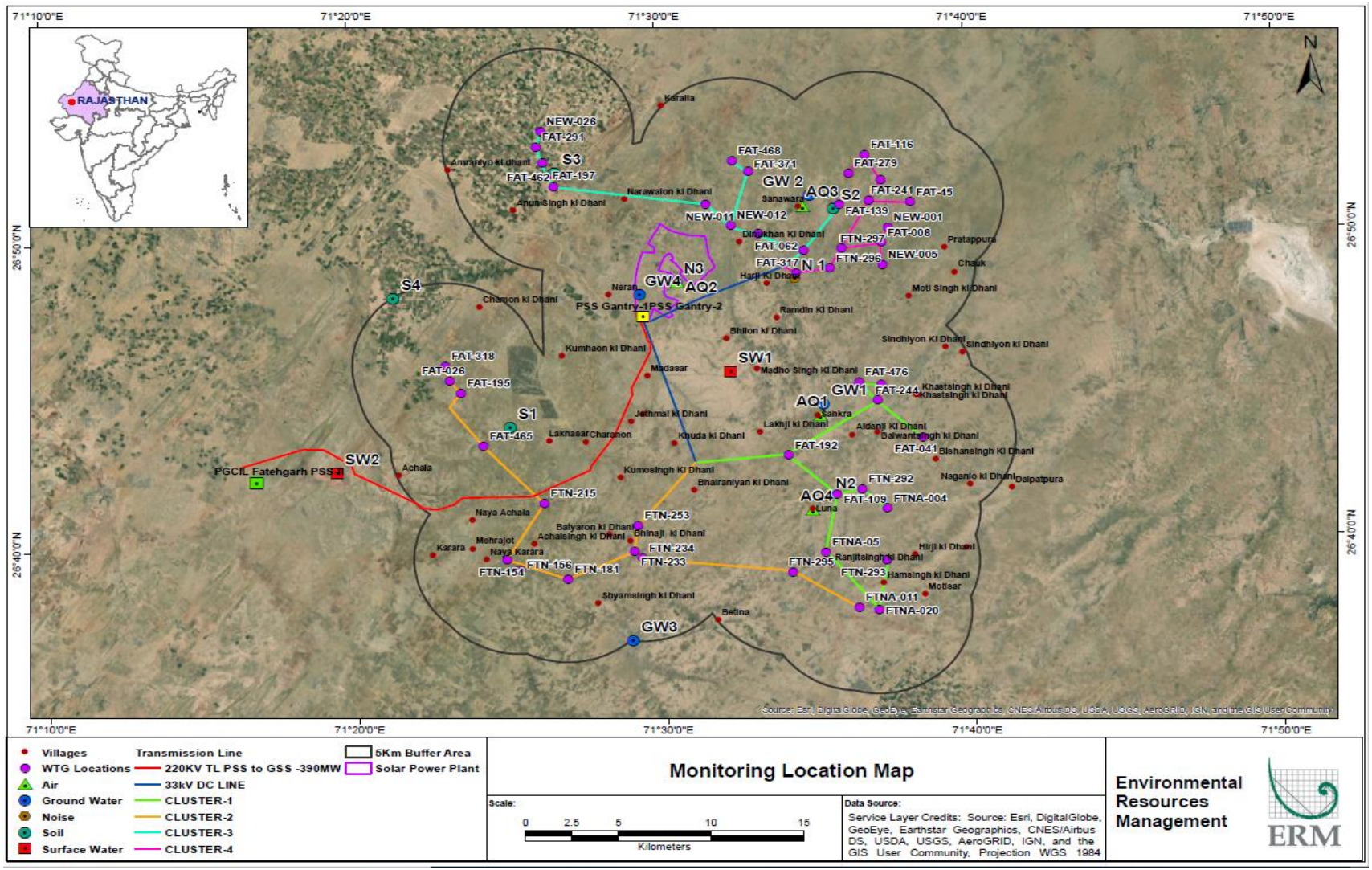
SN.	Soil Test Parameters	Classification
		51-100 less 101-150 good 151-300 Better >300 sufficient
5	Phosphorus (kg/ha)	Up to 15 very less 16-30 less 31-50 medium, 51-65 on an average sufficient 66-80 sufficient >80 more than sufficient
6	Potash (kg/ha)	0-120 very less 120-180 less 181-240 medium 241-300 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 µS/cm (S1), 384 µS/cm (S2), 680 µS/cm (S3) and 354 µS/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

Noise levels were recorded at three locations once during the study period with the aid of a digital noise level meter. Noise levels were recorded for 24 hours and the noise quality has been reported as Leqday and Leqnight for each of the locations. Daytime is considered from 0600 to 2200 hours and night from 2200 to 0600 hours. The details of noise monitoring locations are given in ***Table 5.12***. The noise level in the study area is detailed in ***Source:*** *ERM Monitoring conducted in August, 2020*

Table 5.13. A map highlighting the noise sampling locations within the Project AoI has been presented in ***Figure 5.10***.

Table 5.12 Details of 24 Hour Ambient Noise Monitoring Location

Location Ref	Coordinates (decimal degrees)		Nearest Village
	Latitude	Longitude	
N1	26°48'34.92"N	71°34'24.34"E	Chok village
N2	26°41'27.63"N	71°35'21.79"E	Achalpura village
N3	26°48'31.70"N	71°30'34.82"E	Madhopura village

Source: ERM Monitoring conducted in August, 2020

Table 5.13 Ambient Noise Levels in the Study Area

S.No.	Location	Recorded Levels		CPCB Permissible Levels (Residential)	
		Leq Day dB(A)	Leq Night dB(A)	Leq Day dB(A)	Leq Night dB(A)
1.	N1	53.23	48.30	55	45
2.	N2	49.01	50.89	55	45
3.	N3	48.72	53.16	55	45

Note*: Day time is considered from 6 am to 10 pm and night time is considered from 10 pm to 6am.*
Source: ERM Monitoring conducted in August 2020

The equivalent ambient noise level for day time (Leq day) at all the monitoring locations were observed to be within the prescribed CPCB limits However, the noise level during night time at all the three locations were observed to be exceeding the prescribed limit. The high noise levels during night time can be attributed to high wind speeds at night time in the area, vehicular movement, presence of settlements and presence of other turbines.

5.3.11 Air Quality

Existing ambient air quality of the study area was monitored at four (4) locations during the study period. The monitoring parameters, including Respirable Particulate Matter (RPM) i.e. PM_{10} (particulate matter of particle size less than 10 micrometres) and $PM_{2.5}$ (particulate matter of particle size less than 2.5 micrometres), Sulphur Dioxide (SO_2), Oxides of Nitrogen (NO_X) and Carbon Monoxide (CO). PM_{10}, $PM_{2.5}$, SO_2 and NO_X, were monitored on 24 hourly basis, while CO was monitored on 8 hourly basis for a week during the study period

The details of monitoring locations within the study area has been presented in the ***Table 5.14.*** .

Table 5.14: Air Quality Monitoring Location

S.No.	Sampling ID	Latitude	Longitude	Location
1	AQ1	26°44'6.18"N	71°35'7.64"E	Sankra Village
2	AQ2	26°48'31.70"N	71°30'34.82"E	Village
3	AQ3	26°50'55.84"N	71°34'42.29"E	Sanwara Village
4	AQ4	26°41'1.34"N	71°34'49.41"E	Loona Village

Source: ERM Monitoring conducted in August 2020

The sampling and analysis of ambient air quality parameters was carried out as per the procedure detailed in relevant parts of IS-5182 (Indian Standards for Ambient Air Quality Parameters). Results of ambient air quality monitoring undertaken within the Project study area have been presented in ***Table* 5.15**.

Table 5.15: Ambient Air Quality Monitoring in Study Area

S.No.	Parameter	Unit	AQ 1	AQ2	AQ3	AQ4	CPCB Permissible Limits
1.	PM_{10}	µg/m^3	61.8	53.6	58.7	55.1	100 (for 24 hours)
2.	$PM_{2.5}$	µg/m^3	25.2	20.8	23.9	22.6	60 (for 24 hours)
3.	Sulphur Dioxide (SO_2)	µg/m^3	11.7	14.6	17.2	17.6	80 (for 24 hours)
4.	Nitrogen Dioxide (NO_2)	µg/m^3	14.6	22.3	23.6	23.6	80 (for 24 hours)
5.	Carbon Monoxide (CO)	mg/m^3	0.569	0.379	0.542	0.774	2 (for 8 hours)

Source: ERM Monitoring conducted in August, 2020

Interpretation of Results

It was observed in the above table that none of the assessed parameters exceeded the permissible limits of Ambient Air Quality standards set by the Central Pollution Control Board (CPCB).

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

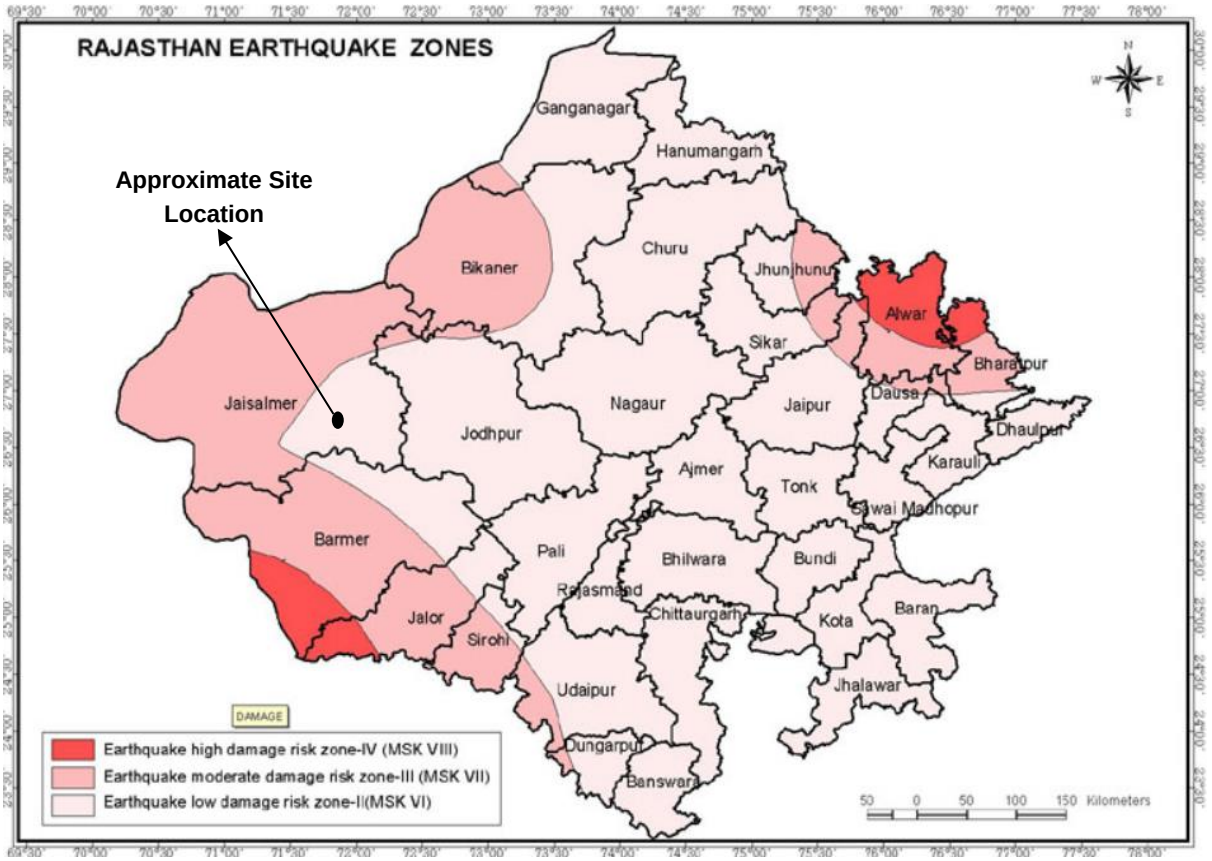
Table 5.16. Hazard zonation maps of the state for earthquake, wind/cyclone, flood and drought are presented in Figure 5.13, and Figue 5.14.

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 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.

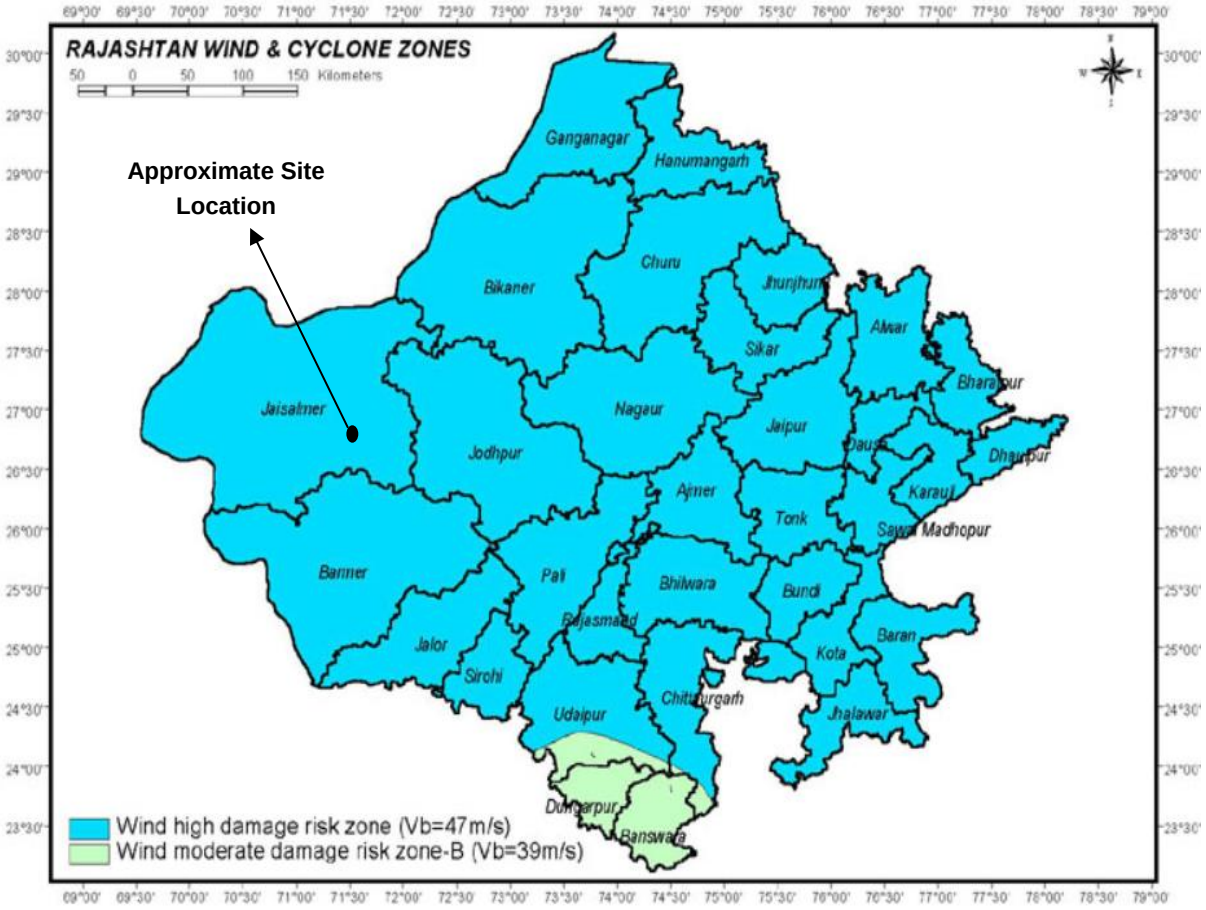
Source: Disaster Management, Relief & Civil Defence Department Rajasthan and Building Materials & Technology Promotion Council (BMTPC), Government of India.

Figure 5.11: Map Showing Earthquake Zones in Rajasthan



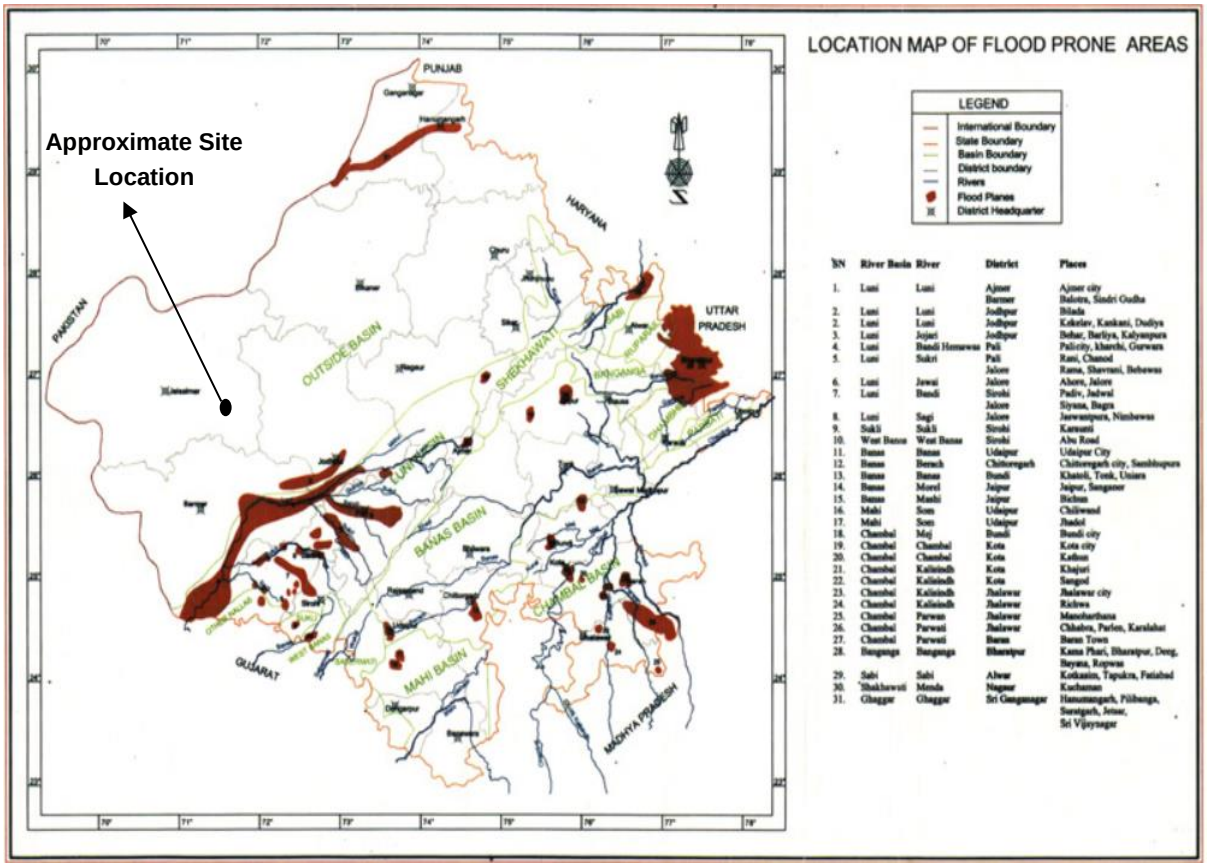
Source: Disaster Management, Relief & Civil Defence Department, Government of Rajasthan

Figure 5.12: Map Showing Wind and Cyclone Zones in Rajasthan



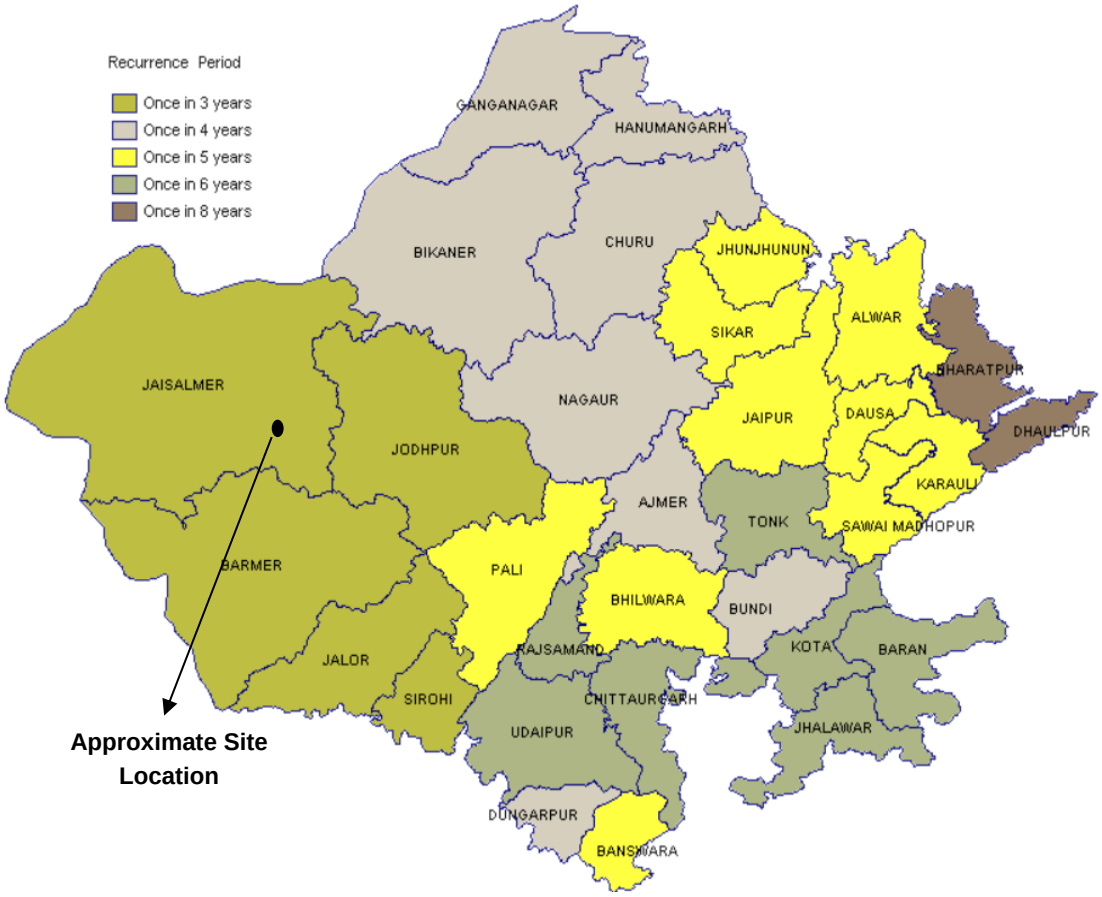
Source: Disaster Management, Relief & Civil Defence Department, Government of Rajasthan

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

5.4.1 Approach

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.

5.4.2 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 5.17** 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
June 26, 2020	Discussion with Project Site team	
June 26, 2020	Discussion with representative of M/s Riti Energy Private Limited (Local partner of ARE(18)L for land leasing for the project)	
June 26, 2020	Discussion with villagers of Madhopura village	The total land for the Solar plant has been leased out from the Madhopura village
June 26, 2020	Discussion with villagers of Sanawda village	19 WTGs out of 46 is located in the Sanawda village

As part of these consultation 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.

5.4.3 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:

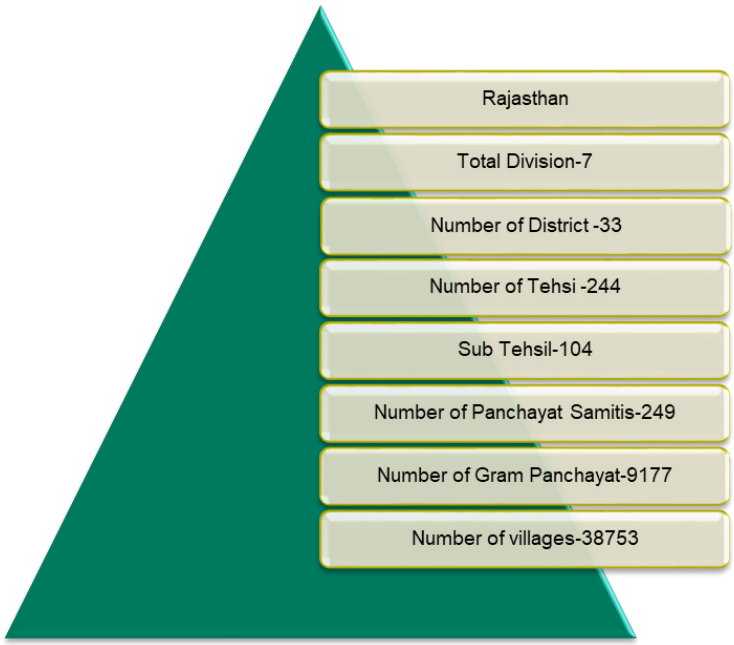
- District Census Handbook, Pokhran
- District Human Development Report, 2016
- Primary Census Abstract data of India, 2011
- Village Directory Census data of India, 2011; and
- Agricultural Contingency plan for Pokhran, 2011.

5.4.3.1 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 it 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.

Rajasthan has total divisions 7, number of district is 33, number of tehsil 244, number of sub tensil-104, number of panchayat samitis-249 and number of villages 38753.

Figure 5.15: Administrative Structure of Rajasthan



Source: Census of India 2011 data

The State comprises of a population of 6,85,48,437 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 5.18: 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	24.87	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

5.4.3.2 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 bounded 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 km[15].

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 low[16].

Table 5.19: 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)[17]	31.81
Total Households	1,17,171
Rural Households	1,00,427
Urban Households	16,744
Average Household Size	5.72
Sex Ratio[18]	852
Child Sex Ratio (0-6 age)	874
Population density[19] (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[20] (percent)	57.22
Male Literacy Rate (percentage)	72.04
Female Literacy Rate (percentage)	39.71

Source: Census of India 2011 data

[15] https://jaisalmer.rajasthan.gov.in/content/raj/jaisalmer/en/about-jaisalmer/geographical-and-physical-features.html# (Accessed on June 30, 2020)
[16] https://jaisalmer.rajasthan.gov.in/content/raj/jaisalmer/en/about-jaisalmer/geographical-and-physical-features.html# (Accessed on June 30, 2020)
[17] Population Growth from year 2001 to 2011
[18] It is the number of females per 1000 males.
[19] Population Density is a measurement of population per square kilometer
[20] It denotes ability to write a letter in any language. Literacy status assessment made for population 7 years and over.

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.

5.4.3.3 Tehsil Profile: Pokhran and Fatehgarh

The two tehsils of Pokhran and Fatehgarh comprise of nearly 60.4 percent of the total population of Jaisalmer district. In terms of SC population, Fatehgarh has a higher share of 16.04 percent in comparison Pokhran tehsil has 14.13 percent. The ST population in the tehsils is near with 6 percent in Fatehgarh and 5.7 percent in Pokhran tehsil. In terms of sex ratio, Pokhran tehsil exhibits a relatively higher number of females per 1000 males (878) in comparison Fatehgarh register sex ratio of 836 per 1000 males.

Table 5.20: Demographic Profile of Tehsil

Attribute	Jaisalmer District	Pokhran Tehsil	Fatehgarh Tehsil
Population	669919	303662	101020
% of District Population	100	45.33	15.1
% of SC Population	14.8	14.13	16.04
% of ST Population	6.3	5.7	6
Sex Ratio	852	878	836
% Total Literacy Rate	57.22	55.68	54.7
% Female Literacy Rate	39.71	37.9	35.3

Source: Census of India 2011 data

5.4.3.4 Area of Influence Profile (AoI)

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 “AoI” of the project, which is spread across villages spanning two tehsils of Jaisalmer district. The concentration of villages is higher in Pokhran tehsil as compared to Fatehgarh.

Figure illustrating the AoI of the project, denoting the boundaries marking, 2 km and 5 km (used for ESIA) from the project marked in the Top sheet. The villages lying in the core and buffer zone of the AoI are also listed in **Table 5.21**

Table 5.21: Core and Buffer Zone Villages

S. No.	Core Area Villages	Tehsil	S. No.	Buffer Area Villages	Tehsil
1.	Naya Sanawara	Pokhran	1.	Neran	Pokhran
2.	Sanawara	Pokhran	2.	Keraliya	Pokhran
3.	Chok	Pokhran	3.	Maheshon ki Dhani	Pokhran
4.	Khateswar	Pokhran	4.	Pratappura	Pokhran
5.	Madasar	Pokhran	5.	Sankra	Pokhran
6.	Bhainsara	Pokhran	6.	Sadrasar	Pokhran
7.	Motisar	Pokhran	7.	Khuhra	Pokhran
8.	Madhopura	Pokhran	8.	Lakhasar	Pokhran
9.	Rasla	Fatehgarh	9.	Baiteena	Pokhran
10.	Achla	Fatehgarh	10.	Motisar	Pokhran
11.	Balasar	Pokhran	11.	Loona Khurd	Pokhran
			12.	Loona Kalan	Pokhran
			13.	Achalpura	Pokhran
			14.	Mehrajot	Fatehgarh

Source: Census of India 2011 data

Note: Uttam Nagar in core villages was not found in the Census 2011 provisional data, therefore could not be used in the assessment of baseline of AoI

Demographic profile

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

Table 5.22: Demographic Profile of AoI

Villages	No. of HH	Population	Average HH Size	Sex Ratio	% SC	% ST	% Lit	% F Lit
Core Area								
Naya Sanawara	195	1102	5.66	813	1.81	12.7	51.23	25.46
Sanawara	304	1947	6.41	812	26.71	0.87	46.5	20.23
Chok	160	748	4.68	820	0	0.13	72.89	57.14
Khateswar	256	1701	6.65	754	11.17	0	57.68	31.3
Madasar	196	1274	6.5	943	25.75	0.16	54.41	34.69
Bhainsara	377	2063	5.48	854	10.42	0.78	61.72	36.64
Motisar	118	700	5.94	862	22.86	0	69.3	52.61
Madhopura	197	1175	5.97	828	0.43	17.28	54.28	30.94
Rasla	182	1047	5.76	932	32.19	0	61.53	46.21
Achla	65	462	7.11	848	0	0	45.41	18.54
Balasar	89	463	5.2	678	19	0	38.8	21.9

Villages	No. of HH	Population	Average HH Size	Sex Ratio	% SC	% ST	% Lit	% F Lit
Core Total	**2139**	**12682**	**6**	**832**	**14.7**	**3.1**	**55.7**	**33.47**
Buffer Area								
Buffer Total	**2463**	**14698**	**6**	**871**	**12.12**	**5.1**	**53.04**	**32.16**
AoI Total	**4602**	**27380**	**6**	**854**	**13.3**	**4.18**	**54.3**	**32.8**

Source: Census of India 2011 data

The core zone of the AOI comprises of 11 villages while the buffer zone has 14 villages, as listed in ***Table 5.8***. The core zone has 2,139 households supporting a population of 12,682 households. The average size of the households is 6 across the core and buffer zone. Out of the total villages in the core area, Madasar village has the highest sex ratio of 943 females per 1000 males.

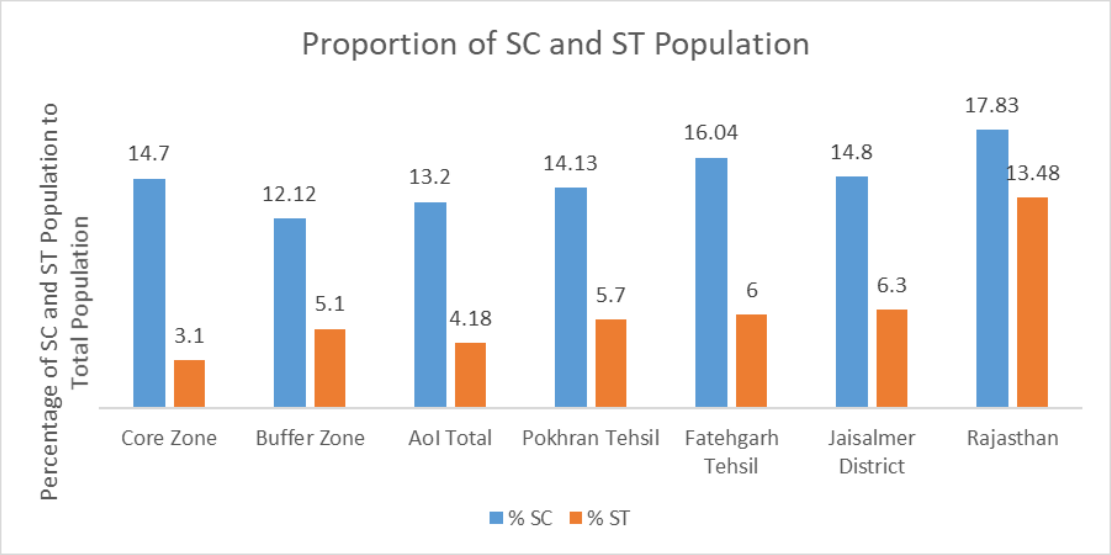
The buffer zone comprises of 2,463 households supporting a population of 14,698 individuals. The buffer zone exhibits a sex ratio of 871 females per 1000 males, which is higher than the district figure of 852 females per 1000 males.

In terms of total literacy rate is higher in the core area with 55.7 in comparison, the literacy rate in the buffer area is 53.04. The proportion of SC population is also nearly equal in core and buffer area with 14.7 percent and 12.12 percent respectively, and so is the ST population distribution with 3.1 percent in the core area and 5.1 percent in the buffer area.

Social Stratification

The 100 percent of the population in the AoI falls in the rural category. The SC population in the core and buffer zone distributed to 14.7 percent and 12.12 percent, respectively. In comparison between tehsils Fatehgarh Tehsil (6 percent) have slightly higher SC population then Pokhran (5.7 percent). The major ST sub caste in the tehsils 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 landless household.

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



Source: Census of India 2011 data

While Rajasthan has a considerable proportion of the ST population (13.48 percent), the presence of ST population is relatively low in the district, and the AoI. ST population has a contribution of 3.1

percent in the core zone and 5.1 percent in the buffer zone. Madhopura village, lying in the core zone, has the highest ST population amongst all core zone villages, with a share of 17.28 percent. The Bhil tribe is the major Schedule Tribe in AoI.

As reported by the local community during the consultation, there is no reported caste based distinction in terms of habitation patterns, with the various caste groups residing together in the villages. Reportedly, there is no difference across the social groups in terms of access to resources and economic opportunities.

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

- ***Rajput:*** The Rajput caste has the majority of the population in AoI. 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 AoI, most of the irrigated land is owned by Rajput.
- ***Meghwal:*** The Meghwals are primarily found in the north-western asrts of India and belong to the Scheduled Caste. Traditionally, they have been a part of the weaver community in India.
- ***Manganiar:*** Manganiars belong to both Hindu and Muslim communities in the desert of Rajasthan and border of Pakistan. They are famous for their classical folk music. They are the groups of hereditary professional musicians, whose music has been supported by wealthy landlords and aristocrats for generations.
- ***Suthar:*** The Suthar or Sutar is a Hindu caste within the Vishwakarma community of India. They are also found in the province of Sing 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 engage 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 are fair share of Muslim community in AoI. As per the consultation with local community there are some proportion of population are Muslim population in every villages of AoI.

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 Bhil[21].
The Bhil tribe makes up 39% of the total tribal population of Rajasthan and is the largest tribe in South Asia. Classifies in two groups, there are Eastern or Rajput Bhils and the central or pure Bhils[22].
In the history of Rajasthan, Bhil people are depicted as important warriors and many Rajput rulers showed faith in them, including instances during battles with Marathas and the Mughals. However, as time passed by, they occupied themselves in small scale agriculture, labor, manufacturing and repairing machinery, leaving their famed profession of archery behind. The Bhils are also skilled wall painters and their paintings, known as Mandno, can be seen on the walls of their houses and temples. The primary language spoken by Bhils tribe in India is an Indo-Aryan language Bhili[23].

[21] http://ignca.gov.in/divisionss/janapada-sampada/tribal-art-culture/adivasi-art-culture/the-bhils-of-rajasthan/ (Accessed on July 01, 2020)
[22] https://www.ohmyrajasthan.com/bhil-tribe-rajasthan (Accessed on July 01, 2020)
[23] https://www.ohmyrajasthan.com/bhil-tribe-rajasthan (Accessed on July 01, 2020)

Land use pattern

The ***Table 5.23*** denotes that in the AoI the land cover under the net sown area (50.33 percent) which is approximately equal to other category of land use. It is important to note that there is no land covered under the forest area and the land covered under the non-agricultural use, i.e. 2.34 percent of the total geographical area. Land covered under the permanent pastures and other grazing land is calculated to 9.2 percent of the total geographical area coming under AoI.

Table 5.23: Land Use Pattern in Core, Buffer

Name of the village	Total Geographical Area (in Hectares)	Forest Area (in Hectares)	Area under Non-Agricultural Uses (in Hectares)	Barren & Un-cultivable Land Area (in Hectares)	Permanent Pastures and Other Grazing Land Area (in Hectares)	Land Under Miscellaneous Tree Crops etc. Area (in Hectares)	Culturable Waste Land Area (in Hectares)	Fallows Land other than Current Fallows Area (in Hectares)	Current Fallows Area (in Hectares)	Agricultural land (in Hectares)
Core Area										
Naya Sanawara	4980	0	15	0	0	0	10	1584	386	2985
Sanawara	8552.04	0	64.04	74	663	0	958	0	2130	4663
Chok	1998	0	83	7	322	0	0	249	111	1226
Khetasar	4623	0	6	19	20	0	58	507	7	4006
Madasar	3352	0	52	2	87	108	261	207	118	2517
Bhainsara	6180.52	0	16.94	937.79	838.7	0	0	2162.9	94.99	2129.2
Motisar	2488	0	8	564	107	0	312	137	89	1271
Madhopura	5996	0	16	20	247	0	1257	1368	23	3065
Rasla	6235.68	0	78.52	2.75	1046.84	0	3569.77	0	0	1537.8
Achla	1215.31	0	12.01	19.51	297.63	0	375.59	0	0	510.57
Balasar	1247.64	0	15.97	10.99	0	0	102.95	584.89	20.89	511.95
% Core Total	**46868.19**	**0**	**0.78%**	**3.53%**	**7.74%**	**0.24%**	**14.73%**	**14.51%**	**6.36%**	**52.11%**
Buffer Area										
% Buffer Total	**40376.16**	**0**	**4.11%**	**2.32%**	**10.6%**	**0%**	**21.16%**	**8.15%**	**5.25%**	**48.41%**
% AoI Total	87244.35	**0**	**2.32%**	**3**	**9.1%**	**0.12%**	**17.7%**	**11.56%**	**5.8%**	**50.4%**

Source: Census of India 2011 data

Table 5.23 represent that a considerable proportion of land area in the core zone comes under land sown area (52.41 percent) which is approximately equal to other category of land use. However, it is to be noted that the farmers are dependent on rain for irrigation of land.

As can be seen in the **Table 5.23** of land use in buffer zone, the same pattern of land use can be found. With almost half (48.2 percent) of the total geographical area is falling under sown area.

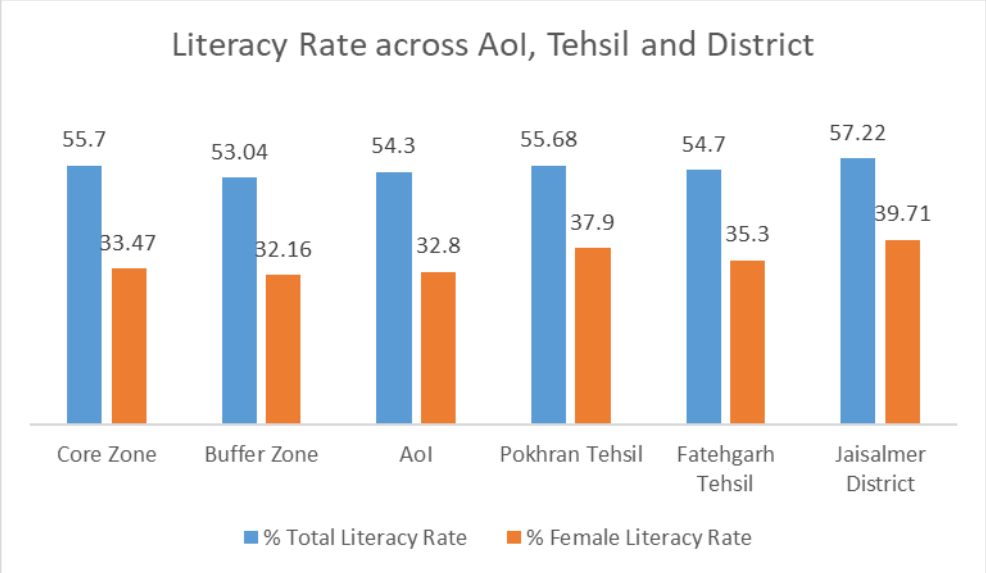
Literacy Profile

The status of male literacy rate (72.1 percent) in the AoI is much higher than the female literacy rate (32.8 percent); the same can be seen in the core zone, the female literacy in core zone is 33.88 percent in comparison the male literacy rate is 76.07 percent. The total literacy in the core and buffer zone is 55.7 percent and 53.04 percent respectively, are lesser than that the district figures of 57.22 percent.

The consultation suggest that the girls are not given equal opportunities to study, as boys. The other reason behind the low female literacy rate is unavailability of higher education schools in the village, early marriages and local doesn't prefer girls to send them far away from the villages to study, which resulted in lower educational attainment and higher dropout rate of girls child.

The boys usually complete school education and those belonging to financially affluent families go for graduate courses in colleges or join technical courses like Industrial Training Institutes (ITI), while other are pulled into work to support their respective families economically.

Figure 5.17: Comparative overview of the Literacy Rate across AoI, Tehsil and District



Source: Census of India 2011 data

Livelihood Profile

The AoI is categorized by 47.94 percent working population (main and marginal workers) in the core zone and 38.15 percent working population in the buffer zone. Majority of the working population of the AoI (47.31 percent) comes under "main workers", i.e., being employed for more than six (6) months in a year. The core zone population nearly 38.15 percent of Main workers, the buffer zone have percentage of 61.85 percent coming under Main workers category. There is a significant ratio of non-working population in the AoI (52.06 percent in the core zone and 60.17 percent in the buffer zone) which includes children, the older people or unemployed youth.

Table 5.24: Proportion and Breakup of working population in AoI

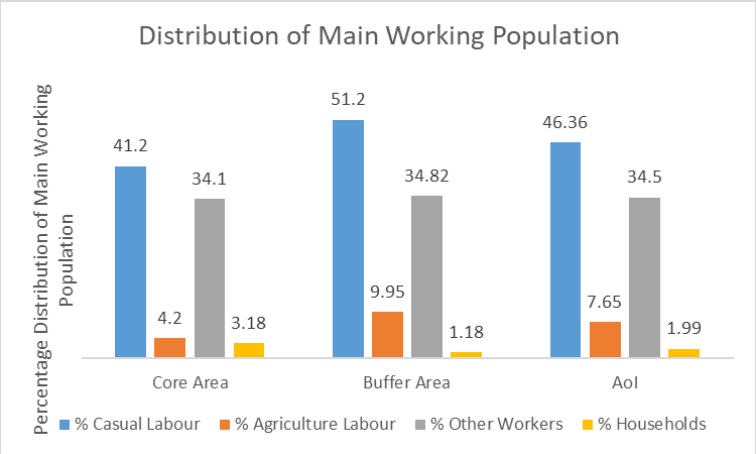
Villages	Working Population Ratio	Main worker(% of total working population)	Marginal (% of total working population)	Non-working population(% of total population)
Naya Sanawara	42.56	46.48	53.52	57.44
Sanawara	46.79	49.73	50.27	53.21
Chok	47.99	46.8	53.2	52.01
Khetasar	58.79	55.6	44.4	41.21
Madasar	44.82	31.7	68.3	55.18
Bhainsara	44.6	29.35	70.65	55.4
Motisar	55.29	3.62	96.38	44.71
Madhopura	49.45	23.24	76.76	50.55
Rasla	41.83	31.74	68.26	58.17
Achla	48.05	45.5	54.5	51.95
Belsara	76.02	44.71	71.2	24
Core Total	**46.2**	**25.47**	**31.2**	**51.06**
Buffer Total	**39.83**	**23.75**	**17.3**	**60.17**
AoI Total	**42.8**	**24.6**	**23.7**	**55.9**

Source: Census of India 2011 data

Out of the main working population, majority of the population can be categorised as other labours[24] who are involved working in lignite mines, small entrepreneurs and some owned petty shops, in comparison cultivators or agricultural labourers, and animal husbandry has a considerable percentage (34.5 percent).

However, the impact of the hybrid project on employment in the AoI could not be established at the time of the assessment, as several projects are in a planning stage.

Figure 5.18: Distribution of Main Working Population in the AoI



Source: Census of India 2011 data

[24] As per Census 2011, Workers other than cultivators, agricultural laborers or workers in Household Industry, is defined above are termed as **Other Workers**. Examples of such type of workers are government servants, municipal employers, teachers, factory workers, plantation workers, those engaged in trades, commerce, business, transport, banking, mining, construction, political or social work, priests, entertainment artists, etc.

The following categories comprise the main occupational activities within the AoI:

- Farm Based Activities: Cultivators, Agricultural Labourers and Livestock rearing;
- Non-farm based activities: Artisans, Contractual Labours in graphite mining and petty shops.

Farm Based Livelihood

As can be seen from ***Figure 5.18***, the farm-based livelihoods play a restricted role in the AoI, contributing only 34.47 percent of the main livelihoods. This is reported to be the result of the limited irrigation facility. Agriculture is majorly dependent on rains and increasing preference amongst the youth for non-farm based livelihoods as well as the decreasing landholdings and agricultural productivity in the area and the rising costs of production.

The agriculture-based livelihood category comprises of cultivator, sharecroppers and agriculture labours.

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. 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, and wheat are the major food crops, 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.

Table 5.25: 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 Consultation undertaken by ERM India, June 2020

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, June 2020

Animal husbandry is the second largest employment providing activities in AoI after agriculture. Animal husbandry is a supplementary activity with agriculture. Animal husbandry is one of the main sources of livelihood for the local community in AoI. Goats and Sheeps are reared for meat, milk, hair and skins in AoI, mainly farming communities as a supplementary income source from milk. Camel and Donkey are reared for breeding purpose and selling them as load-carrying animals.

The Grazing-based livestock production is the most prevalent source for the people in the region, extending to those with access to land and other resources in the AoI. The grazing-based livestock is primarily located in rain fed-dryland areas is dependent on the Commons, both land and water resources which include pastures, barren and uncultivated land and agricultural fallows.

Non-Farm Based Livelihood

According to the consultation with the local community, the non-farm based livelihoods acts as a supplementary source of income to the families in the area, with the households relying on this income to buffer against the fluctuations in agriculture and to provide sustenance during the non-cultivation periods (summer). The non-farm based livelihoods in the area primarily comprise of casual labour involved in local construction work, graphite mines as labour, and in other wind power project as a security guards etc. The daily wage rate for men was reported to be INR 400 per day and INR 300 per day for women

Similarly, demand for casual labour in social infrastructure projects in the locality under the Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA) has also increased. This form of livelihood is restricted only to the younger men of the household. There is lack of economic opportunities in the area due to lack of development.

In terms of industrial and service-based livelihoods, the self-employment (as small entrepreneurial) services is the other source of non-farm based livelihood in the AoI. The local community was reported to be engaged in entrepreneurial activities such as running small shops, provision stores and other petty shops.

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 over agriculture.

Social and Physical Infrastructure

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.

Figure 5.19: Figure of Water tanks and water supply

It can be observed from ***Table 5.26*** that all the villages in the study area have access to the canal, well/tube well and tanks/lakes. It is understood that the facility of tubewell/borehole is available in 9 villages and facility of Tank/Pond/Lake is available in 19 villages in the AOI. The table indicates that the facility of river/canna, handpump are also available. 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 5.26: Source of Water in AoI

Name of the village	Tap Water-Treated	Covered Well	Hand Pump	Tube Wells/Borehole	Spring	River/Canal	Tank/Pond/Lake	Others
Core Area								
Naya Sanawara	1	0	1	1	1	0	1	0
Sanawara	0	0	1	1	1	0	1	0
Chok	0	0	1	0	0	0	1	0
Khetasar	0	1	1	1	0	0	1	0
Madasar	1	0	1	1	1	1	1	1
Bhainsara	1	0	1	1	1	0	1	1
Motisar	0	1	1	0	0	0	1	1
Madhopura	0	0	1	0	0	0	1	0
Rasla	1	0	1	0	0	0	1	1
Achla	0	1	0	0	0	0	0	1
Balasar	0	1	1	0	0	0	1	1
Core Total	**4**	**4**	**10**	**5**	**4**	**1**	**10**	**6**
Buffer Area								

Name of the village	Tap Water-Treated	Covered Well	Hand Pump	Tube Wells/Borehole	Spring	River/Canal	Tank/Pond/Lake	Others
Buffer Total	**3**	**6**	**11**	**4**	**4**	**2**	**10**	**8**
AoI Total	**7**	**10**	**21**	**9**	**8**	**3**	**20**	**14**

Source: Census of India 2011 data

As part of CSR initiative under community infrastructure program, Project has already budgeted the program of deepening and strentgning of village ponds.

Cooking Fuel

It was observed during the site visit and the consultation with the local community, most of the households have LPG (Liquefied Petroleum Gas) connections and is one of the important sources of cooking fuel. However, some households are dependent on the nearby area like the forest area and the shrub land near the village to collect the firewood which is used as fuel.

Figure 5.20: Firewood Collected

Electricity

All the villages in the AoI have access to household electricity supply. However, it was reported during consultations that there is power outages of 2-4 hours daily, with increased power cuts in the summer months.

To improve the community infrastructure in nearby villages that are falling in the proximity of Project. The Project has passed the budget for the installation of solar lights.

Education

It can be observed from the ***Table 5.27*** that in the study area the number of the primary schools 27 which is comparatively more in number than the number of secondary schools (6) and senior secondary schools 3 in the AOI and in each village except Achla there is a primary school.

Table 5.27: Educational Infrastructure in AoI

Village Name	Government Pre - Primary School (Nursery/LKG/UKG) (Numbers)	Government Primary School (Numbers)	Government Middle School (Numbers)	Government Secondary School (Numbers)	Government Senior Secondary School (Numbers)
Core area					
Naya Sanawara	0	1	1	0	0
Sanawara	0	1	1	1	0
Chok	0	1	0	0	0
Khetasar	0	3	3	0	0
Madasar	0	1	1	1	1
Bhainsara	0	2	1	1	1
Motisar	0	1	0	0	0
Madhopura	0	3	3	0	0
Rasla	0	1	1	1	0
Achla	0	0	0	0	0
Balasar	0	0	0	0	0
Core Area Total	**0**	**14**	**11**	**4**	**2**
Buffer Area					
Buffer Area Total	**0**	**13**	**6**	**2**	**1**
AoI Total	**0**	**27**	**17**	**6**	**3**

Source: Census of India 2011 data

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.

Adani at the corporate level has a CSR policies, and in the commitement to undertake CSR activities. AGEL in accordance with the CSR policy, aimed to provide education support in the villages that are falling under the close proximiety of the Project. In present 29 schools from 9 villages and 20 dhanis are being covered under the education supporting programmes.

Following activities have been initiated to undergo in nearby schools:

- Digital literacy program: 30 students registered under digital literacy program;
- Distribution of woolen sweaters: 3500 units distributed;
- Installation of Solar Lights: 50 solar lights installed;
- Distribution of mid-day meals: 3500 students;
- Distribution of school bags: 2000 students;
- Distribution of school furniture: 450 benches to benefit 900 students; and
- Distribution of sports kits.

Health Facilities and Health Seeking Behaviour

The health facilities in the study area are characterised by a three-tier health infrastructure. The health facilities available at the village level comprise of Primary Health Sub Centres and Public Health Centres (PHC). While the sub-centres cater to a population of 5,000 individuals, the PHCs are for a population of 10,000-30,000 individuals. While the PHCs are mostly for OPD (Out Patient

Department) and basic IPD (In-Patient Department) cases, sub-centres usually have a delivery room and two resident nurses (one male and one female). Each PHC has 5-6 sub-centres under them. In turn, a cluster of 6-10 PHCs come under a CHC (Community Health Centre), which caters to a population exceeding 1 lakh, and also provides emergency services. The CHCs, in turn, report to the public hospitals at the district level.

As reported by the local community, there are PHC in every village and only 1 CHC at Pokhran in the area. However, in case of serious illness, 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 5.21: Number of Health Facility amongst core, buffer and AoI

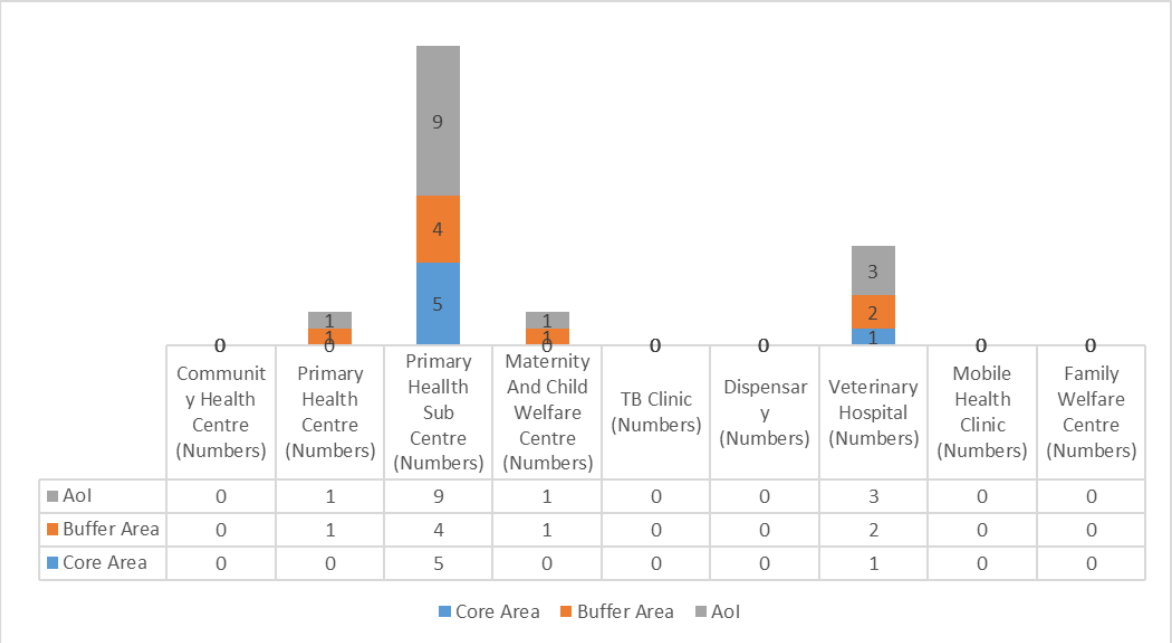


Figure 5.21 presents the details of the health facilities available in the study area. There is no Community Health Centre (CHC) in the study area and only 1 Primary Health Centres (PHC) in the AOI, although, it is understood through the table that the number of primary health sub-centre (9) is significantly higher than the CHC and PHC.

The below table also indicates that the non –government medical facilities out the patient is more in number than the primary or community health centre. It is important to note that in the study area, there is 3 veterinary hospital

5.5 Ecology and biodiversity baseline

Primary ecological surveys were undertaken from 6th to 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 day[25]. 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[26] [27]. 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 study[28]. 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 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 guides[29] 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.

Limitations

- 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

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

[26] 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 Califirnia's hardwood resources. T.R. Plumb, N.H. Pillisbury (eds. Gen. Tech. Regional Environmental Planning. PSW – 100) US Department of Agriculture, Forest Service

[27] 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.

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

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

- As rapid surveys were undertaken for a short duration, report does not address seasonal variability of the data.

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 5.2.**

5.5.3.1 Scrublands and sand dunes

The predominant haitat 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 sindicum, Aristida funiculate, Tragus racemosa, Cyperus bulbosus* and *Cymbopogon jwarancusa* can be seen.

5.5.3.2 Agricultural land

The agriculture in the study area is mostly rain fed 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 sepcies such as *Prosopis cineraria* and *Tecomella undulata Ziziphus. nummularia*, *Ziziphus mauritiana*, *Clerodendrum phlomoidis*, *Balanites aegiptium*, *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

There is no major water body within 5km radius of the Project site. However, a few of the major water bodies in the landscape outside the Study area were visited to establish the presence of aquatic species in the vicinity of the Project site.

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 5.28: Vegetation Classification of the Area

Classification Scheme	Classification
Biogeographical Province of India[30]	3A. Desert-Thar
Agro Ecological Sub Region (ICAR)[31]	Western Plain, Kutch and part of Kathiwar Peninsula (Hot arid eco-region)
Agro-Climatic Region (Planning Commission)[32]	Western Dry Region- (XIV)
Agro Climatic Zone (National Agricultural Research Project)	Arid Western Zone (RJ-1)

[30] Wildlife Institute of India - ENVIS Centre

[31] http://iasri.res.in/agridata//12data%5Cchapter1%5Cdb2012tb1_3.pdf

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

5.5.4.2 Floral Diversity

The list of the floral species observed and reported from this landscape has been provided in Table 5.29.

Table 5.29: Floral Species Reported from the Landscape

SN	Botanical Name	Local Name
1	*Prosopis cineraria*	Khejri
2	*Tecomella undulata*	Rohida
3	*Ziziphus mauritiana*	Bordi
4	*Azadirachta indica*	Neem
5	*Acacía Senegal*	Kumat
6	*Acacia nilotica*	Babool
7	*Tamarix aphylla*	Faras
8	*Cordia myxa*	Gonda
9	*Capparís decidua*	Ker
10	*Balanites ægyptiaca*	Hingota
11	*Salvadora persica*	Jal(Khara)
12	*Prosopis juliflora*	Keekar
13	*Choloroxylon swietenia*	Giri
14	*Leptadenia reticulate*	Kheenp
15	*Ziziphus zizyphus*	Bar
16	*Conmiiphora wiglatii*	Gugal
17	*Ziziphus nummularia*	Thar Beri
18	*Leptadenia pyrotechnica*	Kheemp
19	*Calligonum polygonoides*	Phog
20	*Acacia jacquemontii*	Banwali
21	*Barleria prionitis*	Vajradanti
22	*Mimosa hamata*	Alai
23	*Lycium barbarum*	Murali
24	*Crotalaria burhia*	Senia
25	*Haloxylon salicornicum*	Lana
26	*Aerva persica*	Bui
27	*Tephrosia purpurea*	Beyani
28	*Cassia auriculiformis*	Sonamukhi
29	*Lasiurus sindicus*	Sewan, Common Grasses
30	*Panicum antidotale*	Sewan
31	*Cenchrus bifloris*	Murat
32	*Cenchrus ciliaris*	Bhurat
33	*Dactyloctenium sindicum*	Dhaman
34	*Aristida funiculate*	Gandhiya

SN	Botanical Name	Local Name
35	*Tragus racemose*	Lamp
36	*Cyperus bulbosus*	Hiran Chugi
37	*Cymbopogon jwarancusa*	Moth
38	*Aristida mutabilis*	Bura
39	*Panicum turgidum*	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

During the primary survey, three herpetofaunal species were observed in the study area viz. Brilliant Ground Agama (*Trapelus agilis*), Indian fringe-fingered Lizard (*Acanthodactylus cantoris*) 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 5.30**)

Table 5.30: Herpetofaunal Species reported from Study Area

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

Note: NA: Not Assessed, LC: Least Concern; PS: Primary Survey, SS: Secondary Sources
Secondary sources[33]
Primary sources: Primary survey, Community consultations and ERM's previous experience of working in this landscape

[33] Management Plan of Desert National Park

Figure 5.22: Herpetofaunal Species observed in the Study Area

Indian Fringe-toed Lizard

Common skittering frog

Brillant Ground Agama

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. (Refer **Table 5.30**)

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 heliacal*) 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;
- Consultaions 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 8 km west of WTG FAT-465.
- A visit and consultation at a cow shelter at Bhadariyaji Mata Temple at Bhadariya located at about 24 km north of Project site confimed 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 in mostly restricted to winter season.

Figure 5.23: Avifaunal S pecies 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

Chestnut-shouldered Bush-sparrow

Black-crowned Sparrow Lark

Rufous-tailed Lark

Table 5.31: 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	*Elanus caeruleus*	R	LC	I	PS
2		Cinereous Vulture	*Aegypius monachus*	M	NT	IV	SS
3		Egyptian Vulture	*Neophron percnopterus*	R	EN	I	PS
4		Eurasian Griffon	*Gyps fulvus*	M	LC	IV	SS
5		Eastern Imperial Eagle	*Aquila heliacal*	M	VU	I	SS
6		Indian Vulture	*Gyps indicus*	R	CR	I	SS
7		Long legged Buzzard	*Buteo rufinus*	R	LC	I	SS
8		Red-headed Vulture	*Sarcogyps calvus*	R	CR	I	SS
9		Shikra	*Accipiter badius*	R	LC	I	SS
10		Short-toed Snake Eagle	*Circaetus gallicus*	R	LC	I	SS
11		Steppe Eagle	*Aquila nipalensis*	M	EN	I	SS
12		Tawny Eagle	*Aquila rapax*	R	VU	I	PS
13		White-eyed Buzzard	*Butastur teesa*	R	LC	I	PS
14		White-rumped vulture	*Gyps bengalensis*	R	CR	I	SS
15	Alaudidae	Ashy crowned Sparrow Lark	*Eremopterix griseus*	R	LC	IV	PS
16		Black-crowned Sparrow Lark	*Eremopterix nigriceps*	R	LC	IV	PS
17		Crested Lark	*Galerida cristata*	R	LC	IV	SS
18		Desert Lark	*Ammomanes deserti*	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	*Alaemon alaudipes*	R	LC	IV	SS
20		Indian Bushlark	*Mirafra erythroptera*	R	LC	IV	SS
21		Rufous Tailed Lark	*Ammomanes phoenicura*	R	LC	IV	PS
22	Anatidae	Common Teal	*Anus crecca*	M	LC	IV	SS
23		Indian Pond Heron	*Ardeola grayii*	R	LC	IV	PS
24		Lesser Whistling Duck	*Dendrocygna javanica*	M	LC	IV	SS
25		Little Grebe	*Tachybaptus ruficollis*	R	LC	IV	PS
26		Northern Pintail	*Anus acuta*	M	LC	IV	SS
27		Northern Shoveler	*Anus clypeata*	M	LC	IV	SS
28	Apodidae	Asian Palm Swift	*Cypsiurus balasiensis*	R	LC	IV	SS
29		House Swift	*Apus nipalensis*	R	LC	IV	SS
30	Ardeidae	Great Egret	*Casmerodious albus*	R	LC	IV	PS
31		Cattle Egret	*Bulbulcus ibis*	R	LC	IV	PS
32		Grey Heron	*Ardea cinerea*	R	LC	IV	SS
33		Purple Heron	*Ardea purpurea*	R	LC	IV	SS
34	Charadriidae	Common-ringed Plover	*Charadrius hiaticula*	M	LC	IV	SS
35	Columbidae	Blue Rock Pigeon	*Columba livia*	R	LC	IV	PS
36		Eurasian Collared Dove	*Streptopelia decaocto*	R	LC	IV	PS
37		Laughing Dove	*Spilopelia senegalensis*	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	*Coracias garrulus*	M	LC	IV	SS
39	Corvidae	House Crow	*Corvus splendens*	R	LC	IV	PS
40	Dicruridae	Black Drongo	*Dicrurus macrocercus*	R	LC	IV	PS
41	Estrildinae	Indian Silverbill	*Lonchura malabarica*	R	LC	IV	SS
42	Falconidae	Common Kestrel	*Falco tinnunculus*	M	LC	IV	SS
43		Laggar Falcon	*Falco jugger*	R	NT	IV	PS
44	Glareolidae	Indian Courser	*Cursorius coromandelicus*	R	LC	IV	PS
45	Gruidae	Demoiselle Crane	*Anthropoides virgo***	M	LC	IV	SS
46	Laniidae	Long tailed Shrike	*Lanius schach*	R	LC	IV	SS
47		Southern Grey Shrike	*Lanius meridionalis*	R	LC	IV	SS
48	Leiothrichidae	Large Grey Babbler	*Turdoides malcolmi*	R	LC	IV	SS
49	Meropidae	Blue tailed Bee-eater	*Merops philippinus*	R	LC	IV	SS
50		Blue-cheeked Bee-eater	*Merops persicus*	R	LC	IV	SS
51		Small Green Bee-eater	*Merops orientalis*	R	LC	IV	PS
52	Motacillidae	White Wagtail	*Motacilla alba*	R	LC	IV	SS
53	Muscicapidae	Humes Wheatear	*Oenanthe albonigra*	R	LC	IV	SS
54		Indian Robin	*Saxicoloides fulicatus*	R	LC	IV	PS
55		Pied Bush Chat	*Saxicola caprata*	R	LC	IV	SS
56	Nectariniidae	Purple Sunbird	*Nectarinia asiatica*	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	*Ardeotis nigriceps*	R	CR	I	SS
58	Passeridae	House Sparrow	*Passer domesticus*	R	LC	IV	PS
59		Chestnut-shouldered Bush-sparrow	*Gymnoris xanthocollis*	R	LC	IV	PS
60	Phasianidae	Grey Francolin	*Francolinus pondicerianus*	R	LC	IV	PS
61		Indian peafowl	*Pavo cristatus*	R	LC	I	PS
62	Pteroclidae	Spotted Sandgrouse	*Pterocles senegallus*	M	LC	IV	SS
63		Chestnut-bellied Sandgrouse	*Pterocles exustus*	R	LC	IV	PS
64	Pycnonotidae	Red-vented Bulbul	*Pycnonotus cafer*	R	LC	IV	PS
65		White-eared Bulbul	*Pycnonotus leucotis*	R	LC	IV	PS
66	Rallidae	Common Coot	*Fulica atra*	M	LC	IV	PS
67	Recurvirostridae	Black Winged Stilt	*Himantopus himantopus*	R	LC	IV	SS
68	Scolopacidae	Common Sandpiper	*Actitis hypoleucos*	M	LC	IV	PS
69		Green Sandpiper	*Tringa ochropus*	M	LC	IV	SS
70		Wood Sandpiper	*Tringa glareola*	M	LC	IV	SS
71	Sternidae	River Tern	*Sterna aurantia*	R	NT	IV	SS
72		Common Myna	*Acridotheres tristis*	R	LC	IV	PS
73		Rosy Starling	*Pastor roseus*	M	LC	IV	SS
74	Sylviidae	Lesser Whitethroat	*Sylvia curruca*	M	LC	IV	SS
75	Threskiornithidae	Black headed Ibis	*Threskiornis melanocephalus*	R	NT	IV	SS

SN	Family	Common Name	Scientific Name	Migratory Status	IUCN Status (v 2020-2)	IWPA 1972 Schedule	Source
76		Eurasian Spoonbill	*Platalea leucorodia*	M	NT	I	SS
77		Red-naped Ibis	*Pseudibis papillosa*	R	LC	IV	PS
78	Turdidae	Black Redstart	*Phoenicurus ochruros*	M	LC	IV	SS
79		Desert Wheatear	*Oenanthe deserti*	M	LC	IV	SS
80	Upupidae	Common Hoopee	*Upupa epops*	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[34 35 36 37]
Primary sources: Primary survey, Community consultations and ERM's previous experience of working in this landscape

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

[35] eBird.com

[36] Management Plan of Desert National Park

[37] 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 (*Antilope 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 5.32.

Table 5.32 Mammalian Species Reported from the Landscape

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

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

Secondary sources [38]

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

[38] Management Plan of Desert National Park

Figure 5.24 Mammaian Species observed in the Study Area

Nilgai

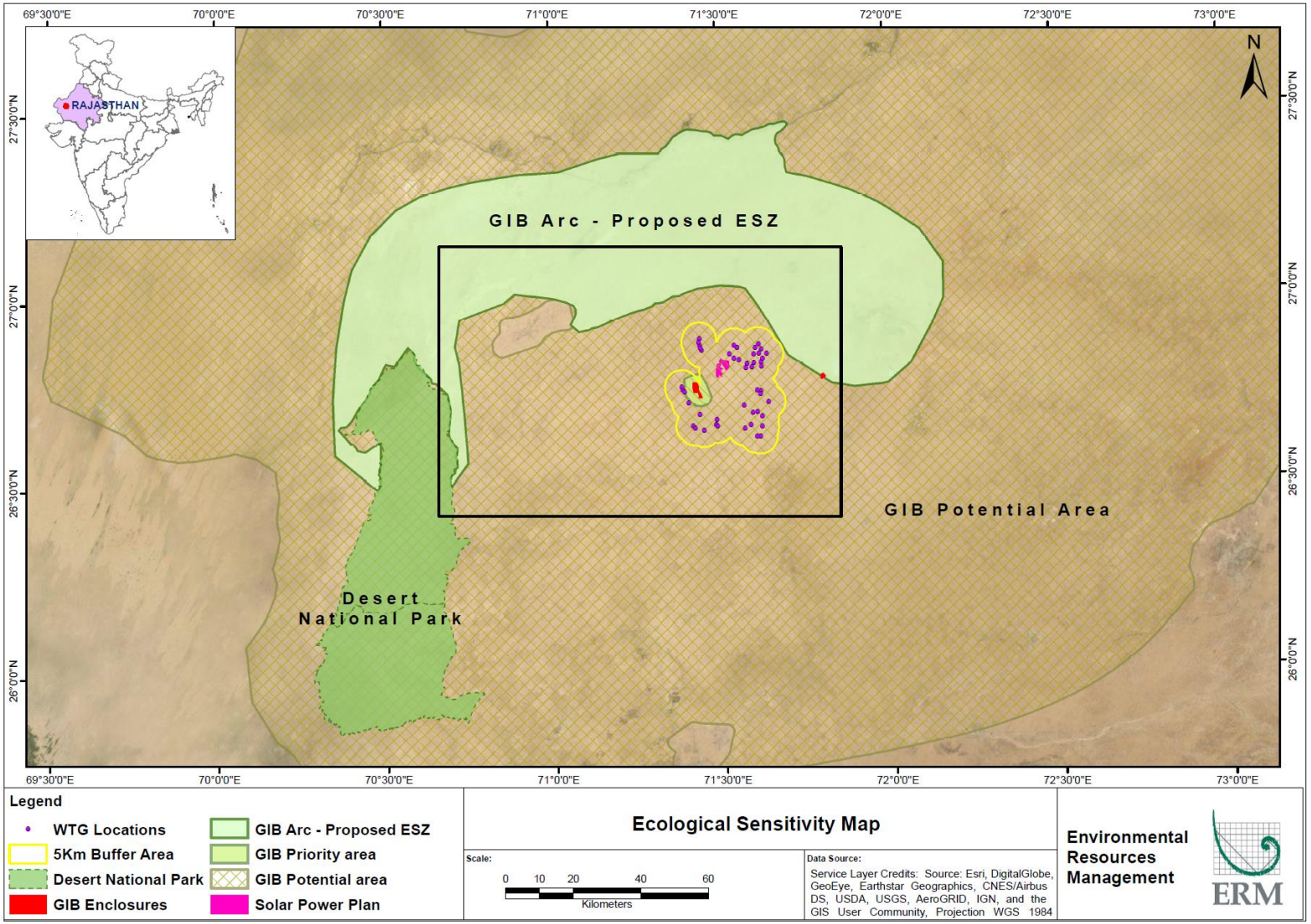
Chinkara

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 69.7 km west of the Project site. The areas of ecological significance around the Project site are presented in **Figure 5.25.**

Figure 5.25 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 species[39] 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 about 5000 km² and serves as a corridor for the movement of the GIB in the landscape. A total of 26 individuals of GIB were recorded[40] from the eastern region of the GIB Arc. During the GIB status asseement undertaken by Wildlife Institute of India in 2017, 65 individuals of GIB were observed in this Thar landscape[42].

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 Area[41] to target high priority areas for immediate conservation actions[42]. 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[41].

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 Sanctuary[40]. 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 2.7 km east of WTG FAT-195 and about 5.8 km southwest of the solar park boundary. During the primary survey,

[39] 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

[40] Management Plan of Desert National Park Wildlife Sanctuary 2017-2027

[41] 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

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

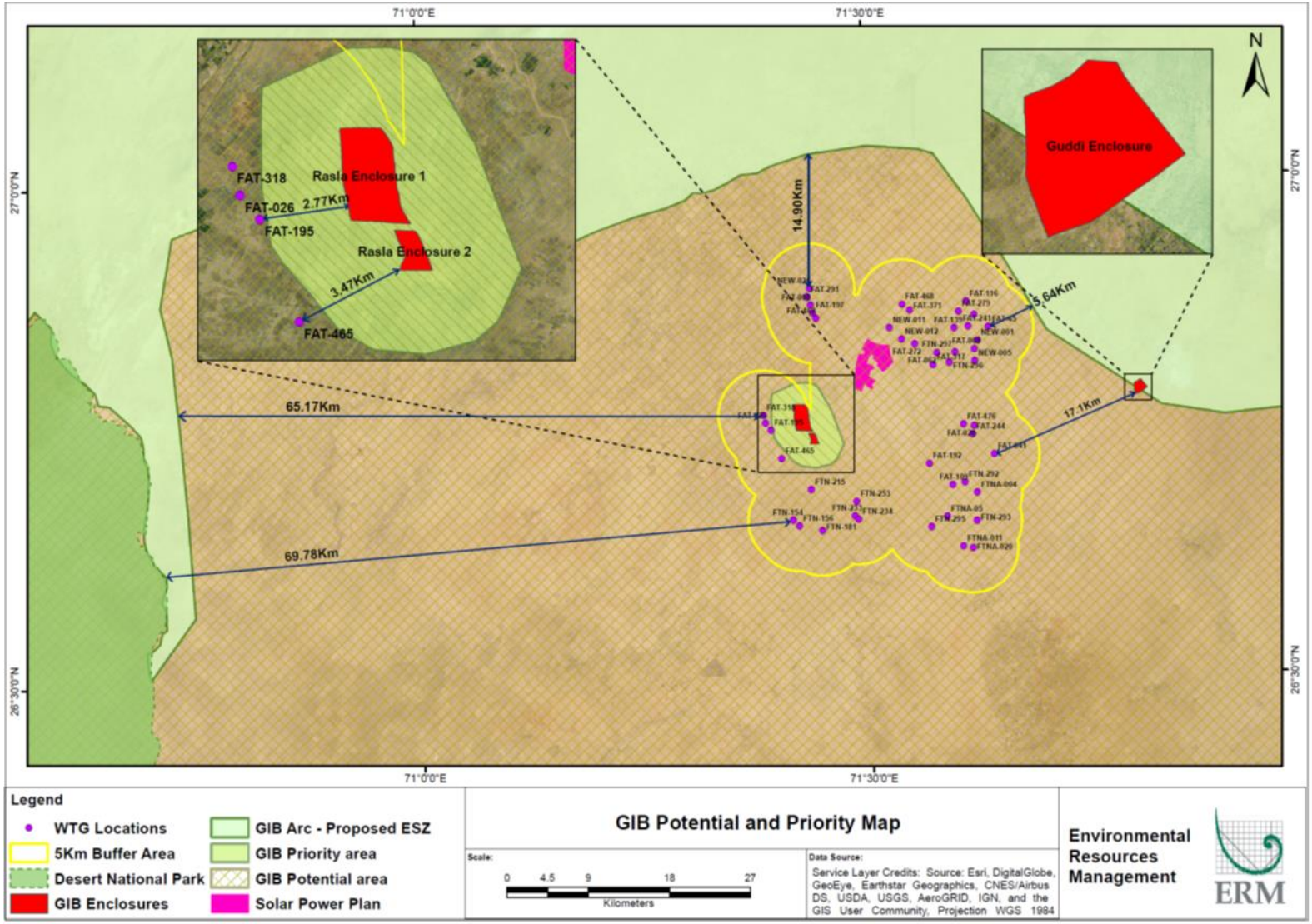
consultations with the local community were undertaken to confirm the movement and presence of GIB inside these enclosures. The locals residing in nearby locations of Rasla enclosure confirmed the presence of two pairs of GIB in the enclosure on annual basis. Since these habitats are situated on either 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 5.26 GIB Enclosures visited during the site visit

Rasla Enclosure

Guddi Enclosure

Figure 5.27 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 subcontinent[43]. About 20 globally threatened and 10 Near Threatened (IUCN NT) species use this flyway for the annual movements.

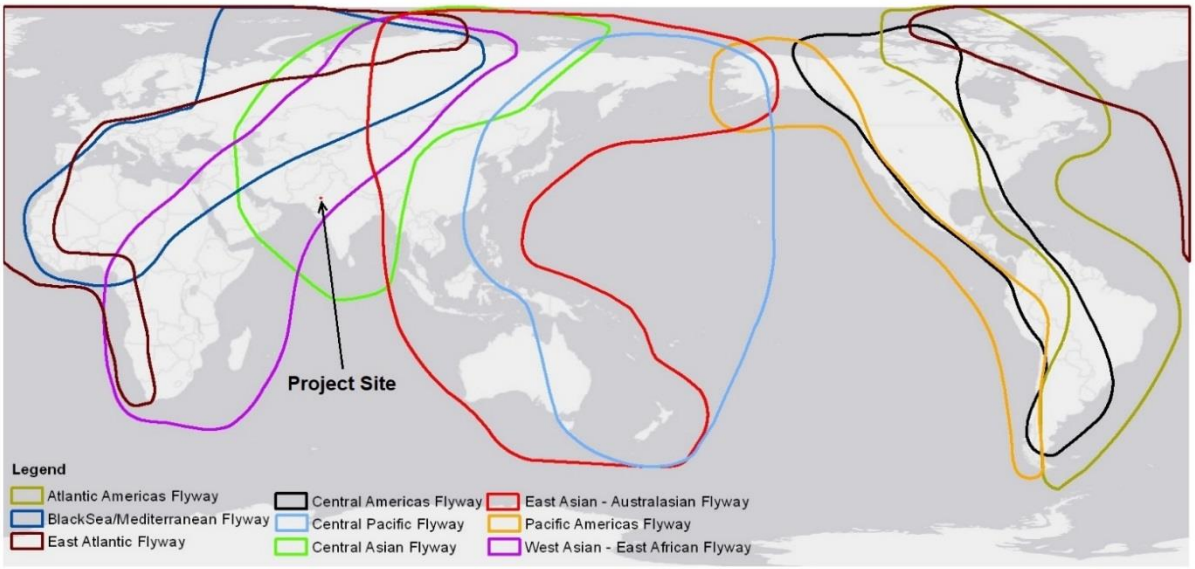
5.5.7.2 West Asian-East African Flyway

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 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 will be 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 5.28 Migratory Flyways of the World



Map Source: Wetlands Internationa

[43] Birdlife International, Central Asian Flyway Factsheet

6. STAKEHOLDER ENGAGEMENT

The subsequent section sheds light on the parameters of identification of and engagement with key stakeholders, in order to assess the impact of the project on them. The stakeholders have been identified as the individuals or institutions, which are being affected, since the inception of the project running down to years of operation and are critical in deciding the way the Wind Power project is shaping in the Study area.

“Stakeholder Analysis” is understood as the process of identifying the individuals or groups that are likely to affect or be affected by a proposed project, and sorting them according to their impact on the project and the impact the project will have on them. This information is then used to assess the manner in which the interests of the stakeholders should be addressed in the project plan, policy, program, or other action.

6.1 Stakeholder Identification and Characterization

A stakeholder is “a person, group, or organisation that has a direct or indirect stake in a project/organisation because it can affect or be affected by the Project/organisation’s actions, objectives, and policies”. Stakeholder this vary in terms of degree of interest, influence and control they have over the project. While those stakeholders who have a direct impact on or are directly impacted by the project are known as Primary Stakeholders, those who have an indirect impact or are indirectly impacted are known as Secondary Stakeholders. Keeping in mind the nature of the project and its setting, the stakeholders have been identified and listed in the table given below.

Table 6.1 Stakeholder Group Categorization

Category	Primary Stakeholder	Secondary Stakeholders
Community	■ Land Owners; ■ Local Community; ■ Vulnerable Groups; ■ Opinion Holders; and ■ Community Leaders	
Institutional Stakeholders	■ Local Gram Panchayats ■ Project Investors	■ Village Institutions (Education and Health department) ■ Political Parties
Government Bodies	■ Regulatory Authorities ■ District Administration	■ State Administration
Other Groups	■ Contractors and Sub-Contractors ■ Contractual Workers	■ Media ■ Local NGOs ■ Other Solar and Wind power developers and investors

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, 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 6.2: Stakeholder Significance and Engagement Requirement: Primary water quality monitoring locations

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

6.3 Stakeholder analysis

The table below has been used to classify the identified stakeholders (directly or indirectly impacting the project) in accordance to their levels of influence on the project. The influence and priority have both been primarily rated as:

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

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

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

Table 6.3: 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 Owners	The land procured for the project is private land	■ The major concern of the stakeholder group till now is related to availability of employment opportunities that the project will generate.	■ The stakeholder groups' influence on the project pertains to the smooth functioning of the project and the timely completion of the project activities.	■ Constituting the most critical stakeholder group, landowners who will lease land for the project were observed to be aware of land procurement process as few renewable power project have been set up in the area for over 5-10 years. However, none of the land owners consulted have sold their land to other developers nearby. ■ The consultations with land owners revealed that the land was leased at a rate of INR 21,000/acre/annum. 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. ■ It was understood during consultations that the farmers 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 land owners who were consulted informed that the compensation received after leasing their land was become part of our regular income	Influence of Stakeholder: HIGH Influence of Project: HIGH
Local Community	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 10 villages in the core area (lying within a radius of 2 km from solar plant and WTGs) and 14 villages in the buffer zone (within 5 km radius from Solar park and WTGs). The population residing in the AoI is 26,917 individuals out of which nearly 13.2 percent population belongs to Scheduled Caste and a mere 4.18 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	■ The expectations and concern of this group from the project: - Receiving benefits from the project in terms of employment and development of infrastructure and the community; - Employment opportunity from the proposed wind project; and - Project will do the community development through their CSR activity in and around their villages where solar plant and WTGs is proposed to be developed.	■ The project has undertaken consultation with land owners and local community. The stakeholder consultations revealed that no formal village meetings have been conducted by the project officials to apprise the villages about the forthcoming WTGs in and around their villages. The land-sellers have been approached through local people or the local partner appointed by the project; ■ The social consultation have also established that generally, agricultural land is being leased out for the solar park and WTG locations. The land-sellers are leasing out it at the lease rate of INR 21,000/acre/annum with escalation rate of 5 percent in every two years; ■ 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; and ■ The stakeholder group may have a significant role to play in the public opinion formation towards the project.	■ The project can prove to be potential employer of the people in the area; and ■ The need-driven CSR activities can play the critical role in the development of the community through economic opportunities and CSR projects.	Influence of Stakeholder: HIGH / MEDIUM Influence of Project: HIGH / MEDIUM

Relevant Stakeholders	Profile	Concerns and Expectations from the project	Influence of Stakeholder on Project	Influence of Project on Stakeholder	Influence Rating
	development in the AoI is very low.				
Vulnerable Groups	This group comprises of those groups/households considered to be vulnerable due to their social. Political or economic status in society. This group in the study area is primarily comprised of ST population, women population and the families below the poverty line. However, based on the understanding of the project and its activities the vulnerable groups are not likely to be severely impacted due to the project activities	■ The key expectation and concerns of the group from the project include: - Receiving benefits from the project in terms of economic opportunities and development programmes; - Access to the economic opportunities and development programmes because of their status in the society; and - Minimal disturbance to the community in regards to access issues, pollution and influx of migrant workers.	This group's influence on the project from the group being part of a local community	The project may play a critical role in the development of these groups, by identifying specific opportunities and programmes for the groups	Influence of Stakeholder: LOW Influence of Project HIGH / MEDIUM
Opinion Holder and Community Leaders	This stakeholder group is comprised of those individuals of the local community who hold traditional and rational power. These stakeholder group members include the elders, community and political leaders in the village and play a critical role in the decision making in the local community	■ The expectations and concerns of this group from the project: - 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	■ 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	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	Influence of Stakeholder: MEDIUM influence of Project: MEDIUM
Local Gram Panchayats	This stakeholder group is comprised of the lowest level of local governance. The gram panchayats consist of one or more revenue villages and are the lowest level of decision making bodies for development activities in the villages	■ The expectations and concerns of this group from the project: - Receiving benefits from the project in terms of employment and development of infrastructure; - Implementation of community development programmes in consultation with the Gram Panchayat and the local community - Preference to the local community in contractor and employment opportunities from the project - Regular updates on the project activities and the opportunities from the project	■ This stakeholder group is crucial in the smooth functioning of the project. The panchayat members can influence the decision making process of the land owners and the entire community, at large; and ■ This stakeholder may also play an important role in the implementation CSR activities planned and the execution of other plans such as stakeholder engagement and grievance management.	The project can play an important role in the development of the villages by undertaking CSR activities in collaboration with the Gram Panchayat, especially in areas where there is a paucity of government funds	Influence of Stakeholder: HIGH Influence of Project: MEDIUM
Regulatory Authorities	This stakeholder group is comprised of the central, state and district level regulatory authorities. These authorities influence the project in terms of establishing policy, granting permits and	The key expectations and concerns of the group from the project include: ■ Project's compliance to the regulatory requirements; and	■ The failure of the project to comply with the various rules and regulations applicable is instrumental for the timely implementation of the project	The influence of the project on the stakeholders pertains to the role the project will play in the development of the Project in the area	Influence of Stakeholder: HIGH Influence of Project: LOW

Relevant Stakeholders	Profile	Concerns and Expectations from the project	Influence of Stakeholder on Project	Influence of Project on Stakeholder	Influence Rating
	approvals for the project, monitoring and enforcing compliance with the applicable rules and regulations	■ Timely disclosure of information and provisioning of updated through the life of the project.	■ This stakeholder group is also critical for various permits/clearances required for the commissioning of the project		
District Administration	This stakeholder group is comprised of the government bodies at the district level. These bodies are vested with funds and decision making authority through the decentralization process. Accordingly the bureaucracy, the Block Development Officers, Block Health Officers, Tehsildaar, Patwari, and Revenue Officer have become extremely influential.	The key expectations and concerns of the group from the project include: ■ Project's compliance to the regulatory requirements ■ Timely disclosure of information and provisioning of updates throughout the life of the project	■ This stakeholder group is critical for the obtaining of the various permits/clearances required for the commissioning of the project and its smooth functioning thereafter ■ This group serves as important points of contact between the state level authorities and the local community	The influence of the project on the stakeholders pertains to the role the project will play in the development of the Project in the area	Influence of Stakeholder: HIGH Influence of Project: LOW
Contractors and Sub-Contractors	This stakeholder group is comprised of Riti Energy Private Limited and EPC contractor will be appointed by the Project for various stages of the project. • M/s Riti Energy Private Limited-land procurement for the project • EPC contractor - Solar plant piling and WTG Foundation work • Contractor will be appointed by the project for Road Construction • Contractor will be appointed by the project for 220 KV Unit Sub Station work • Contractor will be appointed by the Project for construction of 220 kV external Transmission Line Other all contractors will be appointed by the project to work on the various component of the project	The primary concerns and expectations of the group from the project include: ■ the role of the project in continued economic opportunity and work generation; ■ avoidance of any reputational risks associated with the project due to any future community unrest or project activities; ■ clarity in terms of scope of work, expectations, key performance indicators and timelines; ■ timely and adequate disclosure of information to allow the project activities to be carried out; ■ fair business opportunities and contract closure; and ■ business continuity.	■ This stakeholder group is critical for the smooth functioning and timely implementation of the project ■ this group may also play an important role in the formation of public opinion towards the project	The influence of the project on the group pertains to the role of the project in business opportunities and the process of contract closure	Influence of Stakeholder: HIGH Influence of Project: HIGH
Contractual workers	This group is comprised of skilled and semi-skilled workers, involved in the project on a contractual basis. This group is most likely to be comprised of the semi-skilled workers involved in the construction work of the project, access road construction and	The primary concerns and expectations of the stakeholder group pertaining to the project is as follows: ■ the role of the project in continued economic opportunity, work generation and a source of income; ■ timely settlement of dues and payments in keeping with the legal requirements;	■ this stakeholder group is critical for the smooth functioning and timely implementation of the project ■ this group may also play an important role in the formation of public opinion towards the project	The influence of the project on the group pertains to the roles of the project in the continuance of economic opportunities, timely payment of wages and ensuring the health and safety of the workers	Influence of Stakeholder: MEDIUM Influence of Project: HIGH

Relevant Stakeholders	Profile	Concerns and Expectations from the project	Influence of Stakeholder on Project	Influence of Project on Stakeholder	Influence Rating
	security of the WTGs. As reported by the project the first preference of the project is to involve local people, from the neighbouring villages with the remaining workers being migrants, depending upon skill requirement	■ continued work opportunities; and ■ safety at work.			
Secondary Stakeholders					
Village Institutions	This stakeholder group is comprised of health and education institutions at the village level. The institutions in the immediate vicinity of the project are the primary schools in the villages	The main concerns and expectations of the group from the project pertain to: ■ Adequacy of community development activities in the area; ■ Contribution of the project towards the overall development of the area; ■ Involvement in the formulation and implementation of the community development activities; and ■ Timely and adequate disclosure of information pertaining to the project.	The influence of the group on the project pertains to the role of the played by these institutions in the opinion formation and implementation of community development programmes and CSR activities	The influence of the project on the group pertains to the role of the project in the development of these institutions	Influence of Stakeholder: LOW Influence of Project: 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	The key expectations and concerns of the group from the project include: ■ the role of the project in the overall development of the area; ■ the impact of the project on the local community; ■ adequate community development activities throughout the life of the project; and ■ Timely disclosure of information pertaining to the project activities.	The influence of this stakeholder group on the project pertains to the role of the political parties in the formulation of public opinion towards the project.	The influence of the project on the group is expected to be extremely limited, pertaining to the role of the project in the development of the area	Influence of Stakeholder: MEDIUM Influence of Project: LOW
State Administration	The state administration is comprised of the state level agencies of the various departments/authorities such as industries department, revenue department, labour department and land department etc.	The main expectations and concerns of the stakeholder group from the project include: ■ Compliance to the regulatory requirements for the project; ■ Project's role in the development of the area; and ■ Timely disclosure of information pertaining to the project activities.	This stakeholder group is also critical for the obtaining of the various permits/clearances required for the commissioning of the project	The influence of the project on the stakeholders pertains to the role the project will play in the development of wind energy in the state	Influence of Stakeholder: MEDIUM Influence of Project: LOW
Media	The media, comprising of both print and visual media, has a presence in the district. They are known to have played an extremely important role in generating awareness amongst the community.	The main expectations and concerns of the stakeholder from the project include: ■ Compliance to the regulatory requirements for the project; ■ Project's role in the development of the area; ■ Maintenance of positive relationship with the local community and other stakeholders; and ■ Timely disclosure of information in regards to the project activities	The influence of the stakeholder group on the project is likely to pertain to the opinion formation amongst other stakeholders towards the project	The influence of the project on the stakeholder is likely to be extremely limited due to the nature of the project activities	Influence of Stakeholder: LOW Influence of Project: LOW

Relevant Stakeholders	Profile	Concerns and Expectations from the project	Influence of Stakeholder on Project	Influence of Project on Stakeholder	Influence Rating
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.	The main expectations and concerns of the stakeholder from the project include: ■ 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	Influence of Stakeholder: LOW Influence of Project: LOW

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.

However, as part of the CSR activities, the Project has initiated the community engagement process. At the time of COVID-19 pandemic, the Project has provided 1000 food packets of financial aid provided among migrant families and labours of Jaisalmer district. And also have provided Hand Sanitizer and face mask to try further stop the spread of virus in the area.

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.

6.3.2.1 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 staring 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.

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7. IMPACT ASSESSMENT AND MITIGATION MEASURES

7.1 Introduction

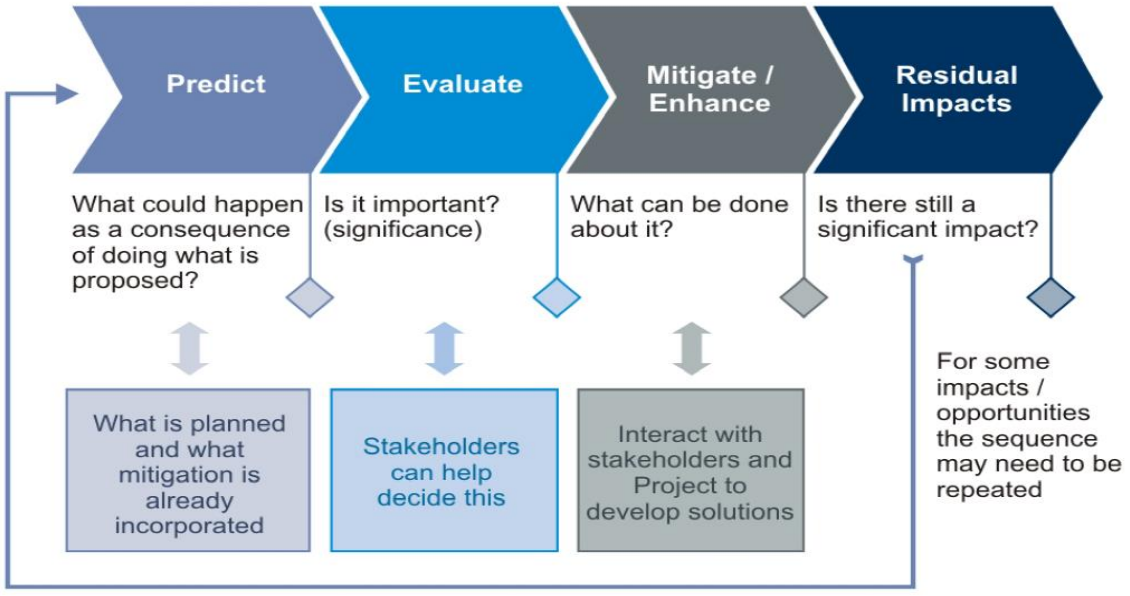
This section assesses the manner in which the Project will interact with elements of the physical, ecological or social environment to produce impacts to resources/ receptors. It has been organized as per the operational and decommissioning phases of the project life cycle to understand the risks and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

❖ *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%)
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).

7.2.2 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).

7.2.3 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 390 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	■ 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	■ Alteration of topography and micro drainage channel due to construction of project site approach road.
Soil Environment	■ Decrease of soil quality due to loss of vegetation cover; ■ Soil erosion during monsoon season and windy periods;

Resource/Receptor	Potentially Significant Impacts
	■ 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	■ 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	■ 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	■ 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	■ 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	■ The soil quality does not support diverse habitat or populations and/or supports habitat or population of low quality.	■ The soil quality has little or no role in provisioning of services as agricultural uses for the local community.
Medium	■ The soil quality supports diverse habitat or population of flora and fauna and supports habitats commonly available in the Project AoI.	■ 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 AoI
High	■ The soil quality supports economically important or biologically unique species or provides essential habitat for such species.	■ 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	■ 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	■ 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 (few months)	■ 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)	■ 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.[44]	Locally designated sites; and/or areas of specific ecological interest, not subject to statutory protection (for example, as defined by the project ecology team).

[44] 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	■ Soil type with large grain size (e.g. sand); and/or No emissions/dust generation due to Project across all phases	■ Soil type with large grain size (e.g. sand); and/or ■ Limited emissions/dust generations for short duration	■ Moderately dusty soil type (e.g. silt); and/or ■ Dust generation and emissions from Projects for long duration	■ 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) Leq 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) Leq, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of the human ear. Leq: 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			
	Negligible	***Small***	***Medium***	***Large***
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 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**

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 AoI, it was observed that majority of land use-land cover includes shrub/waste land (83.56%) followed by agricultural land (12.58%) and gravel waste land (3.86%). The landuse pattern of the Project AoI 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 ~30 km 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 6-8 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 6-8 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 to 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. There are no major water bodies that pass though the proposed Project site. The water channels observed within the Project area are mostly dry. 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 at different parcels of land, whereas in solar plant area, 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** 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** taking into account the 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**				
Residual Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor		Moderate	Major
	Significance of impact is assessed as **negligible**				

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. A small proportion of the waste generated during construction phase will be hazardous and may include used oil, hydraulic fluids, waste fuel, grease and waste oil containing rags. If improperly managed, solid 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 and impact magnitude are assessed as **medium**

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.**

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**.

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**			

Residual Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of residual impact is assessed to be **minor**				

7.4.4 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 from Mohangarh pumping station located 7.2 km from site.

Based on estimates shared by AGE(18)L, approximately 125 KLD water will be required during peak time of construction phase for civil work and approximately 86.40 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 **medium.** However, since the construction phase of the Project will last for a short period of time (~ 6-8 months), therefore, magnitude of impact is assessed as **small**.

❖ *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 **minor**.

❖ *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 **minor** 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	Permanent
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 **minor**				
Residual Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of residual impact is assessed as **minor**				

7.4.4.2 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 measurable changes in the ground water quality during construction activities (i.e. 6-8months). 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

7.4.5.1 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.
- Based on ambient air quality monitoring conducted at four locations within study area, all the parameters were found to be within permissible limits(Refer

***Table* 5.15**). The hybrid Project is spread across a larger area (~2160 aces) and the air quality impacts would be confined to 500 m of the construction activity area, material storage area, on village located the access routes 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 a short duration (i.e. 6-8 months), the impact magnitude is assessed to be **small.**

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.

7.4.5.2 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.

7.4.5.3 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 **minor.**

7.4.5.4 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.

7.4.5.5 Residual impact significance

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

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 **minor**				
Residual Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of residual impact is assessed to be **negligible**				

7.4.6 Impact on Ambient Noise

7.4.6.1 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 6-8 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 721.560[45] and ERM's internal database

Settlements located within 500 m of proposed project (Refer ***Table 2.2***) 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 **small** considering the construction period of the project to last for approximately 6-8 months.

7.4.6.2 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

7.4.6.3 Significance of impact

The overall impact significance is assessed to be **minor**.

[45] Construction Noise Handbook. FHWA-HEP-06-15; DOTVNTSC-FHWA-06-02; NTIS No. PB2006-109102. Final Report August 2006 (updated5/20/2010). <http://www.fhwa.dot.gov/environment/noise/construction_noise/handbook

7.4.6.4 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;
- 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

7.4.6.5 Residual impact significance

After implementation of mitigation measures, the significance of residual impacts will be **negligible** to **minor**.

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	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 **negligible** to **minor**				

7.4.7 Impact on Occupational Health and Safety

7.4.7.1 Impacts

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;
- Construction of support structure for PV module would require operation of pile drivers
- Working in confined spaces at pooling substation or excavated areas;
- Operation of cranes and other mechanical lifting equipment
- Working with rotating machinery including the rollers and layers;
- Working with live electrical components – transmission towers, lines and internal electrical parts; and
- Unhygienic conditions at site including contaminated drinking water for workers.

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

7.4.7.2 Embedded built in controls

- All construction activities (to the extent possible) 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;
- Electrical and maintenance work should not be carried out during poor weather and during lightning strikes;
- Training of the workers on climbing techniques, and rescue of fall-arrested workers; and
- Excavated areas should be temporarily fenced to avoid access to outsiders and wildlife

7.4.7.3 Significance of impact

As reported by Project team, the Project will follow corporate level OHS procedures of AGEL at site. AGEL has developed SOPs with respect to OHS as part of their ESMS. The SOPs in line with OHS includes the following:

- Recognition and Reporting of Incidents, Illness and Safety Hazards
- Personal protective equipment
- Training and Development
- Emergency and Response Plan,
- Transportation safety and handling hazardous materials

Additionally, there is a training calendar developed at corporate level, according to which trainings are conducted periodically at AGEL's project sites. Reportedly, the same will be followed at AGE(18)L site a well.

Therefore, the impact significance on occupational health and safety is therefore assessed as **minor.**

7.4.7.4 Additional mitigation measures

- 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;
- 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 emergency situations. The nearest hospital, ambulance, fire station and police station should be identified in the implemented emergency management plan.

7.4.7.5 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 **negligible** to **minor**				

7.4.8 Impact on Community Health and Safety

7.4.8.1 Impacts

The receptors for impacts on community health and safety include the local community within the study area who may be present in the vicinity of the project activities. This will include locals residing close to the WTGs, cultivators whose land is close to the WTGs, and those in the area for grazing purposes. 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.

The basis on the analysis of preliminary route of 30 Km of External Transmission line and the 30 m RoW of the TL, no cultural heritage is being impacted. However, there is Deg Rai Mata Mandir, which is ~1 km away from the proposed transmission line, and the TL will not have any impact on the temple.

According to the IFC EHS guidelines, the community health and safety risks associated with the construction, operations and decommissioning of onshore wind power projects are similar to those of most large industrial facilities and infrastructure projects. The main risks include structural safety of project infrastructure, life and fire safety, public accessibility and management of emergency situations.

7.4.8.2 Embedded built in controls

As reported AGE(18)L have a health and safety policy in place. The AGE(18)L policy will be applicable to all activities being undertaken as part of the project, including the appointed contractors and sub-contractors activities. AGE(18)L will have a safety supervisor on site who is responsible for daily monitoring of the project activities and the transported related risk. AGE(18)L will also be

involved in monitoring of the project activities to ensure that the requirements of their health and safety standards are met.
As part of the CSR activities, Project is also providing support to community health care and awareness. Under the programmes, healthcare and awareness sessions were organised for seasonal disease, providing health care equipment to Primary Health Subcenters and organizing medical camps. Further, Project is also planning to deploy a mobile healthcare unit in villages that are falling under the proximity of the Project.

7.4.8.3 Significance of impact

The overall impact significance of the community health and safety during the construction phase is assessed **as minor**.

7.4.8.4 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
- The Project will avoid the restriction of access to the temple.

7.4.8.5 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 In-migration of workers

7.4.9.1 Impacts

The peak man power requirement for the construction phase will require the project to recruit skilled, semi skilled and unskilled workers from outside the project area/district.

7.4.9.2 Embedded Control

As reported AGE(18)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.

7.4.9.3 Impact Significance

The in-migration of workers from outside the area will resulted and 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 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**.

7.4.9.4 Additional Mitigation Measures

- Adequate monitoring should be undertaken to ensure the contractor's compliance to the applicable rules and regulations and provisions of the contractual agreement for the remaining duration of construction
- Health screening of migrant workers,
- Undertaking health awareness among the local community,
- 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.
- A labour influx management plan should be put in place to check migrant labours.

7.4.9.5 Residual Impact Significance

After implementation of mitigation measures, the significance of residual impacts will be reduced to N**egligible.**

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
Residual Impact	Negligible	Minor	Moderate	Major
	Negligible			

7.4.10 Impact on landholding and agricultural income

7.4.10.1 Impacts

The area identified for the project consist of 2160 acres of private agricultural land from Pokhran and Fatehgarh Tehsil, Jaisalmer District of Rajasthan. Consultation with land aggregator and land owners revealed that the land was leased out for a period of 29 year and 11 month at a rate of INR 21,000/acre/annum with an escalation rate of 5 percent in every two year. Land owners who have leased out their land for the project were received the amount.

As reported by the consulted land owners, land leased out was only a fraction of their total land holdings. These farmers were 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 staring of alternative livelihood option then farming.

As per the consultation with the landowners and the project team and was observed during the site visit that there were no structures are coming inside the procured land parcels. Therefore, as per the discussing with AGE(18)L land team, land aggregator and land owners, the project does not involve physical displacement of titleholder. The lease of land is also not expected to have significant impact on the agricultural income of the land sellers, as they are not solely dependent on the particular land parcel. 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 (See **section 6.4.7.5**). 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 land owner is rendered landless due to the land procurement for the project. For this purpose, AGE(18)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; and
- Additional employment opportunities may also be created for the local youth by the project.

7.4.10.2 Significance of Impact

The overall impact significance of the land procured during the construction phase is assessed **as minor**.

7.4.10.3 Additional Mitigation Measures

Considering that the leasing out of land will have only a minor implication on the economy of the land owner, the following additional measures may be recommended to minimise this impact:

- Providing preference to members of the families who have lease out the land to the project for livelihood opportunities in Construction and operation phase; and
- Procuring resources from the local sources so as to induce more employment in the supply chain.

7.4.10.4 Residual Impact Significance

After implementation of mitigation measures, the significance of residual impacts will be reduced to N**egligible.**

Impact	**Land Holding and Agriculture Income**				
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 Ration (WPR) in the AoI villages is 43.51 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 pity 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.

7.4.11.1 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.

7.4.11.2 Significance of Impact

The impacts have been assessed as **positive** due to employment opportunities for locals.

7.4.11.3 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.

7.4.11.4 Residual impact significance

The significance of the residual impact willis 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

7.4.12.1 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.

7.4.12.2 Embedded built in controls

As reported AGE(18)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.

7.4.12.3 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;
- AGE(18)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

7.4.12.4 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**				

7.4.13 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 birds[46].

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;

[46] Management Plan of Desert National Park Wildlife Sanctuary, 2017-2027.

- 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;
- Prior to start of construction activity, it should be ensured that project development will be undertaken on pasture land with Old grown mature tree species should be removed. All such areas should be pre identified by undertaking a detailed survey. Efforts should be made to avoid cutting of any large woody trees.
- Identification of large degraded lands in the areas nearby the project area in consultation with the locals and forest department and develop it as pasture land with the help of community participation;
- 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;
- 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 ativity 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 landuse/ land covermap ;
- 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 nearbyvillage 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 vulpeslis*), 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** respectively.

The hazardous waste generated will be disposed through approved vendors (M/s.TES-AMM (India) Private Limited) 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 **negligible**

7.5.1.2 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 **negligible**				

7.5.1.3 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 **small**.

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 **minor.**

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 **negligible**, 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 **minor**				
Residual Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of residual impact is assessed to be **negligible**				

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 cycles 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 AG(18)L has already completed. AGE(18)L has submitted a request for obtaining access to 0.13 cusec of water from IGNP from Mohangarh pumping station (ref: vide no. AGE(18)L/ RRECL/ 390MW/ WATER/ 24072020 dated 24.07.2020).

Approximately 6810 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 is assessed to be **low to medium** and impact magnitude is assessed to be **small.**

Embedded built in controls

As reported, AGE(18)L, intends to implementi 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 **minor**

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 **minor**				
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 **low** and impact magnitude is assessed to be **medium**.

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.

Significance of impact

The overall significance of impacts on water quality due to operational activities is envisaged to be **negligible**.

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 **negligible**.

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 **negligible**			

7.5.3 Impact Due to Noise

There will be negligible noise generated from the solar power plant during operation phase. However, the emanation of noise form 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.

The Project will have 46 operational WTGs, however, currently there are 47 WTGs identified by AGE(18)L. The Client is yet to finalise between WTG FAT-090 and FTN-156. The rated capacity of 2.2 MW each and rotor diameter of 122 m have been considered. The hub height will be 127 m. The noise generation from the turbines have been taken into consideration during strong wind conditions (with wind velocity $\geqslant$ 8 m/s at 10 m height) for the noise assessment to consider worst case scenario.

7.5.3.1 Receptors

A total of 58 receptors within 500 m of the WTGs are considered as noise sensitive receptors in the study area.

7.5.3.2 Embedded/In-built Control

- Regular maintenance of WTGs;
- Periodic monitoring of noise near to the sources of generation to ensure compliance with design specification

7.5.3.3 Prediction of Impacts

Methodology: The environmental noise prediction module (NORD 2000) of WindPro 3.3 was used for modelling noise emissions from the WTGs. In order to consider worst case scenario (with strong wind conditions), it has been assumed that the WTGs are operational at standardised wind speed of 8 m/s at 10 m height[47]. Operating of WTGs with 100% usage scenario was modelled to cover the operation phase of the Project. In addition, to represent a worst-case scenario for the assessment, all WTGs were assumed to be operating simultaneously and for 24 hours. Noise generation had been considered at the hub height of 127 m above ground. Local terrain has been considered for putting noise sources as well as receptors in the model. It has been assumed that the noise sensitive receptors are always in downwind direction to consider the worst case scenario. The geo-profile of the area has been considered to define the area types and relative roughness and surface hardness in order to consider the surface absorption and reflection.

47 IEC profile shear has been considered as z0 = 0.05 m

Predicted Noise Levels at Receptors: The predicted noise levels within the study domain at 58 receptors during day and night-time with cloudy conditions (which provide a stable atmospheric condition and is suitable for worst case consideration) and with strong wind conditions are presented in ***Table 7.25***.

Table 7.25 Predicted Noise Levels at Noise Sensitive Receptors during Operation Phase with Strong Wind Conditions and Most Downwind Conditions

Receptor ID	Structure/ Settlement ID	Nearest WTG	Baseline Noise level (dBA)		Noise from WTG (dBA)	Resultants Noise Level (dBA)		Additional Exposure (dBA)		Applicable Standard as per CPCB(dBA)	
			L_{eq} day	L_{eq} night		L_{eq} day	L_{eq} night	L_{eq} day	L_{eq} night	L_{eq} day	L_{eq} night
A	STLMNT 3	FAT-109	49.01	50.89	43.7	50.13	51.65	1.12	0.76	55	45
B	STLMNT 4	FAT-109	49.01	50.89	43.2	50.02	51.57	1.01	0.68	55	45
C	STR 2	FTN-293	49.01	50.89	43.7	50.13	51.65	1.12	0.76	55	45
D	STR 5	FTN-292	49.01	50.89	45	50.46	51.89	1.45	1.00	55	45
E	STR 6	FAT-192	49.01	50.89	47.8	51.46	52.62	2.45	1.73	55	45
F	STR 7	FAT-192	49.01	50.89	43.5	50.09	51.62	1.08	0.73	55	45
G	STR 8	FAT-192	49.01	50.89	42.8	49.94	51.52	0.93	0.63	55	45
H	STR 9	FTN-253	49.01	50.89	43.5	50.09	51.62	1.08	0.73	55	45
I	STR 10	FTN-233	49.01	50.89	45.8	50.71	52.06	1.70	1.17	55	45
J	STR 11	FTN-233	49.01	50.89	44.8	50.41	51.85	1.40	0.96	55	45
K	STR 12	FTN-233	49.01	50.89	45.5	50.61	51.99	1.60	1.10	55	45
L	STR 13	FTNA-05	49.01	50.89	44.5	50.33	51.79	1.32	0.90	55	45
M	STR 17	FTN-156	49.01	50.89	45.1	50.49	51.91	1.48	1.02	55	45
N	STR 18	FAT-318	48.72	53.16	45.2	50.32	53.80	1.60	0.64	55	45
O	STR 20	FTNA-020	49.01	50.89	43.8	50.15	51.67	1.14	0.78	55	45
P	STR 22	FAT-88	48.72	53.16	47.7	51.25	54.25	2.53	1.09	55	45
Q	STR 24	FAT-291	48.72	53.16	50.8	52.89	55.15	4.17	1.99	55	45
R	STR 25	New-26	48.72	53.16	45.9	50.55	53.91	1.83	0.75	55	45
S	STR 26	New-26	48.72	53.16	44.1	50.01	53.67	1.29	0.51	55	45
T	STR 27	New-26	48.72	53.16	47.4	51.12	54.18	2.40	1.02	55	45
U	STR 28	New-26	48.72	53.16	45.7	50.48	53.88	1.76	0.72	55	45
V	STR 30	FAT-462	48.72	53.16	45.6	50.44	53.86	1.72	0.70	55	45
W	STR 31	FAT-462	48.72	53.16	48.8	51.77	54.52	3.05	1.36	55	45

Receptor ID	Structure/ Settlement ID	Nearest WTG	Baseline Noise level (dBA)		Noise from WTG (dBA)	Resultants Noise Level (dBA)		Additional Exposure (dBA)		Applicable Standard as per CPCB(dBA)	
			L_{eq} day	L_{eq} night		L_{eq} day	L_{eq} night	L_{eq} day	L_{eq} night	L_{eq} day	L_{eq} night
X	STR 38	FAT-192	49.01	50.89	44.2	50.25	51.73	1.24	0.84	55	45
Y	STR 39	FTNA-05	49.01	50.89	44.8	50.41	51.85	1.40	0.96	55	45
Z	STR 42	New-005	53.23	48.3	46	53.98	50.31	0.75	2.01	55	45
AA	STR 44	FAT-317	53.23	48.3	44.5	53.78	49.81	0.55	1.51	55	45
AB	STR 45	New-011	53.23	48.3	43.9	53.71	49.65	0.48	1.35	55	45
AC	STR 46	New-012	53.23	48.3	44.3	53.75	49.76	0.52	1.46	55	45
AD	STR 47	FAT-476	53.23	48.3	45.1	53.85	50.00	0.62	1.70	55	45
AE	STR 48	FAT-244	53.23	48.3	49.6	54.79	52.01	1.56	3.71	55	45
AF	STR 49	FAT-109	49.01	50.89	51.3	53.31	54.11	4.30	3.22	55	45
AG	STR 50	FTN-295	49.01	50.89	46.7	51.02	52.29	2.01	1.40	55	45
AH	STR 51	FTNA-020	49.01	50.89	47	51.13	52.38	2.12	1.49	55	45
AI	STR 52	FTN-154	49.01	50.89	44.2	50.25	51.73	1.24	0.84	55	45
AJ	STR 53	FTN-154	49.01	50.89	43.9	50.18	51.68	1.17	0.79	55	45
AK	STR 55	FAT-195	48.72	53.16	44.2	50.03	53.68	1.31	0.52	55	45
AL	STR 56	FAT-195	48.72	53.16	48.5	51.62	54.44	2.90	1.28	55	45
AM	STR 57	FAT-195	48.72	53.16	43.1	49.77	53.57	1.05	0.41	55	45
AN	STR 58	FAT-88	48.72	53.16	48	51.39	54.32	2.67	1.16	55	45
AO	STR 59	FAT-197	48.72	53.16	54.5	55.52	56.89	6.80	3.73	55	45
AP	STR 60	FAT-008	53.23	48.3	46.8	54.12	50.62	0.89	2.32	55	45
AQ	STR 61	FAT-008	53.23	48.3	46	53.98	50.31	0.75	2.01	55	45
AR	STR 62	FAT-062	53.23	48.3	44.7	53.80	49.87	0.57	1.57	55	45
AS	STR 63	FAT-008	53.23	48.3	49.9	54.89	52.18	1.66	3.88	55	45
AT	STR 64	FAT-062	53.23	48.3	48.7	54.54	51.51	1.31	3.21	55	45
AU	STR 65	FTN-156	49.01	50.89	44.9	50.43	51.87	1.42	0.98	55	45
AV	STR 66	FAT-371	53.23	48.3	46.1	54.00	50.35	0.77	2.05	55	45
AW	STR 67	New-001	53.23	48.3	47.5	54.26	50.93	1.03	2.63	55	45
AX	STR 68	New-001	53.23	48.3	49	54.62	51.67	1.39	3.37	55	45

Receptor ID	Structure/ Settlement ID	Nearest WTG	Baseline Noise level (dBA)		Noise from WTG (dBA)	Resultants Noise Level (dBA)		Additional Exposure (dBA)		Applicable Standard as per CPCB(dBA)	
			L_{eq} day	L_{eq} night		L_{eq} day	L_{eq} night	L_{eq} day	L_{eq} night	L_{eq} day	L_{eq} night
AY	STR 69	New-001	53.23	48.3	45.1	53.85	50.00	0.62	1.70	55	45
AZ	STR 70	FAT-020	53.23	48.3	45	53.84	49.97	0.61	1.67	55	45
BA	STR 71	New-001	53.23	48.3	45.7	53.94	50.20	0.71	1.90	55	45
BB	STR 72	New-001	53.23	48.3	46.2	54.02	50.39	0.79	2.09	55	45
BC	STR 73	FTN-234	49.01	50.89	46.7	51.02	52.29	2.01	1.40	55	45
BD	STR 74	FTN-234	49.01	50.89	49	52.02	53.06	3.01	2.17	55	45
BE	STR 75	FTN-234	49.01	50.89	47.5	51.33	52.53	2.32	1.64	55	45
BF	STR 76	FAT-020	53.23	48.3	46.7	54.10	50.58	0.87	2.28	55	45

Note:

(1) IFC/WB EHS Guidelines: Noise Management dated April 30, 2007 gives, Noise level guidelines for Residential; institutional and educational receptors in daytime (07:00-22:00) 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.

(2) 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

Note: Colour coding used to represent exceedance from applicable standards is as follows:

- > 10 dB(A)
- 10 dB(A) > x > 5 dB(A)
- 5 dB(A) > x > 3 dB(A)
- < 3 dB(A)

7.5.3.4 Significance of Impact

Since there is only one receptor exceeding the permissible limit by 3 dBA during day time and remaining all the receptors are within permissible limit, impact of noise on identified receptor due to operation of WTG during daytime is anticipated to be **small to negligible.**

Impact	**Noise generation from operation of the WTGs – Day time**				
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 within 500 metres of WTGs				
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 **negligible** for all the receptors.				

It is evident from above table that the Baseline noise level during night time exceeds the applicable standard. Therefore, resultant noise level due to operation of the WTGs at all the 58 receptors have also exceeded the applicable standard during night time. Out of the 58 receptors, 1 receptor exceeded the noise level beyond 10 dBA, 50 receptors exceed the noise level having value between 5 dBA and 10 dBA and 7 receptors have noise level between 3 dBA and 5 dBA during nightime. There is 1 receptor which has value less than 3dBA during day time, whereas remaining 57 receptors have value within the permissible limit of 55 dBA during day time. Therefore, the impact of noise on identified receptors due to operation of WTGs during nightime will be as follows:

- Small Impact Magnitude: 7 receptor
- Medium Impact Magnitude: 50 receptors
- Large Impact Magnitude: 1 receptor

Considering this the impact magnitude during night time will vary from moderate to large depending upon receptor distance from the WTGs

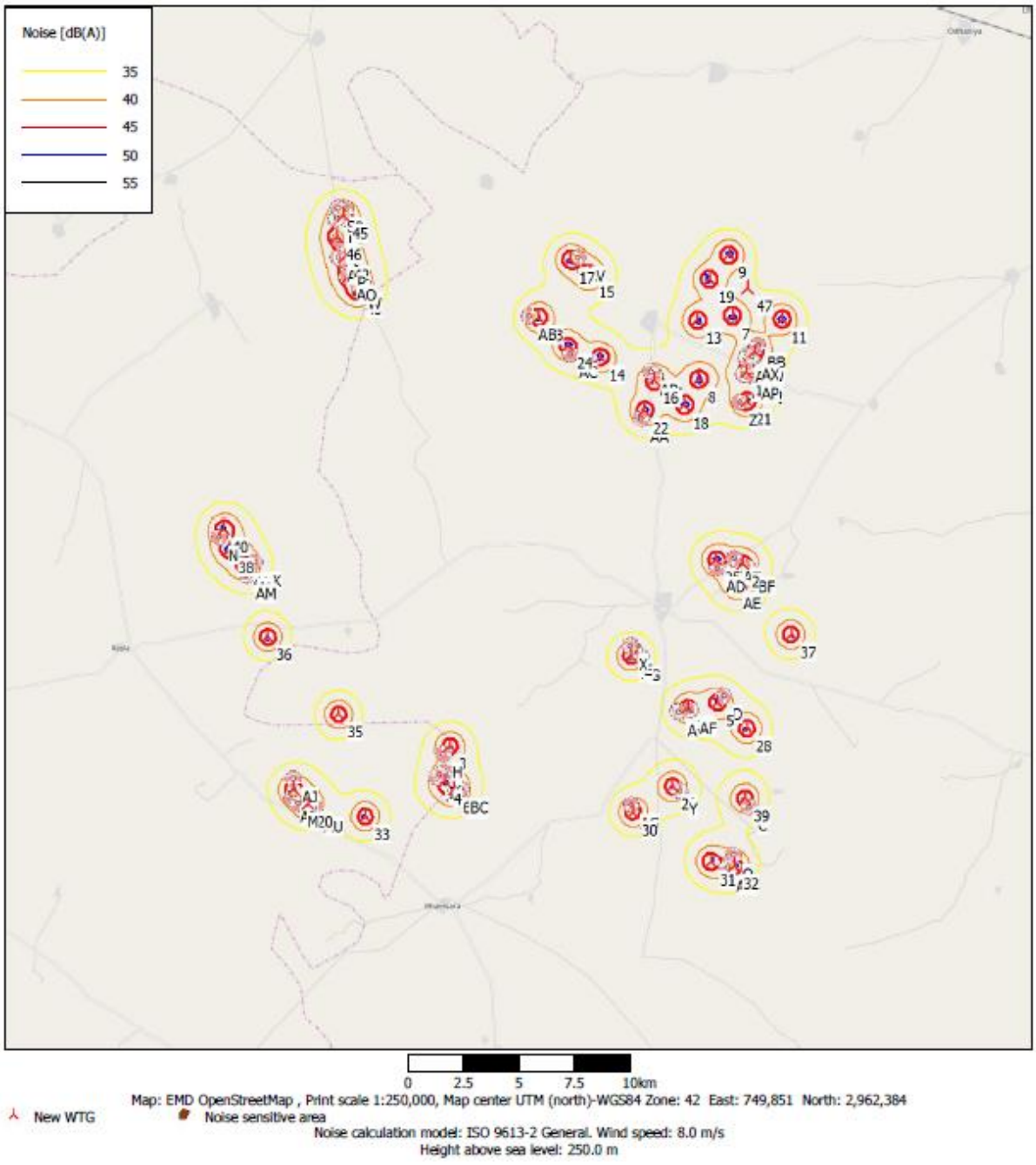
Impact	**Noise generation from operation of the WTGs – Night time**				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	Transboundary		
Impact Scale	Limited to Project area				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource /Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered as **moderate to Large** depending upon receptor distance from the WTGs.				
Residual Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of residual impact is considered to be **negligible to minor** depending upon implementation of safeguard measures				

7.5.3.5 Additional Mitigation Measures

To mitigate operational noise impacts, if any during the operation phase, following measures are proposed:

- Regular maintenance of WTGs.
- Periodic monitoring of noise near to the sources of generation to ensure compliance with design specification.
- Provide noise barriers near receptors with predicted noise levels exceeding more than 10 dB(A) of applicable standards during night time.
- Half yearly monitoring of ambient noise levels (during day and night time) at identified residential receptors for determination of actual impact due to operation of WTGs

Figure 7.2 Wind turbine and noise receptors at the study area



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+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.

(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

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.

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° clockwise[49] 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.

[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.'

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 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 turbine rotor diameters of the wind turbine (~1400 m).
- 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.

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[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.'

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- 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.

7.5.4.5 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 [54]. Therefore, IFC EHS Guidelines for Wind Energy dated August 7, 2015 [55] 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.

7.5.4.6 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 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)

[53] 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

(54) Assumption based upon review of the MNRE website and Onshore Wind Energy Policy.

(55) 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

- 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.

7.5.4.7 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)[56];
- 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 identified within 500m around the wind turbine locations are considered as shadow receptors.

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;
- Turbine locations – coordinates (provided by the Client);
- Turbine rotor diameter for project turbines i.e. 122 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

(1) [56] Available in WindPro database of climatological data

instance, turbine rotor diameter is 122 m; and therefore an area envelope of 1220 m from the nearest turbine is used in shadow flicker analyses.

Appendix A presents identified shadow receptors present within 1.2 km of the wind turbines of the project turbines. A total of 92 receptor have been identified as being within the study area of the wind farm (falling under different villages).

7.5.4.8 Shadow Flicker Analysis

Calculated shadow flicker at each identified shadow receptor due to the proposed windfarm is presented in ***Table 7.26***. 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

Table 7.26 Results of shadow hours at identified receptors

Receptor ID	Structure/Settlement ID	Nearest WTG	Degrees from (south clock-wise) [°]	Worst Case Scenario			Real Case Scenario
				Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
A	STLMNT 1	FAT 244	-152	0:00	0	0:00	0:00
B	STLMNT 2	FTNA-05	-194.9	0:00	0	0:00	0:00
C	STLMNT 3	FAT-109	-80.9	44:37	61	0:54	12:56
D	STLMNT 4	FAT-109	-54.8	104:58	120	1:00	29:24
E	STLMNT 5	FTN-295	-99.7	0:00	0	0:00	0:00
F	STR 1	FTN-295	-210.8	0:00	0	0:00	0:00
G	STR 2	FTN-293	-43.6	0:00	0	0:00	0:00
H	STR 3	FTN-272	-105.8	0:00	0	0:00	0:00
I	STR 4	FTN -297	-225.5	5:25	26	0:15	2:28
J	STR 5	FTN-292	38.2	85:04	86	1:13	42:49
K	STR 6	FAT-192	0	199:05	138	1:40	98:49
L	STR 7	FAT-192	0	0:00	0	0:00	0:00
M	STR 8	FAT-192	65.3	62:31	86	0:57	16:13
N	STR 9	FTN-253	-102.1	0:00	0	0:00	0:00
O	STR 10	FTN-233	0	0:00	0	0:00	0:00
P	STR 11	FTN-233	-44.2	84:19	124	1:04	23:51

Receptor ID	Structure/Settlement ID	Nearest WTG	Degrees from (south clock-wise) [°]	Worst Case Scenario			Real Case Scenario
				Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
Q	STR 12	FTN-233	-17.5	0:00	0	0:00	0:00
R	STR 13	FTNA-05	0	0:00	0	0:00	0:00
S	STR 14	FTN-293	-20	44:13	67	0:51	12:49
T	STR 15	FTN-293	-176.4	0:00	0	0:00	0.00
U	STR 16	FAT-195	-145.5	6:32	27	0:19	1:48
V	STR 17	FTN-156	-177.1	65:29	88	1:03	18:21
W	STR 18	FAT-318	-77.4	0:00	0	0:00	0:00
X	STR 19	FAT-465	-15.6	0:00	0	0:00	0:00
Y	STR 20	FTNA-020	-9.9	12:32	36	0:27	4:44
Z	STR 21	FAT-241	52.6	29:24	59	0:38	11:34
AA	STR 22	FAT-88	-218.1	0:00	0	0:00	0:00
AB	STR 23	FAT-045	33.7	0:00	0	0:00	0:00
AC	STR 24	FAT-291	-236.6	0:00	0	0:00	0:00
AD	STR 25	New-26	20.1	0:00	0	0:00	0:00
AE	STR 26	New-26	-22	0:00	0	0:00	0:00
AF	STR 27	New-26	-105.5	44:25	54	1:01	13:11
AG	STR 28	New-26	-83.5	35:34	52	0:52	10:26
AH	STR 29	FTN-215	-13.2	0:00	0	0:00	0:00

Receptor ID	Structure/Settlement ID	Nearest WTG	Degrees from (south clock-wise) [°]	Worst Case Scenario			Real Case Scenario
				Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
AI	STR 30	FAT-462	15.2	0:00	0	0:00	0:00
AJ	STR 31	FAT-462	12.9	14:03	28	0:39	7:59
AK	STR 32	New-012	27.5	48:13	90	0:38	20:56
AL	STR 33	FTN-296	-233.8	0:00	0	0:00	0:00
AM	STR 34	FTN-296	12.1	0:00	0	0:00	0:00
AN	STR 35	FAT-462	-158.8	0:00	0	0:00	0:00
AO	STR 36	New-012	40.1	54:36	90	0:49	22:48
AP	STR 37	New-012	37.9	56:20	87	0:51	23:15
AQ	STR 38	FAT-192	2.1	0:00	0	0:00	0:00
AR	STR 39	FTNA-05	0	0:00	0	0:00	0:00
AS	STR 40	FTNA-05	86.2	0:00	0	0:00	0:00
AT	STR 41	FTNA-05	-154	0:00	0	0:00	0:00
AU	STR 42	New-005	-85.4	155:08	158	1:16	42:48
AV	STR 43	New-005	26.9	0:00	0	0:00	0:00
AW	STR 44	FAT-317	-135.3	0:00	0	0:00	0:00
AX	STR 45	New-011	-70.7	65:53	82	1:01	18:52
AY	STR 46	New-012	-158	6:54	26	0:21	2:02

Receptor ID	Structure/Settlement ID	Nearest WTG	Degrees from (south clock-wise) [°]	Worst Case Scenario			Real Case Scenario
				Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
AZ	STR 47	FAT-476	-196.2	0:00	0	0:00	0:00
BA	STR 48	FAT-244	-23.6	103:07	81	1:35	29:54
BB	STR 49	FAT-109	46.7	0:00	0	0:00	0:00
BC	STR 50	FTN-295	0	0:00	0	0:00	0:00
BD	STR 51	FTNA-020	-71	149:34	120	1:26	41:55
BE	STR 52	FTN-154	-164.1	0:00	0	0:00	0:00
BF	STR 53	FTN-154	0	0:00	0	0:00	0:00
BG	STR 54	FAT-318	32.4	51:31	73	0:55	16:37
BH	STR 55	FAT-195	-16.3	27:10	55	0:49	10:01
BI	STR 56	FAT-195	-197.9	0:00	0	0:00	0:00
BJ	STR 57	FAT-195	-206.5	0:00	0	0:00	0:00
BK	STR 58	FAT-88	-86.3	203:05	160	1:29	55:46
BL	STR 59	FAT-197	0	91:21	76	1:51	31:58
BM	STR 60	FAT-008	68	0:00	0	0:00	0:00
BN	STR 61	FAT-008	-237.8	0:00	0	0:00	0:00
BO	STR 62	FAT-062	0	0:00	0	0:00	0:00
BP	STR 63	FAT-008	-113.5	0:00	0	0:00	0:00

Receptor ID	Structure/Settlement ID	Nearest WTG	Degrees from (south clock-wise) [°]	Worst Case Scenario			Real Case Scenario
				Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
BQ	STR 64	FAT-062	0	24:20	34	0:54	13:56
BR	STR 65	FTN-156	-28.4	0:00	0	0:00	0:00
BS	STR 66	FAT-371	47.3	93:50	99	1:13	31:29
BT	STR 67	New-001	-144.2	0:00	0	0:00	0:00
BU	STR 68	New-001	-140.7	0:00	0	0:00	0:00
BV	STR 69	New-001	-99.3	0:00	0	0:00	0:00
BW	STR 70	FAT-020	-21.3	110:42	118	1:05	36:19
BX	STR 71	New-001	-99.8	0:00	0	0:00	0:00
BY	STR 72	New-001	19.7	0:00	0	0:00	0:00
BZ	STR 73	FTN-234	0	79:04	90	1:18	23:44
CA	STR 74	FTN-234	69.6	102:58	83	1:32	20:04
CB	STR 75	FTN-234	72.4	185:04	176	1:26	48:05
CC	STR 76	FAT-020	-28.9	0:00	0	0:00	0:00
CD	STLMNT 6	FAT-197	-101.3	0:00	0	0:00	0:00
CE	STLMNT 7	FAT-465	-120.4	0:00	0	0:00	0:00
CF	STLMNT 8	FTN-234	-180.7	0:00	0	0:00	0:00
CG	STLMNT 9	FAT-192	0	0:00	0	0:00	0:00

Receptor ID	Structure/Settlement ID	Nearest WTG	Degrees from (south clock-wise) [°]	Worst Case Scenario			Real Case Scenario
				Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
CH	STLMNT 10	Fat-192	0	0:00	0	0:00	0:00
CI	STLMNT 11	FAT-476	-63.1	0:00	0	0:00	0:00
CJ	STLMNT 12	FAT-317	-159.7	0:00	0	0:00	0:00
CK	STLMNT 13	FAT-317	-146.7	0:00	0	0:00	0:00
CL	STLMNT 14	FAT-139	0	0:00	0	0:00	0:00
NA	STR 77*	FAT-090	-28.4	382:33	195	2:26	162:02
NA	STR 78*	FAT-090	-28.4	95:20	118	1:05	36:19

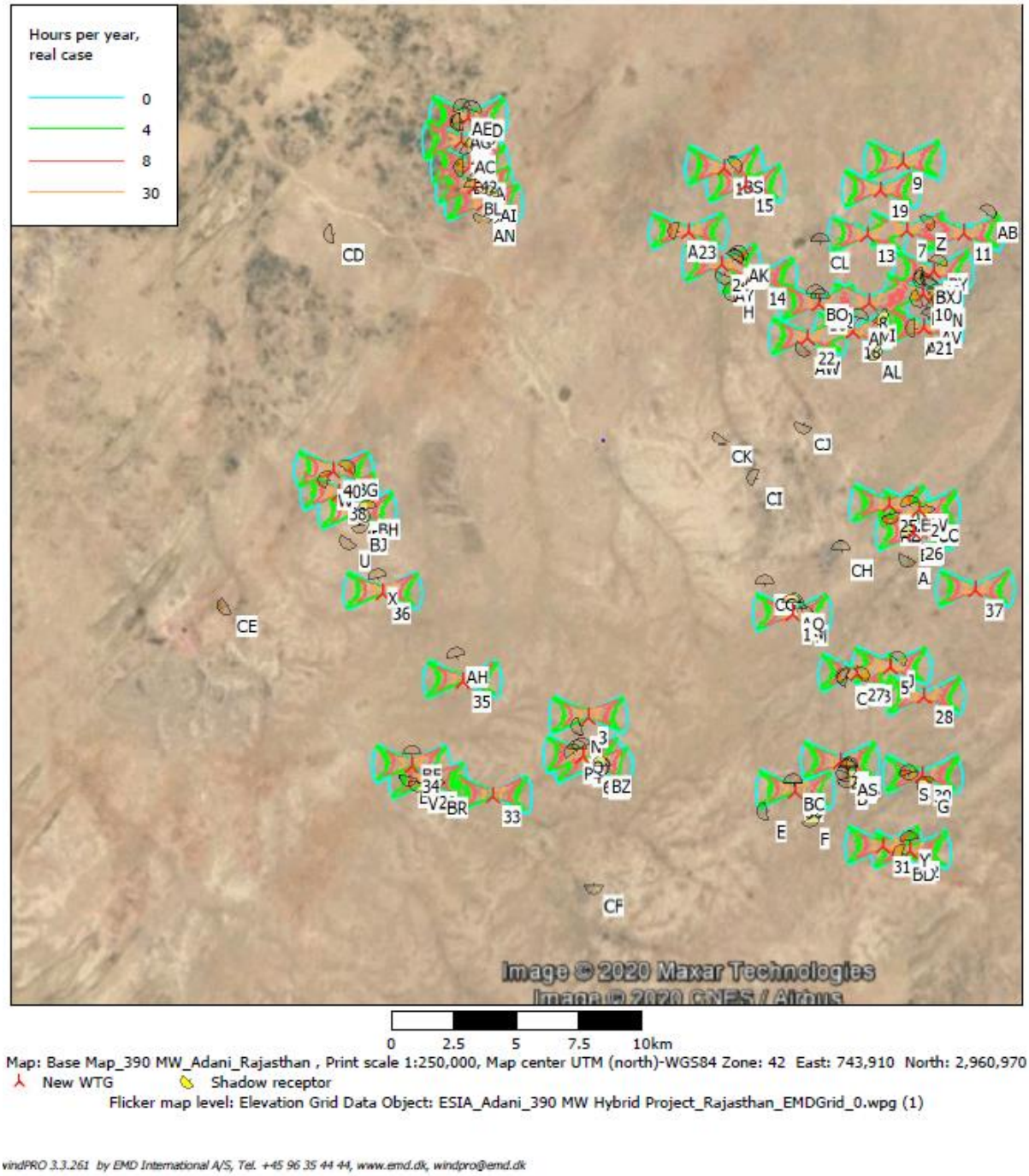
*The results have been incorporated from modelling results based on originally confirmed 46 locations including FAT-090, which now is “pending confirmation”. This is an exceptional case, since FAT-090 may or may not be finalised by AGE(18)L.

(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

Figure 7.3 Wind turbines and shadow receptors of the wind farm



7.5.4.9 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 theoretical shadow flickers impact in the real case scenario occur at one shadow receptor ranging between 60 hr/yr and 120 hr/yr i.e. receptor ID: K with maximum of 98:49 hr/year.

Additionally, one of the receptors located close to FAT-090 have shadow flicker impact more than 120 hr/ yr in real case scenario as shown in Table 7.25. However, as reported by Client, FAT-090 location is yet to be finalised by AGE(18)L project team.

There are eight locations with receptor ID: J, AU, BD, BK, BL, BW ,CB and NA(for FAT-090) which exceeded the value and ranged between 30 hr/year to 60 hr/year as highlighted in yellow in ***Table 7.26.*** Maximum impact is observed on receptor BK located close to wind turbine FAT-88 with a maximum of 55:46 h/year. 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 1 receptor **medium** for 1 receptor, **small** for 8 receptors and **negligible** for 82 receptors.

7.5.4.10 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.

7.5.4.11 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 **negligible to minor** 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	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 **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 **negligible** to **minor**				

7.5.5 Impact on economy and employment

7.5.5.1 Impacts

The average Work Participation Ration (WPR) in the AoI villages is 43.51 percent. The causal 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.

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 approx. 1000 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 have been assessed as **positive** due to employment opportunities for locals.

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 AoI.

7.5.5.5 Residual impact significance

The significance of the residual impact will be **positive**.

Impact	**Economic Opportunity**		
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	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**				

7.5.6 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 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.

7.5.6.2 Embedded built in controls

As reported AGE(18)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.

7.5.6.3 Significance of Impact

The overall impact significance of the labour rights and welfare during the operation phase is assessed **as minor**.

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 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;
- AGE(18)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

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 2.7 km from WTG FAT-195 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 Prioriety 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 *Estern Imperial Eagle (Aquila heliacal), 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 installaed 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*), Estern Imperial Eagle (*Aquila heliacal*), 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 5.6km from the northeastern WTG FAT-045. 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

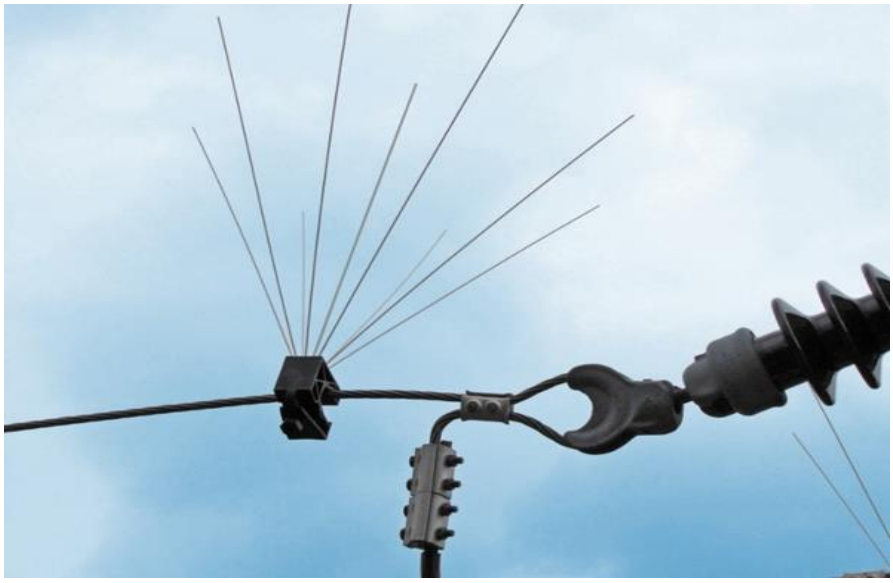
- Long term monitoring of entire transmission lines should be commissioned to understand the movement of migratory species and areas with the presence of EN, CR species such as GIB and Vultures in this landscape. This will help identify the high risk areas of the transmission line stretch and the mitigation 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 7.4.

Figure 7.4: Bird Diverter, insulators and perch rejector

Bird Diverter from Indodivert

Insulation of conductors at Pole Crossovers



Broom type perch rejector

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 **negligible to 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:

- AGE(18)L should 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

Significance of residual impact is assessed to be **negligible** upon incorporation of the above mentioned mitigation measures

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	
	Significance of impact is considered to be **minor**.				
	Positive	Negligible	Small	Medium	Major
	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **negligible.**				

7.7 Cumulative impact assessment

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 390 MW hybrid Project.

- A 50.4 MW wind power plant developed by Suzlon and owned by Orange Renewable Power Private Limited located approximately 4 km from the proposed site;
- A 100 MW wind power project developed by Siemens Gamesa and owned by National Aluminium Company Limited (NALCO) located within 5 km of the proposed project;
- A 450 MW wind power plant developed and owned by Caparo Energy (India) Ltd. at Madasar and Lakhasar village located approximately 9 km southwest of the project site.

As reported by site representative, there are upcoming wind power projects to be developed by Renew and Eden Renewables (capacities not known) within 10-15 km of the proposed project site. AGEL also plans to develop 600MW and 700 MW solar and wind hybrid power project within 10 km of the proposed project. Reportedly, there are no solar power projects in the proposed site vicinity and information on upcoming solar projects other than AGEL's 600 MW and 700 MW hybrid project in the area is currently unavailable.

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 east and south east 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 red desertic soil 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 short duration (6-8 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 390 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(18)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 390 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 390 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 390 MW hybrid power project (including AGE(18)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 AoI:

- 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 (**for more details, please refer to section 8.4.9**). The local community is likely to benefit from the economic opportunities to be created from the following activities in the AoI:

- 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 AoI 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 AoI is consists of shrub/waste land with patches of agricultural land. The coming of hybrid (solar and wind) projects in the AoI 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 reported these of land required for installing solar plant including pooling sub-station will be 1500 acre and for a WTG is 6 acres, which including 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 AoI 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 AoI.

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 AoI 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 reported these of land required for installing solar plant including pooling sub-station will be 1500 acre and for a WTG is 6 acres, which including 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 390 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		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 390 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 habiats 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 390 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, AGE(18)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(18)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(18)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(18)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(18)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 coporate level, AGE(18)L is required to follow the ESMP presented in ***Table 8.1*** during lifecycle of the 390 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	■ 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	■ 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(18) L HSE Team Contractors engaged by AGE(18)L	Site inspection	Upon completion of task	AGE(18)L and their sub-contractor	AGE(18)L EHS personnel	-
1.2	***Land and Soil***									
1.2.1	■ ***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	■ 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(18) L HSE Team Contractors engaged by AGE(18)L	Site Inspection	Monthly monitoring	AGE(18)L and their sub-contractor	AGE(18)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	■ 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(18) L HSE Team Contractors engaged by AGE(18)L	Site Inspection	Monthly monitoring	AGE(18)L and their sub-contractor	AGE(18)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	■ 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 ■ Spill control kits will be used to contain and clean small spills and leaks ■ Transport vehicles and equipment shall undergo regular maintenance to avoid any oil leakages ■ Offloading and loading protocols should be prepared for diesel, oil and used oil respectively and workers trained to prevent/contain spills and leaks.	AGE(18) L HSE Team Contractors engaged by AGE(18)L	Site Inspection	Monthly monitoring	AGE(18)L and their sub-contractor	AGE(18)L EHS personnel	Report from onsite HSE officer to HSE department of AGEL
1.3	***Water Resource Availability and Quality***									
1.3.1	• Civil Work; • Domestic water for site staff and workers;	Depletion of water resources	Construction Operation	■ 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(18) L HSE Team Contractors engaged by AGE(18)L	Site Inspection	Monthly monitoring	AGE(18)L and their sub-contractor	AGE(18)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
				■ Prepare and implement water conservation scheme e.g., rainwater harvesting at the project site.						
1.3.2	■ Storage of hazardous substances and waste onsite; ■ Construction and demolition activities that causes dust and erosion.	Water contamination	Construction Operation Decommissioning	■ 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(18) L HSE Team Contractors engaged by AGE(18)L	Site Inspection	Monthly monitoring	AGE(18)L and their sub-contractor	AGE(18)L EHS personnel	Report from onsite HSE officer to HSE department of AGEL
1.4	***Air Quality***									
1.***4***.1	■ 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	■ 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(18) L HSE Team Contractors engaged by AGE(18)L	Site Inspection Training records Visual	Monthly monitoring	AGE(18)L and their sub-contractor	AGE(18)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	■ Only well-maintained equipment should be operated on-site; ■ If it is noticed that any particular equipment is generating too much noise	AGE(18) L HSE Team Contractors engaged by AGE(18)L	Site Inspection	Monthly monitoring	AGE(18)L and their sub-contractor	AGE(18)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
				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 ■ Regular maintenance of WTGs. ■ Periodic monitoring of noise near to the sources of generation to ensure compliance with design specification. ■ Provide noise barriers near receptors with predicted noise levels exceeding more than 10 dB(A) of applicable standards during night time. ■ Half yearly monitoring of ambient noise levels (during day and night time) at identified residential receptors for determination of actual impact due to operation of WTGs						
1.5.2	Shadow flicker	Impact on receptors due to shadow flicker on the 92 receptors identified as part of the study	Operation Phase	■ There needs to be close monitoring through engagement with residents during the operation phase	AGE(18) L HSE Team	Site Inspection And visual observation	Monthly monitoring	AGE(18)L	AGE(18)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
				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.						
1.6	***Social***									

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
1.6.1	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	■ 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 same and refresher courses will be provided throughout the life of the project	AGE(18)L EPC team	Discussion with EPC Visual inspection	Weekly Monitoring	EHS Manager and EPC EHS Team	AGE(18)L EHS Team	Report from EPC EHS team
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	■ 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(18)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(18)L Land Team	Discussion with Local community and verification of land owners remaining land documents	Before procurement of land	AGE(18)L Land team	AGE(18)L Land team	Report from AGE(18)L Land Team
				■ Additional employment opportunities may also be created for the local youth by the project	AGE(18)L HR Team	Employment Records	Before Operation and at the time of operation f project	AGE(18)L HR team	AGE(18)L HR team	Report from AGE(18)L HR 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
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	■ 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 tea stalls, supply of intermediate raw materials, repair outlets, hardware stores etc. However, these are likely to be temporary	Project Team/HR Site manager	Site Inspection/Internal audits/document verification	Monthly during construction and quarterly during operation	AGE(18)L and appointed contractors	AGE(18)L HSE team	Report from Onsite HSE office to HSE department of AGE(18)L
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	■ 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(18)L site HSE team	Site Inspection/Internal audits/document verification	Prepared disaster management plan and available insurance	AGE(18)L site HSE team	AGE(18)L HSE Team	Report from Onsite HSE office to HSE department of AGE(18)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	Construction and Operation Phase	■ 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;	AGE(18)L HSE Team	Site Inspection/Internal audits/document verification/training records	monthly monitoring	AGE(18)L site HSE team	AGE(18)L HSE Team	Report from Onsite HSE office to HSE department of AGE(18)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
		in the operations phase are likely to result in a risk on the health and safety of the workers on 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. ■ 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 emergency situations. The nearest hospital, ambulance,					

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
				fire station and police station should be identified in the implemented emergency management plan.						
1.6.6	Labour Rights and Welfare	The influx of labour (skilled, semi-skilled and unskilled) may result in impact on labour rights and welfare	Construction and Operation Phase	■ 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; ■ AGE(18)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	Project Team/HR Site manager	/Internal audits/document verification	Monthly during construction and quarterly during operation	AGE(18)L and appointed contractors	AGE(18)L HSE team	Report from Onsite HSE office to HSE department of AGE(18)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	■ 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	AGE(18)L project and CSR team	Study report/CSR report	Monthly reporting	CSR team	AGE(18)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
				programmes in accordance to the same; ■ As part of the stakeholder engagement, ensure adequate representation of the SC/ST groups and vulnerable groups identified, and undertake specific engagement activities with these groups; and ■ Ensure that the grievance management mechanism established is accessible to these groups						
1.7	***Ecology***									
1.7.1	Vegetation Clearance	Site Preparation	Construction	■ 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;	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
				■ 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 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	■ 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 Sun contractor	HSE	Report from onsite HSE officer to HSE
1.7.3	Operational Wind Turbine	Collision Risk	Operation	■ A detailed and long term monitoring of bird and bat	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
				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.						

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
				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.						
1.7.4	Transmission infrastructure	Collision and Electrocution Risk	Operation	■ 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;	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
				■ 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.						

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 390 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
Change in Land Use	Negative	Minor	Minor
Topography and Drainage	Negative	Minor	Negligible
Soil Compaction and Erosion	Negative	Minor	Negligible
Soil Contamination	Negative	Moderate	Minor
Water availability	Negative	Minor	Minor
Water Quality	Negative	Moderate	Minor
Air Quality	Negative	Minor	Negligible
Ambient Noise	Negative	Minor	Negligible to Minor
Occupational Health and Safety	Negative	Minor	Negligible to Minor
Community Health and Safety	Negative	Minor	Minor
In-Migration of workers	Negative	Minor	Negligible
Impact on Landholding and Agricultural Income	Negative	Minor	Negligible to Minor
Employment Opportunity	Positive	Positive	Positive
Vegetation Clearance	Negative	Critical	Major
Approach Roads	Negative	Major	Negligible

Construction Activities	Negative	Major	Negligible
Operation and Maintenance			
Waste Disposal/Generation	Negative	Negligible	Negligible
Soil Contamination	Negative	Minor	Negligible
Water Availability	Negative	Minor	Minor
Water Quality	Negative	Negligible	Negligible
Noise Quality- day time	Negative	Negligible to Minor	Negligible
Noise Quality-night time	Negative	Moderate to Major	Negligible to MInor
Shadow Flicker	Negative	Moderate to Major	Negligible to Minor
Occupational Health and Safety	Negative	Minor	Negligible to Minor
Labour Rights and Welfare	Negative	Minor	Minor
Bird and bat collision with wind turbine	Negative	Major	Moderate
Collision and electrocution hazards from transmission infrastructure	Negative	Critical	Major
Decommissioning Phase			
Soil Environment	Negative	Minor	Minor to Negligible
Air Quality	Negative	Minor	Negligible
Ambient Noise	Negative	Minor to Negligible	Negligible
Economy and Employment	Negative	Minor	Negligible to Minor
Cumulative Impacts			
Environment	Negative	Moderate to Minor	Minor
Social	Negative	Moderate	Minor

9.3 Project categorization

IFC's Environmental and Social Review Procedure Manual [57] has provided a provisional categorization tool for projects. The tool assigns an E&S category based on risk inherent to the particular sector, as well as on the likelihood of a development taking place and on what can be reasonably ascertained about the environmental and social characterization of the Project's likely geographical setting. The categories are defined as follows:

1. **Category A:** Projects with potential significant adverse environmental or social risks and/or impacts that is diverse, irreversible or unprecedented.
2. **Category B:** Projects with potential limited adverse environmental or social risks and/or impacts that is few in number, generally site-specific, largely irreversible and readily addressed through mitigation measures.
3. **Category C:** Projects with minimal or no adverse environmental or social risks and/or impacts.

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) and Indian Vulture (Gyps indicus) and Red-headed Vulture (*Sarcogyps calvus*) are likely to be present within and in the areas adjacent to the wind farm. 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 5.6 km east of WTG FAT-045.Also one 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 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 movemet and presence of CR Vulture species in larger number near Bhadariya, 24 km north of Project site. Endangered Egyptatian Vulture (*Neophron percnopterus*) were also observed inside the Project area. The Vultures can fly great distances in search of food and thus their movement in the wind farm 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).
- **Potentially limited risks/impacts and reversible**: Environmental and social impacts of the Project are anticipated during the operation, construction and decommissioning phase and will encompass changes in land-use, increased noise levels, changes in air quality, use and changes

(57) 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.

in water availability and quality, occupational health & safety, etc. Most of these impacts are limited to the Project site and their immediate vicinity and can be minimized through application of mitigation measures as proposed in the ESMP;

- **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 390 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 shrub/waste land, agricultural land and gravel waste land. The site location of the project does not involve any anticipated settlements and physical displacement.

  Additionally, given the guidelines of 30 hours or less per year is considered acceptable, the operation of the wind turbines theoretically results in shadow flicker impact on the structures and settlements present in vicinity. The results show that theoretical shadow flicker impact in real case scenario occur at 1 receptors with higher than 120 shadow hours per year, 1 receptor with shadow impact between 60 hours per year and 30 hours per year and 8 receptors with shadow more than 30 hours per year from a total of 92 receptors identified within the Project area.

  Shadow flicker related impacts can be mitigated through implementation of technical measures

9.4 Conclusion

The proposed project is a green energy project that will comprise of 46 operating WTGs and 1,216,180 solar PV modules to generate 390 MW power through wind and solar 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.

It is important for AGE(18)L to implement the suggested mitigation measure to minimize the impacts over the environment, social and ecological resources in order to mitigate overall impact significance.

The Environmental and Social Management Plan (ESMP) and specific management plans describes mitigation measures for impacts specific to project activities and also discuss implementation mechanism. To conclude, the implementation of ESMP will help AGE(18)L in complying with national/ state regulatory framework as well as to meet IFC / EDF reference framework requirements.

APPENDIX A WIND TURBINE GENERATOR (WTG) PROFILING

S.No.	WTG ID	Latitude (Decimal)	Longitude (Decimal)	Nearest village	North	South	East	West	Remarks	Receptor type (within 500-1220 metres)	Receptor ID	Approximate distance from WTG location (metres)	Direction from WTG	Receptor Latitude (Decimal)	Receptor Longitude (Decimal)
1	FAT-192	26.71393260°	71.56793501°	Sankara	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land		Structure	STR 6	263.83	NE	26.71545759°	71.56996665°
										Structure	STR 7	457.86	N	26.71790596°	71.56853759°
									STR 8 is a group of structures (5 in number) each 25m apart	Structure	STR 8	476.55	E	26.71351781°	71.57274852°
										Structure	STR 38	411.75	N	26.71762500°	71.56767200°
										Settlement	STLMNT 10	1890.00	NE	26.736821°	71.587513°
										Settlement	STLMNT 9	1220.00	NW	26.724621°	71.556699°
2	FTN-253	26.67710540°	71.48592791°	Sadrasar	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land	Patches of Shrub/waste land exist on 500m perimeter from proposed turbine in East, South, SW and NW directions	Structure	STR 9	476.16	SW	26.67381795°	71.48281624°
3	FTN-233	26.66298686°	71.48364310°	Sadrasar	Shrub/waste land	Shrub/waste lands	Shrub/waste lands	Shrub/waste land	STR 10, 11, 12 can be grouped as a settlement in NW direction from proposed turbine sprawling 500m	Structure	STR 10, 11, 12	366.71	NW	26.66568314°	71.48148926°
4	FTN-292	26.69475153°	71.60735690°	Achalpura	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land	Man made water pond and a strcuture at 307.02m in NW direction	Structure	STR 5	384.40	NE	26.69705946°	71.61024850°
5	FTN-234	26.65936713°	71.48783310°	Baiteena	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land		Structure	STR 74	235.82	SE	26.658542°	71.490006°
										Structure	STR 75	293.06	SE	26.659186°	71.490764°
										Structure	STR 73	317.93	SE	26.659519°	71.491086°
										Settlement	STLMNT 8	5000.00	S	26.616627°	71.487971°
6	FAT-241	26.85122410°	71.61421477°	Naya Sanawara	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land		Structure	STR 21	740.00	NE	26.85377982°	71.62125468°
7	FTN-297	26.82537396°	71.59896721°	Naya Sanawara	Shrub/waste land	Shrub/waste land	Agricultural land	Shrub/waste land	East: Agricultural land is only in patches	Structure	STR 4	630.00	S	26.820936°	71.603088°
8	FAT-116	26.87602162°	71.61265216°	Maheshon ki Dhani	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land							
9	FAT-008	26.82824027°	71.62064650°	Chok	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land		Structure	STR 63	195.43	SW	26.827056°	71.619156°
										Structure	STR 61	355.11	SE	26.826281°	71.623517°
										Structure	STR 60	312.06	SE	26.826883°	71.623467°
10	FAT-045	26.84994865°	71.63672873°	Naya Sanawara	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land		Structure	STR 23	1220.00	NE	26.857647°	71.645800°
11	NEW-001	26.83653684°	71.62430769°	Chok	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land		Structure	STR 72	336.56	NE	26.839236°	71.625925°
										Structure	STR 71	400.34	SW	26.834542°	71.620903°
										Structure	STR 69	489.68	SW	26.833553°	71.620589°
										Structure	STR 68	231.69	SW	26.834622°	71.623253°
										Structure	STR 67	304.77	SW	26.833881°	71.623386°
12	FAT-139	26.84940506°	71.59835938°	Naya Sanawara	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land		Settlement	STLMNT 14	1900.00	W	26.847071°	71.579495°
13	FAT-272	26.83419199°	71.55427834°	Sanawara	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land		Structure	STR 3	1111.00	W	26.829409°	71.544279°
14	FAT-371	26.86810077°	71.54935546°	Sanawara	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land							
15		26.82484503°	71.57856872°	Naya Sanawara						Structure	STR 62	405.13	NW	26.828286°	71.577242°

S.No.	WTG ID	Latitude (Decimal)	Longitude (Decimal)	Nearest village	North	South	East	West	Remarks	Receptor type (within 500-1220 metres)	Receptor ID	Approximate distance from WTG location (metres)	Direction from WTG	Receptor Latitude (Decimal)	Receptor Longitude (Decimal)
	FAT-062				Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land		Structure	STR 64	240.33	NE	26.826903°	71.579267°
16	FAT-468	26.87395029°	71.54071267°	Sanawara	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land		Structure	STR 66	348.40	E	26.874597°	71.544128°
17	FTN-296	26.81488176°	71.59247256°	Sanawara	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land		Structure	STR 33	1090.00	SE	26.807857°	71.600329°
										Structure	STR34	560.00	NE	26.819698°	71.594570°
18	FAT-279	26.86607321°	71.60363008°	Naya Sanawara	Shrub/waste land	Shrub/waste land	Shrub/waste lands	Shrub/waste land							
19	NEW-005	26.81635416°	71.62078522°	Chok	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land		Structure	STR 42	340 m	W	26.815966°	71.617377°
				Chok	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land		Structure	STR 43	470 m	NE	26.820200°	71.623096°
20	FAT-317	26.81272296°	71.57431188°	Unnamed	Gravel Waste Land	Gravel Waste Land	Gravel Waste Land	Gravel Waste Land	Road passing from Nort to South at 260 m east of the site. Also, Structures are in Cluster	Structure	STR 44	360 m	S	26.809328°	71.572783°
										Settlement	STLMNT 12	2890.00	S	26.782065°	71.572644°
										Settlement	STLMNT 13	5000.00	SW	26.777700°	71.539530°
21	NEW-011	26.85074089°	71.52617026°	Sanawara	Shrub/waste land	Shrub/waste land	Shrub/waste lands	Shrub/waste land	The structure identified could be a pump station	Structure	STR 45	430 m	W	26.851033°	71.521863°
22	NEW-012	26.83897846°	71.53952883°	Sanawara	Shrub/waste lands	Land under Miscellaneous Tree Crops	Shrub/waste lands	Land under Miscellaneous Tree Crops		Structure	STR 46	430 m	S	26.835271°	71.540534°
										Structure	STR32	750.00	NE	26.842334°	71.546461°
										Structure	STR 36	590.00	E	26.841277°	71.544892°
										Structure	STR 37	560.00	E	26.841099°	71.544634°
23	FAT-476	26.75283505°	71.60685254°	Sankara	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land	Road passing from East to West at 460 m south of the site	Structure	STR 47	400m	S	26.749263°	71.607424°
										Settlement	STLMNT 11	5000.00	W	26.762508°	71.553366°
24	FAT-244	26.74288614°	71.61692680°	Khetasar	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land	Two Roads passing North to South at 320 m and 380 m towards West of WTG	Structure	STR 48	210 m	W	26.742134°	71.614989°
										Settlement	STLMNT1	1040.00	S	26.733818°	71.614361°
25	FAT-109	26.69241944°	71.59379235°	Achalpura	Shrub/waste land	Shrub/waste lands	Shrub/waste land	Shrub/waste land		Settlement	STLMNT3	440.63	SW	26.69081176°	71.58973316°
										Settlement	STLMNT4	464.56	SW	26.69136047°	71.58925722°
									The structure identified is a temple used by local community	Structure	STR 49	150 m	W	26.691631°	71.595059°
26	FTNA-004	26.68420867°	71.62077790°	Achalpura	Shrub/waste land	Shrub/waste lands	Shrub/waste land	Shrub/waste land	Kuccha road is passing North to South towards West of site						
27	FTNA-05	26.66084465°	71.58696145°	Loona Khurd	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land	Settlement is outside the 500 m, but can be considered for shadow flicker	Settlement	STLMNT2	727.70	S	26.654845°	71.589630°
										Structure	STR 13	395.19	SE	26.65877861°	71.59025135°
										Structure	STR 39	382.17	SE	26.65923500°	71.59042100°

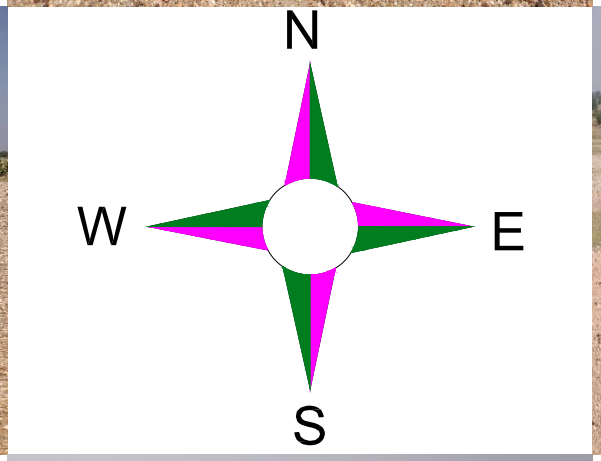
S.No.	WTG ID	Latitude (Decimal)	Longitude (Decimal)	Nearest village	North	South	East	West	Remarks	Receptor type (within 500-1220 metres)	Receptor ID	Approximate distance from WTG location (metres)	Direction from WTG	Receptor Latitude (Decimal)	Receptor Longitude (Decimal)
										Structure	STR 40	387.79	SE	26.65845400°	71.58984200°
										Structure	STR 41	492.41	SE	26.65686200°	71.58931500°
28	FTN-295	26.65053291°	71.56894426°	Motisar	Shrub/waste lands	Shrub/waste lands	Shrub/waste lands	Shrub/waste lands	Structure identified can be an abondoned house or a pump house. Additionally, kucha road is passin from West to east at 80 m towards South of WTG	Structure	STR 50	290 m	N	26.653228°	71.568356°
										Structure	STR 1	1220.00	S	26.640611°	71.574849°
										Settlement	STLMNT5	1220.00	SW	26.643316°	71.557265°
29	FTNA-011	26.63064044°	71.60439312°	Motisar	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land	Kucha road is passing North to Soith at 140 m towards West from site						
30	FTNA-020	26.62894692°	71.61504737°	Motisar	Shrub/waste lands	Shrub/waste land	Shrub/waste land	Shrub/waste land	Kucha road is passing adjacent to the site in west direction	Structure	STR 20	464.75	N	26.63310829°	71.61473880°
										Structure	STR 51	310 m	W	26.628207°	71.612048°
31	FTN-181	26.64878926°	71.44741370°	Bhainsara/Baiteena	Shrub/waste lands	Culturable Waste Land	Shrub/waste lands	Shrub/waste lands							
32	FTN-154	26.65972459°	71.41483465°	Achla	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land	A manmade water body is located at 310 m towards SW	Structure	STR 52	460 m	S	26.655606°	71.413822°
				Achla	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land		Structure	STR 53	430 m	N	26.663683°	71.414999°
				Mehrajot	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land		Structure	STR 17	740.00	SW	26.653770°	71.417354°
33	FTN-215	26.68995541°	71.43544380°	Lakahasar	Agricultural land	Agricultural land	Shrub/waste lands	Shrub/waste lands	Unpaved road passing West to East at 320 m towards North	Structure	STR 29	950.00	N	26.698666°	71.432960°
34	FAT-465	26.72162908°	71.40322733°	Lakahasar	Shrub/waste lands	Shrub/waste lands	Shrub/waste lands	Shrub/waste lands	Paved road passing West to east at a distance of 500 towards north of WTG	Structure	STR 19	580.00	N	26.726818°	71.401132°
										Settlement	STLMNT 7	6000.00	SW	26.716956°	71.340545°
35	FAT-026	26.75710120°	71.38571845°	Rasla	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land							
36	FAT-318	26.76520627°	71.38349520°	Rasla	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land		Structure	STR 18	415.10	SW	26.76193532°	71.38122823°
										Structure	STR 54	490.00	E	26.765788°	71.388333°
37	FAT-195	26.75048833°	71.39309903°	Rasla	Shrub/waste lands	Shrub/waste land	Shrub/waste land	Shrub/waste land	Structures are found in clusters. Two- three structures are located together	Structure	STR 55	420.00	NW	26.751408°	71.397249°
										Structure	STR 56	240.00	E	26.748775°	71.394584°
										Structure	STR 57	490.00	SW	26.746171°	71.393850°

S.No.	WTG ID	Latitude (Decimal)	Longitude (Decimal)	Nearest village	North	South	East	West	Remarks	Receptor type (within 500-1220 metres)	Receptor ID	Approximate distance from WTG location (metres)	Direction from WTG	Receptor Latitude (Decimal)	Receptor Longitude (Decimal)
										Structure	STR 16	1220.00	SW	26.740353°	71.389811°
38	FAT-88	26.87477300°	71.43822627°	Dhaysar	Agricultural land	Agricultural land	Agricultural land	Agricultural land		Structure	STR 22	321.38	SE	26.87229184°	71.43993508°
									UnPaved road is passing from North to South at 170 m towards west of WTG	Structure	STR 58	280.00	W	26.874485°	71.435464°
39	FAT-462	26.86139136°	71.44392565°	Keraliya	Shrub/waste lands	Shrub/waste land	Agricultural land	Shrub/waste land		Structure	STR 30	421.09	NE	26.86456062°	71.44623190°
										Structure	STR 31	249.29	N	26.86354330°	71.44477480°
										Structure	STR 35	510.02	S	26.85679700°	71.44381200°
40	FAT-197	26.86725815°	71.44019812°	Keraliya	Shrub/waste lands	Shrub/waste land	Agricultural land	Shrub/waste land	Un paved road passing West to East at 270 m towards south	Structure	STR 59	70.00	SW	26.866908°	71.439686°
										Settlement	STLMNT 6	6000.00	W	26.849909°	71.382873°
41	New-26	26.89164003°	71.43762231°	Keraliya	Agricultural land	Agricultural land	Agricultural land	Agricultural land	Paved road passing from West to East at 70 m towards North	Structure	STR 25	343.75	NE	26.89446041°	71.43910676°
										Structure	STR 26	436.45	NW	26.89485056°	71.43517628°
										Structure	STR 27	291.30	SW	26.89048626°	71.43492713°
										Structure	STR 28	380.73	SW	26.89019706°	71.43414039°
42	FAT-291	26.88315138°	71.43484373°	Dhaysar	Agricultural land	Agricultural land	Agricultural land	Agricultural land		Structure	STR 24	180.46	SE	26.88194520°	71.43602047°
43	FTN-156	26.653681°	71.421577°	Mehrajot	Agricultural land	Shrub/waste land	Shrub/waste land	Shrub/waste land		Structure	STR 17	433.46	W	26.653770°	71.417354°
					Agricultural land	Shrub/waste land	Shrub/waste land	Shrub/waste land		Structure	STR 65	386.00	SE	26.651791°	71.424782°
44	FAT-041	26.722531°	71.640687°	Khetasar	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land		Nil	Nil				
45	FAT-020	26.751079°	71.618904°	Sankara	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land	Road passing towards west of WTG at 400 m	Structure	STR 70	434.00	W	26.753144°	71.615203°
				Sankara	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land		Structure	STR 76	327.00	E	26.749391°	71.621563°
46	FTN-293	26.655992°	71.619811°	Loona Khurd	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land		Structure	STR 2	444.00	SE	26.652397°	71.621604°
										Structure	STR-14	500.00	W	26.656574°	71.614537°
										Structure	STR 15	500.00	W	26.657403°	71.614847°
47	FAT-090	26.86249497°	71.62098321°	Naya Sanawara	Shrub/waste land	Shrub/waste land	Shrub/waste land	Shrub/waste land		Structure	STR 77	146.76	NW	26.863503°	71.619992°
										Structure	STR 78	325.83	NW	26.864789°	71.616969°

APPENDIX B PHOTO DOCUMENTATION

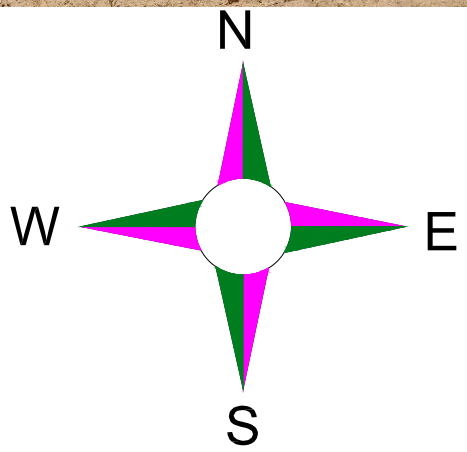
Solar Power Plant Location

Solar Power Plant



Wind Turbine Generator (WTGs)Locations

FAT-279



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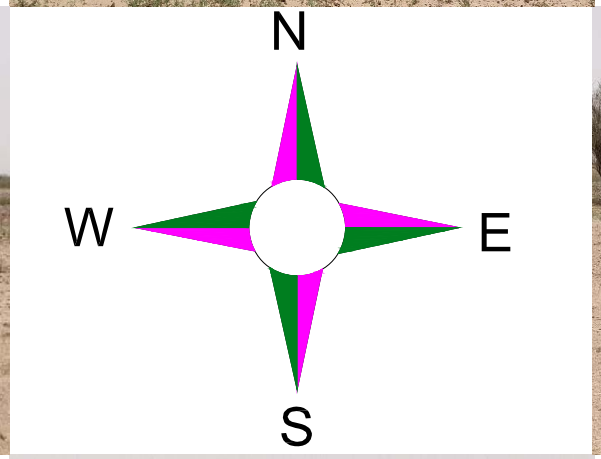

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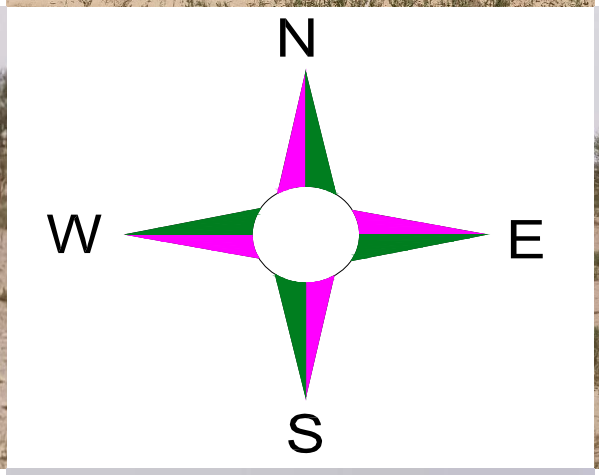

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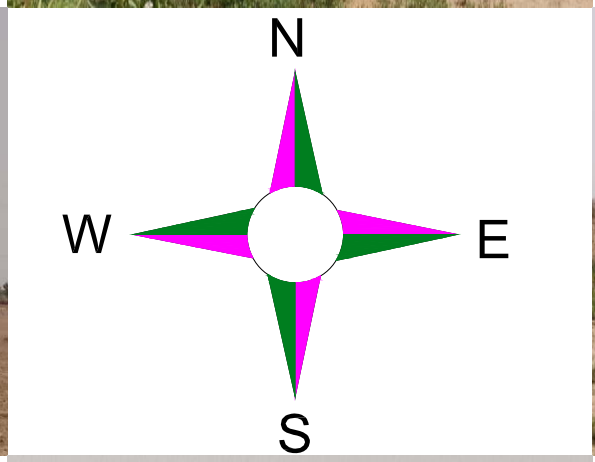

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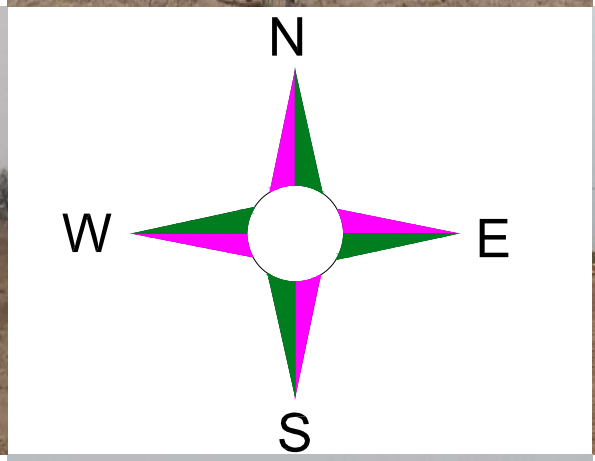

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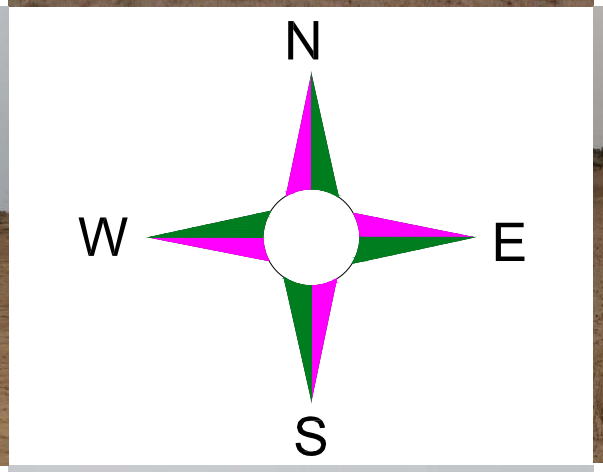

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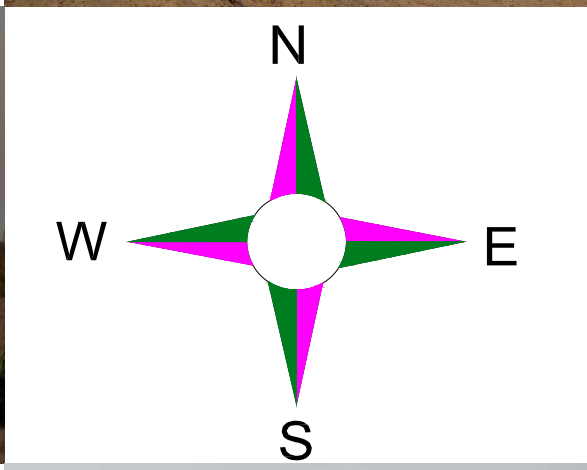

Site Office and Pooling Substation Location

Site Office

Material Storage near site office

Location of Pooling Substation

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