

# Environmental and Social Due Diligence Report

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Project Number: 47083-004  
April 2020

## INDIA: Accelerating Infrastructure Investment Facility in India – Tranche 3 Spring ALT Energy Private Limited (Part 2 of 5)

Prepared by India Infrastructure Finance Company Limited for the India Infrastructure Finance Company Limited and the Asian Development Bank.

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- The concentrations of Arsenic, Residual Chlorine, Cadmium, Lead, Copper, Selenium, and Hexavalent Chromium were found to be below detectable limits in both GW-1 and GW-2
- The total Coliform content in GW-1 was observed as 10 MPN which indicates slight biological contamination.

### **Surface Water Quality Analysis**

The surface water sample was analyzed for parameters as mentioned in IS: 2296-1982 standards and the analysis was undertaken as per IS 12296 and relevant American Public Health Association (APHA) standard methods. The results of Surface Water Quality analysis are given below in **Table 4-10**.

**Table 4-10: Results of Water Quality Analysis**

Sr. No.	Parameter	IS: 2296 (Class C)	Unit	Surface Water	
				SW-1	SW-2
1	Color	300	Hazen	<1.0	<1.0
2	Electrical Conductivity	--	uS/cm	2480	1350
3	pH	6.5-8.5	-	7.5	7.7
4	DO	4	mg/l	6.7	6.6
5	BOD (27°C for 3 days)	3.0	mg/l	4.2	4.0
6	Total Dissolved Solids		mg/l	1644	860.0
7	Total hardness	200 (600)	mg/l	888	488.4
8	Chlorides	600	mg/l	604	205.4
9	Sulphate	200 (400)	mg/l	162.3	82.0
10	Fluoride	1.5	mg/l	0.55	0.25
11	Nitrate (as NO <sub>3</sub> <sup>-</sup> )	50	mg/l	77.4	62.8
12	Potassium (as K)		mg/l	6.0	8.0
13	Sodium (as Na)		mg/l	300.0	160.0
14	Sodium Absorption Ratio (SAR)			8.8	6.3
15	Calcium	75 (200)	mg/l	209.5	103.0

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16	Magnesium	30 (100)	mg/l	88.5	56.1
17	Iron		mg/l	0.5	0.7
18	Cadmium	0.01	mg/l	<0.003	<0.003
19	Cyanides	0.05	mg/l	<0.01	<0.01
20	Arsenic	0.001 (0.05)	mg/l	<0.005	<0.005
21	Chromium (as Cr)		mg/l	<0.02	<0.02
22	Copper	0.05 (1.5)	mg/l	<0.02	<0.02
23	Selenium	0.01	mg/l	<0.005	<0.005
24	Mercury		mg/l	<0.001	<0.001
25	Lead		mg/l	<0.01	<0.01
26	Aluminium (as Al)			0.27	0.50
27	Total Coliform	5000	MPN/1000 ml	172	198
28	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH)	0.005	mg/l	<0.001	BDL (DL:0.001)
29	Anionic detergents (as MBAS)	1.0	mg/l	BDL (DL:0.05)	BDL (DL:0.05)
30	Oils and grease		mg/l	<2.0	<2.0
31	Aluminium (as Al)		mg/l	BDL (DL:0.01)	BDL (DL:0.001)

Source: TUV SUD Environmental Monitoring

\* Values in ( ) indicate permissible limits

ND: Not Detected

BDL: Below Detectable Limit

#### Inferences:

The summary of the analysis of water samples results is as follows:

- pH of SW-1 and SW-2 was observed as 7.5 and 7.7 which indicates slightly alkaline nature;
- DO of SW-1 and SW-2 was observed as 6.7 and 6.6 while BOD was observed as 4.2 mg/l and 4.0 mg/l respectively
- The Total Dissolved Solids concentration and hardness are within permissible limits
- The fluoride concentration in SW-1 and SW-2 was observed as 0.55 and 0.25 mg/l which indicates that there is no fluoride contamination in the water samples

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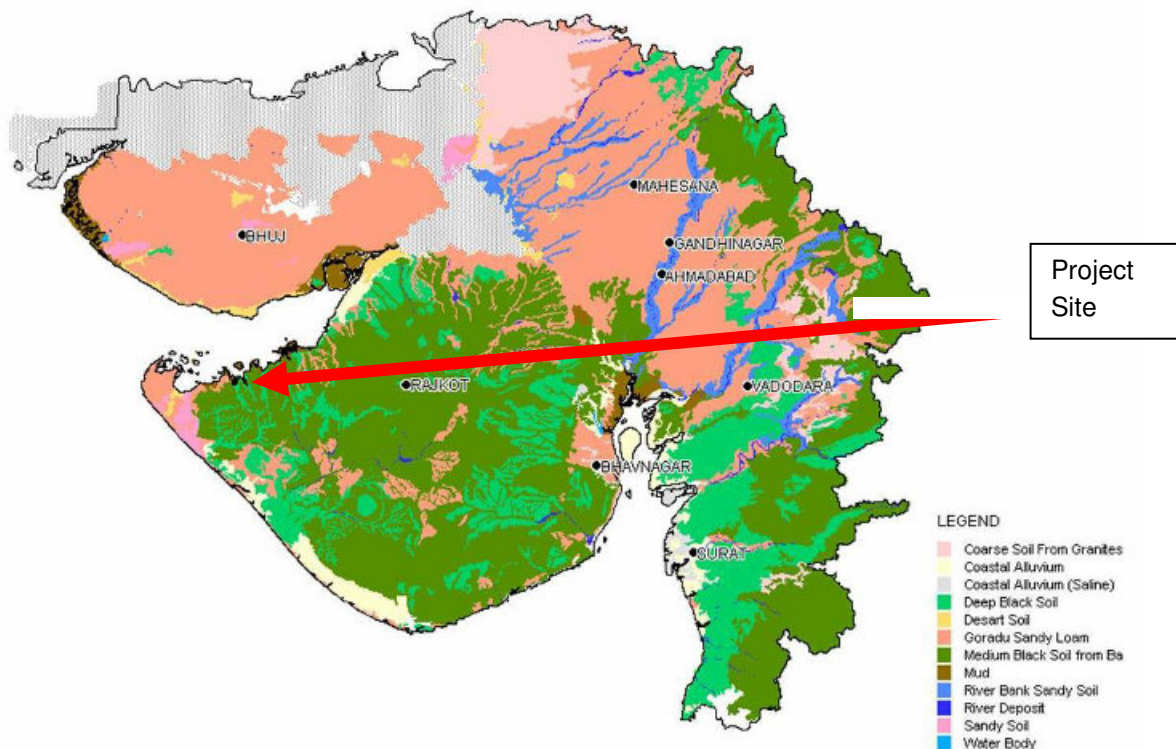
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- The Calcium concentration was observed as 209 mg/l which is slightly higher than permissible limits
- The concentration of heavy metals like mercury, aluminium, iron, chromium, cadmium, and lead was not detected in both the samples.
- The coliform count in SW-1 and SW-2 was observed as 172 MPN and 198 MPN which indicates slight fecal contamination of the water samples.

#### 4.13 SOIL QUALITY

The shallow black soils are found in study area falling in Jamjodhpur Taluka of Jamnagar district. These soils are generally 25 cm deep.



The soil quality of the project area was evaluated and samples from two locations were collected and analyzed to determine the same. Details of soil sampling locations are

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presented in **Table 4-11** below. Soil samples have been collected using auger up to a depth of 60 cm below ground level.

**Table 4-11: Details of the Soil sampling locations**

S.No.	Monitoring Location	Geographical Coordinates	Reasons for selecting location
1	S1	21°49'22.45"N, 70°04'42.09"E	Unirrigated agricultural land near MLV05 in Malvada
2	S2	21°49'53.94"N, 69°58'38.01"E	Forest land near VDV09 in Mahiki

The soil samples were analyzed for various physical and chemical parameters of soil and the results of the soil quality analysis are given in **Table 4-12** below:

**Table 4-12: Results of Soil Quality Analysis**

S. No.	Parameter	Unit	S1	S2
1	pH	---	7.5	6.3
2	Electrical Conductivity	Mmhos/cm	0.46	0.20
3	Potassium (as K)	mg/kg	99.5	49.7
4	Sodium (as Na)	mg/kg	199.1	119.3
5	Organic Matter	%	0.14	0.04
6	Sodium Absorption Ratio	meq/kg	4.5	4.7
7	Carbonate (as CO <sub>3</sub> )	mg/kg	<20.0	<20.0
8	Chloride (as Cl <sup>-</sup> )	mg/kg	83.5	66.7
9	Phosphorus (as P)	mg/kg	110.8	28.1
10	Sulphate	mg/kg	220.8	68.3
11	Bulk Density	gm/cc	1.24	1.25
12	Moisture	%	0.63	0.4
13	Total N	mg/kg	44.5	58.6
14	Iron (as Fe)	mg/kg	1431	1470

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15	Boron [as B]	mg/kg	46.0	31
16	Copper (as Cu)	mg/kg	145.0	79
17	Zinc (as Zn)	mg/kg	80	96

The results of the soil quality analysis were compared with the standard soil classification provided by the Indian Council of Agricultural Research (ICAR) and as given in **Table 4-13** below.

**Table 4-13: Standard Soil Classification**

Soil Parameters	Classification	
<b>pH</b>	Normal to saline	6.0 to 8.5
	Tending to become alkaline	8.5-9.0
	Alkaline	Above 9.0
<b>Electrical conductivity (mmhos/cm)</b>	Up to 1.00 – Normal	
	1.01- 2.00 - Critical to germination	
	2.01-4.00 - Critical for growth of the sensitive crops	
	Above 4.00 – Injurious to most crops	

Source: Indian Council of Agricultural Research, New Delhi

#### **Inference**

- pH of the soils samples ranged from 6.3-7.5, showing normal to saline in nature;
- Electrical conductivity of SW-1 was observed as 0.46 mmhos/cm and 0.201 mmhos/cm which indicates normal soil conditions

#### **4.14 NOISE ENVIRONMENT**

Primary noise monitoring was carried out for continuous 24 hours at the six (06) identified receptor locations by TUV-SUD team to evaluate the baseline noise levels at the project site. The ambient noise monitoring has been undertaken, taking into consideration factors like wind induced noise and human activities such as movement of vehicles. The baseline ambient noise levels represent the background noise levels that would be present in the absence of the proposed wind power plant.

Ambient noise level was monitored continuously for 24 hours using Sound Level Meter. Sound pressure levels were recorded at every 10 minutes to calculate the Leq (hourly) values. The relevant statistic measured was the LA90 (10min) (The A-weighted sound

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pressure level exceeded for 90 % of the 10minute interval). The noise levels obtained were analyzed to arrive at the equivalent continuous noise level (Leq) for day and night time. The day and night time hours ranged from 06:00 to 22:00 hrs and 22:00 to 06:00 hrs respectively. The noise monitoring locations are given below in **Table 4-14**.

For noise levels measured over a given period of time, it is possible to describe important features of noise using statistical quantities. This is calculated using the percent of the time certain noise levels exceeds the time interval. The notation for the statistical quantities of noise levels is described below:

- Hourly Leq values have been computed by integrating sound level meter.
- Lday: As per the CPCB guidelines the day time limit is between 06:00 hours to 22.00 hours as outlined in Ministry of Environment and Forest Notification S.O. 123 (E) dated 14/02/2000.
- Lnight: As per the CPCB guidelines the night time limit is between 22:00 hours to 06.00 hours as outlined in Ministry of Environment and Forest Notification S.O. 123 (E) dated 14/02/2000.

**Table 4-14: Details of Noise Level Monitoring Locations**

S.No.	Monitoring Location	Geographical Coordinates	Reasons for selecting location
1	N1	21°45'42.54"N, 70° 1'47.61"E	Upwind direction located in Residential Area (Paradva) near PRD 05 and proximity to village road
2	N2	21°50'20.59"N 69° 57'14.72"E	Near Valvada village and in proximity to MLV 05
3	N3	21°53'23.59"N, 69° 57'17.51"E	Near Balva village, in proximity to BLB 05
4	N4	21°50'43.05"N, 69°59'07.44"E	Near Mahiki village, in proximity to VDV 09
5	N5	21°52'02.94"N, 69°55'35.42"E	Near Chur village, in proximity to CHR03 and CHR 05

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6	N6	21°50'12.75"N, 69°54'51.09"E	Near Satapar village and in proximity to STP 07
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It was observed that the baseline noise levels ranged from 32.5-54.9 dB (A) during day time and 31.7 to 43.6 dB (A) during night time. The noise monitoring analysis results are given in **Table 4-15**. The noise levels were observed to be within the prescribed CPCB standards for day and night time.

**Table 4-15: Results of Noise Level Monitoring**

Noise Monitoring Location		Land Use (as per CPCB Standards)		
N1: Paradva		Residential Area		
S.No.	Parameters	Unit	Day time	Night Time
1	L <sub>eq</sub>	dB(A)	48.65	40.15
2	L <sub>10</sub>	dB(A)	47.8	40.75
3	L <sub>50</sub>	dB(A)	43.5	39.05
4	L <sub>90</sub>	dB(A)	40.55	34.7
5	L <sub>max</sub>	dB(A)	49.8	41.1
6	L <sub>min</sub>	dB(A)	34.6	32.6
Noise Monitoring Location		Land Use (as per CPCB Standards)		
N2: Valvada village		Residential Area		
S.No.	Parameters	Unit	Day time	Night Time
1	L <sub>eq</sub>	dB(A)	51.35	40.3
2	L <sub>10</sub>	dB(A)	52.7	42.45
3	L <sub>50</sub>	dB(A)	44.15	36.35
4	L <sub>90</sub>	dB(A)	37.15	35.15
5	L <sub>max</sub>	dB(A)	55.1	43.1
6	L <sub>min</sub>	dB(A)	34.8	32.4
Noise Monitoring Location		Land Use (as per CPCB Standards)		
N3: Balva village		Residential Area		

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S.No.	Parameters	Unit	Day time	Night Time
1	L <sub>eq</sub>	dB(A)	49.65	42.45
2	L <sub>10</sub>	dB(A)	51.4	42.2
3	L <sub>50</sub>	dB(A)	44.1	39.8
4	L <sub>90</sub>	dB(A)	39.75	38.15
5	L <sub>max</sub>	dB(A)	51.6	42.9
6	L <sub>min</sub>	dB(A)	39.1	37.7
<b>Noise Monitoring Location N4: Mahiki village</b>		<b>Land Use (as per CPCB Standards) Residential Area</b>		
S.No.	Parameters	Unit	Day time	Night Time
1	L <sub>eq</sub>	dB(A)	52.4	42.6
2	L <sub>10</sub>	dB(A)	56.1	43.1
3	L <sub>50</sub>	dB(A)	42.15	38.2
4	L <sub>90</sub>	dB(A)	38.05	34.85
5	L <sub>max</sub>	dB(A)	57.1	43.6
6	L <sub>min</sub>	dB(A)	34.2	34.3
<b>Noise Monitoring Location N5: Chur village</b>		<b>Land Use (as per CPCB Standards) Residential Area</b>		
S.No.	Parameters	Unit	Day time	Night Time
1	L <sub>eq</sub>	dB(A)	50.85	42.9
2	L <sub>10</sub>	dB(A)	52.1	41.45
3	L <sub>50</sub>	dB(A)	41.8	36.8
4	L <sub>90</sub>	dB(A)	36.15	33.2
5	L <sub>max</sub>	dB(A)	55.2	43.6
6	L <sub>min</sub>	dB(A)	32.5	31.7
<b>Noise Monitoring Location N6: Satapar village</b>		<b>Land Use (as per CPCB Standards) Residential Area</b>		

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S.No.	Parameters	Unit	Day time	Night Time
1	$L_{eq}$	dB(A)	54.05	42.25
2	$L_{10}$	dB(A)	54.5	42.1
3	$L_{50}$	dB(A)	47.4	37.5
4	$L_{90}$	dB(A)	37.1	34.6
5	$L_{max}$	dB(A)	54.9	42.6
6	$L_{min}$	dB(A)	34.4	34.3

#### 4.15 ECOLOGY

Ecological studies are one of the important aspects of Environmental and Social Impact Assessment (ESIA) with a view to conserve biodiversity. Ecological systems show complex inter-relationships between biotic and abiotic components including dependence, competition and mutualism. Biotic components comprise of both plant and animal communities, which interact not only within and between themselves but also with the biotic components viz. physical and chemical components of the environment. Generally, biological communities are good indicators of climatic and edaphic factors. Studies on biological aspects of ecosystems are important for safety of flora and fauna. The biological environment includes terrestrial and aquatic ecosystems.

The observations and assessment of overall ecological scenario presented in this chapter include details of flora, fauna, natural habitats, protected areas, wildlife species and their migration corridors etc. Such baseline information provides better understanding of the situation and overall ecological importance of the area. This baseline information viewed against industrial activities help in predicting their impacts on the wildlife and their habitats in the region.

This section of report describes, the methodology adopted for secondary data collection, diversity of higher flora and fauna recorded through primary field studies and the secondary data sourced from published scientific literature, habitat profile and ecosystem services profile and nearest designated areas of the project site.

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#### 4.15.1 Scope and Objectives

The ecology & Bio Diversity study carried out Project area, which is approximately 15 km radius study area around project area. The scope of the study is to generate baseline data and prediction of site specific, habitat specific and species specific impacts from the proposed project and suggesting time bound mitigation measures.

##### **Objectives:**

- Review and analyse the available literature data related to habitats, flora and fauna of the site around proposed project i.e. WTG locations (Core Zone) and surrounding areas till 15 km radius (Buffer Zone)
- Identification of critical habitats, wildlife corridors, National Parks, Wildlife Sanctuary, any other areas of ecological significance.
- Identification of native, alien, exotic, rare, threatened and endangered species (if any).
- Assessment of impacts of the project on ecology during construction and operation phase.
- Suggestion of mitigation measures to minimize/avoid adverse impacts on ecology during construction and operation phase.

#### 4.15.2 Biogeographic Description of the Study Area

As per global classification defined by WWF, the region falls in Indo-Malay Realm A (IM 1303) and Deserts & Xeric Scrublands Biome. The North-western Thorn Scrub Forests [IM1303] ecoregion represents a large expanse of degraded dry forest surrounding the Thar Desert. Neither exceptionally species-rich nor high in endemism, the ecoregion nevertheless harbours viable populations of antelopes. As per classification of Indian Biogeographic zones by Rodgers et al. (2000), Saurashtra region falls under Biogeographic Zone 4 - the Semi Arid with the Biotic Province 4-B. As per the forest classification of Champion and Seth (1968), forest of Saurashtra is generally *Prosopis* thorn forest.

The forest sub-types found in the study area are:

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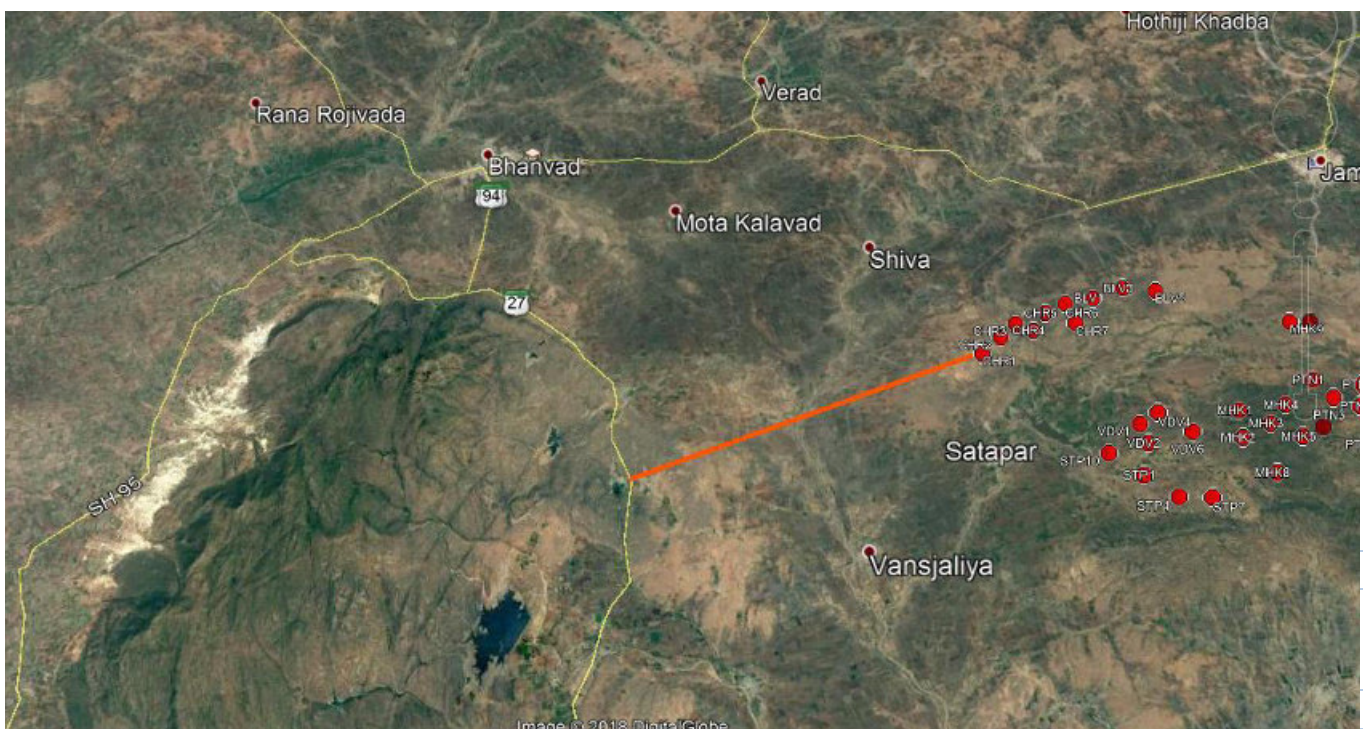
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- Type: 5A-Southern tropical forests (5A/C3-Southern dry mixed deciduous forests; 5D/S3-*Euphorbia* scrub; 5/DS1 -Dry deciduous scrub; 5/E3-*A. nilotica*; 5/E9-Dry bamboo brakes in small areas; 5/E1- *Anogeissus* scrub) and
- Type 6B-Northern tropical thorn forest (6B/DS1-*Zizyphus* scrub; 6/E2-*Acacia Senegal*). Dominated by trees such as *Acacia senegal*, *Acacia leucophloea* and *Prosopis cineraria*. Typical grasses of the ecoregion include *Chrysopogon fulvus*, *Heteropogon contortus*, *Eremopogon foveolatus*, *Aristida setacea*, and *Dactyloctenium species*.

#### 4.15.3 Protected Area and Eco-Sensitive Zones

The study area comprising of core and buffer zone was assessed for the presence of important wildlife habitats and protected areas, mangroves, breeding and nesting habitats of fauna, coastal habitats, important wetlands, and grassland area from WTG locations (core area). These important areas such as Protected areas (National Park, Wildlife Sanctuaries, Conservation Reserves etc.), Wetlands of national importance, Ramsar sites, Important Bird Areas (IBAs), classified by the Birdlife International and Bombay Natural History Society etc. Data collected and information gathered from primary and secondary sources on flora, fauna, protected area, natural habitats, wildlife species etc., were analysed and results are presented below in **Table 4-16**.

**Figure 4-9: Distance of Barda Wildlife Sanctuary from the proposed project Site**





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**Table 4-16: Details of protected areas, forests & ecologically sensitive areas in Study Area**

Ecological sensitive habitat	Direction and Distance from the project site
<b>Gir Wildlife Sanctuary</b>	74 km in East
<b>Barda Wildlife Sanctuary</b>	11 km in West
<b>Reserved Forests</b>	No Reserved forest
<b>Wildlife Corridors &amp; Routes</b>	No notified wildlife corridors are present in 10 km vicinity
<b>Wetlands / Water bodies</b>	There are two rivers, Bileshvary River and Joghri River, and two dams, Khambala and Fodara in Buffer zone of Barda wildlife sanctuary.
<b>Ramsar Site</b>	NIL
<b>Important Bird Areas</b>	Nil
<b>Breeding/nesting areas of endangered species</b>	Not present at proposed WTG area
<b>Mangroves</b>	Nil

There are no forests or wildlife sanctuaries or biosphere reserves or nesting or breeding grounds for any of the rare species or other protected areas within the project area. There are no mangroves or mangrove forests in the project area. There are no national parks or wildlife sanctuaries or biosphere reserves or nesting sites of Marine turtles either in the study area or around it in a radius of over 10 Km. The nearest boundary of Barda Wildlife Sanctuary is at a distance of 11 km. The project site comprising of WTG locations is not situated within or adjacent to any protected areas, buffer zones of protected areas, or special areas for protecting biodiversity. As such the area identified for the project is not ecologically sensitive.

#### **4.15.4 Primary and Secondary Survey**

The primary surveys were undertaken to identify the ecological features of the area with particular reference to identify and quantify any sensitive ecological communities in the study area within 15 km. radius of the proposed project. Secondary surveys Literature surveys were conducted to identify Rare, Endangered, Endemic and Threatened species (REET) and/or habitats within the study area. The reference has been taken from, The Wildlife (Protection) Act, 1972 and Red Data Book.

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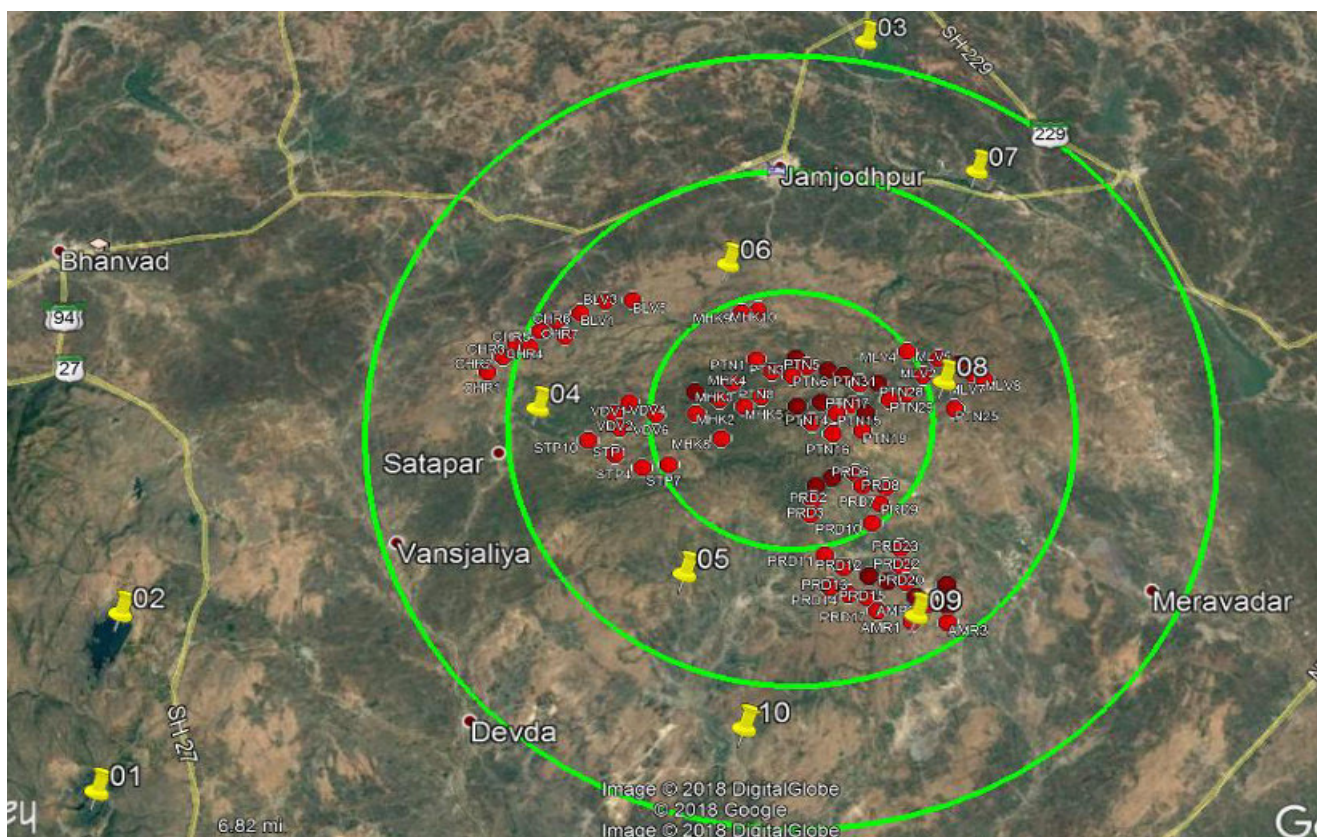
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The filed study was undertaken from 24<sup>th</sup> April 2018 to 27<sup>th</sup> April 2018 (Four days). The relevant, observations noted in that assessment have been included in the current assessment and referenced accordingly.

**Table 4-17:GPS coordinates of the critical habitats observed during the study (other than the proposed WTG points)**

S.No.	Latitude	Longitude
1	21°44'23.04"N	69°45'31.52"E
2	21°47'39.96"N	69°46'33.22"E
3	21°56'14.57"N	70° 4'26.24"E
4	21°49'50.89"N	69°55'33.03"E
5	21°45'51.94"N	69°57'34.19"E
6	21°51'58.17"N	70° 0'9.13"E
7	21°52'46.78"N	70° 5'50.52"E
8	21°48'28.86"N	70° 3'46.09"E
9	21°44'0.57"N	70° 1'47.37"E
10	21°42'41.27"N	69°57'54.25"E

**Figure 4-10: Map showing Sampling points of the ecosensitive habitats identified in the proposed project area. (Each ring ranges 5 km radius)**



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#### **4.15.5 Methodology Adopted for the Study**

A participatory and consultative approach has been followed for executing the assignment on ecological biodiversity assessment of both project area and study areas of the project site in consultation with Forest Department officials and local community as well as project proponent. The survey was undertaken by a team of experts on ecology and biodiversity aspects from TUV SUD and collected the primary and secondary data.

The ecological biodiversity assessment data was collected in Summer season. There are no National Parks, Sanctuaries, Biosphere Reserves, Wildlife corridors, Tiger/Elephant reserves (existing as well as proposed) within 5 – 10 km of the proposed area.

#### **4.15.6 Sampling Methodology Adopted for Flora**

In order to provide representative ecological status for the study area, the 15 -km radius study area has been divided into three clusters for better understanding the ecology of the region. The three major clusters are Chur, Mahiki and Parvada clusters. The migratory path of the winter season birds in the adjoining areas are also been noted and marked in the map given in **Figure 4-11**. Quantification done for trees (20x20m), shrubs (10x10m) and herbs (1x1m) depending upon prevailing geographical conditions and bio-diversity aspects of study area.

#### **Survey Type Used**

1. Point quarter plot-less method (random sampling) for terrestrial vegetation
2. Belt transect method for trees, shrubs and herbs for quantification.
3. Indirect and direct evidences for faunal species in the sample plots.
4. Point count method for birds near aquatic bodies.
5. Interview with local villagers within the study area for past history for faunal migratory routes and ecosensitive habitats.

#### **Equipment/Instruments Deployed**

- Digital Camera (NIKON 42 X zoom)
- GPS (Available in Mobile and inbuilt camera)

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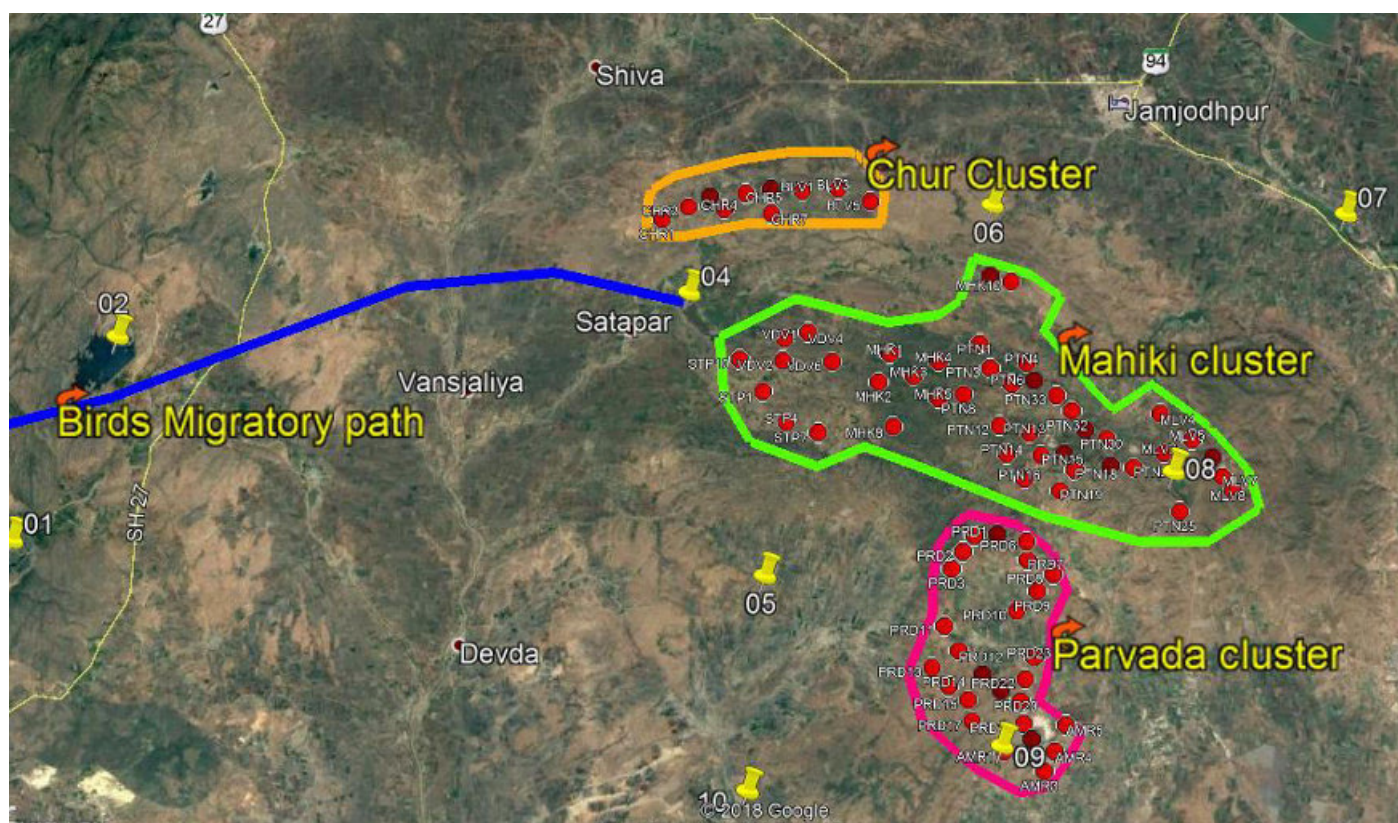
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- Binoculars (OLYMPUS 10 X 50 DPSI)
- Field observation book, Field guides, Pen, Measuring tape etc

During belt transects, an area of 100 m X 10 m width was estimated for statistical analysis. List of floral species observed at each transect was documented. The number of sampling points depend on the Area- Species graph. Species listed are compared with standard books (BSI, ZSI and IUCN) and noted the species required for conservation criteria. The plants were identified using floras by Gamble (1915-36), Saxena and Brahmam (1994-96), Nair and Henry (1983), Henry et al. (1987), Henry et al. (1989) and also by using updated check list from [www.theplantlist.org](http://www.theplantlist.org)

**Figure 4-11: Map showing WTG points in three clusters and direction of migratory path of the seasonal birds to the site**



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**Figure 4-12: Observations on Habitat in Core Zone**



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**Figure 4-13: Observations on Habitat in Buffer Zone**



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#### 4.15.7 Observations and Results of Flora

A detailed study in both project area and study area has been carried out to assess the present floristic composition in the region. The present study documented 119 plant species for both WRG points (Core project area) and buffer zone area upto 15 km radius. Study revealed that higher number of trees compare to other life forms in the region. Among the quartiles, South-western quartile recorded higher number of species compare to other three quartiles. Being semi-arid and high wind speed zone, this region support low plant growth and therefore, not many large trees with sizable canopies are present on the hilly regions and reserve forest areas, where as the buffer zone has good tree cover along the edges of agriculture fields. Moreover, at every village local people have managed to grow very good tree cover for shade and aesthetic values.

**Core area:** The proposed project site falls in the semi-arid climatic condition. Our field survey and literature review suggest that the vegetation types and vegetation community in the project area is that of semi -arid region. It is represented by dense to sparse thorny scrub vegetation in between the fallow agriculture land. The major part of the project area is devoid of large trees and mainly consists of *Butea monosperma*, *Balanitesa egyptiaca*, *Prosopis juliflora*, *Acacia leucophloea*, *Indigofera spinosa*, *Zizyphus numularia*, *Euphorbia caducifolia*, *Prosopis chilensis*, *Azadirachta indica*, *Phoenix acaulis*, *Opuntia dillenii*, *Lantana camara*,

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*Calotropus procera*, *Euphorbia neriifolia*, *Senna auriculata* etc. Major grasses include several species of *Cyperus* and *Aristida* etc.

**Buffer area:** The buffer area (15 km periphery) comprises mainly of agriculture land, forest area comprising *Prosopis juliflora*, etc. Most dominant vegetation in the buffer area is *Prosopis juliflora*, *Lantana camara*, *Leucaena leucocephala*, *Acacia nilotica*, *Ficus benghalensis*, *Ailanthus excelsa*, *Opuntia dillenii*, *Ficus racemosa*, *Salvadora persica*, *Tamarindus indica*, *Delonix regia*, *Cassia fistula*, *Agave americana* etc and among the wild plants and groundnut, cotton, sorghum, millet among the cultivated crops are the most dominant plants in the buffer area. There are no rare, endangered or conservation concern plant species present in the close vicinity of the project area in the buffer zone. The list of flora observed in the study area

**Table 4-18: List of Flora found in the study area**

S.No.	Botanical Name	Family	Habit	Status	Core Zone	Buffer Zone
1	<i>Acacia auriculiformis Benth.</i>	Leguminosae	Tree	Rare	A	P
2	<i>Acacia leucophloea (Roxb.)</i>	Leguminosae	Tree	Dominant	P	P
3	<i>Acacia nilotica (L.) Delile</i>	Leguminosae	Tree	Dominant	P	P
4	<i>Ailanthus excelsa Roxb</i>	Simaroubaceae	Tree	Common	P	P
5	<i>Albizia amara (Roxb.) B.Boivin</i>	Leguminosae	Tree	Sparse	A	P
6	<i>Albizia lebbeck (L.) Benth.</i>	Leguminosae	Tree	Sparse	P	P
7	<i>Annona squamosa L.</i>	Annonaceae	Tree	Sparse	A	P
8	<i>Azadirachta indica A.Juss.</i>	Meliaceae	Tree	Dominant	P	P
9	<i>Balanitesa egyptiaca (L.) Delile</i>	Zygophyllaceae	Tree	Dominant	P	P
10	<i>Butea monosperma (Lam.) Taub.</i>	Leguminosae	Tree	Dominant	P	P
11	<i>Cassia fistula L.</i>	Leguminosae	Tree	Common	P	P
12	<i>Cassia siamea Lam.</i>	Leguminosae	Tree	Common	P	P
13	<i>Ceiba pentandra (L.) Gaertn</i>	Malvaceae	Tree	Sparse	A	P
14	<i>Chukrasia tabularis</i>	Meliaceae	Tree	Common	P	P
15	<i>Cocos nucifera L.</i>	Arecaceae	Tree	Sparse	P	P
16	<i>Dalbergia latifolia Roxb</i>	Leguminosae	Tree	Sparse	P	P
17	<i>Dalbergia sissoo DC.</i>	Leguminosae	Tree	Rare	P	P
18	<i>Delonix regia (Hook.) Raf.</i>	Leguminosae	Tree	Sparse	P	P
19	<i>Dendrocalamus strictus</i>	Graminae	Tree	Sparse	P	P

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20	<i>Diospyros melanoxylon Roxb.</i>	Ebenaceae	Tree	Sparse	P	P
21	<i>Eucalyptus globulus Labill.</i>	Myrtaceae	Tree	Sparse	A	P
22	<i>Euphorbia tirucalli L.</i>	Euphorbiaceae	Tree	Sparse	P	P
23	<i>Ficus benghalensis L.</i>	Moraceae	Tree	Dominant	P	P
24	<i>Ficus racemosa</i>	Moraceae	Tree	Common	P	P
25	<i>Ficus religiosa L.</i>	Moraceae	Tree	Rare	A	P
26	<i>Leucaena leucocephala (Lam.)</i>	Leguminosae	Tree	Sparse	A	P
27	<i>Limonia acidissima L.</i>	Rutaceae	Tree	Sparse	A	P
28	<i>Mangifera indica L.</i>	Anacardiaceae	Tree	Common	A	P
29	<i>Morinda tinctoria Roxb.</i>	Rubiaceae	Tree	Rare	A	P
30	<i>Murraya paniculata (L.) Jack</i>	Rutaceae	Tree	Sparse	A	P
31	<i>Musa paradisiaca L.</i>	Musaceae	Tree	Sparse	A	P
32	<i>Nerium odoratum Lam.</i>	Apocynaceae	Tree	Rare	A	P
33	<i>Parkinsonia aculeata L.</i>	Leguminosae	Tree	Rare	A	P
34	<i>Phoenix acaulis</i>	Palmae	Tree	Dominant	P	P
35	<i>Phyllanthus emblica L.</i>	Phyllanthaceae	Tree	Sparse	A	P
36	<i>Pithecellobium dulce (Roxb.) Benth.</i>	Leguminosae	Tree	Sparse	A	P
37	<i>Plumeria alba L.</i>	Apocynaceae	Tree	Rare	A	P
38	<i>Polyalthia longifolia (Sonn.) Thwaites</i>	Annonaceae	Tree	Common	A	P
39	<i>Pongamia pinnata (L.) Pierre</i>	Leguminosae	Tree	Rare	A	P
40	<i>Prosopis chilensis (Molina) Stuntz</i>	Leguminosae	Tree	Common	P	P
41	<i>Prosopis juliflora</i>	Mimosaceae	Tree	Dominant	P	P
42	<i>Salvadora persica</i>	Salvadoraceae	Tree	Common	P	P
43	<i>Tamarindus indica L.</i>	Leguminosae	Tree	Sparse	P	P
44	<i>Tecoma stans (L.) Juss. ex Kunth</i>	Bignoniaceae	Tree	Sparse	A	P
45	<i>Tectona grandis L.f.</i>	Lamiaceae	Tree	Rare	A	P
46	<i>Terminalia catappa L.</i>	Combretaceae	Tree	Sparse	A	P
47	<i>Thespecia populnea</i>	Malvaceae	Tree	Sparse	A	P
48	<i>Thevetia neriifolia</i>	Apocynaceae	Tree	Sparse	A	P
49	<i>Vitex negundo L.</i>	Verbenaceae	Tree	Sparse	A	P
50	<i>Abutilon indicum (L.) Sweet</i>	Malvaceae	Shrub	Sparse	P	P
51	<i>Agave americana L.</i>	Asparagaceae	Shrub	Sparse	P	P

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52	<i>Caesalpinia bonduc</i> (L.) Roxb.	Leguminosae	Shrub	Common	P	P
53	<i>Caesalpinia pulcherrima</i> (L.) Sw.	Leguminosae	Shrub	Sparse	P	P
54	<i>Calotropis gigantea</i> (L.) Dryand.	Apocynaceae	Shrub	Dominant	P	P
55	<i>Calotropis procera</i> (Aiton) Dryand.	Apocynaceae	Shrub	Dominant	P	P
56	<i>Capparis zeylanica</i> L.	Capparaceae	Shrub	Common	P	P
57	<i>Carissa carandas</i> L.	Apocynaceae	Shrub	Common	P	P
58	<i>Euphorbia caducifolia</i> Haines	Euphorbiaceae	Shrub	Dominant	P	P
59	<i>Indigofera spinosa</i> Forssk	Leguminosae	Shrub	Dominant	P	P
60	<i>Lantana camara</i> L.	Verbenaceae	Shrub	Dominant	P	P
61	<i>Morinda pubescens</i> Sm.	Rubiaceae	Shrub	Sparse	A	P
62	<i>Opuntia dillenii</i> (Ker Gawl.) Haw.	Cactaceae	Shrub	Dominant	P	P
63	<i>Senna auriculata</i> (L.) Roxb.	Leguminosae	Shrub	Dominant	P	P
64	<i>Senna occidentalis</i> (L.) Link	Leguminosae	Shrub	Dominant	P	P
65	<i>Azolla pinnata</i> subsp. <i>africana</i> (Desv.)	Salviniaceae	Hydrophyte	Common	P	P
66	<i>Hydrilla</i> Rich.	Hydrocharitaceae	Hydrophyte	Common	P	P
67	<i>Ipomoea aquatica</i>	Convolvulaceae	Hydrophyte	Common	P	P
68	<i>Lemna minor</i> Hegelm.	Araceae	Hydrophyte	Common	P	P
69	<i>Limnophila heterophylla</i> R. Br.	Plantaginaceae	Hydrophyte	Common	P	P
70	<i>Marsilea quadrifolia</i> L.	Marsileaceae	Hydrophyte	Common	P	P
71	<i>Neptunia oleracea</i> Lour.	Leguminosae	Hydrophyte	Common	P	P
72	<i>Operculina turpethum</i> (L.) Silva Manso	Convolvulaceae	Hydrophyte	Common	P	P
73	<i>Typha angustata</i>	Typhaceae	Hydrophyte	Dominant	A	P
74	<i>Vallisneria</i> L.	Hydrocharitaceae	Hydrophyte	Common	P	P
75	<i>Achyranthes aspera</i> L.	Amaranthaceae	Herb	Dominant	P	P
76	<i>Alternanthera sessilis</i> (L.) R.Br. ex DC.	Amaranthaceae	Herb	Sparse	P	P
77	<i>Amaranthus spinosus</i> L.	Amaranthaceae	Herb	Rare	P	P
78	<i>Argemone mexicana</i> L.	Papaveraceae	Herb	Sparse	A	P
79	<i>Croton bonplandianus</i> Baill.	Euphorbiaceae	Herb	Sparse	A	P
80	<i>Hyptis suaveolens</i> (L.) Poit.	Lamiaceae	Herb	Dominant	P	P
81	<i>Leucas aspera</i>	Lamiaceae	Herb	Sparse	A	P
82	<i>Mimosa pudica</i>	Leguminosae	Herb	Rare	A	P

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83	<i>Ocimum canum Sims</i>	Lamiaceae	Herb	Rare	A	P
84	<i>Parthenium hysterophorus L.</i>	Asteraceae	Herb	Rare	A	P
85	<i>Sida acuta Burm.f.</i>	Malvaceae	Herb	Sparse	P	P
86	<i>Solanum surattense Burm. f.</i>	Solanaceae	Herb	Common	P	P
87	<i>Tridax procumbens (L.) L.</i>	Asteraceae	Herb	Common	P	P
88	<i>Ziziphus nummularia</i>	Rhamnaceae	Herb	Dominant	P	P
89	<i>Aeluropus lagopoides</i>	Poaceae	Grass	Sparse	P	P
90	<i>Apluda mutica L.f.</i>	Poaceae	Grass	Sparse	P	P
91	<i>Aristida adscensionis</i>	Poaceae	Grass	Common	P	P
92	<i>Aristida funiculata</i>	Poaceae	Grass	Common	P	P
93	<i>Aristida hystrix L.f.</i>	Poaceae	Grass	Common	P	P
94	<i>Chloris barbata Sw.</i>	Poaceae	Grass	Common	P	P
95	<i>Chloris virgata Sw.</i>	Poaceae	Grass	Common	P	P
96	<i>Chrysopogon fulvus</i>	Poaceae	Grass	Sparse	A	P
97	<i>Chrysopogon lancearius (Hook.f.) Haines</i>	Poaceae	Grass	Sparse	A	P
98	<i>Cymbopogon citratus</i>	Poaceae	Grass	Common	P	P
99	<i>Cymbopogon martinii</i>	Poaceae	Grass	Sparse	A	P
100	<i>Cynodon dactylon</i>	Poaceae	Grass	Sparse	P	P
101	<i>Cyperus castaneus</i>	Poaceae	Grass	Common	P	P
102	<i>Cyperus difformis</i>	Poaceae	Grass	Common	P	P
103	<i>Cyperus flavidus</i>	Cyperaceae	Grass	Sparse	A	P
104	<i>Cyperus rotundus L.</i>	Cyperaceae	Grass	Common	P	P
105	<i>Dactyloctenium aegyptium</i>	Poaceae	Grass	Sparse	A	P
106	<i>Eragrostis cilianensis</i>	Poaceae	Grass	Sparse	A	P
107	<i>Fimbristylis cymosa R.Br.</i>	Cyperaceae	Grass	Sparse	A	P
108	<i>Heteropogon contortus</i>	Poaceae	Grass	Common	P	P
109	<i>Ischaemum indicum</i>	Poaceae	Grass	Sparse	P	P
110	<i>Sporolobus maderaspatenus</i>	Poaceae	Grass	Common	P	P
111	<i>Tragusroxburghii Panigrahi</i>	Poaceae	Grass	Common	P	P
112	<i>Urochandra setulosa</i>	Poaceae	Grass	Sparse	A	P
113	<i>Zizania latifolia</i>	Poaceae	Grass	Common	P	P
114	<i>Clitoria ternatea L.</i>	Leguminosae	Climber	Sparse	P	P
115	<i>Ipomoea nil (L.) Roth.</i>	Convolvulaceae	Climber	Common	P	P
116	<i>Ipomoea obscura (L.) Ker Gawl.</i>	Convolvulaceae	Climber	Rare	A	P

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117	<i>Pergularia daemia</i> (Forssk.) Chiov.	Apocynaceae	Climber	Common	P	P
118	<i>Rivea hypocrateriformis</i> Choisy.	Convolvulaceae	Climber	Common	P	P
119	<i>Tinospora cordifolia</i> (Willd.)	Menispermaceae	Climber	Rare	A	P

Core Zone: within the project site

Buffer Zone: Project boundary to 15 km radius

P: Present

A: Absent (Not found during field study but recorded with secondary data)

**Figure 4-14: Flora Observed in Study Area**



*Mangifera indica*



*Delonix regia*

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*Butea monosperma*



*Prosopis juliflora*



*Azadirachta indica*

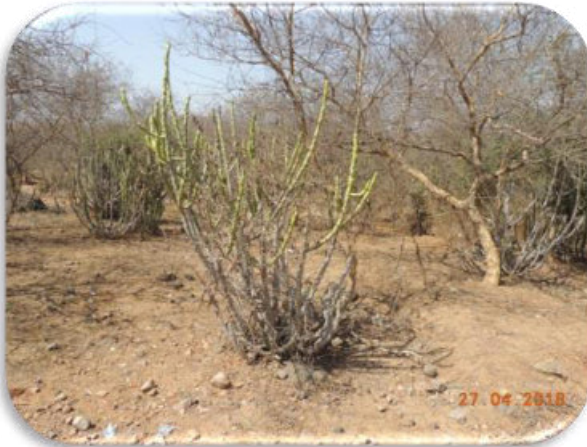


*Phoenix acaulis*

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*Euphorbia caducifolia*



*Salvadora persica*



*Eucalyptus globulus*



*Dendrocalamus strictus*

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*Lantana camara*



*Calotropis gigantea*



*Opuntia dillenii*



*Chukrasia tabularis*

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*Agave americana*



*Polyalthia longifolia*



*Cassia fistula*



*Pithecellobium dulce*

#### 4.15.8 Quantitative analysis

The study area is mainly focused through secondary data validation from primary observations. The Checklist has been prepared and species noticed ewere marked during rapid assessment. Around 20 sampling points were selected through Area-Species graph and the quantitative analysis was carried out based on the methodology adopted for various

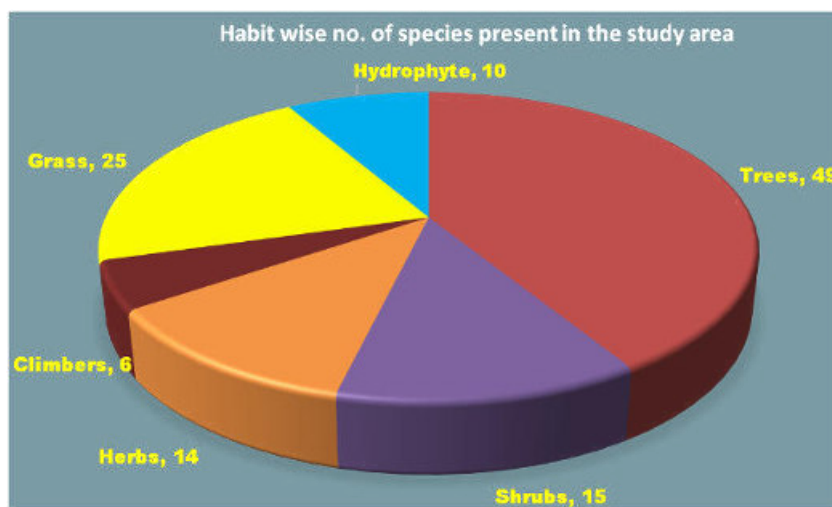
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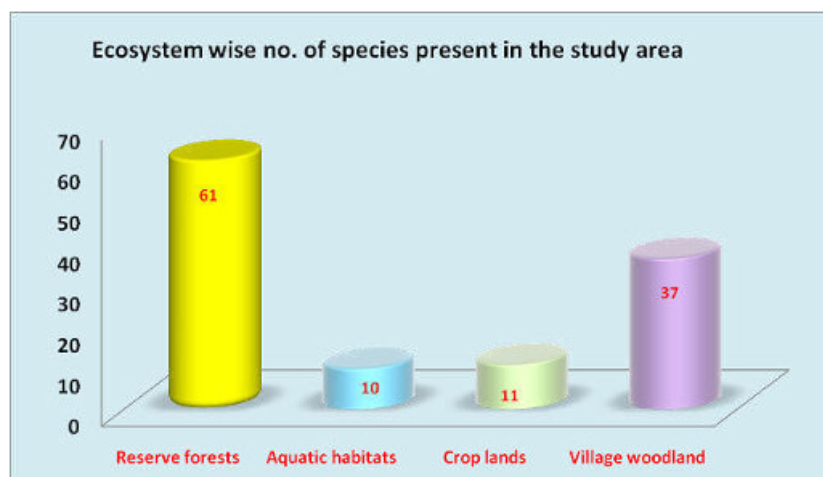
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species. The habit wise and ecosystem wise status of various floral species, phyto-sociological data and Important Value Index of dominant floral species within study area in all WTG sampling points were calculated as given in **Figure 4-15- Figure 4-19**. Biodiversity indices values have been calculated through statistical software tools (PAST) and analysis is given in detailed in **Table 4-19**.

**Figure 4-15:Graph showing Habit wise number of species recorded in the study area**



**Figure 4-16: Graph showing zone wise number of species recorded in the study area**

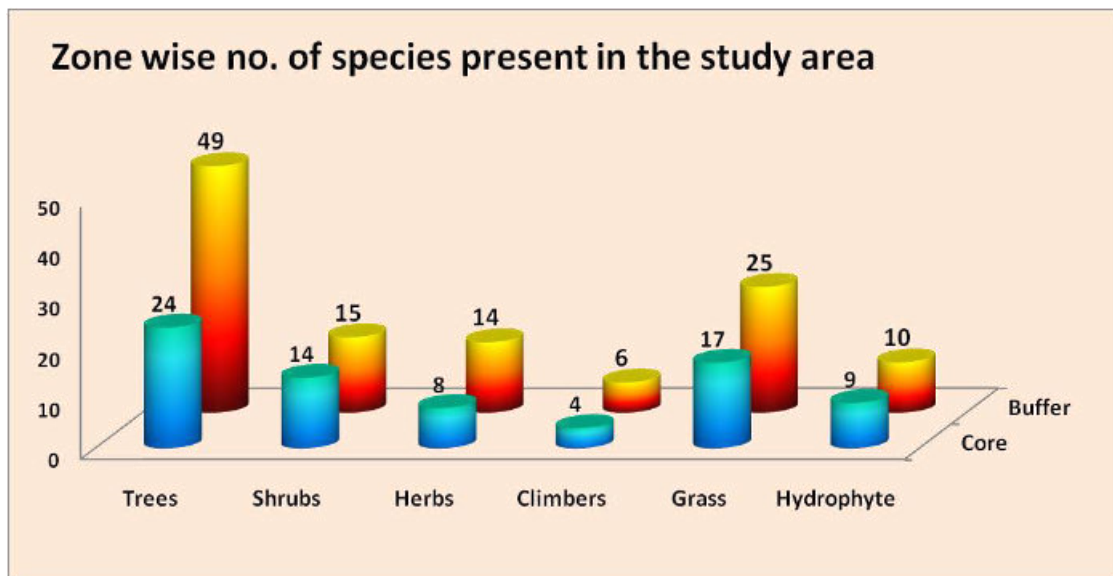


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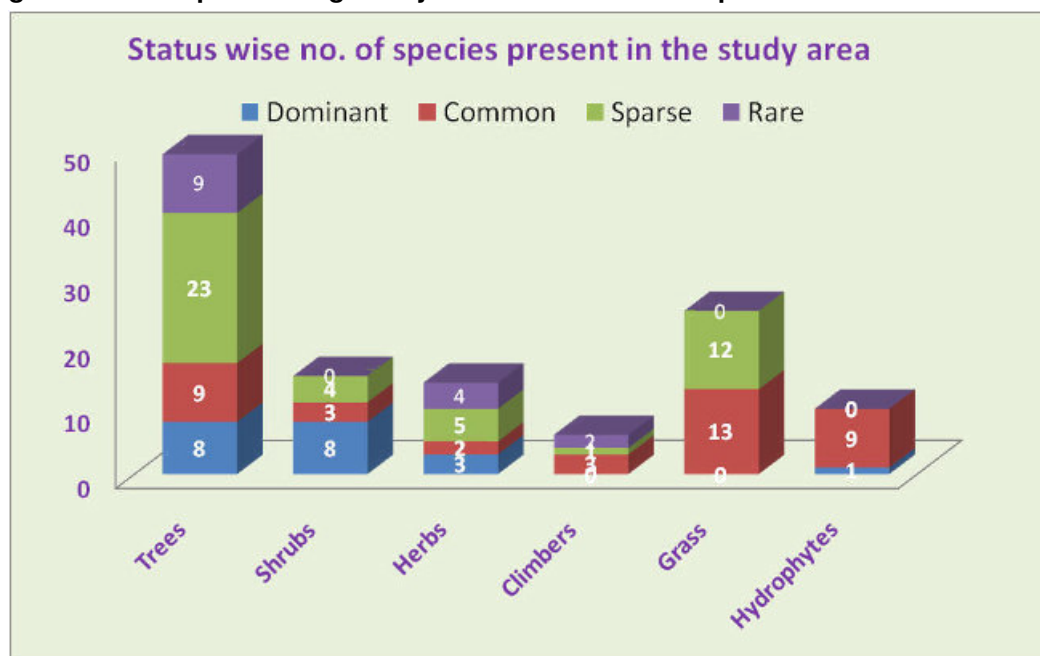
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**Figure 4-17: Graph showing Status wise number of species recorded in the study area**



**Figure 4-18: Graph showing Ecosystem wise number of species recorded in the study area**

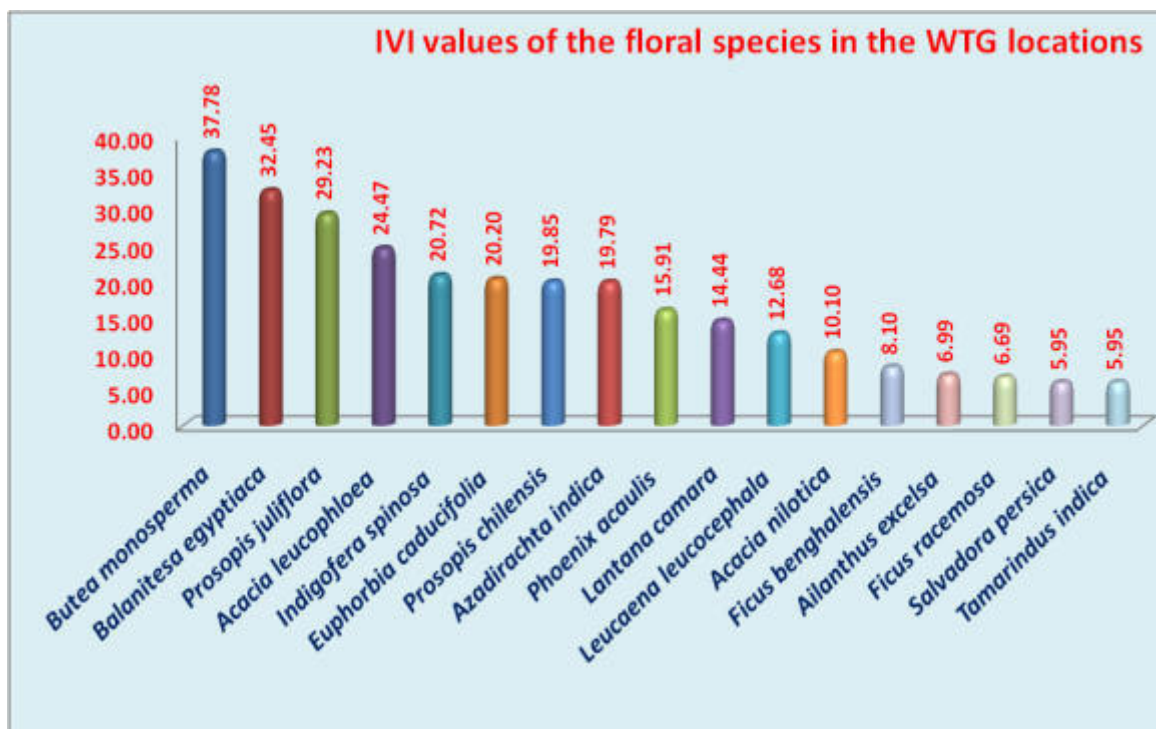


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**Figure 4-19: Graph showing Important Value Index of dominant tree species within study area**



**Table 4-19: Phyto-sociological data of study area**

S.No	Scientific Name	Density	Rel Density	Frequency	Rel Frequency	Abundance	Rel Abundance	IVI
1	<i>Cassia fistula</i>	0.15	0.44	15.00	1.79	1.00	1.49	3.72
2	<i>Ailanthus excelsa</i>	0.45	1.33	25.00	2.98	1.80	2.69	6.99
3	<i>Delonix regia</i>	0.25	0.74	20.00	2.38	1.25	1.87	4.98
4	<i>Prosopis juliflora</i>	4.10	12.08	65.00	7.74	6.31	9.41	29.23
5	<i>Lantana camara</i>	1.45	4.27	40.00	4.76	3.63	5.41	14.44
6	<i>Leucaena leucocephala</i>	1.15	3.39	30.00	3.57	3.83	5.72	12.68
7	<i>Acacia nilotica</i>	0.70	2.06	50.00	5.95	1.40	2.09	10.10
8	<i>Azadirachta indica</i>	2.30	6.77	65.00	7.74	3.54	5.28	19.79
9	<i>Acacia leucophloea</i>	3.15	9.28	75.00	8.93	4.20	6.27	24.47

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10	<i>Balanitesa egyptiaca</i>	4.75	13.99	85.00	10.12	5.59	8.34	32.45
11	<i>Butea monosperma</i>	5.80	17.08	70.00	8.33	8.29	12.36	37.78
12	<i>Phoenix acaulis</i>	1.30	3.83	20.00	2.38	6.50	9.70	15.91
13	<i>Ficus benghalensis</i>	0.50	1.47	40.00	4.76	1.25	1.87	8.10
14	<i>Ficus racemosa</i>	0.35	1.03	35.00	4.17	1.00	1.49	6.69
15	<i>Prosopis chilensis</i>	2.35	6.92	55.00	6.55	4.27	6.38	19.85
16	<i>Salvadora persica</i>	0.30	0.88	30.00	3.57	1.00	1.49	5.95
17	<i>Tamarindus indica</i>	0.30	0.88	30.00	3.57	1.00	1.49	5.95
18	<i>Euphorbia caducifolia</i>	2.10	6.19	30.00	3.57	7.00	10.44	20.20
19	<i>Indigofera spinosa</i>	2.50	7.36	60.00	7.14	4.17	6.22	20.72
			<b>100</b>		<b>100</b>		<b>100</b>	<b>300.00</b>

**Table 4-20: Biodiversity indices values of the sampling sites in project site:**

<b>a</b>	A/F value	0.080
<b>b</b>	Shannon H	2.756
	Simpson 1-D	0.927
<b>c</b>	Dominance D	0.073
	Evenness e <sup>H/S</sup>	0.828

#### 4.15.9 Analysis of the result:

- Distribution pattern (A/F ratio):** The ratio between abundance and frequency was used to interpret the distribution pattern of species (Whitford, 1949). Distribution pattern of species in the study area is identified as **contagious distribution** as the value of A/F ratio is **0.080**. This distribution of species is mainly due to similar ecosystem patterns and habitats within the proposed site.
- The Shannon indices** value of study area is **2.756** indicates **moderate diversity** (Normal diversity in ecological studies is 1.5 to 3.5 range (Kerkhoff, 2010). As there are no RFs within the proposed site, diversity is less compared to core and buffer regions.
- Population size and Dominance of the species** is **7%** and Evenness is around **83%** (Indicates the species are evenly distributed in the proposed site). This might be due to contiguous patches of natural species such as *Butea sp*, *Azadirachta indica*,

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*Euphorbia sp, Indigofera sp, Phoenix sp, Prosopis juliflora (near the WTG sites), Delonix regia and Subabul (near road side).*

- d. **Frequency classification** indicates  $A < B > C > D > E$  as per the Raunkiaer's law of frequency classification indicates that species diversity is distributed maximum for 20 to 40%. This result indicates that very few of the floral species are found throughout the region. In some WTG sites, *Butea* is dominant and in few *Euphorbia* is predominant.

#### 4.15.10 Endangered/ threatened/ protected floral species

With reference to IUCN red data book, there are no endangered, endemic, rare plant species observed within the WTG sites and buffer zone.

##### 4.15.10.1 Invader or exotic species:

*Prosopis juliflora* is an evergreen tree native to South America, Central America and the Caribbean. In the United States, it is well known as mesquite. It is fast growing, nitrogen-fixing and tolerant to arid conditions and saline soils. *Prosopis juliflora* is an exotic and invasive widespread, multi-branched shrub/tree species in the India. It has been invading grasslands, native scrubland and forests of Gujarat and India. Our study showed that the *Prosopis juliflora*, is one of the most dominant and wide spread shrub/tree species in the core and buffer areas of the project site.

##### 4.15.10.2 Ecosystem services

Direct ecosystem source of local people is forest produce. The local people utilize the forest nearby to the village in four ways such as Fire wood, Bamboo, Major forest produce, Minor forest produce. Apart from that the Aesthetics and habitat for faunal resources are extensive. There are number of grass, herbs, shrubs and trees species which have various usages in the day to day life of people and their livestock. These plants are used for food, fodder, medicinal usages, fuel wood, timber, culture and religion, aesthetic purposes. The present ecosystem is well suitable for commercial propagation of any type of plants due to edaphic and climatic factors. This ecosystem also serves to local for firewood and fodder for goats and sheep.

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#### 4.15.10.3 Cropland Ecosystem

The villages were surveyed for enlisting agricultural crops in study area, the project and study area which include 16 species. Dry farming is practiced near the coast and irrigated farming is practiced in the farms that are nearer to villages. Cotton, Jowar, Millet, Groundnut are the main crops grown here. Apart from the several vegetables such as red chillies, Brinjal, Bhendi and leafy vegetable crops could also grow in this region. The detail of staple crops and commercial crops in study area is enclosed as **Table 4-21**.

**Table 4-21: List of agricultural crops & commercial crops (including vegetables) species recorded in study area:**

S. No	Scientific Name	Family	Common name
<b>Crops</b>			
1	<i>Arachis hypogea</i>	Fabaceae	Ground Nut
2	<i>Gossypium hirsutum</i>	Malvaceae	Cotton
3	<i>Sorghum bicolor</i>	Poaceae	Sorghum
4	<i>Vigna mungo</i>	Fabaceae	Black Gram
5	<i>Vigna radiate</i>	Fabaceae	Green Gram
6	<i>Zea mays</i>	Poaceae	Maize
<b>Horticulture Crop</b>			
7	<i>Citrus medica.</i>	Rutaceae	Citrus
8	<i>Mangifera indica</i>	Anacardiaceae	Mango
9	<i>Musa paradisiaca</i>	Musaceae	Banana
10	<i>Psidium guajava</i>	Myrtaceae	Guava
<b>Vegetable/Commercial Crops</b>			
11	<i>Abelmoschus esculentus</i>	Malvaceae	Bhendi

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12	<i>Capsicum annuum</i>	Solanaceae	Chilli
13	<i>Caricca papaya</i>	Caricaceae	Papaya
14	<i>Lycopersicon esculentum</i>	Solanaceae	Tomato
15	<i>Moringa oleifera</i>	Moringaceae	Drumstick
16	<i>Solanum melongena</i>	Solanaceae	Brinjal

#### 4.15.11 Faunal Profile

Field surveys are designed based on standard ecological methods, described in technical publications and in the current scientific literature. The design of wildlife survey requires knowledge of the species expected to be present, especially when **Rare Or Endemic or Endangered Or Threatened (REET)** species or species of special concern are likely to occur. Thus, information on habitat types, as well as general information on the seasonal occurrence, activity patterns, and behaviour of the wildlife expected in the area, is essential in order to select stations and to time the surveys to maximize the chances of encountering various species. In addition, reconnaissance surveys help to identify what species may be present in the area and to select sampling locations. Areas of potentially suitable habitat for REET species of special concern should be searched where such species are most likely to be found. Other special habitats should also be selected and searched. These include vernal pools, streams, rocky outcrops, grazing lands and thickets. For species-specific surveys, a trained wildlife biologist with extensive experience of finding the target species have been used who are capable of rapidly identifying wildlife species by sight, sound, and signs including circumstantial evidence.

Primary survey of wildlife was based on both direct observations of wildlife and indirect or circumstantial evidence such as droppings, excreta, feathers, hairs, hooves, skeletons, carcasses, footprints etc. Watching during certain seasons or times and at specific locations where suitable habitat exists such as water holes during dry season are among the different considerations that have gone in to the survey. Direct observations include observing wildlife with binoculars. Indirect observations include evidence of wildlife, such as

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amphibian and bird calls, bird songs, tracks, droppings, burrows, runs, catches, and remains, such as feathers, bones, skeletons, and road kill.

#### 4.15.11.1 Herpeto-fauna

Majority of the reptile species are fossorial in habit therefore the assessment of reptiles and their diversity etc. holds special significance for any development projects. The study was carried out study based on interview survey, secondary literature as well as direct observation. No endangered, rare, threatened or endemic species of reptiles and amphibians are reported from the study area.

**Table 4-22: List of Reptiles either spotted or reported from the study area.**

Scientific Name	Common Name	IUCN	IWPA
<i>Ahaetulla nasutus</i>	Green whip snake	-	
<i>Naja naja</i>	Indian Cobra	-	II
<i>Vipera russelli</i>	Russel Viper	-	II
<i>Dendrelaphis tristis</i>	Tree Snake	-	
<i>Ptyas mucosus</i>	Common Rat snake	-	II
<i>Trimeresurus gramineus</i>	Green pit viper	-	IV
<i>Typhlops hypomethes</i>	Common blind snake	-	IV
<i>Varanus bengalensis</i>	Common Indian monitor*	LR	II
<i>Mabuya carinata</i>	Common Skink*	-	
<i>Calotes rouxi</i>	Forest Calottes*	-	
<i>Calotes versicolor</i>	Common garden lizard*	-	
<i>Hemimidactylus brooki</i>	House gecko*	-	
<i>Hemidactylus forenatus</i>	Southern House Gecko	-	
<i>Natrix piscator</i>	Cheakered Keelback Keelback	-	
<i>Echis carinatus</i>	Saw scaled viper	-	

(\*indicates Primary data)

**Table 4-23: List of Amphibians either spotted or reported from the study area**

Scientific Name	Common Name	IUCN	IWPA
<i>Bufo melanostictus</i>	Common toad	-	Sch-IV
<i>Rana hexadactyla</i>	Common green frog *	-	Sch-IV

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<b><i>Rana leptodactyla</i></b>	Small forg	-	Sch-IV
<b><i>Rana tigrina</i></b>	Bullfrog	-	Sch-IV
<b><i>Rhacophorus maculatus</i></b>	Common Tree Frog*	-	Sch-IV

\*Status assigned by the IUCN, where – CR – Critically Endangered; EN – Endangered; LC – Least Concern; NT – Near Threatened; VU – Vulnerable, DA – Data Deficient, NE – Not Evaluated

Sources:

- Indraneil Das (2002). *Snakes & other Reptiles of India*. New Holland Publishers (UK) Ltd pp. 1-144;
- Romulus Whitaker & Ashok Captain (2006). *Snakes of India; Dreko Books, Chennai, pp 1-146*;
- IUCN (2015); *The IUCN Red List of Threatened Species*. Version 2015-4;
- *Schedules I to VI: Indian Wildlife (Protection) Act, 1972*.

#### 4.15.12 Avifauna

Birds, occupying higher trophic levels in the ecosystems, respond quickly to the changes in the habitats and therefore serve as one of the best indicators for evaluating the status of the area. Therefore, we created baseline data on birds by systematically and scientifically collected data on occurrence in the study area. During our visits we recorded species of birds from various habitat types such as wetlands, forest types and cultivation lands in the study area. While sampling for the bird, we recorded number of species that were identified in the study area. Apart from direct sampling, we also relied on random observation on bird species in specific habitats, interview surveys and expert consultation methods in order to improve the inventory of the bird species of the project area and the buffer area. Birds were observed mostly during most active period of the day around 5.30 hrs to 8.30 hrs and 15.30 hrs to 18.30 hrs. Birds were identified by direct observation, identifying the physical features with the help of field guides (The book of Indian Birds by Salim Ali) and reference books. In case of complications in identification, photographs were taken for identification in later stages. Birds were observed in different types of habitats and those areas where sighting chances are more. However, we put more efforts on secondary sources for migratory paths and seasonality, foraging behaviour etc. The list of avifauna observed recorded or observed in study area is presented in **Table 4-24**.

Based on the primary and secondary data collected from the study area, it was observed that there is no migratory pathway of birds within the core area i.e. near WTG locations. A total of 103 bird species belonging to 16 orders were recorded in the study area. The only partially

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migratory bird species recorded was *Clamator jacobinus* (*Pied crested cuckoo*). Of these 9 threatened bird species are reported. The threatened bird species include 2 Critically Endangered species of vultures (White-rumped Vulture, & Long billed Vulture), 7 Near Threatened species species which includes Lesser Flamingo, Oriental White Ibis, Painted Stork, Oriental Darter, and Egyptian Vulture.

Majority of the birds reported from the core and buffer area belong to the Schedule-IV of Wildlife Protection Act 1972 (WPA 1972), whereas 3 species belongs to Schedule-I of WPA 1972. (All three types of vultures and Indian Peafowl) whereas Common crow belong to Schedule-V.

The birds were recorded mainly from Barda wildlife sanctuary, Reserve forest area of the core zone, non-forested, degraded areas and in the surrounding agriculture landscape interspersed with scattered small ponds. The bird species groups observed in the study area were represented by species of open scrubland such as Passerines, Shrikes, Francolin, Quails etc. and water bodies birds such as Egrets, Herons, and members of rallidae family (moorhens) etc. Majority of the birds observed in the study area represent birds of semi arid non-forested landscapes with several small ponds and lakes in the villages etc. Moreover, majority of the bird species reported in the present study are abundant and common even in human dominated landscapes such as Mahiki, Satapur and Patan villages, lakes and ponds etc. Majority of the resident species reported in the study area are known to breed in this region as well as in entire Gujarat. No rare, endangered, endemic bird species were found to breed in the core project area.

One of the important vulture (Long billed Vulture) feeding sites (Vulture Safe Zone) is observed in Khambada reservoir basin is located at 21 km West from the proposed wind turbine locations (STP 11). According to local villagers, Demoiselle Cranes (*Anthropoides virgo*) are one of the seasonal migratory birds that come to Satapur Reservoir basin during winter.

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**Table 4-24: Terrestrial & Wetland associated birds in the project and study area**

S.No	Common Name	Scientific Name	IUCN status	IWLP status
1	House Swift	<i>Apus affinis</i>	LC	Sch-IV
2	Asian Palm Swift	<i>Cypsiurus balasiensis</i>	LC	Sch-IV
3	Indian Night jar	<i>Caprimulgus asiaticus</i>	LC	Sch-IV
4	Grey Nightjar	<i>Caprimulgus indicus</i>	LC	Sch-IV
5	Red-wattled Lapwing	<i>Vanellus indicus</i>	LC	Sch-IV
6	Pheasant-tailed Jacana	<i>Hydrophasianus chirurgus</i>	LC	Sch-IV
7	Blackwinged Stilt	<i>Himantopus himantopus</i>	LC	Sch-IV
8	Indian Skimmer	<i>Rynchops albicollis</i>	LC	Sch-IV
9	Large Egret	<i>Ardea alba</i>	LC	Sch-IV
10	Grey Heron	<i>Ardea cinerea</i>	LC	Sch-IV
11	Purple Heron	<i>Ardea purpurea</i>	LC	Sch-IV
12	Pond Heron	<i>Ardeola grayii</i>	LC	Sch-IV
13	Little Egret	<i>Egretta garzetta</i>	LC	Sch-IV
14	Medium Egret	<i>Egretta Intermedia</i>	LC	Sch-IV
15	Painted Stork	<i>Mycteria leucocephala</i>	NT	Sch-IV
16	Eurasian Spoonbill	<i>Platalea leucorodia</i>	LC	Sch-IV
17	Black Ibis	<i>Pseudibis papillosa</i>	LC	Sch-IV
18	Oriental White Ibis	<i>Threskiornis melanocephalus</i>	NT	Sch-IV
19	Rock Pigeon	<i>Columba livia</i>	LC	Sch-IV
20	Spotted Dove	<i>Streptopelia chinensis</i>	LC	Sch-IV
21	Eurasian Collared Dove	<i>Streptopelia decaocto</i>	LC	Sch-IV
22	Common Kingfisher	<i>Alcedo atthis</i>	LC	Sch-IV
23	Pied Kingfisher	<i>Ceryle rudis</i>	LC	Sch-IV
24	White-breasted Kingfisher	<i>Halcyon symensis</i>	LC	Sch-IV
25	Indian Roller	<i>Coracias benghalensis</i>	LC	Sch-IV
26	Pied Cuckoo	<i>Clamator jacobinus</i>	LC	Sch-IV
27	Indian Cuckoo	<i>Cuculus micropterus</i>	LC	Sch-IV
28	Asian Koel	<i>Eudynamys scolopacea</i>	LC	Sch-IV

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29	Shikra	<i>Accipiter badius</i>	LC	Sch-IV
30	Common Buzzard	<i>Buteo buteo</i>	LC	Sch-IV
31	Marsh Harrier	<i>Circus aeruginosus</i>	LC	Sch-IV
32	White-rumped Vulture	<i>Gyps bengalensis</i>	CR	Sch-I (Part III)
33	Long-billed Vulture	<i>Gyps indicus</i>	CR	Sch-I (Part III)
34	Brahminy Kite	<i>Haliastur indus</i>	LC	Sch-IV
35	Black Eagle	<i>Ictinaetus malayensis</i>	LC	Sch-IV
36	Black Kite	<i>Milvus migrans</i>	LC	Sch-IV
37	Egyptian Vulture	<i>Neophron percnopterus</i>	NT	Sch-IV
38	Red-necked Falcon	<i>Falco chicquera</i>	LC	Sch-IV
39	Osprey Pandion	<i>Pandion haliaetus</i>	LC	Sch-IV
40	Common Quail	<i>Cotumix cotumix</i>	LC	Sch-IV
41	Painted Francolin	<i>Francolinus pictus</i>	LC	Sch-IV
42	Indian Peafowl	<i>Pavo cristatus</i>	LC	Sch-I
43	Common Crane	<i>Grus grus</i>	LC	Sch-IV
44	White breasted Waterhen	<i>Amauromis phoenicurus</i>	LC	Sch-IV
45	Common Coot	<i>Fulica atra</i>	LC	Sch-IV
46	Common Moorhen	<i>Gallinula chloropus</i>	LC	Sch-IV
47	Indian purple Moorhen	<i>Porphyrio porphyrio</i>	LC	Sch-IV
48	Demoiselle Crane	<i>Anthropoides virgo</i>	LC	Sch-IV
49	Ashy-crowned Sparrow-Lark	<i>Eremopterix grisea</i>	LC	Sch-IV
50	Indian Bush Lark	<i>Mirafraga erythroptera</i>	LC	Sch-IV
51	Small Minivet	<i>Pericrocotus cinnamomeus</i>	LC	Sch-IV
52	Scarlet Minivet	<i>Pericrocotus flammeus</i>	LC	Sch-IV
53	Large-billed Crow	<i>Corvus macrorhynchos</i>	LC	Sch-IV
54	House Crow	<i>Corvus splendens</i>	LC	Sch-IV
55	Black Drongo	<i>Dicrurus adsimilis</i>	LC	Sch-IV

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56	Ashy Drongo	<i>Dicrurus leucophaeus</i>	LC	Sch-IV
57	Black headed Munia	<i>Lonchura malacca</i>	LC	Sch-IV
58	White-rumped Munia	<i>Lonchura striata</i>	LC	Sch-IV
59	Red-rumped Swallow	<i>Hirundo daurica</i>	LC	Sch-IV
60	Common Iora	<i>Aegithina tiphia</i>	LC	Sch-IV
61	Brown Shrike	<i>Lanius cristatus</i>	LC	Sch-IV
62	Tree Pipit	<i>Anthus trivialis</i>	LC	Sch-IV
63	White Wagtail	<i>Motacilla alba</i>	LC	Sch-IV
64	Yellow Wagtail	<i>Motacilla flava</i>	LC	Sch-IV
65	Indian Blue Robin	<i>Erithacus brunneus</i>	LC	Sch-IV
66	Blue throat	<i>Erithacus svecica</i>	LC	Sch-IV
67	Desert Wheatear	<i>Oenanthe desertii</i>	LC	Sch-IV
68	Purple Sunbird	<i>Nectarinia asiatica</i>	LC	Sch-IV
69	House Sparrow	<i>Passer domesticus</i>	LC	Sch-IV
70	Indian Pitta	<i>Pitta brachyura</i>	LC	Sch-IV
71	Black-breasted Weaver	<i>Ploceus benghalensis</i>	LC	Sch-IV
72	Baya Weaver	<i>Ploceus philippinus</i>	LC	Sch-IV
73	Red-vented Bulbul	<i>Pycnonotus cafer</i>	LC	Sch-IV
74	Common Myna	<i>Acridotheres tristis</i>	LC	Sch-IV
75	Thickbilled Warbler	<i>Acrocephalus aedon</i>	LC	Sch-IV
76	Booted Warbler	<i>Hippolais caligata</i>	LC	Sch-IV
77	Asian Brown Flycatcher	<i>Muscicapa latirostris</i>	LC	Sch-IV
78	Tailor Bird	<i>Orthotomus sutorius</i>	LC	Sch-IV
79	Ashy Prinia	<i>Prinia socialis</i>	LC	Sch-IV
80	Whitethroat	<i>Sylvia communis</i>	LC	Sch-IV
81	Desert Warbler	<i>Sylvia nana</i>	LC	Sch-IV
82	Common Babbler	<i>Turdoides caudatus</i>	LC	Sch-IV
83	Jungle Babbler	<i>Turdoides striatus</i>	LC	Sch-IV
84	Indian Shama	<i>Copsychus malabaricus</i>	LC	Sch-IV
85	Oriental Magpie Robin	<i>Copsychus saularis</i>	LC	Sch-IV
86	Indian Robin	<i>Saxicoloides fulicata</i>	LC	Sch-IV
87	Dalmatian Pelican	<i>Pelecanus crispus</i>	NT	Sch-IV

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88	White or Rosy Pelican	<i>Pelecanus onocrotalus</i>	NT	Sch-IV
89	Lesser Flamingo	<i>Phoenicopterus minor</i>	NT	Sch-IV
90	White-cheeked Barbet	<i>Megalaima viridis</i>	LC	Sch-IV
91	White-bellied Woodpecker	<i>Dryocopus javensis</i>	LC	Sch-IV
92	Oriental Darter	<i>Anhinga melanogaster</i>	NT	Sch-IV
93	Large Cormorant	<i>Phalacrocorax carbo</i>	LC	Sch-IV
94	Indian Shag	<i>Phalacrocorax fuscicollis</i>	LC	Sch-IV
95	Little Cormorant	<i>Phalacrocorax niger</i>	LC	Sch-IV
96	Little Grebe	<i>Podiceps ruficollis</i>	LC	Sch-IV
97	Rose-ringed Parakeet	<i>Psittacula krameri</i>	LC	Sch-IV
98	Barn Owl	<i>Tyto alba</i>	LC	Sch-IV
99	Black-headed Bunting	<i>Emberiza melanocephala</i>	LC	Sch-IV
100	Little Bunting	<i>Emberiza pusilla</i>	LC	Sch-IV
101	White-capped Bunting	<i>Emberiza stewarti</i>	LC	Sch-IV
102	House Bunting	<i>Emberiza striolata</i>	LC	Sch-IV
103	Common Rose finch	<i>Carpodacus erythrurus</i>	LC	Sch-IV

\*Status assigned by the IUCN, where – CR – Critically Endangered; EN – Endangered; LC – Least Concern; NT – Near Threatened; VU – Vulnerable, DA – Data Deficient, NE – Not Evaluated

The above table comprises of details of avifauna recorded in study area of 15 km radius however the following four (4 no.) bird species were observed in Khambada reservoir basin located at 21 km West from the proposed wind turbine locations (STP 11) near study area.

S.No	Common Name	Scientific Name	IUCN status	IWLP status
1	Red Headed vulture	<i>Sarcogyps calvus</i>	CR	Sch-IV
2	Steppe eagle	<i>Aquila nipalensis</i>	EN	Sch-IV
3	Saker falcon	<i>Falco cherrug</i>	EN	Sch-IV
4	Pallas's fish eagle	<i>Haliaeetus leucoryphus</i>	EN	Sch-IV

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#### Sources:

- Ali, S and Ripley, S.D. 1969. Handbook of the Birds of India and Pakistan together with those of Nepal, Sikkim, Bhutan and Ceylon, 3. Stone Curlews to Owls. Oxford University Press, Bombay, 327pp.
- BirdLife International 2012. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <[www.iucnredlist.org](http://www.iucnredlist.org)>. Downloaded on 11 March 2013.
- Grimmett, R., Inskipp, C and T. Inskipp, 2001. Pocket Guides to the Birds of the Indian Subcontinent. Christopher Helm Publishers, Oxford University Press, 384pp.
- [http://wiienvis.nic.in/Database/ScheduleSpeciesDatabase\\_7969.aspx](http://wiienvis.nic.in/Database/ScheduleSpeciesDatabase_7969.aspx)

#### Flight activity of the target species

The flight activity of the target species (Direct sighted during recorded period) are analysed for each vantage point for summer season and collected the secondary data on presence of winter migratory birds in the study area from past 10 years. No such migratory birds are recorded in the vicinity from past 10 years period. All the recorded species are very commonly seen throughout India and no peculiar habitat preference observed for birds of the region. Baya weaverbirds nesting sites are sighted on *Phoenix* species and eggs of few Passeriformes recorded bit away from the WTG points. The overview of the bird activity in terms of number of flights, number of individuals, total flight times for each species and Collision probability risk percentage is recorded near three vantage points selected in the Project area in **Table 4-25**. The number of flights shows that how many times the species were observed during the whole season. The total number of birds recorded is the total number of birds during the whole season. The total time recorded shows how many seconds the species use the survey area. Further, the average flight distance is given in below table.

**Table 4-25: Flight activity of the target species (Direct sighted during recorded period) from three vantage points**

S.No.	Common Name	Number of Flights	Number of Birds recorded	Total Flight Time (hrs)	Flight Time spent at each Vantage point (hrs)	Collision probability risk %	Flight Distance (meters)
1	House Swift	6	16	6	2	33.33	150
2	Asian Palm Swift					0.00	150
3	Indian Night jar					0.00	10
4	Grey Nightjar	2	5	4	0	0.00	10
5	Red-wattled Lapwing	23	20	12	8	0.75	50
6	Pheasant-tailed Jacana					0.00	10
7	Blackwinged Stilt	12	15	10	1	10.00	20

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8	Indian Skimmer					0.00	20
9	Large Egret	5	3	3	0	0.00	30
10	Grey Heron	6	2	4	0	0.00	30
11	Purple Heron					25.00	25
12	Pond Heron	3	2	1	0	0.00	20
13	Little Egret	5	2	0	0	0.00	20
14	Medium Egret					0.00	20
15	Painted Stork					100.00	80
16	Eurasian Spoonbill	2	1	0	0	0.00	10
17	Black Ibis	5	2	0	0	0.00	50
18	Oriental White Ibis					0.00	20
19	Rock Pigeon	6	100	15	2	100.00	40
20	Spotted Dove	5	15	8	2	50.00	50
21	Eurasian Collared Dove					50.00	50
22	Common Kingfisher	8	7	6	1	50.00	40
23	Pied Kingfisher	7	2	5	2	25.00	40
24	White-breasted Kingfisher	6	3	4	4	25.00	40
25	Indian Roller	8	4	2	0	0.00	20
26	Pied Cuckoo					0.00	20
27	Indian Cuckoo					0.00	20
28	Asian Koel	5	4	3	1	33.33	50
29	Shikra	5	2	4	2	50.00	60
30	Common Buzzard	4	1	3	1	33.33	80
31	Marsh Harrier	5	18	3	1	33.33	90
32	White-rumped Vulture	2	4	1	1	100.00	150
33	Long-billed Vulture					50.00	150
34	Brahminy Kite					50.00	200
35	Black Eagle	3	9	2	1	50.00	200
36	Black Kite					75.00	200
37	Egyptian Vulture					75.00	150
38	Red-necked Falcon					10.00	100
39	Osprey Pandion					0.00	50
40	Common Quail					0.00	50
41	Painted Francolin					0.00	40
42	Indian Peafowl	5	2	2	2	0.00	20
43	Common Crane					0.00	0
44	White breasted Waterhen					0.00	0
45	Common Coot					0.00	0
46	Common Moorhen					0.00	0
47	Indian purple Moorhen					0.00	0

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48	Demoiselle Crane					0.00	30
49	Ashy-crowned Sparrow-Lark					25.00	5
50	Indian Bush Lark	10	5	5	1	25.00	5
51	Small Minivet	5	2	5	0	25.00	20
52	Scarlet Minivet					25.00	20
53	Large-billed Crow					25.00	30
54	House Crow	20	10	0	0	30.00	30
55	Black Drongo	15	30	0	0	25.00	30
56	Ashy Drongo					0.00	30
57	Black headed Munia					0.00	10
58	White-rumped Munia					0.00	10
59	Red-romped Swallow					0.00	50
60	Common Iora	14	5	2	2	0.00	5
61	Brown Shrike					25.00	20
62	Tree Pipit					25.00	20
63	White Wagtail					5.00	10
64	Yellow Wagtail					10.00	20
65	Indian Blue Robin	6	5	10	2	10.00	10
66	Blue throat	6	2	5	2	0.00	15
67	Desert Wheatear					25.00	20
68	Purple Sunbird	20	25	15	5	25.00	20
69	House Sparrow	20	30	5	0	25.00	20
70	Indian Pitta	10	2	0	0	5.00	10
71	Black-breasted Weaver					25.00	20
72	Baya Weaver	3	1	2	0	30.00	10
73	Red-vented Bulbul	40	16	26	5	25.00	20
74	Common Myna	14	5	5	2	25.00	20
75	Thickbilled Warbler					5.00	10
76	Booted Warbler					5.00	10
77	Asian Brown Flycatcher					0.00	20
78	Tailor Bird					25.00	20
79	Ashy Prinia					20.00	10
80	Whitethroat	5	4	1	1	25.00	10
81	Desert Warbler	1	1	1	0	25.00	10
82	Common Babbler	14	10	2	0	25.00	5
83	Jungle Babbler					25.00	5
84	Indian Shama					25.00	5
85	Oriental Magpie Robin					25.00	20
86	Indian Robin	2	1	2	0	25.00	20
87	Dalmatian Pelican					25.00	100

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88	White or Rosy Pelican					25.00	100
89	Lesser Flamingo					25.00	150
90	White-cheeked Barbet					25.00	25
91	White-bellied Woodpecker					25.00	10
92	Oriental Darter					25.00	20
93	Large Cormorant	1	1	0	0	25.00	20
94	Indian Shag					0.00	20
95	Little Cormorant					0.00	20
96	Little Grebe					0.00	20
97	Rose-ringed Parakeet	2	5	2	0	20.00	20
98	Barn Owl					25.00	10
99	Black-headed Bunting					0.00	10
100	Little Bunting					0.00	20
101	White-capped Bunting					0.00	15
102	House Bunting					0.00	15
103	Common Rose finch					0.00	15

#### 4.15.13 Mammals

The mammals are occupying higher trophic levels in many ecosystems and respond quickly to the changes in their habitats therefore, serves as best indicators of the ecosystem health. Hence, the baseline information on distribution and abundance of mammals is prepared. A qualitative check list of mammals based on their presences and absence using indirect evidences and signs such as footprints, dens, droppings, diggings, scrap marks, etc. in the study area was prepared. This survey has helped in identifying various species, their behaviour and characteristics. For faunal inventory, both direct sightings and indirect evidences (like dung, scats, pellets, foot prints, nests, dens etc.) were accounted. No endangered or Schedule-I species reported from the core area of the project site. The details of mammalian species recorded are given below in **Table 4-26**.

**Table 4-26: Mammalian species found in the project and study area**

Scientific Name	Common Name	IUCN	WPA Status
<i>Bendicota bengalensis</i>	Indian mole rat	LC	
<i>Bendicota indica</i>	Bandicoot rat	LC	
<i>Boselaphus tragocamelus</i>	Nilgai	LC	Sch III
<i>Felis chaus</i>	Jungle cat	LC	Part II of Sch II

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<i>Funambulus palmarum</i>	Three striped palm squirrel	LC	
<i>Herpestes javanicus</i>	Common Indian Mongoose	LC	Part II of Sch II
<i>Lepus nigricollis</i>	Black-naped Hare	LC	Sch IV
<i>Mus booduga</i>	Little Indian Field mouse	LC	
<i>Mus musculus</i>	House Mouse	LC	
<i>Pipistrellus coromandra</i>	Indian Pipistrelle (bat)	LC	
<i>Pteropus giganteus</i>	Indian Flying fox bat	LC	
<i>Rattus rattus</i>	House rat	LC	
<i>Rhinopoma microphyllum</i>	Grater Mouse-Tailed Bat	LC	
<i>Sus scrofa</i>	Wild Boar	LC	Sch III

\*Status assigned by the IUCN, where – CR – Critically Endangered; EN – Endangered; LC – Least Concern; NT – Near Threatened; VU – Vulnerable, DA – Data Deficient, NE – Not Evaluated

Sources:

- Vivek Menon (2014), *Indian Mammals: A Field Guide*. Hachette Book Publishing India Pvt. Ltd., Gurgaon, India, pp 1-522;
- IUCN (2015). *The IUCN Red List of Threatened Species*. Version 2015-4;
- *Schedules I to VI: Indian Wildlife (Protection) Act, 1972*.

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**Figure 4-20: Fauna Observed in Study Area**



Cattle egrets and Painted stork



Red wattled lapwing



Cormorant



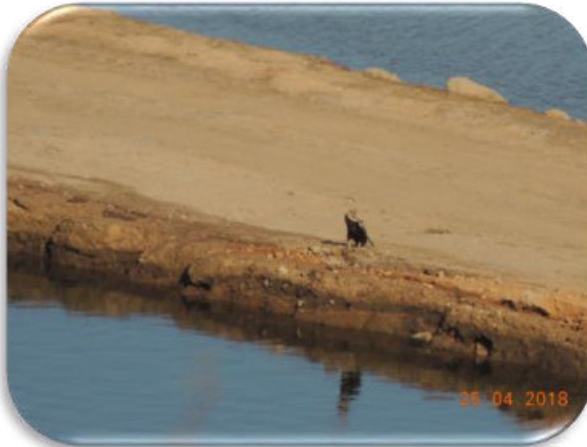
Oriental White Ibis

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Long-billed Vulture



Grey Heron



Indian Peafowl



Pellets of Nilgai

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Common Iora



Common Indian monitor



Rock Pigeon



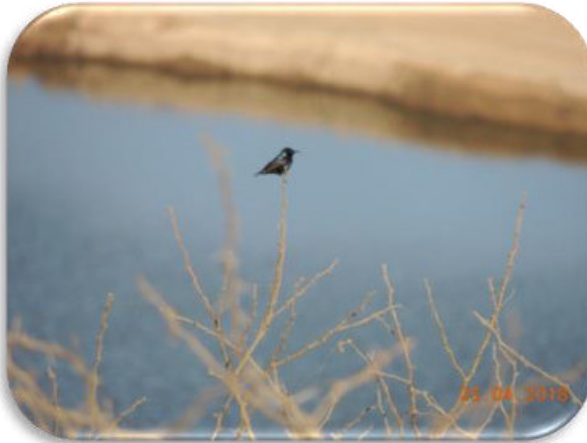
Jungle babbler

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Paid Bushchat



Red-vented Bulbul



Green bee eater



Indian Robin

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#### 4.15.14 Butterflies

Butterflies spotted in the study area were identified as per Butterflies of India. List of butterflies in the study area are presented in table 11. A total of 19 species of butterfly were reported various habitats such as agricultural field, degraded habitat, scrub forest, open grassland, dry forest and near settlements of near forest region. As per Wildlife (Protection) Act, 1972 all species were fall in the Schedule-IV. The most of them were preferred habitats are dry deciduous forest and open grasslands.

**Table 4-27: List of Butterflies either spotted or reported from the study area**

S.No.	Scientific Name	Common Name	IUCN	IWLP (1972) Status	Act
1	<i>Acraea violae</i>	Tawny Coster	LC	Not listed	
2	<i>Danaus chrysippus chrysippus</i>	Plain Tiger *	LC	Not listed	
3	<i>Danaus genutia genutia</i>	Striped Tiger*	LC	Not listed	
4	<i>Euploea core core</i>	Common Crow	LC	Sch- IV	
5	<i>Phalanta phalantha phalantha</i>	Common Leopard	LC	Not listed	
6	<i>Precis lemonias lemonias</i>	Lemon Pansy	LC	Not listed	
7	<i>Precis orithya ocyale</i>	Blue Pansy *	LC	Not listed	
8	<i>Chilades laius</i>	Lime Blue	LC	Not listed	
9	<i>Everes lacturnus syntala</i>	Indian Cupid	LC	Not listed	
10	<i>Freyeria trochylus</i>	Grass Jewel*	LC	Not listed	
11	<i>Jamides celeno aelianus</i>	Common Cerulean *	LC	Not listed	
12	<i>Tarucus nara</i> Kollar	Rounded Pierrot*	LC	Not listed	
13	<i>Colotis etrida</i>	Small or Little Orange Tip*	LC	Not listed	
14	<i>Colotis eucharis eucharis</i>	Plain Orange Tip*	LC	Not listed	
15	<i>Catopsilia pomona</i>	Common Emigrant*	LC	Not listed	
16	<i>Eurema hecabe simulata</i>	Common Grass	LC	Not listed	

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		Yellow*		
17	<i>Papilio demoleus</i>	Lime Butterfly	LC	Not listed
18	<i>Papilio polytes polytes</i>	Common Mormon	LC	Not listed
19	<i>Papilio polytes stichius</i>	Common Mormon	LC	Not listed

(\* indicates Primary data)

\*Status assigned by the IUCN, where – CR – Critically Endangered; EN – Endangered; LC – Least Concern; NT – Near Threatened; VU – Vulnerable, DA – Data Deficient, NE – Not Evaluated

#### 4.16 SOCIO-ECONOMIC PROFILE

This section provides an understanding of the administrative setup of the district, the demographic profile of the study area, the social groups present, the land use pattern in the area, the livelihood profile of the community, the common property resources, the social and physical infrastructure available in terms of the education and health infrastructure, the water supply for irrigation and drinking purposes, sanitation facilities and connectivity. The purpose of this section is to allow for evaluating Social impacts, the key issues identified as well as identify areas of intervention in future scenarios and preparing a Social Management Plan. The data from secondary sources like the Primary Census Abstract of 2011 and has been utilized to establish the socio-economic conditions of the local community.

#### Study Approach and Methodology

The delineated area for the study has been identified giving significance to the area where revenue land is being acquired and the impact of the project on the surrounding areas within 10 km radius of the project site.

**Literature Review of Secondary Data:** The study included review of secondary information obtained from Census Report of India 2011 along with District Socio Economic Reports, Economic Census, and District websites which were compiled to give an overview of the socio-economic baseline.

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**Legislative Review:** The study incorporated relevant social legislation, regulations, guidelines and standards which were reviewed and compiled.

**Baseline Data Collection:** A focus group discussion to gather the primary data was conducted to ensure establishment of proper baseline information.

**Identification of potential social impacts:** The information collected through the focus group discussion was primarily collected to identify the potential social issues and this was supplemented by IFC Performance Standards.

**Impact Assessment:** The socio - economic and project information were collected to assess the potential impacts of the proposed activities. The assessment covered the following aspects:

- The present baseline conditions and consultations with the local communities
- The potential changes in the social parameters likely to be affected by project related activities
- The identification of potential impacts
- The evaluation of the likelihood and significance of potential impacts
- The defining of mitigation measures to reduce impacts to as low as practicable

## Methodology

A meeting with the project proponent was initially conducted to develop a common understanding of the project activities, and discussion with the villagers, and to identify a continuous point of contact for all future correspondence.

The baseline information included aspects like demographic information, economic activities, literacy profile, land use, infrastructure resource, economic facilities, cultural heritage, life style and other value system.

The following methods were used as a benchmark to collate the baseline information:

- Stakeholders consultation meeting which included the Project Influenced Population in Patan, Paradva, Satapar, Vadvala and Mahiki village

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- Consultations with land sellers in Satapar, Paradva and Vadvala villages to understand the socio-economic status, education facilities and the literacy levels

The delineation of Preliminary Stakeholders were based on the following points,

- the type of stakeholders, and
- their connection and influence levels on the project .

An open ended questionnaire was prepared for the focus group discussions prior to the start of the consultation process to obtain the information from the population. Different stakeholder groups were consulted to understand the concerns/ issues, expectations/ benefits and other advantages that they have on the project.

#### **4.16.1 JAMJODHPUR TALUKA PROFILE**

Jamjodhpur is a Taluka in Jamnagar District of Gujarat State, India. It is located 62 KM towards South from District head quarters Jamnagar. 352 KM from State capital Gandhinagar towards East.

Jamjodhpur Taluka is bounded by Bhanvad Taluka towards west, Lalpur Taluka towards North, Upleta Taluka towards South, Jamkandorna Taluka towards East. Upleta City, Kalavad City, Ranavav City, Khambhalia City are the nearby Cities to Jamjodhpur. Jamjodhpur consist of 113 Villages and 68 Panchayats. It is in the 101 m elevation(altitude). Jamnagar, Porbandar, Girnar (Girnar Hill), Junagadh , Gondal are the near by important tourist destinations in Jamjodhpur.

#### **4.16.2 VILLAGES FALLING UNDER STUDY AREA**

The study area within 10 km radius covers sixteen (16) villages in Jamjodhpur Taluka, Jamnagar District including the revenue land from the adjoining villages which shall be acquired for the project. The list of villages in the study area is given below in **Table 4-28**.

**Table 4-28: List of villages in Study Area**

S.No.	Name of Village	Taluka	District
1.	Patan	Jamjodhpur	Jamnagar
2.	Paradva	Jamjodhpur	Jamnagar

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3.	Satapar	Jamjodhpur	Jamnagar
4.	Mahiki	Jamjodhpur	Jamnagar
5.	Vadvala	Jamjodhpur	Jamnagar
6.	Chur	Jamjodhpur	Jamnagar
7.	Vansjaliya	Jamjodhpur	Jamnagar
8.	Amrapar	Jamjodhpur	Jamnagar
9.	Vadekhan	Jamjodhpur	Jamnagar
10.	Malvada	Jamjodhpur	Jamnagar
11.	Naliyero	Jamjodhpur	Jamnagar
12.	Balva	Jamjodhpur	Jamnagar
13.	Paniya	Jamjodhpur	Jamnagar
14.	Udepur	Jamjodhpur	Jamnagar
15.	Ramnagar	Jamjodhpur	Jamnagar
16.	Khageshri	Jamjodhpur	Jamnagar

#### 4.16.3 DEMOGRAPHIC DETAILS

##### ***Jamjodhpur Taluka***

Jamjodhpur Taluka of Jamnagar district has total population of 132,498 as per the Census 2011. Out of which 68,228 are males while 64,270 are females. In 2011 there were total 27,255 families residing in Jamjodhpur Taluka. The Average Sex Ratio of Jamjodhpur Taluka is 942.

As per Census 2011 out of total population, 19.5% people lives in Urban areas while 80.5% lives in the Rural areas. The average literacy rate in urban areas is 84% while that in the rural areas is 70.5%. Also the Sex Ratio of Urban areas in Jamjodhpur Taluka is 961 while that of Rural areas is 937.

The population of Children of age 0-6 years in Jamjodhpur Taluka is 15172 which is 11% of the total population. There are 7869 male children and 7303 female children between the age 0-6 years.

##### **Sex Ratio**

The Sex Ratio of Jamjodhpur Taluka is 942. Thus for every 1000 men there were 942 females in Jamjodhpur Taluka. Also as per Census 2011, the Child Sex Ration was 928 which is less than Average Sex Ratio (942 ) of Jamjodhpur Taluka.

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### **Literacy Rate**

Average literacy rate of Jamjodhpur Taluka in 2011 were 73.19% in which, male and female literacy were 80.54% and 65.4% respectively. Total literate in Jamjodhpur Taluka were 85,869 of which male and female were 48,613 and 37,256 respectively.

### **Scheduled Caste and Scheduled Tribes**

The Census records indicate that the Schedule Caste (SC) constitutes 11.4% while Schedule Tribe (ST) were 4.4% of total population in Jamjodhpur Taluka.

**Table 4-29: SC and ST Profile as per Census data, 2011**

	Total	Male	Female
<b>Jamjodhpur Taluka</b>			
<b>Schedule Caste</b>	15,083	7,755	7,328
<b>Schedule Tribe</b>	5,813	2,964	2,849

### **Religion wise Demography details**

The religion-wise demography profile indicates that maximum population belongs to Hindus nearly 95.34%) followed by Muslims (4.38%). Most part of the study area has been occupied by Hindus and they play a vital role in making cultural and religious activities.

### **Working Population**

In Jamjodhpur Taluka out of total population, 61,467 were engaged in work activities. 81.4% of workers describe their work as Main Work (Employment or Earning more than 6 Months) while 18.6% were involved in Marginal activity providing livelihood for less than 6 months. Of 61,467 workers engaged in Main Work, 21,836 were cultivators (owner or co-owner) while 16,412 were Agricultural labourer.

### **House Types:**

Houses in the study area are generally semi-pacca and pacca. The houses are generally made by bricks and stones. Around 80-90% households have facility of toilet. Piped water

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supply are the main source of drinking water and other domestic use. There is a Water Treatment Plant in every Taluka and water is supplied through overhead tanks to every household through tap water supply.

#### **Occupation and Economy:**

The main occupation of the study area is agriculture (50-70%). Apart from monsoon season, water is being stored in water tanks by individual farmers. The main crops grown in the study area are Cotton, Groundnut, Maize, Cumin and Wheat. The primary occupation is agriculture however most of the younger generation have been gaining higher education and moving to metropolitan cities for jobs. The average land holding size of the study area is 4-5 acres per family.

The people in the study area are also employed under MNREGA Scheme and are earning Rs. 10,000-15,000 per month.

#### **Infrastructure Facilities**

##### **Roads:**

The study area of the proposed project is well connected with village road which is around 20 m wide and in partly good condition. The internal roads of the villages which link one village to another are semi-pucca.

##### **Education:**

Considering the educational facilities in the study area, Govt. Primary School, High School is available in all villages. The Senior Secondary School is available in the study area in Satapar. In every school and college there is facility of toilets for girls and boys separately.

##### **Health:**

There are Primary Care Center (PCC) in all the villages in Jamjodhpur Taluka. The Government Community Health center and a number of Private Hospitals are also working with better facility in the study area. There is no any epidemic or chronic disease have been reported in the study area during consultation with local villagers

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#### **Drinking Water Facility:**

As reported during consultation, there is acute shortage of water only for agricultural activities therefore farmers are storing water in individual water tanks for meeting up agricultural water demand.

#### **Communication:**

The villages in the study area are well connected via mobile, telephone and internet. Government post office is also available in most of the village panchayat of the study area.

#### **Electricity Facility:**

The study area is good in terms of electricity supply. In general, 24 hours' electricity is available in most of the villages of the study area.

The implementation of the proposed Wind power project will throw opportunities to local people for both direct and indirect employment. Furthermore, direct and indirect employment arising from the project activity during the course of construction and operation of project activity can open up new avenues of employment and source of earning. Thus proposed project will improve socio-economic status of the study area.

#### **4.16.4 OBSERVATIONS AND NEED BASED ASSESSMENT**

The project site does not inhabit any indigenous communities like tribes, ethnic minorities, aboriginals etc. as defined by the IFC Performance Standards 7. Therefore, the applicability and relevance of the clauses/ special concessions of PS 7 – IFC Policy on indigenous people development does not stand good in this study area.

On the basis of interpretation made above, primary survey (interaction with stakeholders, FGD, community consultation, consultation with government official and discussion with influential person of the study area) and secondary sources, the major outcomes specify the following need based gaps in the study area:

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- There are limited opportunity of employment and livelihood in the study area. Youth and people gaining higher education generally migrate to adjoining citiies for job in case of limited opportunities in the area;
- Regular connectivity and proper transfortation infrastructure facility lacking.

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## 5. PUBLIC CONSULTATIONS AND STAKEHOLDER ANALYSIS

Stakeholder Engagement is an important process through which a two-way dialogue is created between the project proponent and the stakeholders. As per survey of the delineated area of the proposed wind plant site, the project influenced population was identified in undertaking stakeholder consultations.

The criteria for identifying these areas were based on the proximity to the site area, the influence of impacts on the households in the area and the socio cultural characteristics of the resident population.

### 5.1 STAKEHOLDER IDENTIFICATION

The stakeholders for the project were prioritized by identifying the direct and indirect stakeholders. The key stakeholders that were consulted as part of the study included the following:

- Local Population residing near the project site
- Local Community:
  - Residents – Patan, Paradva, Satapar, Vadvala and Mahiki village
  - PAP- Satapar, Paradva and Vadvala villages

### 5.2 STAKEHOLDER CONSULTATION

A stakeholder is any group or individual who may affect or be affected by a specific project. They could have a direct as well as an influence on the project. Stakeholders may comprise of local persons/community, government and non-government officials, project proponents etc. related to internal and external matter related to the project. Stakeholder identification is useful to prioritize, analyze and assess stakeholder issues while creating management systems and strategies to address specific concerns.

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Stakeholder interactions were conducted by TUV SUD team with the local population in project influenced villages. Besides this, interactions also took place with the representatives of Envision and Enerfra.

Discussions with the land owners and local community members were undertaken at the project sites in Satapr, Paradva, and Vadvala villages. The findings were based mainly on the participatory method of focus group discussions (FDG) with the randomly selected villagers and Sarpanches. Members from TUV and IFC along with Envision, Enerfra and SPRNG ALT Energy carried out the discussions with the stakeholders. A list of open-ended questions was used for understanding the perception of the stakeholders regarding the project

Socio economic questionnaire survey was undertaken to understand the overall social and economic impact on the population. This was done to study and evaluate the impact of the operating turbines on the affected population of these small hamlets. The stakeholder consultation comprised primarily of a social survey and consultation initiated by TUV SUD. Consultations in the form of Questionnaire (QA) surveys were carried out with selected groups of local residents from the Project influenced villages and settlement cluster.

The process of stakeholder consultation involved:

- identification of the relevant stakeholders including all those individuals, groups and organizations potentially affected by or interested in the project;
- Imparting information about the project and its potential impacts on their lives in local and simple language;
- Recording of their concerns and aspirations through survey and discussions; and
- Responding to their queries in a neutral manner.

Information was exchanged both ways between the consultants and potentially influenced population residing in the project influenced villages. The following table gives the details of meeting conducted during site visit and the list of participants

### 5.2.1 METHODOLOGY ADOPTED

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The stakeholder consultation comprised primarily of a social survey and consultation initiated by TUV SUD. The findings are based mainly on the use of participatory methods like focus group discussions, key informant interviews and natural interviews. These methods give an in depth and intensity to the discussion and incorporates the locals point of view within a short period of time.

The aspects covered questions and broad responses obtained during the consultation are as provided below:

### **Awareness about the project**

Since there are close half a dozen wind and solar power plants around the project site (some are 20 years old) all the respondents were aware of the proposed projects. They were aware of the components involved in the project including Wind Power modules and transmission lines. They were also aware of the various phases of development and the schedule of construction.



Figure 5-1: Consultations with local community from Paradva village



Figure 5-2: Consultations with local community from Paradva village

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Figure 5-3: Consultations with local community from Vadvala village



Figure 5-4: Consultations with local community from Vadvala village



Figure 5-5: Consultations with local community from Satapar village



Figure 5-6: Consultations with local community from Satapar village

### **Occupation and Livelihood**

Agriculture and livestock rearing are the key occupations among the local community. Some people are also engaged as daily wage labours in the surrounding areas. The agricultural

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productivity of the area is moderate to good. Some of the villagers have business like Bela stone quarry and stone crushing plants within the project site.

#### **Use of the procured land**

Most of the land owners and community has reported that they do either their own farming or give it to others for shared crop basis farming. It was reported that roughly 60% of population own land and do their own farming while rest of the 40% population is either labourer or do shared crop farming with the land holders. There is moderate rain fall and the rain fed water bodies are not adequate for yearlong farming hence many of the framers have their own water tanks that they filled with bore well water.

#### **Migrant Labour**

The community were aware that some of the skilled workers will come from outside the area and were comfortable with migrant labourers coming and working in their area.

### **5.3 STAKEHOLDERS IDENTIFIED**

A stakeholder is any group or individual who may affect or be affected by a specific project. They should be prioritized by identifying direct (those who have a direct interest or influence on the project) and indirect stakeholders whose interest is indirect. Stakeholders may also be internal within the project or external to the project. Stakeholder identification is useful to prioritize, analyze and assess stakeholder issues while creating management systems and strategies to address specific concerns. The stakeholders identified and summary of consultation with the stakeholders is provided in **Table 5-1**.

**Table 5-1: Details of Stakeholders**

Stakeholders	Profile	Perception
Local Community	All the lands purchased for the project are revenue land	--
	Local Community Local community represents the	The perception of the local community about the project was:

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Stakeholders	Profile	Perception
	people from the project affected villages which are likely to be affected due to project activities such as transportation of WTGs, influx of migrant labour etc.	<ul style="list-style-type: none"> <li>Local community expressed that they were pleased with the project. They reported that the power supply situation in the region is poor and coming up of such projects, supplying power to the local grids is likely to improve the power availability;</li> <li>Locals also reported that the project has provided employment opportunities to individuals and local contractors.</li> </ul>
Govt. institutions	Regulatory authorities <i>State Labour department</i> is the agency for implementation of labour standards and the state labour policy. <i>GETCO</i> will receive the power generated for further transmission to Grid	The main concerns of the State Labour Policy would be ensuring compliance to labour and working condition standards and implementation  <i>GETCO</i> has finalized the substations for power evacuation.
Local NGOs and Civil Societies	In project area no NGO/civil society has been noticed in function for development programme in concerned communities.	Social organisations observed in the area were not directly associated with any of the project related functions.
Site Developer	The site developer is SPRNG, and has procured land through land aggregator Opera Wind.	Gujarat States land acquisition policy was followed for acquiring the revenue land.

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Stakeholders	Profile	Perception
Site Occupier and Project Developer	Envision will be responsible for all the project activities undertaken directly or through the sub contractors.	Envision shall engage with the community on regular basis during all phases of the project. Envision shall engage with the Panchayats and explore potential for CSR initiatives.

The project proponent informed that the construction and operation of the project would involve local manpower. The project does not require any displacement of local population. Also, the installation of transmission lines would not create any inconvenience to the local population.

#### 5.4 FOCUSED GROUP DISCUSSIONS (FGD) WITH LOCAL INHABITANTS/ VILLAGERS

The outcomes of interaction with villagers residing near the project site in Paradva, Satapar and Vadvala villages who have given their land for setting up of project is given below

##### Social Perception Survey – Questionnaire - ESIA for 197.5 MW WPP

**Name of the village:** Paradva

**Date:** 25/4/2018

**Tehsil/Taluka:** Jam Jodhpur

**District:** Jamnagar

##### Questions specific to the area:

S.No.	Questions	Response
1	Total population of the area:	Approx. 1700
2	Average Household Size:	4
3	Literacy rate:	70%
4	Marital Age	21 years
5	Caste/tribe details:	Mix caste/ No Tirbal
6	Religion:	99% Hindu Few Muslims

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S.No.	Questions	Response
7	Major Occupation:	90% Farming
8	Crops Grown:	Cotton, Groundnuts, Jeera, Wheat, Bajara
9	Source of Drinking Water	Government water supply
10	Electricity Connectivity	100%
11	Land Holding details:	Average 4 Acres by 50% of population
12	Approx. Monthly Income:	Rs. 15000.00
13	Type and number of livestock per household:	2 Cows/ Bulls
14	BPL Holders/Other government scheme:	10%
15	Cultural Site around the area:	None
16	Customs and traditions:	--
17	Educational facilities:	1 Primary School and 1 Higher secondary School
18	Transport facilities:	Mettled road, State transport connectivity
19	Health care facilities:	Primary health care with a MBBS Dr.
20	Water Supply facilities:	Gov. Water supply
21	Electricity facilities:	24Hrs
22	Government Schemes	MNREGA
23	NGO's in the area	None
24	Veterinary Facilities	Kageshree at 6 Km
25	Fertilizer/Seed Shop	Yes
26	Fair Price Shop	Yes
27	Self Help group/NGO and their details:	None
28	Role of Women:	House and farm work
29	Education level among women	Less the 30 years have graduate level More than 30 years primary school
30	Employment opportunities within the area. Do people migrate in search of job opportunities?	Farming, local stone quarry

**Questions specific to Wind Power Projects:**

What do you know about Wind power projects? Broad perception?

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**Yes, there are close to half a dozen solar and wind project in the area**

Is there any drastic change in environment/area/region due to the WPPs? How has the change influenced them?

**Not much**

If land is used primarily for agriculture, what is the reason for selling land? Do you want to invest this cost in mechanized farming in the rest of the agricultural patches owned by you or put it as investment in some equipments/machinery or put it as savings and use it when required?

**No land was sold for the project by anyone**

What is the present land rates prevailing in the area for various types of Lands: Private, Government, Trust/Mutt and Gayran?

NA

If there are any WPPs coming up, what are your expectation and concerns? Do you want increase in employment opportunities, if so, what type of work are you looking forward to?

**Any kind of skilled or unskilled work including contracts**

If there are migrant workers coming up in the area, do you expect any issues or is it ok?

**Yes, no issues were faced when earlier projects brought migrant labours. The migrant labour shall not be hired for the project. In case of hiring migrant labour, IFC norms shall be adhered by the Contractor**

Are there any other development projects in the adjoining area/region or same area/region? Nature of project?

**Yes half a dozen solar and wind power plants in Dhank village**

Are there any large birds or different species of animals seen in this locality?

**Russian migratory birds Demoiselle Crane are spotted during winter when the ground nut crop is the fields during winter season.**

**Name of the village: Vadvala  
Tehsil/Taluka: Jam Jodhpur**

**Date: 25/4/2018**

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**District:** Jamnagar

**Questions specific to the area:**

S.No.	Questions	Response
1	Total population of the area:	Approx. 1700
2	Average Household Size:	4
3	Literacy rate:	100%
4	Marital Age	21 years
5	Caste/tribe details:	OBC 40-50%, 5-7% SC/ No Tirbal
6	Religion:	100% Hindu
7	Major Occupation:	100% Farming
8	Crops Grown:	Cotton, Groundnuts, Jeera, Wheat, Bajara
9	Source of Drinking Water	Government water supply
10	Electricity Connectivity	100%
11	Land Holding details:	Average 4 Acres by 80% of population
12	Approx. Monthly Income:	Rs. 10000.00 – 15000.00
13	Type and number of livestock per household:	2 Cows/ Bulls
14	BPL Holders/Other government scheme:	10%
15	Cultural Site around the area:	None
16	Customs and traditions:	--
17	Educational facilities:	1 Primary School
18	Transport facilities:	Mettled road, State transport connectivity
19	Health care facilities:	Primary health care CHC
20	Water Supply facilities:	Gov. Water supply
21	Electricity facilities:	24Hrs
22	Government Schemes	MNREGA
23	NGO's in the area	None
24	Veterinary Facilities	Satapar, 7 KM
25	Fertilizer/Seed Shop	Yes
26	Fair Price Shop	Yes

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S.No.	Questions	Response
27	Self Help group/NGO and their details:	None
28	Role of Women:	House and farm work
29	Education level among women	Less the 30 years are 100% literate More than 30 years primary school
30	Employment opportunities within the area. Do people migrate in search of job opportunities?	Farming, local stone quarry

**Questions specific to Wind Power Projects:**

What do you know about Wind power projects? Broad perception?

**Yes, there are close to half a dozen solar wind project in the area**

Is there any drastic change in environment/area/region due to the WPPs? How has the change influenced them?

**Not much**

If land is used primarily for agriculture, what is the reason for selling land? Do you want to invest this cost in mechanized farming in the rest of the agricultural patches owned by you or put it as investment in some equipments/machinery or put it as savings and use it when required?

**No land was sold for the project by anyone**

What is the present land rates prevailing in the area for various types of Lands: Private, Government, Trust/Mutt and Gayran?

NA

If there are any WPPs coming up, what are your expectation and concerns? Do you want increase in employment opportunities, if so, what type of work are you looking forward to?

**Any kind of skilled or unskilled work including contracts**

If there are migrant workers coming up in the area, do you expect any issues or is it ok?

**Yes, no issues were faced when earlier projects brought migrant labours. The migrant labour shall not be hired for the project. In case of hiring migrant labour, IFC norms shall be adhered by the Contractor.**

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Are there any other development projects in the adjoining area/region or same area/region? Nature of project?

**Yes half a dozen solar and wind power plants in Dhank village**

Are there any large birds or different species of animals seen in this locality?

**Russian migratory birds Demoiselle Crane are spotted during winter when the ground nut crop is the fields during winter season.**

**Name of the village: Satapar**

**Date: 25/4/2018**

**Tehsil/Taluka: Jam Jodhpur**

**District: Jamnagar**

**Questions specific to the area:**

S.No.	Questions	Response
1	Total population of the area:	Approx. 2800-3000
2	Average Household Size:	4
3	Literacy rate:	99%
4	Marital Age	21 years
5	Caste/tribe details:	OBC 40-50%, 5-7% SC/ No Tirbal
6	Religion:	100% Hindu
7	Major Occupation:	90% Farming
8	Crops Grown:	Cotton, Groundnuts, Jeera, Wheat, Bajara
9	Source of Drinking Water	Government water supply
10	Electricity Connectivity	24 Hours
11	Land Holding details:	Average 4 Acres by 75% of population
12	Approx. Monthly Income:	Rs. 15000.00
13	Type and number of livestock per household:	2 Cows/ Bulls
14	BPL Holders/Other government scheme:	5-7%
15	Cultural Site around the area:	None

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S.No.	Questions	Response
16	Customs and traditions:	--
17	Educational facilities:	3 Schools
18	Transport facilities:	Mettled road, State transport connectivity
19	Health care facilities:	Primary health care with a MBBS Dr.
20	Water Supply facilities:	Gov. Water supply
21	Electricity facilities:	24Hrs
22	Government Schemes	MNREGA
23	NGO's in the area	None
24	Veterinary Facilities	Kageshree at 6 Km
25	Fertilizer/Seed Shop	Yes
26	Fair Price Shop	Yes
27	Self Help group/NGO and their details:	None
28	Role of Women:	House and farm work
29	Education level among women	Less the 30 years have graduate level More than 30 years primary school
30	Employment opportunities within the area. Do people migrate in search of job opportunities?	Farming, local stone quarry

**Questions specific to Wind Power Projects:**

What do you know about Wind power projects? Broad perception?

**Yes, there are close to half a dozen solar wind project in the area**

Is there any drastic change in environment/area/region due to the WPPs? How has the change influenced them?

**Not much**

If land is used primarily for agriculture, what is the reason for selling land? Do you want to invest this cost in mechanized farming in the rest of the agricultural patches owned by you or put it as investment in some equipments/machinery or put it as savings and use it when required?

**No land was sold for the project by anyone**

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What is the present land rates prevailing in the area for various types of Lands: Private, Government, Trust/Mutt and Gayran?

NA

If there are any WPPs coming up, what are your expectation and concerns? Do you want increase in employment opportunities, if so, what type of work are you looking forward to?

**Any kind of skilled or unskilled work including contracts**

If there are migrant workers coming up in the area, do you expect any issues or is it ok?

**Yes, no issues were faced when earlier projects brought migrant labours. The migrant labour shall not be hired for the project. In case of hiring migrant labour, IFC norms shall be adhered by the Contractor for construction of labour camp**

Are there any other development projects in the adjoining area/region or same area/region? Nature of project?

**Yes half a dozen solar and wind power plants in Dhank village**

Are there any large birds or different species of animals seen in this locality?

**Russian migratory birds Demoiselle Crane are spotted during winter when the ground nut crop is the fields during winter season.**

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## 6. ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

This chapter describes various environmental and social impacts identified and assessed for the construction and operation phases of the Wind Power Project. The identification of impacts has been done based on the review of available project information; discussions with the local community; representatives of the project proponents and other sector specific professionals.

The section also identifies and assesses the range of potential impacts and extent of their severity on environment, ecology, socio-economic resources, demographics, livelihood issues. Mitigation measures for the identified impacts are also suggested with a management plan for the proposed mitigation measures.

### 6.1 IMPACT ASSESSMENT CRITERIA

Identified impacts have been appraised through social and environmental components and have been presented in **Table 6-1** below. The appraisal criteria are classified according to spread, duration, intensity and nature of the impact. Severity levels have been sub classified under each criterion with specifics outlining the limits of each severity level.

**Table 6-1: Impact Assessment Criteria**

Criteria	Sub-Classification	Defining Limit	Remarks
<b>Spread: Refers to area of direct influence from the impact of a particular project activity.</b>	Insignificant/ local spread	impact is restricted within the foot prints of the Project boundary	except for ecology (which is defined as limited loss of vegetation only at site)
	Medium Spread	impact is spread up to 2 km around the project area	except for ecology (which is defined as loss of vegetation at site including large trees with limited

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			disturbance to adjoining flora & fauna)
	High spread	impact is spread beyond 2 km from footprint boundary of the Project	except for ecology (which is defined as loss of vegetation at site and/ or damage to adjoining flora and fauna
<b>Duration: Based on duration of impact and time taken by an environmental aspect to recover to its original state</b>	Insignificant / Short Duration	when impact is likely to be restricted for a duration less than 2 years	the anticipated recovery of the impacted environmental aspect is within 2 years
	Medium Duration	when impact extends up to five years	the anticipated recovery of the impacted environmental aspect is within 5 years
	Long Duration	when impact extends beyond five years	the anticipated recovery of the impacted environmental aspect is more than 5 years
<b>Intensity: Defines the magnitude of impact</b>	Insignificant intensity	when changes in the prevailing (baseline) environmental conditions does not exceed 10%	However, it shall be reconsidered where the baseline values are already high
	Low intensity	when changes in the prevailing (baseline) environmental conditions does not exceed 20%	for ecology it refers to minimal changes in the existing ecology in terms of their reproductive capacity, survival or habitat change
	Moderate intensity	when changes in the prevailing (baseline) environmental conditions does not exceed 30%	for ecology, it refers to changes that are potentially recoverable
	High intensity	when changes in the	While for ecology, high

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		prevailing (baseline) environmental conditions exceeds 30%	intensity refers to changes that result in serious destruction to species, productivity or critical habitat.
<b>Nature: Refers to whether the effect is considered beneficial or adverse</b>	Beneficial	-	Useful to Environment and Community
	Adverse	-	Harmful to Environment and Community

A “significance assessment matrix” has been adopted in order to assess impacts appraised as per criteria mentioned in **Table 6-2**. The below section provides the impact significance criteria adopted for assessment.

**Table 6-2: Impact Significance Criteria**

Spread	Duration	Intensity	Overall Significance	
			Adverse	Beneficial
Local	Short	Low	Insignificant	Insignificant
Local	Short	Moderate	Minor	Minor
Local	Medium	Low		
Local	Medium	Moderate		
Medium	Short	Low		
Local	Long	Low		
Local	Short	High	Moderate	Moderate
Local	Medium	High		
Local	Long	Moderate		
Medium	Short	Moderate		
Medium	Medium	Low		
Medium	Medium	Moderate		
Medium	Long	Low		
Medium	Long	Moderate		
High	Short	Low		
High	Short	Moderate		
High	Medium	Low		
High	Medium	Moderate		
High	Long	Low		

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Local	Long	High	Major	Major
Medium	Short	High		
Medium	Long	High		
High	Short	High		
High	Medium	High		
High	Long	Moderate		
High	Low	Low		
High	Low	High		

## 6.2 IMPACT IDENTIFICATION

Based on the activities involved, an impact interaction matrix for construction and operation phases has been prepared for the project. Impacts have been categorized based on Environment and Social Aspects and are covered under the following subsections:

- Construction Phase
- Operational Phase

### 6.2.1 IMPACT IDENTIFICATION MATRIX

The impact identification matrix for construction, operation and decommissioning phases of the project, based on environmental, social and occupational health and safety variables are given in **Table 6-3 and Table 6-4** respectively. Each of the impacts identified has been further discussed and corresponding mitigation measures have been proposed.

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**Table 6-3: Impact Identification Matrix – Construction and Operation Phase**

S.No	Main Activities	Environmental and Social Components										
		Land Use	Ecology	Water Resources	Ambient Air Quality	Soil Resources	Noise Ambient Quality	Water Quality	Traffic / Transport	Social/ Livelihood/Cultural	Occupational Health & Safety	Visual Aesthetics
I.	CONSTRUCTION PHASE											
1	Site Preparation											
	Procurement of land	√								√		
	Site Grading		√			√						
	Site /Vegetation clearance		√			√						
2	Labour Engagement											
	Employment of workers									√	√	
	Water requirement			√								
	Power requirement				√							
	Waste handling and disposal					√						

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S.No	Main Activities	Environmental and Social Components										
		Land Use	Ecology	Water Resources	Ambient Air Quality	Soil Resources	Noise Ambient Quality	Water Quality	Traffic / Transport	Social/ Livelihood/Cultural	Occupational Health & Safety	Visual Aesthetics
	Sewage disposal					√		√				
3	Material Handling and Storage											
	Transportation and Unloading of construction material				√	√	√		√	√	√	
	Transportation, storage and handling of Wind Turbines –Hub, rotar blades				√	√	√		√	√	√	
4	Construction Works											
	Preparation/Mixing of construction material			√	√	√	√	√			√	
	Utilities (Water, power, sanitation etc)				√	√		√				

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S.No	Main Activities	Environmental and Social Components										
		Land Use	Ecology	Water Resources	Ambient Air Quality	Soil Resources	Noise Ambient Quality	Water Quality	Traffic / Transport	Social/ Livelihood/Cultural	Occupational Health & Safety	Visual Aesthetics
	Operation of construction machinery				√	√	√				√	
	Handling and Disposal of construction wastes		√				√				√	
	Laying of transmission lines	√									√	√
5	De-Mobilisation of Construction Equipment											
	Dismantling of temporary support construction structures /equipments				√	√	√					√
	Removal of construction machinery					√					√	
	Transportation of Construction /Dismantled wastes				√				√		√	

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S.No	Main Activities	Environmental and Social Components										
		Land Use	Ecology	Water Resources	Ambient Air Quality	Soil Resources	Ambient Noise Quality	Water Quality	Traffic / Transport	Social/ Livelihood/Cultural	Occupational Health & Safety	Visual Aesthetics
II.	OPERATION PHASE											
1	Wind power generation										√	
3	Repair and maintenance works					√					√	
4	Power Transmission		√									

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**Table 6-4: Matrix relating to project stage and social impact assessment variables**

Social impact assessment variables	Construction Phase	Operation and Maintenance Phase	Decommissioning Phase
<b>Land Procurement</b>			
Loss of land	•		
Changing occupational opportunities	•		
<b>Influx of migrant Workers</b>			
Presence of an outside agency	•	•	
Conflicts Between Local Residents and Newcomers	•	•	
Income generating opportunities	•	•	
Increase in local employment	•	•	
Introduction of new Social classes	•		
Change in the commercial/industrial focus of the community	•	•	
Stress on local Infrastructure	•		
Loss of jobs			•
<b>Community Infrastructure and property</b>			
Change in community infrastructure		•	
Land acquisition or disposal	•		
Initiation of community development activities	•	•	
Effects on known cultural, historical and archaeological resources			

### 6.3 IMPACT ASSESSMENT - CONSTRUCTION PHASE

The construction activities for the 197.5 MW plant has not yet started. This section presents the impacts identified primarily for the construction phase of the 197.5MW plant. Based on the activity – impact interaction matrix for construction phase, impacts on the following aspects have been identified:

1. Soil Resources and Quality;
2. Land Use;

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3. Waste Generation, Storage and Disposal;
4. Water Resources and Quality;
5. Ecology;
6. Traffic and Transport;
7. Ambient Air Quality;
8. Ambient Noise Quality;
9. Occupational Health and Safety;
10. Cultural Heritage;
11. Socio-economic
12. Road construction
13. Painting and finishing
14. Clean up operations
15. Landscaping

### **6.3.1 Soil Resources and Quality**

#### **Project Phases and Associated Activities**

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

#### Construction Phase

- Construction/strengthening of access roads;
- Selective clearing of vegetation in areas designated for WTG erection, PSS and electrical poles;
- Stripping and stockpiling of soil layers;
- Excavation for WTG foundations and electrical poles; and
- Storage and transport of construction materials.

#### **Anticipated Impacts**

The site clearance, excavation and access road construction will largely affect the top layers of the soil. Loss of top soil quality would have an impact on the agricultural productivity of the land but the effects can be reversed over time. Site clearance for the site is anticipated to be

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minimal because the scrubland patches are not located in a direct impact area (500m) of the proposed wind farm. Scattered vegetation may be removed from private land for construction but this can be easily avoided as most vegetation is around seasonal natural drainage channels or existing roads.

Road quality in the region is good and therefore vehicles will be encouraged to utilize the established roads instead of going off-road. The usage of existing roads by vehicles and minimal access road construction will reduce the impact from soil compaction in the area.

The Impact Magnitude has been assessed to be small because of the reversible impact on the soil environment and limited impact from access road construction. The topography of the site is also flat and the region does not experience very high winds decreasing the chances of erosion.

#### **Embedded/In-built Controls**

- Vehicles will utilize existing roads to access the site. Existing roads will be widened to have the width and turning radius to accommodate the necessary vehicles for the Project;
- Stripping of top soil will be conducted only when required; and
- Stripping of top soil, excavation and access road construction will not be carried out during the monsoon season or during heavy winds to minimize erosion and run-off.

#### **Significance of Impact**

The overall impact significance on soil erosion and compaction has been assessed as minor. The existing infrastructure and wind levels can reduce the impacts due to soil compaction and erosion respectively.

#### **Mitigation**

##### **Additional Mitigation Measures**

- Top soil that has been stripped should be stored for landscaping of the site;
- The stock piles of soil should be kept moist to avoid wind erosion of the soil;
- Soil should be ploughed in compacted areas after completion of construction work; and
- Site should be restored at the end of the Project life cycle to pre-Project levels.

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### Significance of Residual Impacts

The significance of residual impacts has been reduced to negligible taking into account the recommended mitigation measures.

### Impact Significance

The impact on soil will have moderate intensity with a local spread for a short duration which will result in an overall minor impact without mitigation. However with proper implementation of suggested mitigation measures the overall impact will be insignificant.

**Table 6-5: Impact Significance – Soil Resources and Quality**

Aspect	Scenario	Spread	Duration	Intensity	Overall
Soil Resources and Quality	Without Mitigation	Local	Short	Moderate	Minor
	With Mitigation	Local	Short	Low	Insignificant

### 6.3.2 Land Use

#### Impacts

The construction activities followed by commissioning of the Wind project will permanently change the land use of the site. Since the land used is revenue land the impact is considered to be minimum

#### Mitigation

The impacts on land use are restricted to the construction phase, which is expected to be for a maximum duration of six months for the current wind farm capacity. Construction activities will also be restricted to within the allotted land and immediate surroundings only. After construction work, any land taken for a temporary basis for operation of batching plant, storage or labour camp(s) will be restored to their original form. Existing roads will be used for access to the wind farm components with the exception of a small connection from the main village road to the foundation of each individual WTG.

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### Additional Enhancement Measures

- On completion of construction activities, land used for temporary facilities such as stockyard, batching plant and labour camps should be restored to the extent possible; and
- The land use in and around permanent project facilities should not be disturbed.

### Significance of Impact

Impact due to change of landuse will have low intensity with a local spread for a long duration which will result in an overall minor impact without mitigation, which will remain a minor impact owing to permanent change in landuse.

**Table 6-6: Impact Significance – Land Use**

Aspect	Scenario	Spread	Duration	Intensity	Overall
Land Use	Without Mitigation	Local	Long	Low	Minor
	With Mitigation	Local	Long	Low	Minor

### 6.3.3 Waste Generation, Storage and Disposal

The construction activities such as site clearing, excavation works, setting up of labour camps, installation of modules etc. will generate different types of solid and hazardous wastes. The construction demobilisation which includes removal of machinery, workers, campsite and other temporary structures will also generate some amount of solid waste. The following types of wastes will be generated due to construction of the project:

1. Domestic solid waste from labour colonies
2. Waste oil from generator and other construction machinery
3. Packaging waste such as gunny bags, plastics, etc.
4. Empty paint containers, metal scrap, etc.
5. Construction debris
6. Sewage from labour colonies

### Impacts

There is potential for spread of construction debris to areas outside the plant boundary during construction. The debris generated from construction activities can be carried along with the wind into nearby areas. Improper disposal of construction debris can lead to contamination of water bodies in the proximity of the Project.

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Improper disposal of solid waste from the labour camps at site and lack of proper sanitation facility for labour can lead to unhygienic conditions and spread of diseases in the area. It can lead to discontent of local community and result in conflicts with the labour engaged at site.

Improper disposal of packaging materials, boxes, plastics, ropes etc. can lead to littering in the construction site and surrounding areas. Hazardous wastes such as waste oil, lubricants, hydraulic oil etc can cause contamination of soil and water bodies if adequate precautions for management and handling are not undertaken. Use of chemicals such as paints, curing chemicals can lead to contamination of soil.

### Mitigation

The quantity of domestic waste generated daily from the labour camps will be small and limited. However the construction contractor Envision shall ensure that the campsites provided at site have adequate sanitation and waste disposal facilities. Common latrines and bathing facilities, duly segregated for male and female labour, shall be provided at the campsites. Provision of segregated toilets for male and female workers in the ratio of 1:15 and 1:10 (toilet to workers) respectively shall be made at the campsites in order to maintain hygienic and clean surroundings. Disposal of sewage shall be made through a septic tank – soak pit arrangement. Arrangements for collection of garbage in dustbins and daily disposal to the nearest dumpsite shall be made.

Waste/used oil generated from generators and construction machinery and equipments will be stored on paved surface in a secure location at the project site. The waste oil will be sold to GPCB approved vendors at frequent intervals. Empty paint containers will also be stored at a secured area designated for scrap and sold to authorised vendors. All packaging material will be also be collected at the storing area and sold to vendors.

Construction debris and excavated material will be stored in a confined area to prevent spread by wind or water. The construction debris will be used for backfilling of excavated areas and for foundation works at site and excess soil will be given to the local villagers for filling up of low lying areas in the vicinity.

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### Significance of Impact

The impact due to waste disposal will have moderate intensity with a local spread for a short duration which will result in an overall minor impact without mitigation. However with proper implementation of suggested mitigation measures the overall impact will be insignificant.

**Table 6-7: Impact Significance- Waste Disposal**

Aspect	Scenario	Spread	Duration	Intensity	Overall
Waste Disposal	Without Mitigation	Local	Short	Moderate	Minor
	With Mitigation	Local	Short	Low	Insignificant

### 6.3.4 Water Resources and Quality

#### Impact

About 150-200m<sup>3</sup> of water will be required for construction depending on various stages of the process besides domestic requirement of the workers at site.

There are natural drainage channels (seasonal) close to the western boundaries of the site. Construction at site can alter the natural drainage pattern of the area at a micro level. The project area has large water body, a check dam near Satapar village which is used for agricultural purposes. There is potential of contamination of such water bodies due to sediment runoff from construction activities. Improper disposal of sewage and wastewater and construction debris can contaminate the ground water resources in the area.

#### Mitigation

Water for construction activities will be met through authorized water tankers. Drinking water in the labour camps is being supplied through packaged water cans.

The natural slope of the site will be maintained to the extent possible in order to avoid any change in the drainage pattern. Adequate arrangement for storm water management during construction period will be made to avoid sediment runoff from the site. Storm water flow will be directed to the existing channels with silt traps to avoid sedimentation of the channels or the receiving water body.

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### Significance of Impact

The impact on water resources will have moderate intensity with a medium spread for a short duration which will result in an overall moderate impact without mitigation. However with proper implementation of suggested mitigation the impact will be reduced to minor.

**Table 6-8: Impact Significance - Water Resources**

Aspect	Scenario	Spread	Duration	Intensity	Overall
Water Resources	Without Mitigation	Medium	Short	Moderate	Moderate
	With Mitigation	Local	Short	Moderate	Minor

### 6.3.5 Ecology

IFC Performance Standard 6 recognizes that protecting and conserving biodiversity—the variety of life in all its forms, including genetic, species and ecosystem diversity—and its ability to change and evolve. This Performance Standard reflects the objectives of the Convention on Biological Diversity to conserve biological diversity and promote use of renewable natural resources in a sustainable manner.

### Impacts

The impacts from the construction phase on the local ecology have been assessed with respect to the following activities:

- Clearance of vegetation for construction activities:
  - Removal of mature trees from agricultural habitat due to access road widening, internal road construction, WTG foundation and ancillary facilities,
  - Loss of connectivity of habitat,
  - Removal of scrub vegetation from boundaries of agricultural land and in open scrubland; and
- Impacts of construction activities on resident fauna:
  - Loss of habitat for burrowing species,
  - Effect of sedimentation and contamination in soil layers and surface water bodies,
  - Noise related impacts on sensitive species,
  - Increased vehicular and anthropogenic movement that increases
  - road kills and human-wildlife conflicts.

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### Impacts due to Vegetation Clearance

Site clearing activities prior to start of construction involves removal of vegetation from the site, which will mainly include shrubs and grasses. This might result in potential loss of habitat for small mammals and birds. Noise from construction and frequent movement of vehicles can also disturb the avifauna of the area.

Loss of vegetation will directly affect the floral diversity in the area and indirectly affect fauna through loss of habitat, loss of connectivity and decrease in soil/water quality. Additionally, loss of vegetation can reduce options for nesting habitat, shelter from predators, foraging resources, shade, perching habitat and breeding sites.

The project area and the proposed wind turbine locations does not fall in the ecologically sensitive location and therefore, the overall impact on ecology due to erection of wind turbines is likely to be negligible. The site has dense to sparse *Prosopis juliflora* thickets present in the project land and its surrounding. The *Prosopis juliflora* is considered to be an invasive species and site clearing operations will not have impacts on flora in the area.

### Impacts on Flora

There is no rare, endangered and important plant species present in the project area. The project area vegetation represents invasive and thorny species dominant landscape. In some of the locations, *Prosopis juliflora* would need to be removed for installation of the wind turbines. The removal of invasive species is considered beneficial for local environment and ecology. Therefore, the project activities are not likely to have any significant impacts on the native vegetation of the project area and the study area. Project activities may temporarily disturb the vegetation in terms of dusting due to traffic movement and digging for foundation. This would be on a very small scale and negligible. Further, plants like *Prosopis juliflora* are resilient and hardy enough to sustain such temporary dusting.

### Impacts on Protected Areas, Forests and Habitat

The protected areas are located at distance exceeding 15 km from the project site, therefore the impacts of project activities on them would be negligible. However, the Reserve Forest areas comprising of *Prosopis juliflora* is located close to the project land. This forest area is

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having *Prosopis juliflora* thickets, and do not have significant wildlife species populations. Therefore, the impacts of wind turbines on forest area located close to the project site would be negligible. These impacts could be in terms of temporary disturbance, and dusting due to traffic movement etc. In order to minimize such impacts, the project staff shall be instructed to take care so that they do not blow horns, do not park their vehicles inside the forest areas and shall not disturb any vegetation etc.

### **Impacts on Waterbodies**

There is one reservoir near the project area i.e. near Satapur Village. Wind turbine locations maintain safe distances from this reservoir and small canals passing near Mahiki village. Therefore, as such the waterbodies are less likely to be affected by the wind turbine installation. However, the construction of access roads or transportation may cause temporary disturbance to the wetlands during the construction phase only. Such impacts are temporary in nature and could be nullified by taking proper care during the transportation of materials to the project locations.

### **Impacts on Fauna**

The proposed wind farm project can impact fauna in 2 principal ways:

- 1) they can eat up or fragment habitat and/or
- 2) they can directly kill birds and bats.

Habitat fragmentation occurs when wind farms and their associated roads, power lines and other structures displace wildlife. However, the proposed project has technical requirement of large open space but it actually occupies negligible physical land space (for tower holding wind turbine and electrical apparatus). Therefore, the proposed project is less likely to create any obstructions or fragmentation of wildlife habitats. Further, there are total 15 reptile species reported from the core project area. As per observations during Primary Ecological Survey, no rare, endangered or Schedule-I species are reported from the core area. No rare or high conservation significance species of reptiles are present in the core area of the proposed project site.

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### Mitigation

Prior to procurement, the land at project site was unused revenue land. The project site was also devoid of dense vegetation and will not involve felling of trees during site clearing. Therefore, the loss of vegetation at site is considered to be limited. No major loss of habitat or fragmentation due to construction activities is envisaged.

Construction activity should be conducted in a phased manner to prevent excessive noise, anthropogenic movement and vehicular movement throughout the entire wind farm area at any given time; and Clearance of mature trees or continuous scrub should be avoided to the extent possible when planning the wind farm components.

Clearing of vegetation will be limited to removal of undergrowth or shrubs at the plant site. It will have no impact on the flora of the area.

### Significance of Impact

The impact on fauna and flora will have low intensity with a moderate spread for a long duration which will result in an overall moderate impact without mitigation.

All project activities will be undertaken with appropriate noise mitigation measures to avoid disturbance to faunal population in the region. Activities generating high noise will be restricted to day time and will be mitigated to minimise the noise level outside the site boundary. The generator sets shall have acoustic enclosures to minimize the noise emissions.

Movement of construction and transport vehicles will be restricted to dedicated paths to minimise any harm to small mammals within the site. Transportation of construction material will be kept to day time hours in order to minimise noise and disturbance to fauna in the area.

### Significance of Impact

The impact on fauna and flora will have minor intensity with a local spread for a short duration which will result in an overall minor impact without mitigation. However with proper implementation of suggested mitigation the impact will be reduced to insignificant.

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