

Environmental and Social Impact Assessment (ESIA) of two wind energy projects: *Tamil Nadu*

Simran Wind Power Private Limited

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Environment Resource Management (ERM) India has been commissioned by Simran Wind Project Private Limited (SWPPL, hereinafter referred to as SWPPL or Simran), Pune to undertake a Social and Environmental Impact Assessment (SEIA) of its proposed 126.9 MW wind farm project in Tamil Nadu state in India.

This SEIA report has been prepared based on detailed survey of the sites, environmental monitoring, analysis and review of available documents and consultations/ discussions with the project proponents and related stakeholders. The report assesses the proposed project for social and environment aspect with respect to the International Finance Corporation (IFC) Performance Standards.

1.1**PROJECT BACKGROUND**

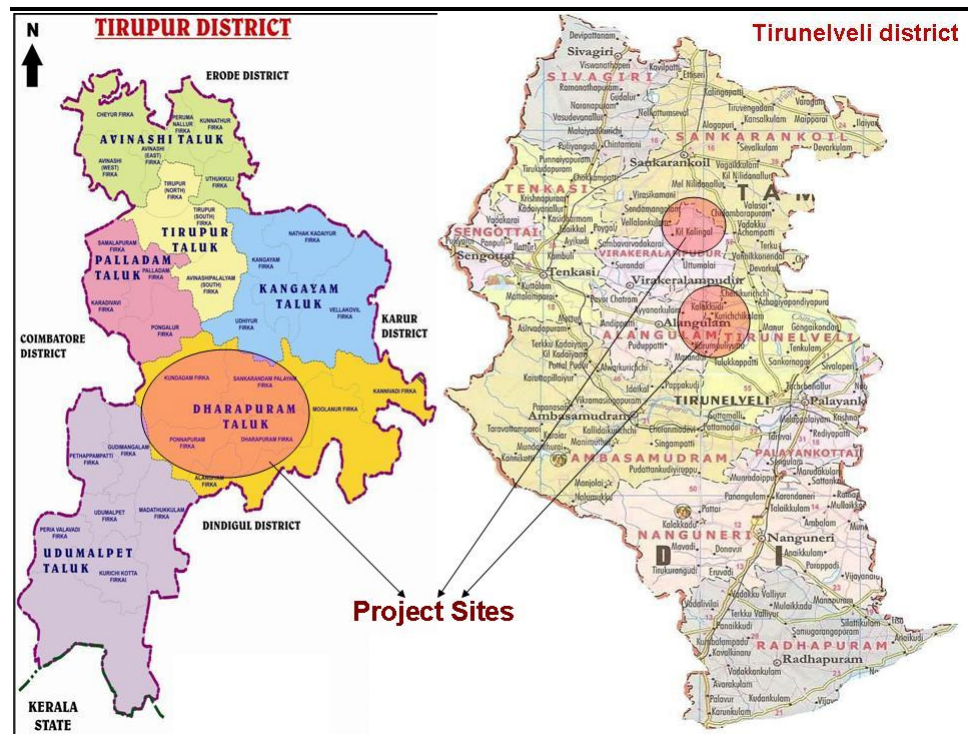
SWPPL is a 100% subsidiary of Techno Electric & Engineering Company Limited (TEECL), which has its corporate office at Kolkata. TEECL is an EPC Company working in the field of Power Sector for last 3 decades. TEECL has been involved in setting up of Power Plants and Power transmission /evacuation facilities, Balance of Plants (Electrical & Mechanical, Setting up of Sub-Stations/Switchyards upto 765 KV), Power Distribution Systems all over India to the extent of above 50,000 MW capacity with NTPC, BHEL, PGCIL, DVC, NEEPCO, NHPC and other State Power Utilities on select basis.

TEECL has developed and owns 95.45 MW Wind Power Generating capacity in the States of Tamil Nadu and Karnataka through its subsidiaries.

Simran Wind Project Private Limited (SWPPL) is a wholly owned subsidiary of TEECL which is investing in two Windfarm sites in Tamil Nadu.

SWPPL is also expecting an IFC investment and therefore wants to understand the environmental and social impacts of the two proposed wind energy project in line with the requirements of IFC Performance Standards (PSs). Based on the requirements of the IFC PSs, adequate management plan and systems are also expected to be developed as part of this assessment.

Figure 1.1 Location of the Project –Tirunelveli and Tiruppur



Source: Adapted from gis.nic.in

1.2 OBJECTIVES AND SCOPE OF WORK

1.2.1 Objective for the study

The objective of the SEIA study is to assess social and environmental impacts and develop social and environmental management strategies to comply with the IFC Performance Standards for the proposed 126.9 MW wind power project. The specific objectives are to:

- Assess the Social and Environmental Impacts from the project on the environment and social setting;
- Prepare mitigation measures and environmental and social management plan (SEMP) for each site; and
- Develop a corporate level Environment & Social Management System (SEMS) commensurate to the need of the project.

1.2.2 Scope of Work

The scope of work for SEIA includes the following:

1. Prepare of an SEIA report for the project as per the requirements of Performance Standard-1, covering other aspects as per Performance Standards-2 to 8. The study covers description of social and environmental impact assessment and management plans (SEMP) in

- accordance with IFC's Performance Standard outlining key actions for impact mitigation; and
2. Prepare a Social and Environmental Management System (SEMS) for SWPPL aligned to the requirements of IFC performance Standards and responsive to the findings of SEIA.

The reference framework used for the ESIA is:

- IFC Performance Standards (PS) 1 to 8;
- The applicable IFC / World Bank Guidelines:
 - The general EHS Guidelines,
 - EHS Guidelines Wind Energy; and
 - EHS Guideline for Transmission and distribution.
- Applicable local, national and international environmental and social legislation.

1.3

ERM'S APPROACH & BRIEF METHODOLOGY FOR THE STUDY

The broad approach and methodology adopted for the project is described below:

- a) Identified and reviewed applicable local, state, national and international environmental and social regulatory and institutional frameworks;
- b) Established environmental baseline conditions of the site and surrounding area through the following:
 - Detailed surveys to observe environmental and social characteristics of the project area in both the districts;
 - Discussions with the local community, landlosers, Panchayats and identification key issues during planning, construction and operation phase of the project;
 - Primary baseline data collection of the site and study area with respect to water and soil quality, ambient air and noise quality, and ecology;
 - Ecological assessment on flora and fauna of the site and study area through primary and secondary surveys.
- c) Assessed the socio-economic environment through collation of secondary information of the site, supplemented by consultations with the local communities to understand community perception with regard to the project and its activities. The approach included:
 - Stakeholder identification;
 - Focussed group consultations with selected land sellers general community, SC community and other impacted groups;
 - Field surveys and data compilation;
 - Group/Community Consultations: Group meetings and consultations with local and community representatives; and
- d) Reviewed the current HR, Social, Environmental, Occupational Health and Safety Management System of SWPPL to understand its adequacy and efficacy with respect to the PS requirements.
- e) Prepared the SEIA report which includes:

- **Project Description** describing the proposed project and its geographic, ecological, social, health and temporal context, including any related facilities that may be required;
 - **Applicable Environmental and Social Regulatory Framework** including host country regulations, obligations for implementing relevant international social and environmental treaties, agreements, and conventions and IFC Performance Standards;
 - **Environmental & Social Baseline Conditions** on the basis of the above identified parameters to understand the profile of the study area and describe relevant physical, biological, socioeconomic, health and labour conditions in the project area of influence;
 - **Analysis of Alternatives** comparing reasonable alternatives to the proposed project site, technology, design, and operation in terms of their potential environmental impacts;
 - **Impact Assessment and Mitigation Measures** for environmental and social components for pre construction/construction and operation phases. To minimize the adverse impacts mitigations measures have been suggested.
- f) Preparation of Social and Environmental Management Plan (SEMP) and Management System which includes the following:
- Mitigations for adverse environmental and social impacts and associated risks;
 - Institutional arrangement - management tools and techniques for the implementation of environmental impacts and risk mitigations;
 - Monitoring and reporting of requirements and mechanisms for the effective implementation of the suggested mitigations;
 - Monitoring arrangements for effective implementation of suggested mitigations for the proposed project; and
 - Reporting requirement to the regulatory agencies and funding institutes.
- g) Preparation of SEMS: Corporate level Social and Environmental Management System (SEMS) based on the current profile of activities of SWPPL with respect to the Wind power Project, and the findings of SEIA. The SEMS will be in accordance with the Performance Standards of IFC.

1.3.1 *Agencies Contacted*

The following agencies/stakeholders were contacted during the SEIA study:

- State Pollution Control Board, Tirunelveli;
- Tourism Office, Tirunelveli;
- State Archaeological Office, Tirunelveli;
- All India Radio, Tirunelveli;
- Doordarshan, Tirunelveli;
- Bharat Sanchar Nigam Limited (BSNL) office, *Palladam*
- Air Traffic Controller office, Coimbatore Airport
- Public Works Department (Tiruppur division, Highways section)
- Town & Country Planning office, Tirunelveli;

- Centre for Environmental Sciences, MS University;
- Project Truck Drivers, Tirunelveli;
- DGM Land, Suzlon
- Forest department- Working Plan Circle;
- Enviro Care Private Limited, a National Accreditation Board for Testing and Calibration Laboratories (NABL) certified and MoEF approved Laboratory for baseline monitoring;
- Economics and Statistical Records Office, Tiruppur.

Stakeholders contacted included the following:

- Project Proponents:
 - Representatives from SWPPL- onsite and in Kolkatta;
 - Representatives from Century Consulting Group.
- Local Community:
 - President of Panawadi Panchayat
 - Vannikonendal Panchayat President
 - Landsellers- Thirumalapura, Village
 - Land broker- Oothumalai village;
 - Land broker- Nelkatancheval villages;
 - Retired Village Administrative Officer
 - Member of Madhavkurichi panchayat
 - Land broker (promoter)
 - Poultry farm owners
 - Pushpattur Village
 - SC community

1.4

LIMITATIONS

This SEIA report is based upon the application of professional judgment to certain facts with resultant subjective interpretations. Professional judgments expressed herein are based on the facts currently available within the limits of the scope of work, information provided by the client or its representative, prevailing secondary data, budget and schedule.

To the extent that more definitive conclusions are desired by client than are warranted by the currently available facts, it is specifically ERM's intent that the conclusions and recommendations stated herein will be intended as guidance and not necessarily a firm course of action except where explicitly stated as such. We make no warranties, express or implied, including, without limitation, warranties as to merchantability or fitness for a particular purpose. In addition, the information provided to client in this report is not to be construed as legal advice.

The remaining sections of the report include the following:

Section 2: Project description;

Section 3: Applicable Environmental and Social Legislative Framework;

Section 4: Social and Environment baseline;

Section 5: Stakeholder Analysis

Section 6: Social and Environmental Impact Assessment;

Section 7: Analysis of Alternatives; and

Section 8: Social and Environmental Management Plan

Section 9: Conclusion

Section 10: References

Annexes to the report include the following:

Annex A: Environmental and Social Baseline data

2.1

PROJECT LOCATION

Simran is developing two wind farm projects (75.90 + 51.00 MW) aggregating 126.90 MW located in Tirunelveli (Amuthapuram & Rastha) and Tiruppur (Muthiamapatti) districts respectively in Tamil Nadu.

1. Amuthapuram area, in Sankarankovil Taluk of Tirunelveli district will have 12 Wind Turbine Generators (WTGs) of 2.1 MW constituting 25.20 MW will be located;
2. Two locations in Rastha in Tirunelveli district will have 17Nos WTGs of 1.5 MW constituting 25.50 MW and 12 WTGs of 2.1 MW constituting 25.20 MW; both aggregating 50.70 MW. (Both Amuthapuram & Rastha are referred to as "the Project 1");
3. Muthiamapatti, Dharapuram Taluk, in Tiruppur district will have 34 WTGs of 1.5 MW constituting 51.00 MW will be located (referred as "the Project- 2").

Both these two Project sites (project 1 and project 2) are being developed by Suzlon ("Developer") on a turnkey basis, which involves securing land, necessary consents and approvals, material, construction and commissioning. Further, the Project will be operated and maintained (O&M) by Suzlon under an O&M contract with Simran.

Both these two sites are being developed by Suzlon as clusters of WTGs, exclusively for SWPPL. The entire Operation and Maintenance (O&M) of the Windfarm will be done by Suzlon, while SWPPL will only have a supervisory/management role. Both sites are being developed on turn key basis, which involves securing land, necessary consents and approvals, material, construction, commissioning, operation and maintenance. Both the sites are expected to be commissioned progressively by December 2011.

The power generated from the project will be evacuated into the State Grid. A Power Purchase Agreement (PPA) has been executed with Tamil Nadu Electricity Board (TNEB) for sale of power generated from the Project.

The power generated from Amuthapuram site will be evacuated to the Amuthapuram substation (220/33kV). Power generated at both the sites in Rastha will be evacuated to the Rastha substation (110/33kV). Similarly, power generated at Muthiamapatti site will be evacuated at the Sadyapalayam substation (220/33 kV). All three substations are in close vicinity to the windfarm sites.

The geographical coordinates of the potential locations for WTGs in *Tirunelveli* and *Tiruppur* district are provided in **Table 2.1**.

Table 2.1 *Geographical Co-ordinates of WTGs locations in Tirunelveli & Tiruppur districts*

S. No	Loc. No	Lat/Long Coordinates
Amuthapuram- 2.1 MW each¹		
1	VL307 (Sf no 1529)	N9 1 55.6 E77 37 8.6
2	VL315 (Sf no 1305, 1183)	N9 3 51.2 E77 36 51.9
3	TDA142 (Sf no 719, 720)	N9 04 41.4 E77 35 27.7
4	TDA156 (Sf no 66)	N9 04 26.7 E77 36 06.6
5	TDA129 (Sf no 445)	N9 03 34.5 E77 35 04.1
6	TDA139 (Sf no 465)	N9 03 19.2 E77 35 26.6
7	TDA77(Sf no 493)	N9 02 28.6 E77 34 35.0
8	VL309 (Sf no 1473, 1495)	N9 02 22.2 E77 37 11.3
9	Sf no 352, 353	N9 3 26 E77 35 46
10	Sf no 645, 664	N9 2 20.5 E77 36 16.6
11	Sf no 209, 210	N9 4 9.3 E77 35 31.7
12	Sf no 36	N9 1 19 E77 35 5.5
13	TDA140 (Sf no 370)	N9 3 41.5 E77 35 46.4
14	Sf no 1242	N9 3 48.5 E77 37 42.3
15	Sf no 1515	N9 2 7.7 E77 37 11
16	VL056 (Sf no 1042)	N9 4 14 E77 38 35.7
Rastha 1- 1.5 MW each²		
1	Sf no 257, 258	N8 51 54.4 E77 37 22.9
2	M046 (Sf no 231)	N8 52 12.5 E77 37 12.8
3	M071 (Sf no 469)	N8 52 08.5 E77 37 54.6
4	M034 (Sf no 309)	N8 51 32.9 E77 34 57.3
5	M079 (Sf no 158, 159)	N8 51 26.1 E77 37 19.8
6	M080 (Sf no 117, 118)	N8 51 08.2 E77 36 53.7
7	M122 (Sf no 1719)	N8 50 14.6 E77 36 53.6
8	M137 (Sf no 1751)	N8 50 10.1 E77 37 34.3
9	M098 (Sf no 137, 138)	N8 50 05.6 E77 36 41.6
10	M123 (Sf no 127)	N8 50 00.0 E77 36 23.1
11	M095 (Sf no 386, 387)	N8 49 53.4 E77 35 16.8
12	M168 (Sf no 1519)	N8 49 25.3 E77 37 59.2
13	M 139 (Sf no 1359, 1362)	N8 48 45.6 E77 37 28.7
14	M 100	N8 50 34 E 77 36 35.5
15	M 133 (Sf no 180)	N8 49 35.4 E77 36 43.6
16	M 187 (Sf no 1477)	N8 49 4.5 E77 38 3.4
17	M188 (Sf no 1333, 1334)	N8 48 55.5 E77 37 51.4
18	M197 (Sf no 341)	N8 48 57.6 E77 38 33.2
19	M33 (Sf no 317, 318)	N8 51 23.4 E77 34 46.7
20	Sf no 45	N8 51 35.2 E77 36 23.1
21	Sf no 480	N8 51 8.4 E77 35 39.1
Rastha 2- 2.1 MW each³		
1	M056	N8 50 17.4 E77 33 35.9
2	M057	N8 50 1.5 E77 33 56.9
3	M058	N8 50 9.9 E77 34 11.7
4	M090	N8 49 54.1 E77 34 32.7
5	M091	N8 49 45.7 E77 34 17.9
6	M020 (Sf no 7)	N8 52 15.2 E77 35 10.8
7	M327 (Sf no 205)	N8 50 20.7 E77 42 46.9
8	M349 (S no 180)	N8 50 11.6 E77 43 29.1
9	M351 (Sf no 174)	N8 49 48.2 E77 43 19.2
10	M352 (Sf no 159)	N8 49 33.4 E77 43 9.5
11	Sf no 183/184	N8 49 49.2 E77 42 56.2
12	Sf no 209, 210	N8 49 30 E77 42 39.3
13	Sf no 13	N8 51 51.6 E77 36 13.6
14	Sf no 221	N8 49 11.6 E77 42 28.8
15	Sf no 409, 410	N8 49 34.5 E77 39 48.7

S. No	Loc. No	Lat/Long Coordinates
16	Sf no 477	N8 51 4.4 E77 34 6.7
17	Sf no 253	N8 49 2.4 E77 42 13.3
18	Sf no 451	N8 51 2.1 E77 33 41.3
19	Sf no 500	N8 50 33.2 E77 34 0
		Muthiampatti- 1.5 MW each⁴
1	M-08(Sf no.509)	N10 48 3.7 E77 23 0.2
2	M-12 (Sf no-508)	N10 48 15.8 E77 23 6.3
3	M-14(Sf no.251)	N10 47 46.9 E77 22 33.2
4	M-18(Sf no.198)	N10 46 48 E77 22 20.6
5	M-22	N10 47 58.4 E77 21 57.2
6	M-24(Sf no.733)	N10 48 23.6 E77 21 51.6
7	M-28	N10 50 9.5 E77 21 44.3
8	M-285(SF-240/1)	N10 46 53 E77 19 29.2
9	M-3(Sf no.418)	N10 49 36 E77 22 23
10	M-32(Sf no.801)	N10 49 30.4 E77 20 51.7
11	M-40(Sf no.2)	N10 47 20.5 E77 21 10.1
12	M-56(Sf no.770)	N10 48 19.6 E77 21 5.2
13	Sf no.1004	N10 49 29.9 E77 20 2.5
14	Sf no.1054	N10 49 16.7 E77 18 57.4
15	Sf no.238	N10 49 54.5 E77 21 12
16	Sf no.403	N10 49 52.6 E77 22 37.9
17	Sf no.609	N10 49 5.8 E77 22 33
18	Sf no.684	N10 49 47.7 E77 21 46.4
19	Sf no.689	N10 49 24.7 E77 21 26.9
20	Sf no.754	N10 47 31.6 E77 21 4.6
21	Sf no.798	N10 49 18.1 E77 21 6
22	Sf no.817(Option-2)	N10 50 7.8 E77 19 51
23	Sf no.939	N10 49 0 E77 19 11.9
24	Sf no.961	N10 49 4.6 E77 19 43
25	Sf no-184 /2	N10 47 1.2 E77 22 5.4
26	Sf no-254 /4	N10 49 37.6 E77 21 18.4
27	Sf no-389 /2	N10 50 7.4 E77 22 22.5
28	KD-100(Sf no.108)	N10 48 11.6 E77 25 15.2
29	KD-125(Sf no.268)	N10 49 35.3 E77 24 26
30	KD-133(SF No- 202)	N10 47 37.5 E77 25 5.5
31	KD-244(Sf no.258)	N10 49 12.4 E77 24 2.4
32	KD-245(Sf no.311)	N10 49 25.4 E77 23 45.6
33	KD-246(Sf no.295)	N10 49 44.1 E77 23 35.2
34	KD-247(Sf no.940)	N10 50 5.1 E77 23 45.4
35	KD-250	N10 50 37.4 E77 23 23.9
36	KD-268	N10 49 26.8 E77 23 4.4
37	KD-69 (Sf no-149/3)	N10 47 49.3 E77 26 20.1
38	KD-97(Sf no-90b)	N10 47 36.1 E77 25 31.5
39	Sf no.232	N10 46 53.5 E77 26 14.8
40	Sf no.28	N10 48 52.4 E77 24 16.7
41	Sf no-263	N10 47 2.8 E77 25 20

Source: Suzlon

1: of these 16 locations, 12 will be finally selected;

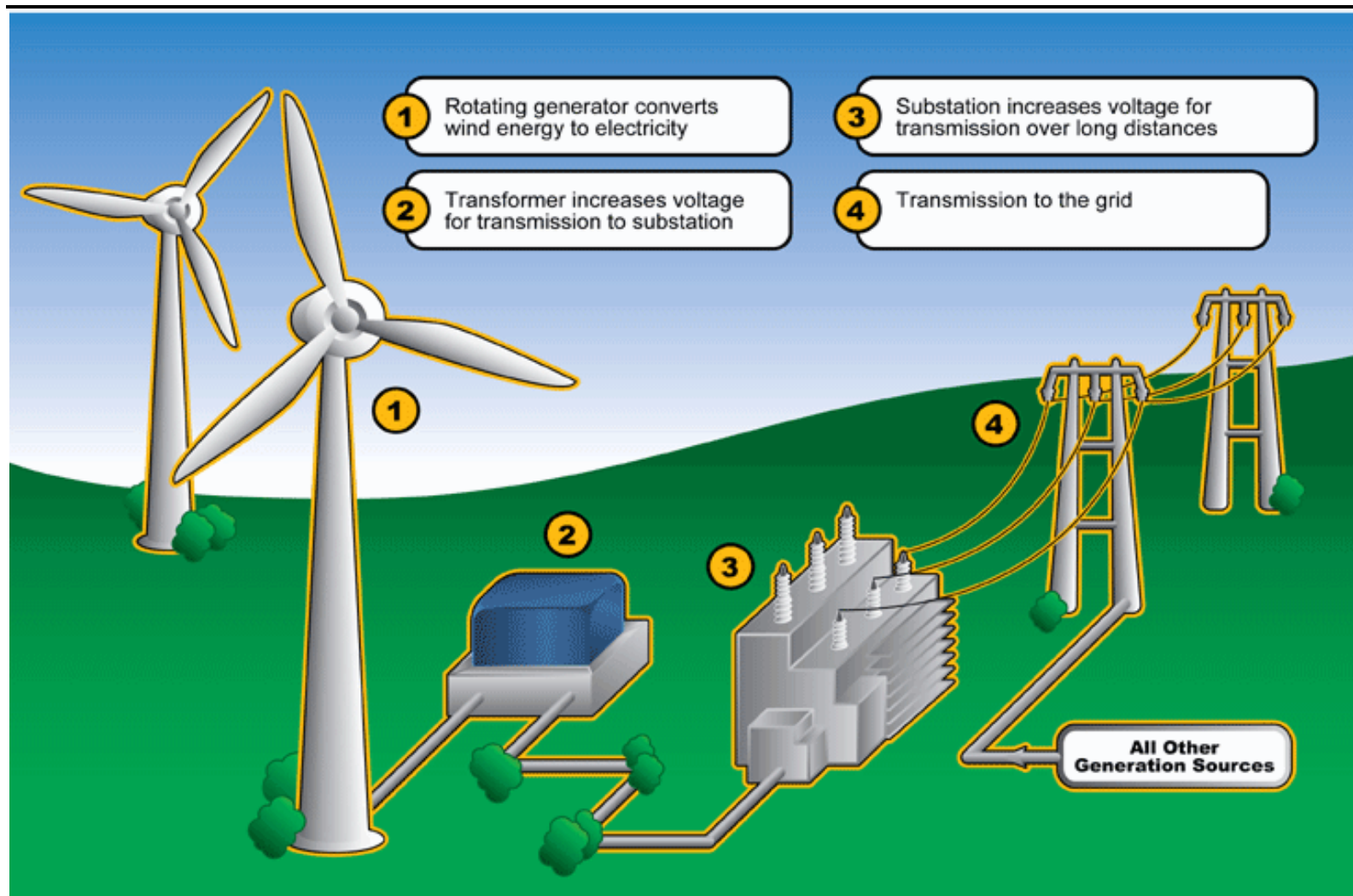
2: of these 21 locations, 17 will be finally selected;

3: of these 19 locations, 12 will finally be selected;

4: of these 41 locations, 34 will finally be selected

.

Figure 2.1 Typical Wind farm schematic



Source: <http://images.vizworld.com/wp-content/uploads/2010/06/windpower-large.jpg>

In line with the proposed SEMS, Simran will have a local project level team at the windfarm sites, which will be supported and guided by the Corporate level SEMS team.

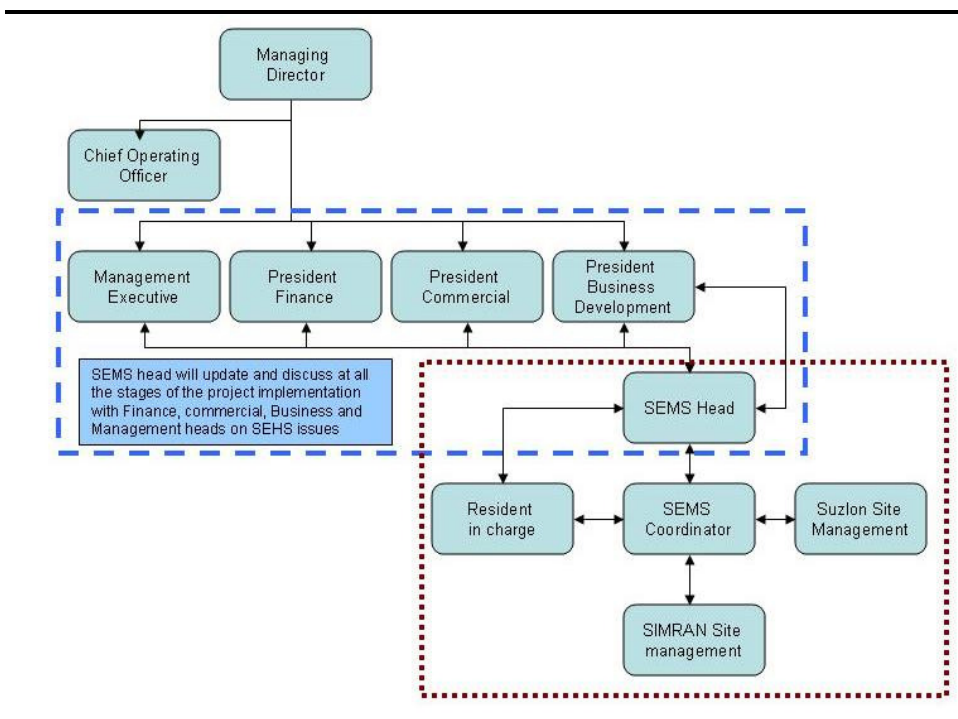
At corporate level there will be a Management board under the Managing Director. This management board will have representation from line departments like Finance, Commercial and Business Development.

At project level, there will be a SEMS head, who will be responsible for screening and managing the E&S risks and implementing the mitigation measures (as required by the ESMP/ESAP or outcome of ESIA study). SEMS head will also be responsible for ensuring that the implementation of mitigation measures and plans is in accordance with the SEMS and any lessons learnt during project life cycle are reflected back in the SEMS as improvement areas.

Under the SEMS head, will be the SEMS coordinator, who will be responsible for day to day coordination with Suzlon for O&M. SEMS coordinator will be adequately supported with field level staff.

The following will be the structure

Figure 2.2 *Simran's Organizational Structure*



Suzlon has four verticals, namely-

- Infrastructure Planning and Development;
- Project;
- Operation and Management Services (OMS); and
- Business development, marketing and sales.

2.3.1 *Infrastructure Planning and Development (IPD) vertical*

IPD is also headed by a state head under whom, there are regional managers. For Tamil Nadu, IPD has three regions, Sangneri, Devarkulam and Palladam. Under regional managers are the departmental heads departmental heads of civil, mechanical, electrical, stores & MIS and commissioning departments; and functional support like HR, Finance, administration, EHS and Quality Control.

All these departments have their own set of contractors who are managed through a separate vertical called Supply Chain Management (SCM). As part of SCM, Suzlon has a vendor evaluation process which ensures the requirements of ISO 9001, 14001 and OHSAS 18001 are inserted into the contract clauses while issuing work orders. In addition to this, separate work instructions focussing on H&S aspects are also issued to the contractors.

Among others, the key activities undertaken by IPD vertical are:

- Feasibility study of site accessibility from nearest National Highway;
- Putting wind masters and undertaking micrositing;
- Procuring and developing land (*done by the land team within IPD*);
- Filing of NOCs to TNEB; and
- Providing technical specifications on site suitability, turbine type etc to 'Project'.

2.3.2 *Project vertical*

The project vertical is headed by a state head under whom, there are regional managers and then the departmental heads as in the case of IPD.

The work of Projects starts around 2-3 years after the IPD. The key activity of this vertical is construction, installation, ensuring power evacuation and commissioning of the project. This includes taking necessary approvals and local NOCs and testing of structural stability of bridges, culverts etc, access roads strengthening or construction of new by-pass roads depending on the site.

2.3.3 *Operation and Management Services (OMS)*

OMS also has the similar structure and its activities start once the project is commissioned.

2.3.4 *Business development, marketing and sales*

Role of business development, marketing and sales is more of selling the project locations to potential investors and maintaining customer relations.

2.4 *SUMMARY OF PROJECT ACTIVITIES*

2.4.1 *Wind Resource Assessment*

The wind resource assessment unit of Centre for Wind Energy Technology (C-WET) autonomous R&D institution by the Ministry of New and Renewable Energy (MNRE), Government of India identifies wind resource rich regions in the country by conducting wind resource micro survey. These reports for different states are bought by Suzlon to take informed decision of investing in wind energy projects. C-WET also undertakes further detailed surveys of smaller regions within the wind potential areas on consultancy basis. Any wind farm developer can rely on the data collected by C-WET. However, to be doubly sure, Suzlon also install its own wind master (or meteorological master) in a possible wind potential area as has been done in Tirunelveli and Tiruppur districts. This activity is undertaken by the IPD team.

Figure 2.3 C-WET report

 CENTRE FOR WIND ENERGY TECHNOLOGY CHENNAI ISO 9001-2000	
Table2. Details of Muthiampatti wind monitoring station	
Station	Muthiampatti
Owned by	M/s Suzlon Infrastructure Services Ltd., Pune
District	Tiruppur
State	Tamilnadu
Latitude	10° 48' 33.9" N
Longitude	77° 18' 55.1" E
Elevation	362m AMSL
Period of Data taken for Analysis	April 2006 to March 2007
Duration	12 months
Data Recovery	100%
Length of the time step	10 minutes
Annual mean Temperature April 2006 to March 2007	25.68 ° C
Annual mean Turbulence Intensity @ 15 m/s	0.139 @ 80m AGL
Annual mean wind speed April 2006 to March 2007	7.22 m/s @ 80m AGL
	6.83 m/s @ 65m AGL
	6.37 m/s @ 50m AGL (Interpolated)
Annual wind power density April 2006 to March 2007	375.76 W/m ² @ 80m AGL
	323.96 W/m ² @ 65m AGL
	264.74 W/m ² @ 50m AGL (Interpolated)


(SEAL OF C-WET)

2.4.2 Micrositing and Tower Scheduling

Based on wind resources data and energy modelling, optimal Suzlon estimates Wind Turbine Generator (WTG) locations using appropriate modelling tools. This process is called as *micrositing* which leads to identification of GPS Co-ordinates of individual WTG locations and their turbine/model specifications.

There are specific standards for micrositing, which depend on the overall potential of the area and the distance criteria between two WTGs. Normally, a 7D distance is maintained between two WTGs while placing in the flow wind direction and a distance of 5D is maintained while placing perpendicular to wind flow direction. Here 7D/5D means seven / five times the diameter of the rotor blades, which vary depending on the capacity of the WTG. e.g. for a 2.1 MW WTG, the rotor diameter is 88 meters, hence while placing the WTGs (Micrositing), the distance between two WTGs of 2.1 MW has to be maintained at 7X88 meters= 616 meters in windflow

direction and $5 \times 88 = 440$ meters in the perpendicular direction. Similarly, for a 1.5 MW WTG the rotor diameter is 82 meters.

While doing Micrositing, the WTGs are placed in a manner which ensures maximum WTGs in a given area, so as to maximise the generation from the Windfarm. This is called tower Scheduling. Based on *micrositing*, the planning team releases the Land Purchase Indent (LPI) to land team which then pursues the land purchase process.

2.4.3 *Land purchase*

Land is purchased through a willing seller -buyer agreement. On average, per WTG around 5 Acres of land is purchased. This includes the land for tower and transformer. Not all of this land is required for the WTG during operation phase. Only a central parcel of land square in shape with side measuring **rotor diameter + 10 meter** (roughly 100 m X 100 meter i.e. 2.5 Acres) is required for routine operation and maintenance activities. This is retained for routine maintenance activities as well as from safety point of view in case of accidental breakoff of the blades or any other part of WTG. This area is kept sacrosanct and normally no agricultural activities are allowed in this area.

Remaining 2.5 acres remains mostly unused, and in majority of cases is left open for grazing or minor cultivation. In cases of any emergency fault where rotor blades need to be replaced, a main crane (110 m boom length and 500 ton weight) or an auxiliary crane (250 ton weight) is required and in that case, this 2.5 Acres may be used. The developers purchase the 5 Acre area and once WTG is commissioned, the central 2.5 Acre is transferred to the investor/purchaser of the WTG while the outer 2.5 Acre is retained for emergency O&M activities. However, as a general trend and due to remote chances of emergency operations, the land is mostly left for grazing or cultivation purpose i.e. the past land use is allowed to continue.

Land for Access route

An exclusive access to the construction site is usually required prior to mobilization of manpower and machinery. The land for access roads is also purchased. The construction of access road primarily involves removal of vegetation and modification of topography.

In many cases, the existing *kutcha* roads or village roads connecting to the WTG locations are used after necessary upgradation and strengthening. The access to this road is not restricted and thus it becomes a public utility, barring the core of WTG area.

Land for Transmission line

The power generated by the project is evacuated through intrafarm transmission lines which connect to the nearest substation. The voltage generated at WTG is of 690 volts which is stepped up to 11 or 33 kV

depending on the substation capacity, this is done by using a step up transformer (*land for transformer is included within the 5 Acres*).

From the transformer until the nearest substation (*in case of parallel evacuation or lesser number of WTGs*) or next WTG's evacuation line (*in case of series evacuation or more number of WTGs*) the land for pole line footings is also purchased. This land area is very miniscule at 2 ftX2 ft and is purchased by paying a one time compensation (*which includes the compensation for crops in the Right of Way*).

Once the project is commissioned and the line is energised, the State Electricity Board (SEB) assumes the ownership of evacuation line.

Box 2.1 *Process of land purchase*

Process of land purchase normally involves a land sale deed between the seller and the buyer on a judicial stamp paper. Developers in many cases adopt different methods of land purchase in different geographies, which is mostly due to the local social sensitivities and quality of land records. In cases where titles are clear and large parcels are available, i.e. fewer titleholders per parcel, the developer tend to directly negotiate with the landowner and enter into a direct sale deed. However, in cases where land titleholder are numerous the developers prefer to involve a third party who first purchases land from the numerous titleholders and then sells all that land to the developer. This process is called a land consolidation. The third party is generally an individual from the local area (generally restricted to local panchayat where land is to be bought) and is paid some commission for this process.

There are cases where the developer does not have good control over the third party and as a result, the local community or land sellers have grievances mostly on account of differential rates of compensation. However, developers with good control and systems also undertake a self review process which includes survey of land rates in the area, survey of prevailing market rate and then arrive at a range of rate (minimum and maximum value) within which the negotiation is done. This rate is then communicated to the third party. Suzlon adopts more or less the above process. Suzlon also undertakes survey of land rates on its own before arriving at the range for negotiations. However, since all negotiations are done by promoters and Suzlon is not involved directly in negotiations with individual land sellers the control over the rates offered by promoters to the land sellers is sometimes lost and the then cases of differential rates do arise. More details on this process for the project is given in Box 6.2 through 6.4.

2.4.4 *Components of a wind farm¹*

A typical Windfarm has the following components.

1) Wind Turbine Generator (WTG) or Wind Energy Generator (WEG)

The Wind Electricity Generators (WEGs) are broadly divided into three parts:

- Tower - supports the Nacelle and Rotor
- Nacelle - contains the key components of the wind turbine
- Rotor - converts kinetic energy into electrical energy

The tower structure has two variations: tubular structure or lattice structure. Tubular structures are now being preferred over lattice structures due to

(1) ¹ Source: Public domain information from various websites

lesser space requirement, aesthetic appeal, material safety (vandalism has been reported in lattice structures) and overall durability. Tubular structures are in form of a hollow cylindrical shell within which the control unit can be placed, thus the additional space requirement of a separate room for placing control unit, as in case of a lattice structure, is avoided.

2) Gearbox

Gearboxes are positioned inside the nacelle. These are lubricated with oil by a pressure lubrication system. They are also splash lubricated so that in case of any sudden grid failure, the Mechanical Pump and the splash lubrication ensure a lubrication film is maintained on all bearings & contact teeth mesh.

3) Coupling

It transmits torque from the gearbox to the generator. It is integrated with a slipping device between the brake disc and the generator and protects the whole drive train from high torques.

4) Rotor Shaft

One end of the Rotor Shaft is connected to the Rotor and the other end is fixed to the Gearbox Input/ Low Speed Shaft. The Rotor transfers the mechanical energy to drive the Gearbox, which in-turn steps up the speed to run the Generator.

Suzlon generators have a generation voltage at 690V, which can be stepped up to 11 kV or 33 kV (the local grid voltage) through a transformer. The inrush currents remain at safe limits and the wind turbines are provided with protection schemes.

The generators feature:

- Vacuum / air circuit breakers
- Lightning arrestors
- Earth fault protections
- Under / over voltage protections
- Under / over frequency protections
- Over load protections

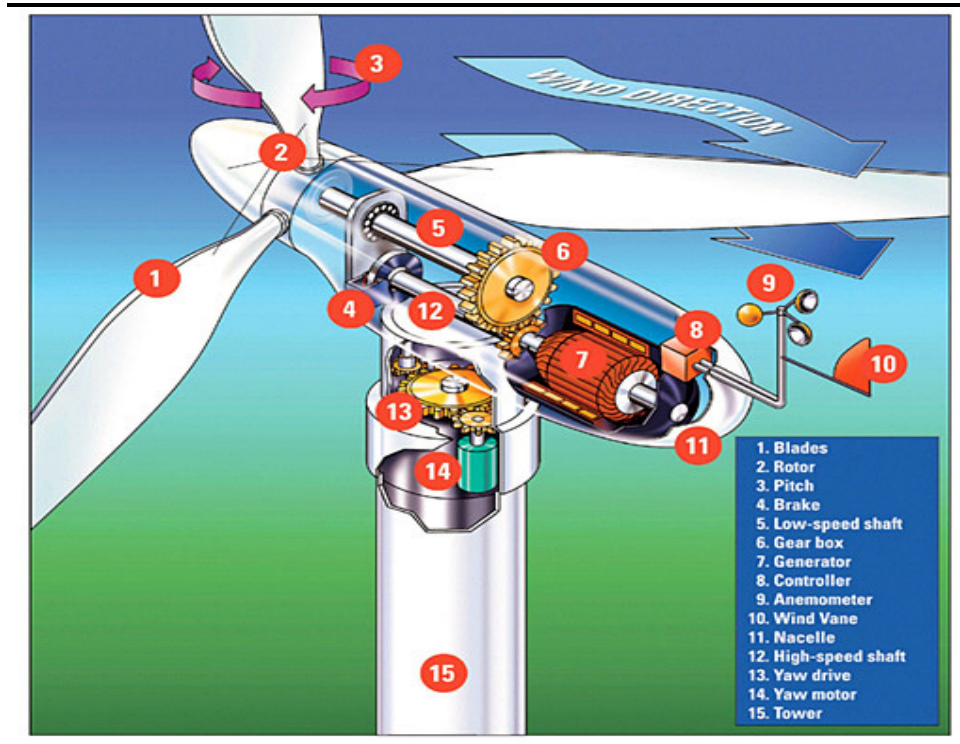
5) Yaw Drive

Whenever the direction of wind changes, the Wind Turbine Generator changes its direction to continue being in operation. This movement of the Wind Turbine Generator, in upwind direction, is called Yawing. The wind turbine yaw mechanism is used to turn the wind turbine rotor against the wind. This turning takes place with the help of Yaw motors and Yaw drives.

6) Pitch Drive

To start and stop the Wind Turbine Generator, the blade must change its angle. This rotational movement is called Pitching, which is carried out by Pitch Drives. The steady rotation of the Rotor is required for continuous and maximum power generation.

Figure 2.4 *Components of a WTG*



Source: <http://www.alternative-energy-news.info>

2.4.5 *Site Development*

The site development activities commence with mobilisation of labour and machinery for construction activities. The main activities associated with development of site are briefly described in the following subsections.

Clearing of vegetation

Removal of vegetation will be involved primarily during the mobilisation phase of the project starting from access road, to the erection of the wind farm and the transmission towers and during the decommissioning activity. The process would involve removal of crops, forest land, plantations areas depending on the site selection. However, there is no major damage to the site in terms of degradation.

Construction of access roads

Existing access roads, culverts and bridges are tested for load strength and structural stability. This is done because heavy cranes (upto 500 ton gross

weight) are deployed for construction. Necessary widening and strengthening of these structures is done before the vehicles arrive.

In many cases, the turning radius, load stress and stability is not compatible or due to encumbrances like houses, buildings etc are also encountered, while in some cases, the local community does not permit the use of road by project vehicles. In such cases, Suzlon constructs bye-pass roads from the closest NH/SH location to avoid all such encumbrances and a free flowing traffic. All these roads are kept open for access and use by general public.

2.4.6 **Construction Activities *1**

A) Component unloading

An auxiliary crane of 250 ton lifts the tower sections and hydra unloads the saddles. Cushioning material of rubber sheet of Styrofoam is used on saddles to avoid contact damage. Blade is unloaded by two hydras operating at either ends of the blades. In the meantime, electrical installations are carried out to erect the switchyard.

B) Onsite Quality inspection

Inspection of the rotor blades:

- Damage to the surface, paint peel off and scratches are noted and corrected on site;
- Drainage vent at the tip of the blade is checked to ensure it is not blocked; and
- Lightning conductor plate is checked.

Inspection of the tower:

- Scratched, dents and discoloration are touched up onsite;
- Boltholes and flanges are ensured to be free of any dust and oil;
- Ladder and cable guards are inspected for any loose bolts; and
- Welded joints are physically examined for damages.

Inspection of the nacelle:

- The nacelle exhaust fan, wench motor and panel are inspected followed by the generator;
- Special attention is paid to the bushing on the anti-vibration mounds and provisions for earthing; and
- Lifting hooks, service light and supply points are inspected.

C) Plinth preparation

A pedestal foundation resting on a PCC bed below the ground is constructed on which anchor studs are fixed. The first section of the tower section is bolted on these anchor studs. The concrete of grade M 45 is used for the pedestal

(1) ¹ Source: Video's provided by Suzlon

while concrete of grade M 30 is used for the tapering slab. 20 alignment plates (shim plates of thickness varying from 0.5 mm to 20 mm coated with red oxide) are used for levelling.

D) Installation of load spreading plates

Load spreading base plates are used to spread the load of the entire WTG structure equally in all directions to minimise the stress. 12 ton crane (hydra) is used to lift and release the plates in position on the anchor studs.

E) Installation of base frame

Base frame comprises- one power panel, two capacitor panels and one transformer compensation panel. Rack of base frame is first positioned on the plinth and bolted and then the components are positioned on it with the help of hydra.

F) Installation of the tower sections

The full tower comprises four sections. First section of the tower is the heaviest. It weighs 47.28 ton and has a length of 17.27 meters and a diameter of 4.3 meters. 40 ton wire rope slings and 40 ton deshackles are used to lift the section.

The main crane lifts the upper end, while the auxiliary crane holds the lower end. Once in vertical position, the auxiliary crane is removed. The tower section is then swivelled towards the foundation with the help of three nylon guide ropes. Once in position with the plinth, the tower section is then bolted.

The second section is of same length and 4 m in diameter and weighs around 35.9 ton. Lifting and positioning on first section is done similarly. Third section is lifted directly from the trailer in the same manner. It has 4 m diameter and length of 19.6 meters and weight of 29.4 ton. Fourth Section also has similar diameter of 4 meters, length of 21 meters and weight of 23.84 ton.

No installation is done if wind speed is more than 12 m/sec or if unfavourable conditions are predicted. Also, the tower section is not left without installing the nacelle for more than one day in case of wind is blowing at more than 12 m/sec, because of possible vibrations.

G) Installing the nacelle

Nacelle is the central component of the WEG, which houses the resistors. The following steps are involved in installation of nacelle:

- Resistor boxes are put inside the nacelle;
- Damages to the nacelle due to transport are repaired and open splices are joined;
- Nacelle jig is unloaded using the 12 ton crane and shackled to the main crane;
- Nacelle is then hoisted horizontal by using the main crane; and

- It is then brought in desired position at the tower section and bolted.

H) Installing the Rotor assembly

Rotor assembly comprise the rotor hub and the three blades which are then mounted on the tower section. The following steps are involved:

- Hub weighing around 11.63 ton is unloaded and hooked into position using the 250 ton auxiliary crane;
- Hydra is used to unload the 0.5 ton nose cone which is bolted over the hub;
- Two hydras are used to bring the first blade close to the hub;
- The blade is lifted at the centre of gravity by a 100 ton crane and moved into position with the hub and bolted;
- Similarly blade 2 and 3 are also fixed to the hub;
- A rain protection sleeve (silicon sealant) is applied on the blade; and
- Vortex generators are fixed using an adhesive.

As a precautionary measure, the rotor is not lifted if the wind speed is above 8 m/sec as it may oscillate and the blades may get damaged upon colliding with the tower.

2.4.7

Grid Connection¹

The generation voltage is 690 V and is stepped up to the local grid voltage (which is normally of 11 to 33 kV levels) through a Wind Turbine transformer. The transient peaks currents during the starting of the wind turbines are limited to safer limits by means of soft starters. The wind turbines are provided with protection like vacuum circuit breakers/air circuit breakers, lightening arrestors, earth fault protections, under/over voltage protections, under/over frequency protections, over load protections etc. to enable tripping of the wind turbine in case of any abnormalities, thus safe guarding the grids from the wind turbines. The effects of wind fluctuations/gusts on power outputs are damped by means of high slip arrangements provided in the respective wind turbine generators/systems. T-lines will be on Single pole structure and DOG Conductors will be used for the same

(2) ¹ Source: Video's provided by Suzlon

Box 2.2 *Typical approval process*

Suzlon submits the land documents, Toposheets, technical specifications and distance from nearest substation in a proforma for project registration with TNEB. Along with this a registration fee and administrative charges (Rs 10,000) and Infrastructure Development Charges (IDC of Rs 30 Lakh per MW) is also deposited. This proforma with prescribed amount is submitted to TNEB Chief Engineer (CE) and Superintending Engineer (SE) in Chennai. CE then refers it back to the Executive Engineer (EE) of the concerned substation. The EE then comes to the site for inspection and verifies the plan, Rows and Columns as per 5D /7D requirement.

Based on this the EE prepares an inspection report/feasibility report and sends it back to SE office, who sends it to CE. The CE issues an NOC, allots grid type (substation) to Suzlon, and marks the NOC to SE and EE. A High Tension Service Connection (HTSC) number is also allotted by the CE to Suzlon.

Once this is complete, the EE and SE once again come for a second round of inspection and prepares an estimate for the interfacing (*power to be sold to TNEB*) or wheeling charges (*10% of power sold*). The interfacing line is then constructed by Suzlon.

An approval and certificate of Electricity Safety is also required to be procured from Chief Electrical Inspectorate to Govt (CEIG). The HTSC number and the electricity safety certificates are to be submitted to get commissioning which is done by EE (Distribution). Once this is done, the line is energised and TNEB issues a certificate to Suzlon referring the HTSC number and saying that the generation of power has started.

Parallely, Suzlon signs a PPA with TNEB. Power Evacuation infrastructure is built by Suzlon and bill is presented to TNEB, who then matches it with its own cost estimates and accordingly reimburses.

Labour

During construction stage manpower ranging from 30 to 40 will be required depending on the stage of construction. Most of the labour required for the construction will be locally hired and therefore labour camp will generally not be required at site. However, there may be a requirement for labour camps when migrant labour from other states is utilized. Adequate facility for drinking water and sanitation will be provided at the construction site including the labour camps.

2.5 *OPERATION & MAINTENANCE*

The operation of WTG is relatively simple and dependent on wind flow. With automated functions and switchyard controllers, the maintenance is mostly oriented towards better up keep and monitoring of overall performance of the system.

Remote online monitoring through SCADA system is undertaken at the Central Monitoring Station (CMS) and the faults are detected and attended to immediately. Scheduled maintenance is done twice a year for which specific checklist has been prepared.

2.5.1 Half yearly & Annual maintenance

The checkpoints of half yearly and annual maintenance are mentioned here very briefly:

Operational check:

- Operational behaviour of generator
- Operational behaviour of gear box
- Operational behaviour of yaw system
- Operational behaviour of rotor

Safety system:

- Bottom cabinet
 - functionality of emergency stop button in operation and idling modes
 - functionality of residual current circuit breaker (RCCB)
 - temperature in Sc-Commander
- Top cabinet
 - functionality of emergency stop button in idling mode
 - functionality of residual current circuit breaker (RCCB)
- Yaw platform
 - functionality of emergency stop button in idling mode
- Operation box
 - functionality of emergency stop button in idling mode
 - functionality of residual current circuit breaker (RCCB)

Tower

- Normal operation
- Unusual noise
- Bottom cabinet door filters
 - *Electrical terminals and component connections*
 - *Setting of power supply*
 - *Status of pre-fuses of surge arrestor*
 - *Ventilation*
- Tower cables
 - *Damage to cables, cable lugs, cable duct, cable run*
 - *Insulation of power cables*
- Tower foundation
 - *Cracks on concrete*
 - *Integrity of bolts*
 - *Joints at tower flanges*
- Tower base section
 - *Bolts, joints, ladder*
 - *Cable holder*
- Nacelle
 - *Fan grilles*
 - *Handrails and exhaust hoses*
 - *Connection and alignment of anemometer/wind vane*

- *Connection and alignment of 2D ultrasonic wind sensor*
 - *Connection and corrosion of lightening rod*
 - *Power cable, ceramic insulator and resistor box*
- *Yaw system*
 - *Yaw drive lubrication, grease level, cleanliness*
 - *Bolt connections*
 - *Adjustment of yellow box*
 - *Leakage of pipes*

3.1

INTRODUCTION

This section highlights the environmental and social regulations applicable to the proposed Wind Power project. **Table 3.1** describes the applicability of various environmental and social laws, regulations and policies relevant to the project.

Table 3.1 *Applicable Environmental and Social Laws, Regulations and Policies*

S.N.	Issues	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirement
1	Environmental Protection	Construction activities will generate air and noise emissions. Scattering of debris and construction material can contaminate the soil and surroundings,	- The Environment (Protection) Act 1986, as amended in April 2003; - EPA Rules 1986, as amended in 2002;	- TNPCB - MoEF - CPCB	Compliance under the rules to maintain stipulated standards and environmental management through various supporting rules promulgated under the Act.
			- National Environmental Policy 2006 - The dominant theme of this policy is that while conservation of environmental resources is necessary to secure livelihoods and well-being of all, the most secure basis for conservation is to ensure that people dependent on particular resources obtain better livelihoods from the fact of conservation, than from degradation of the resource.	MoEF	SWPPL will follow a stringent Environment and Social Management Plan

S.N.	Issues	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirement
2	General Safety	Occupational Health and Safety associated with Power Generation and Supply	- The Electricity Act, 2003 including rules 1956 and 2005 - The Rules specify the general safety requirements for construction, installation, protection, operation and maintenance of electricity supply lines and apparatus.	State Electricity Board	SWPPL will follow the safety standards as specified by Central Electrical Authority under section 73 of the Electricity Act 2003.
6	Prevention and Control of Water Pollution	Waste water generation from construction and operation of the Plant	The Water (Prevention and Control of Pollution) Act, 1974, amended in 1988	TNPCB	- Consent for Establishment - Consent to Operate - Compliance under the Water Act
7	Water Cess Collection (a tax on water use and water pollution caused)	Water use and waste water generation	The Water (Prevention and Control of Pollution) Cess Rules 1978, as amended through 16th July 1992 and the Water (Prevention and Control of Pollution) Cess Act 1977, as amended through 6th May 2003	TNPCB	- Filing of monthly returns as per prescribed format (Form I under the Act) - Compliance under the Act
8	Prevention and Control of Air Pollution	Operation of diesel generators for power backup at CMS and other facilities.	- The Air (Prevention and Control of Pollution) Act, 1981, amended in 1987. (Movement of vehicles, excavation of pits for tower erection, operation of diesel generators for power at campsite or other construction activities).	TNPCB	- Consent for Establishment - Consent to Operate - Compliance under the Act

S.N.	Issues	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirement
9	Groundwater Resource Conservation	Water required for operation phase of the power plant	- The MOEF Notification dated 14th January 1997 - Constitution of Central Ground Water Authority (CGWA); - Tamil Nadu Groundwater (Development and Management) Act-2003 - Rain Water Harvesting (RTRWH) in building by laws: Vide Ordinance No. 4 of 2003 dated July, 2003	CGWA	- Registration and approval of existing bore well for industrial purposes - Specific compliance requirement indicated through notices issued by the agency like CGWA's Public Notice #5/2001. - Requirement of Rooftop Rainwater Harvesting Systems for industrial establishments using groundwater and located in Notified Area(s), as amended through Public Notice # 3/2004 dated 29th July 2004.
10	Noise Emissions	- Noise generated from operation of construction machinery - Noise generated from WTG operations	- The Noise (Regulation & Control) Rules, 2000 as amended in October 2002 - As per the Environment (Protection) Act (EPA) 1986 the ambient noise levels are to be maintained as stipulated by the Central Pollution Control Board (CPCB) for different categories of areas like, commercial, residential and silence zones etc	- TNPCB - District administration	- There will be generation of Noise during construction activities. - Noise levels will be monitored at different locations and near the sensitive receptors throughout the project operation phase, as per the SEMP - Compliance under the rules to maintain stipulated standards

S.N.	Issues	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirement
11	Hazardous Wastes Management	- The proposed project will generate waste oil from diesel generator and transformer oil from switchyard. - Solvents and chemicals used or cleaning, sealing etc	Hazardous Wastes (Management Handling and Trans boundary Movement) Rules, 2008 as amended up to 2009 under the Environment (Protection) Act, 1986	TNPCB	- Authorisation for collection, reception, storage, transportation and disposal of hazardous wastes - Filing of annual return under the rules - Other compliance under the rules - Authorisation by Central Pollution Control Boards to vendors accepting waste/used oil - Liability of the occupier, transporter and operator of a facility: The occupier, transporter and operator of a facility shall be liable for damages caused to the environment resulting due to improper handling and disposal of hazardous waste listed in schedules to the Rules; - The occupier and operator of a facility shall also be liable to reinstate or restore damaged or destroyed elements of the environment; - The occupier and operator of a facility shall be liable to pay a fine as levied by the State Pollution Control Board with the approval of the Central Pollution Control Board for any violation of the provisions under these rules.
12	Storage of Petroleum products	There will be storage of Diesel at site for operation of generators during construction and operation.	- The Petroleum Act 1934, as amended in August 1976 - The Petroleum Rules 1976, as amended in March 2002.	PESO (Chief Controller of Explosives)	The site (Suzlon) will store a small quantity of fuel at site.

S.N.	Issues	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirement
13	Protection of WildLife	Presence of, snakes, Peacock and other animals in the area	The Wildlife (Protection) Act, 1972, 2002 and Rules 2003 and amendments	State Department of forest	- The Wildlife Act inter-alia deals with prohibition of hunting of wild animals except in certain cases; protection of specified plants; declaration and protection of sanctuaries; restrictions on entry in sanctuary; prohibition on destruction in sanctuary except under a permit; declaration of national parks; power of Central Government to declare areas as sanctuaries or national parks; regulations for trade and commerce in wild animals, animal articles and trophies; prohibition of dealings in trophy and animal articles without a licence; forfeiture of property derived from illegal hunting and trade; penalties for contravention; etc. - SWPPL will ensure compliance.
14	Surface Transportation	Movement of construction vehicles and other vehicles for transportation of workers	- The Motor Vehicles Act 1988, as amended by Motor Vehicles (Amendment) Act 2000, dated 14th August 2000 - The Central Motor Vehicles Rules 1989, as amended through 20th October 2004 by the Central Motor Vehicles (Fourth Amendment) Rules 2004.	State Transport Authority	- Compliance of stipulated standards under rule 115 - Safety compliance under the rules
15	Welfare and Work Environment	Engagement of workers for construction and operation of the plant	The Factories Act, 1948 and Tamil Nadu Factories Rules, 1950	Deputy Chief Inspector of Factories.	- SWPPL/SUZLON shall comply to all requirement of factories rules and participate in periodic inspection. - SWPPL will ensure that no child labour is engaged.
			Tamil Nadu Shops and Establishments act	State Labour Department	- SWPPL shall comply to all requirement of factories rules and participate in periodic inspection. - SWPPL will ensure that no child labour is engaged.

S.N.	Issues	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirement
			The Child Labour (Prohibition and Regulation) Act, 1986	Department of Inspectorate of Factories, TN	- The Act prohibits employment of children in certain occupation and processes. The Act also specifies conditions of work for children, if permitted to work. - SWPPL will ensure compliance
			Bonded Labour (Abolition) Act 1976	Department of Inspectorate of Factories, TN	- All forms of bonded labour is abolished - SWPPL will ensure compliance
			Minimum Wages Act, 1948	Department of Inspectorate of Factories, TN	- Requires the Government to fix minimum rates of wages and reviews this at an interval of not more than 5 years. Every employer shall be responsible for the payment to persons employed by him of all wages required to be paid under this Act. - SWPPL will ensure compliance
			Equal Remuneration Act 1976	Department of Inspectorate of Factories, TN	- It is the duty of an employer to pay equal remuneration to men and women workers for same work or work of a similar nature. - SWPPL will ensure compliance
			Workmen's Compensation Act, 1923	Department of Inspectorate of Factories, TN	- Requires if personal injury is caused to a workman by accident arising out of and in the course of his employment, his employer shall be liable to pay compensation in accordance with the provisions of this Act. - SWPPL will ensure compliance
			Maternity Benefit Act, 1961	Department of Inspectorate of Factories, TN	- No employer shall knowingly employ a woman in any establishment during the six weeks immediately following the day of her delivery or her miscarriage. No pregnant woman shall, on a request being made by her in this behalf, be required by her employer to do during the period any work which is of an arduous nature or which involves long hours of standing, or which in any way is likely to interfere with her pregnancy or the normal development of the foetus, or is likely to cause her miscarriage or otherwise to adversely affect her health. - SWPPL will ensure compliance
16	Public Consultation and Local Grievances	The project is set in rural area	Tamil Nadu Panchayats Act 1994	Panchayat Union	- Provides for application of consent from the respective panchayat body / village administrative officer etc during the project life cycle. - SWPPL will ensure compliance

A brief description of the relevant enforcement agencies with respect to the institutional framework is described in the following **Table 3.2**.

Table 3.2 *Relevant Enforcement Agencies*

SN	Agency	Functions
1	The National Green Tribunal	National Green tribunal has been constituted in 2010 for effective and expeditious disposal of cases relating to environmental protection and conservation of forests and other natural resources including enforcement of any legal rights relating to environment and giving relief and compensation for damages to persons and property. The tribunal will have jurisdiction over all civil cases relating to implementation of the following regulations: • The Water Act, 1974; • The Water Cess Act, 1977; • The Forest Conservation Act, 1980; • The Air Act, 1981; • The Environment Protection Act, 1986; • The Public Liability Insurance Act, 1991; and • The Biological Diversity Act, 2002 The Act provides for compensation on account of following • Relief and compensation to the victims of pollution and other environmental damage arising under enactment of the above acts; • Restitution of property damaged; and • Restitution of the environment. U/s 17, any person responsible for any untoward incidents (defined in Schedule II of the Act) is liable to pay relief or compensation as determined by the tribunal, failing which a penalty (u/s 26 and 27) is imposable which may lead to imprisonment upto 3 years or fine upto 10 crores or both and an additional fine of Rs 25,000 per day for any delay, which may further be increased to one lac per day.
2	Ministry of Environment and Forests	The Ministry of Environment and Forests (MoEF) is the nodal agency in the administrative structure of the Central Government, for the planning, promotion, co-ordination and overseeing the implementation of environmental and forestry programmes. The specific functions of MoEF include the following: • Environmental policy planning; • Effective implementation of legislation; • Monitoring and control of pollution; • Environmental Clearances for industrial and development projects covered under EIA notification; • Promotion of environmental education, training and awareness; and • Forest conservation, development, and wildlife protection. The MoEF is responsible for the implementation and enforcement of the Environment Protection Act, 1986, and Rules issued under the Act, including the EIA notification. Under sections 3 and 5 of the EP Act, 1986, it retains enormous powers to issue directions in the interests of environment protection.

SN	Agency	Functions
3	Central Pollution Control Board	The Central Pollution Control Board (CPCB) has been created for the control of water, air and noise pollution, land degradation and hazardous substances and waste management. The executive responsibilities for the industrial pollution prevention and control are primarily executed by the CPCB at the central level, which is a statutory body, attached to the MoEF. The specific functions of CPCB include the following: • Advise the Central Government on any matter concerning prevention and control of water and air pollution and improvement of the quality of air; • Plan and cause to be executed a nation-wide programme for the prevention, control or abatement of water and air pollution; • Co-ordinate the activities of the State Boards and resolve disputes among them; • Provide technical assistance and guidance to the State Boards, carry out and sponsor investigation and research relating to problems of water and air pollution, and for their prevention, control or abatement; • Plan and organise training of persons engaged in programme on the prevention, control or abatement of water and air pollution; • Organise through mass media, a comprehensive mass awareness programme on the prevention, control or abatement of water and air pollution; • Collect, compile and publish technical and statistical data relating to water and air pollution and the measures devised for their effective prevention, control or abatement; and • Lay down, modify or annul, in consultation with the State Governments concerned, the standards for stream or well, and lay down standards for the quality of air.
4	Tamil Nadu Pollution Control Board (TNPCB)	The Tamil Nadu Pollution Control Boards (TNPCB) was constituted in 1982 to control pollution from any activities in the state of Tamil Nadu. The TNPCB performs following functions: • To plan a comprehensive programme for the prevention, control and abatement of water and air pollution; • To encourage, conduct and participate in investigations and research relating to problems of water, land and air pollution and its prevention, control and abatement thereof; • To inspect sewage and trade effluent treatment plants for their effectiveness and review plans, specifications for corrective measures; • To collect samples of sewage/trade effluents and emissions of air pollutants and to analyze the same for specific parameters; • To lay down, modify or annul effluent standards for the sewage/trade effluents and for the emissions of air pollutants into the atmosphere from the industrial plants and automobiles and for the discharge of any air pollutant into the atmosphere from any other source; • To evolve best economically viable treatment technology for sewage and trade effluents and to evolve efficient methods of disposal of sewage and trade effluent on land; • To monitor the generation, transportation, treatment, storage and disposal of hazardous wastes; • To identify and monitor the isolated storage of hazardous chemicals ; • To collaborate with CPCB in organizing training of persons engaged or to be engaged in programmes relating to prevention, control or abatement of water/air pollution and to organize mass education programme relating thereto.

SN	Agency	Functions
5	Tamil Nadu Department of Environment	The Department of Environment was created in 1995 as the Nodal Department for dealing with environmental management of the State. The Department of Environment (DoE) is the nodal Agency for planning, promotion, coordination and overseeing the implementation of all the aspects of environment other than those dealt with Tamil Nadu Pollution Control Board. The department is also responsible to formulate State Environment Impact Assessment Authority (SEIAA) for assigning environmental clearance for projects falling under B1 category under the new EIA notification.
6	Tamil Nadu Forest Department	Chief Conservator of Forests is responsible for forest related management in the State. He is supported by Divisional Forest Officers for all matters related to diversion of forestland and management of forest in the divisions within the State. Department of Wildlife is managed by Chief Wildlife Warden of the State who is supported wildlife wardens and rangers for management and upkeep of wildlife in the State. The main objective of Tamil Nadu Forest department are : • To ensure environmental stability by restoring ecological balance in forest ecosystem. • To increase the forest cover/tree cover in the state, and enhance the quality of forests. • To conserve the wide array of Bio diversity through scientific management and improve habitat conditions for improved forest health. • To protect and develop the forest catchment area of rivers, lakes, reservoirs and all aquatic eco systems. • To meet the genuine requirement of fuel, fodder, non-wood forest produce and small timber to the extent possible on a sustainable basis through the principles of watershed development and Joint Forest Management. • To sensitise all sections of the society for forest / tree conservation through planning, interpretation, integration and collaboration. • Increase forest based entrepreneurship to support improved livelihood and develop efficient marketing strategies. • To make available the traditional forest produce to the tribal people living inside the forests and make them partners in forest management. • To develop non-conventional renewable alternative energy sources to meet the energy requirement of remote villages. • Scientific management of forests for multiple objectives and to strengthen growth, yield and productivity systems. • Stabilising coastal eco-systems for ensuring protection from natural calamities like cyclones, tsunami, etc.,
7	State Transport Authority, Government of Tamil Nadu	Transport Departments is established for enforcement of the provisions of the Central Motor Vehicles Act, 1988 and Rules, 1989. Transport Department is responsible for management of traffic on roads and compliance of requirement for freight of hazardous goods including (flammable hazardous petroleum products) as per safety codes and safety requirements as laid down in Central Motor Vehicles Rules. The Transport Department is headed by the Transport Commissioner and functions under the administrative control of the Home Department of the Government. The Transport Commissioner also functions as State Transport Authority.

SN	Agency	Functions
8	Tamil Nadu Electricity Board	The Tamil Nadu Electricity Board is constituted under the Electricity (Supply) Act, 1948 (Central Act 54 of 1948) and authorised to function as the State Transmission Utility and a Licensee as notified by the Government of Tamil Nadu under provision of clause (a) of Section 172 of the Electricity Act, 2003. The main objective of Tamil Nadu Electricity Board is to generate, transmit and distribute electricity efficiently and to supply quality power to its consumers.
9	District Administration (Collector's Office)	Land acquisition, if any under the Land Acquisition Act, 1894 for the proposed project will be regularised by the State government through district collector's office.
10	Department of Inspectorate of Factories Tamil Nadu	The Department of Inspectorate of Factories functions under Ministry of Labour & Employment, Government of Tamil Nadu and enforces central and state Acts along with Tamil Nadu state Rules for the benefit of working population mainly in the organized manufacturing sector. The Inspectorate of Factories enforces the Factories Act, 1948 and 13 other Labour enactments in Factories registered under the Factories Act, 1948 and the Tamil Nadu Factories Rules, 1950. By the enforcement of these important Labour Legislations, the Health, Safety, Welfare, good working conditions, etc. of the workers employed in the registered Factories are protected. For the effective implementation of the provisions of the Factories Act, 1948 and other Labour Acts, inspections are periodically conducted in Registered Factories.
11	State Labour Department	All issues pertaining to implementation of labour laws in any establishment, shop or factory.
12	Central Ground water Authority	Central Ground Water Authority has been constituted under Section 3 (3) of the Environment (Protection) Act, 1986 to regulate and control development and management of ground water resources in the country. Powers & Functions: The Authority has been conferred with the following powers: (i) Exercise of powers under section 5 of the Environment (Protection) Act, 1986 for issuing directions and taking such measures in respect of all the matters referred to in sub-section(2) of section 3 of the said Act. (ii) To resort to penal provisions contained in sections 15 to 21 of the said Act. (iii) To regulate and control, management and development of ground water in the country and to issue necessary regulatory directions for the purpose. (iv) Exercise of powers under section 4 of the Environment (Protection) Act, 1986 for the appointment of officers.
13	Concerned Panchayats	The local Panchayats are empowered with management of local resources like forests, groundwater, common land and infrastructure like roads, buildings etc. No Objection Certificates are also required to be taken from the Panchayats at the time of initiating a project in local area. Panchayats are also empowered to levy and collect local taxes on land, property and provisioning of facilities. Professional tax is applicable to WTGs

SN	Agency	Functions
14	Tamil Nadu Energy Development Agency (TEDA)	Tamil Nadu Energy Development Agency (TEDA) was constituted in 1985, as per G.O.Ms.No.163, P. & D. (EC) Department, dated 29.11.1984. The overall objectives of TEDA are • To promote the use of new and renewable sources of energy (NRSE) and to implement projects therefor. • To promote energy conservation activities. • To encourage research and development on renewable sources of energy Some of the activities that TEDA undertakes are: • Facilitates wind power development by undertaking wind resource assessment, setting up demonstration wind farms, offering financial incentives, etc. • Encourages investment through attractive power purchase policies such as wheeling and banking facilities at concessional rate for captive use, reasonable tariff for power sold to TNEB. • Organises awareness programmes on the use of renewable energy and energy conservation and efficiency for different sections of the public. • Encourages decentralised power generation for rural applications through solar lighting, solar water/ air heating , solar/ wind mill water pumping, biomass gasifiers, biogas plants, etc.
15	Indian Renewable Energy Development Agency Limited (IREDA)	IREDA was established on 11th March, 1987 as a Public limited Government Company under the Companies Act, 1956 and it promotes, develops and extends financial assistance for Renewable Energy and Energy Efficiency/Conservation Projects. IREDA has been notified as a “Public Financial Institution” under section 4 ‘A’ of the Companies Act, 1956 and registered as Non-Banking Financial Company (NFBC) with Reserve Bank of India (RBI). The main objectives of IREDA is to provide financial support to specific projects and schemes for generating electricity and / or energy through new and renewable sources and conserving energy through energy efficiency.

SN	Agency	Functions
16	Centre for Wind Energy Technology (C-WET)	Centre for Wind Energy Technology (C-WET) has been established in Chennai in the year 1998, as an autonomous R&D institution by the Ministry of New and Renewable Energy (MNRE), Government of India. The Centre for Wind Energy Technology is functioning with the following structure. • Research & Development unit: Its main focus towards novelty in developments of components as well as in sub-systems of wind turbines by collaborative works with other R&D institutions/industry. • Wind Resource Assessment Unit: The unit identifies resource rich regions in the country by conducting wind resource micro survey and offers its services to the wind farm developers. To prepare wind map for the nation, it is assessing and analyzing wind resources. • Testing Unit: To establish world class facilities in testing of complete Wind Turbine Generator Systems (WTGS) according to international standards (IEC) and Type Approval Provisional Scheme (TAPS-2000). • Standards and Certification Unit: The unit carries out Provisional Type Certification of Wind Turbines as per the Indian Certification Scheme for Wind Turbines viz. Type Approval - Provisional Scheme - TAPS - 2000 (amended). Standards on Wind Energy are being developed by the unit. • Information, Training & Commercial Service Unit: To establish and update the data bank and serve as finest information centre in wind energy by collecting, collating and analyzing the related information. National and International training workshops are being organised for the benefit of stakeholders by the unit regularly. The unit publishes a quarterly newsletter, PAVAN that carries topical information regarding the field and addresses the need for information, both for casual and serious interest.

3.3

INTERNATIONAL FINANCE CORPORATION'S PERFORMANCE STANDARDS ON SOCIAL & ENVIRONMENTAL SUSTAINABILITY

International Finance Corporation (IFC) applies the Performance Standards to manage social and environmental risks and impacts and to enhance development opportunities in its private sector financing in its member countries eligible for financing. The Performance Standards may also be applied by other financial institutions choosing to support them in the proposed project.

Together, the eight Performance Standards establish standards that the client is required to meet throughout the life of an investment by IFC or other relevant financial institution:

- Performance Standard 1: Social and Environmental Assessment and Management System;
- Performance Standard 2: Labour and Working Conditions;
- Performance Standard 3: Pollution Prevention and Abatement;
- Performance Standard 4: Community Health, Safety and Security;
- Performance Standard 5: Land Acquisition and Involuntary Resettlement;
- Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management;
- Performance Standard 7: Indigenous Peoples; and

- Performance Standard 8: Cultural Heritage.

These performance standards and guidelines provide ways and means to identify impacts and affected stakeholders and lay down processes for management and mitigation of adverse impacts.

3.4

APPLICABLE INTERNATIONAL CONVENTIONS

The sub sections describe applicable International Conventions ratified and signed by India.

Table 3.3 *Applicable International Conventions*

Convention	Application	Relevance
Conventions on the Conservation of Migratory species of wild animals and migratory species	India is contacting party to the convention on conservation of migratory species of wild animals and migratory species.	<i>The project sites, do not fall in any migratory bird route as per discussions with the concerned forest department officials. The nearest possible migratory route is in Port Calimere which is around 250 km from both the districts of Tirunelveli and Tiruppur.</i> <i>However, as per secondary literature, there are atleast 75 species of birds which are winter and summer visitors in these two districts</i>
Ramsar Convention: The Convention on Wetlands of International Importance Especially as Waterfowl Habitat, 1971	This convention was signed by India in 1981 and ratified in February 1982. The convention requires protection of identified wetlands of international importance as identified under Ramsar convention.	<i>The proposed project do not fall any area identified under Ramsar convention.</i> <i>The nearest Ramsar site is Point Calimere at a distance of about 250 km (aerial distance) from both the districts</i>
Kyoto Protocol	The Kyoto protocol was signed by India in August 2002 and ratified in February 2005. The convention pertains to the United Nations framework on Climate Change. The 3rd Conference of the Parties to the Framework Convention on Climate Change (FCCC) in Kyoto in December 1997 introduced the Clean Development Mechanism (CDM) as a new concept for voluntary greenhouse-gas emission reduction agreements between industrialized and developing countries on the project level	<i>The proposed project being a wind power generation project becomes the basis for Clean Development Mechanism. The project will reduce greenhouse emission and generate 101.4MW of clean energy.</i>
Basel Convention	Basel convention was signed by India in March 1990 and ratified in June 1992. The import and export norms for the hazardous waste have been provided in conformance with the Basel Convention.	SIPL will be using non hazardous solar panels with amorphous silica based panels and shall have adequate arrangement for disposal of used/waste oil.

The Ministry of Environment and Forests (MoEF) has the overall responsibility to set policy and standards for the protection of environment in association with the Central Pollution Control Board (CPCB).

Ambient Air Quality

National Ambient Air Quality Standards (NAAQ Standards), as prescribed by MoEF vide, Gazette Notification dated 16th November, 2009. The prescribed standards are given below in **Table 3.4**.

Table 3.4 **National Ambient Air Quality Standards (NAAQS)**

S no	Pollutant	Time Weighted Avg.	Concentration in Ambient Air	
			Industrial, Residential, Rural & Other Areas	Ecologically Sensitive Areas (notified by Central Government)
1	Sulphur dioxide (SO ₂) µg/m ³	Annual Average*	50	20
		24 Hours**	80	80
2	Oxides of Nitrogen (NO _x) µg/m ³	Annual Average*	40	30
		24 Hours**	80	80
3	Particulate Matter (PM 10) µg/m ³	Annual Average*	60	60
		24 Hours**	100	100
4	Particulate Matter (PM 2.5) µg/m ³	Annual Average*	40	40
		24 Hours**	60	60
5	Ozone (O ₃) µg/m ³	8 Hours**	100	100
		1 Hour**	180	180
6	Lead (Pb) µg/m ³	Annual Average*	0.50	0.50
		24 Hours**	1.0	1.0
7	Carbon monoxide (CO) mg/m ³	8 Hours**	02	02
		1 Hour**	04	04
8	Ammonia (NH ₃) µg/m ³	Annual*	100	100
		24 Hours**	400	400
9	Benzene (C ₆ H ₆) µg/m ³	Annual*	05	05
10	Benzo(a)Pyrene-particulate phase ng/m ³	Annual*	01	01
11	Arsenic (As) ng/m ³	Annual*	06	06
12	Nickel (Ni) ng/m ³	Annual*	20	20

Note: *Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform interval.

** 24 hourly/8 hourly/1 hourly monitored values, as applicable shall be complied with 98% of the time in a year. 2% of the time, it may exceed but not on two consecutive days of monitoring.

As the project is in rural/residential set up, NAAQS for rural/residential area will be applicable for the project.

Water Quality Standards

The designated best use classification as prescribed by CPCB for surface water is as given:

Table 3.5 Primary Water Quality Criteria for Designated-Best-Use-Classes

Designated-Best-Use	Class	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	- Total Coliforms Organism MPN/100ml shall be 50 or less - pH between 6.5 and 8.5 - Dissolved Oxygen 6mg/l or more - Biochemical Oxygen Demand 5 days 20°C 2mg/l or less
Outdoor bathing (Organised)	B	- Total Coliforms Organism MPN/100ml shall be 500 or less - pH between 6.5 and 8.5 - Dissolved Oxygen 5mg/l or more - Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	- Total Coliforms Organism MPN/100ml shall be 5000 or less - pH between 6 to 9 - Dissolved Oxygen 4mg/l or more - Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Propagation of Wild life and Fisheries	D	- pH between 6.5 to 8.5 - Dissolved Oxygen 4mg/l or more - Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	- pH between 6.0 to 8.5 - Electrical Conductivity at 25°C micro mhos/cm Max.2250 - Sodium absorption Ratio Max. 26 - Boron Max. 2mg/l
	Below-E	Not Meeting A, B, C, D & E Criteria

Source: Central Pollution Control Board

Ambient Noise Standards

Noise standards notified by the MoEF vide gazette notification dated 14 February 2000 based on the A weighted equivalent noise level (L_{eq}) are as presented in **Table 3.6**.

Table 3.6 Ambient Noise Standards

Area Code	Category of Area	Limits in dB(A) L_{eq}	
		Day time*	Night Time
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone**	50	40

(1) Note: * Day time is from 6 am to 10 pm, Night time is 10 pm to 6.00 am; ** Silence zone is defined as area up to 100 meters around premises of hospitals, educational institutions and courts. Use of vehicle horns, loud speakers and bursting of crackers are banned in these zones.

As the project is in rural/residential set up, noise standards for residential area will be applicable for the project.

Noise Standards for Occupational Exposure

Noise standards in the work environment are specified by Occupational Safety and Health Administration (OSHA-USA) which in turn are being enforced by Government of India through model rules framed under the Factories Act.

Table 3.7 ***Standards for Occupational Noise Exposure***

Total Time of Exposure per Day in Hours (Continuous or Short term Exposure)	Sound Pressure Level in dB(A)
8	90
6	92
4	95
3	97
2	100
3/2	102
1	105
¾	107
½	110
¼	115
Never	>115

Note:

1. No exposure in excess of 115 dB(A) is to be permitted.
2. For any period of exposure falling in between any figure and the next higher or lower figure as indicated in column (1), the permissible level is to be determined by extrapolation on a proportionate scale.

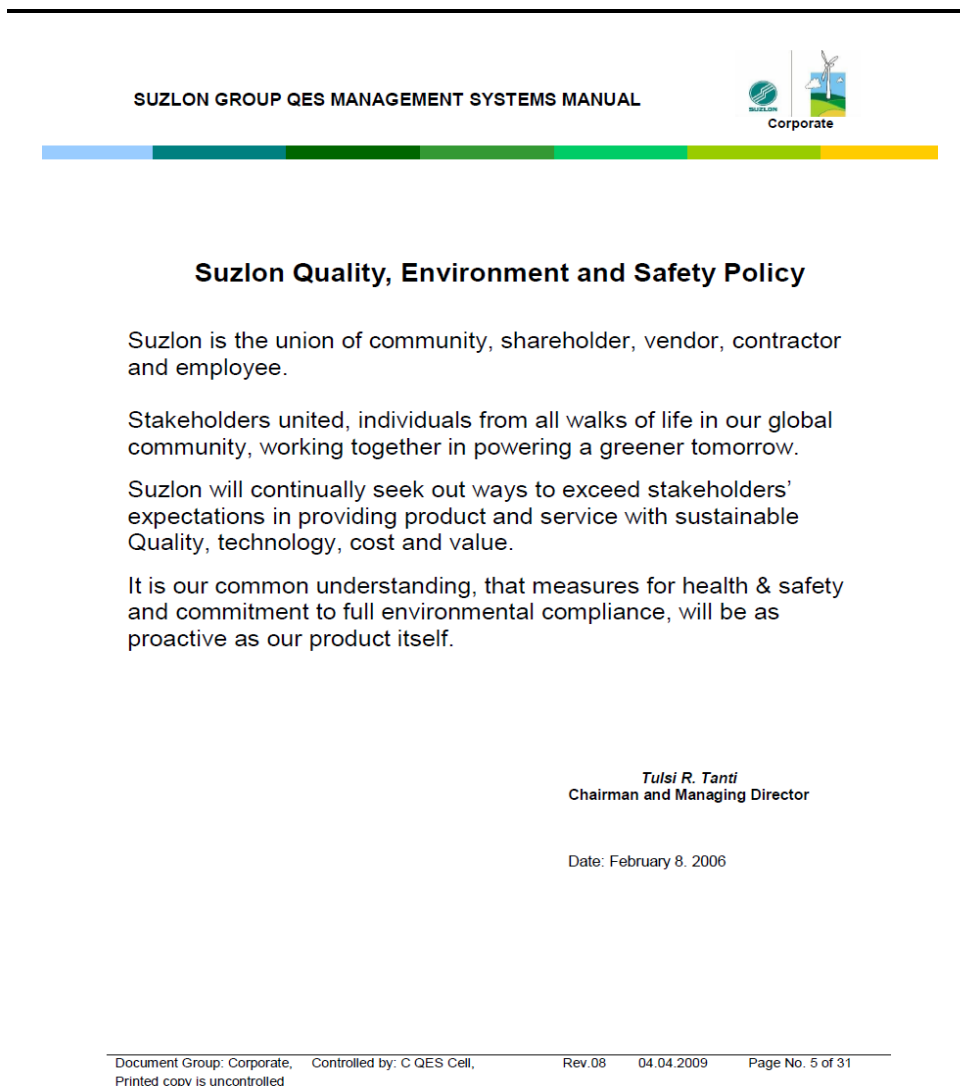
3.6 ***CONTRACTOR'S POLICY***

Suzlon has a quality, environment and safety policy which is rolled out in form of site specific operational procedures, annual HSE targets and objectives etc.

The annual HSE targets are more objective, and project site specific. The objectives are met by way of specific management plans and monitoring the implementation. Periodic training of employees and awareness of contractual workers is also carried out.

Internal and external audits and management review is an integral part of this system which is aligned to the requirements of ISO 9001, ISO 14001 and OHSAS 18001 systems.

Figure 3.1 Suzlon's Corporate Policy on Quality, Environment and Safety



Source: Suzlon

Figure 3.2 ISO certificates of Suzlon



Source: Suzlon

4.1 OVERVIEW

ERM conducted a reconnaissance survey of the proposed wind farm project sites at Tirunelveli and Tiruppur Districts and surroundings to understand the environmental and social setting of the proposed project in early January 2011. The reconnaissance survey was followed by primary baseline data generation for environment and social aspects of the study area in late January 2011 and continued through February 2011. The following section is based on the data generated from primary baseline monitoring, social survey, reconnaissance survey and available secondary information about the site and surrounding.

4.1.1 Study Area

The baseline environmental conditions with respect to air, water, soil, noise, traffic and ecology were monitored during the study period in January and February 2011. It is to be noted that the proposed wind energy project sites (individual WTG locations) in Tirunelveli and Tiruppur districts are located in clusters across three taluks and within larger and already well developed wind farm sites (*Some of the wind farm sites in both the districts are in operation for more than a decade now and newer wind farms are coming up along the low wind zones and along the fringes of high wind zone*). Hence, the baseline study area cannot be a defined and bounded geographical area as is done in conventional EIA studies.

In order to get representative baseline assessment of prevailing environment in the project site, following four (4) clusters where the proposed wind energy projects (individual WTG locations) are located in maximum numbers were chosen for undertaking baseline assessment:

- Tirunelveli District
 - Amudhapuram cluster
 - Rasta cluster
- Tiruppur District
 - Muthiampatti cluster
 - Pushpathoor cluster

Following sub-sections present the environmental features of both Tirunelveli and Tiruppur districts wherein the proposed wind energy projects are coming up.

4.1.2 Baseline Monitoring & Surveys

Secondary data on the meteorology, terrain, geology, soil etc. was collected from literature review and relevant agencies. The information collected and the interpretation of the information collect is presented in the following subsections.

Environment monitoring was carried out in the four clusters (mentioned above) identified based on the number of WTG projects proposed under the project. ERM engaged M/s Enviro Care India Private Limited – a Madurai based environmental analytical laboratory having about 10 years of experience in the pollution monitoring work - to carry out monitoring for ambient air quality, noise levels, water quality, soil quality, traffic volume count and ecological survey.

4.2 CLIMATE AND METEOROLOGY

Rainfall

The observations of rainfall in district Tirunelveli and Tiruppur district (*earlier in Coimbatore District*) for the last five years (2005-2009) as provided by the Hydro-met division of the India Meteorological Department is given in **Tables 4.1 and 4.2**.

Table 4.1 Rainfall for Tirunelveli District (in mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
2005	8.2	23.6	68.5	204.7	22.3	18	82.5	17.8	29.5	76	265.8	206.9	1023.8
2006	69.2	3.2	120.7	28.6	34.9	26.4	26.7	25.4	44	382.9	393.9	21.1	1177
2007	19.8	0.1	7.5	119.7	9.1	94.2	48.1	30.9	84.4	152.3	161.2	113	840.3
2008	9.4	53.2	400.5	106.4	2.9	11	41.4	74	21.3	322	171.3	77.5	1290.9
2009	8.2	0	28.2	69.9	25.8	15.3	54.1	30	27.9	115	405.4	133	912.8
												Average	1049

Source: <http://www.imd.gov.in>

Table 4.2 Rainfall for Coimbatore## District (in mm)

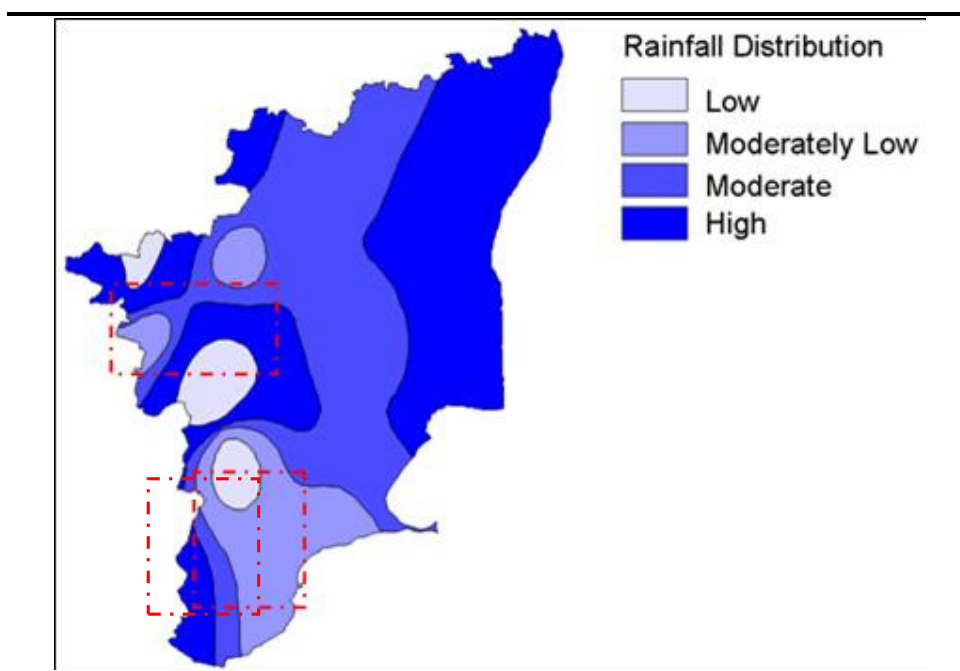
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
2005	5.9	20.7	43.8	119.8	131.1	25.7	76.6	39	36.3	242.1	202.1	61.5	1004.6
2006	17.7	0	55.8	40.2	66.1	31.6	22.3	27.1	60.5	133.6	308.8	1.9	765.6
2007	5.2	5.9	0	56.9	71.5	36.8	39.1	77.2	51.3	198	51	129.4	722.3
2008	3.6	21.4	112.1	28.4	50.3	145.1	212.8	207.6	129.5	251.8	54.5	17.3	1234.4
2009	1.3	0	46.2	28.7	82.4	96.6	360.5	115.6	192.7	81.6	203.6	20.9	1230.1
												Average	991.4

Source: <http://www.imd.gov.in>

Note: ## - Tiruppur District was formed newly in 2009. Most of the WTG locations were located in erstwhile Coimbatore District.

In the State of Tamil Nadu, the project regions are located in low to moderately low rainfall receiving regions. The rainfall distribution map for the State of Tamil Nadu presented in **Figure 4.1** highlights this aspect very clearly.

Figure 4.1 Rainfall Distribution in the State of Tamil Nadu (Project Region Highlighted)

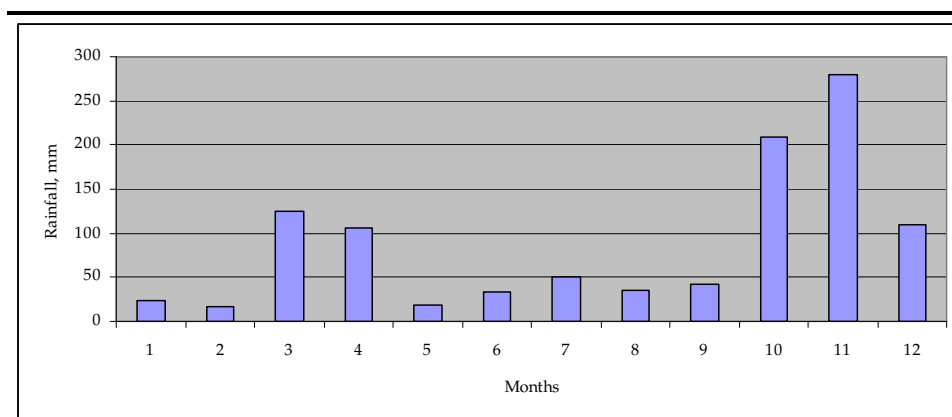


Source: <http://mapsof.net>

Tirunelveli district receives rain under both Southwest and Northeast monsoons. The Northeast monsoon which sets in between October and December chiefly contributes to the rainfall in the district. Rainfall data pertaining to last 100 years (1901-2000) for Tirunelveli District indicates that normal annual rainfall over the district is 879 mm. It is the maximum around Senkottai, Sankarankoil and all along the coast and it decreases towards inland. The areas around Ambasamudram, Tirunelveli and Kadayanallur receive minimum rainfall.

The average monthly rainfall data for Tirunelveli District from available last 5 year data is illustrated in *Figure 4.2*.

Figure 4.2 Tirunelveli District Average Monthly Rainfall (2005-2009)

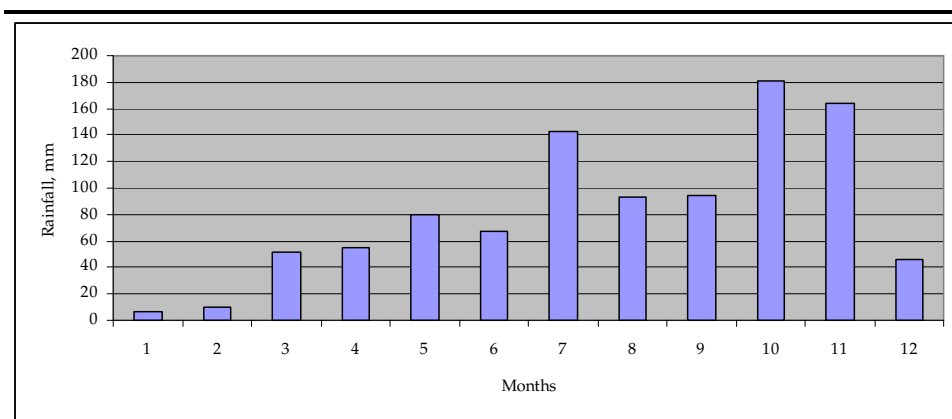


Source: <http://www.imd.gov.in/section/hydro/distrainfall/kvebrain/tamilnadu/tirunelveli.txt>

Coimbatore district (along with Dindigul and Erode Districts) from which most of the newly formed Tiruppur District has been carved out receives rain under both southwest and northeast monsoon seasons of the Country. Like Tirunelveli, it is the Northeast monsoon which chiefly contributes to the rainfall in the district and summer rains are negligible. The 100 year (1901-2000) average annual rainfall in the district varies between 550mm and 900mm. The eastern part of the district (currently Tiruppur district where Wind farms are located) receives minimum rainfall while the Southern portion of the district receives maximum around the hills.

The average monthly rainfall data for Coimbatore District from available last 5 year data is illustrated in *Figure 4.3*.

Figure 4.3 *Coimbatore District Average Monthly Rainfall (2005-2009)*



Source: <http://www.imd.gov.in/section/hydro/distrainfall/wvebrain/tamilnadu/coimbatore.txt>

During stakeholder consultations, it was indicated that both the regions are rain dependant for water and this year (2010 monsoon season) the rainfall received was above normal.

Temperature

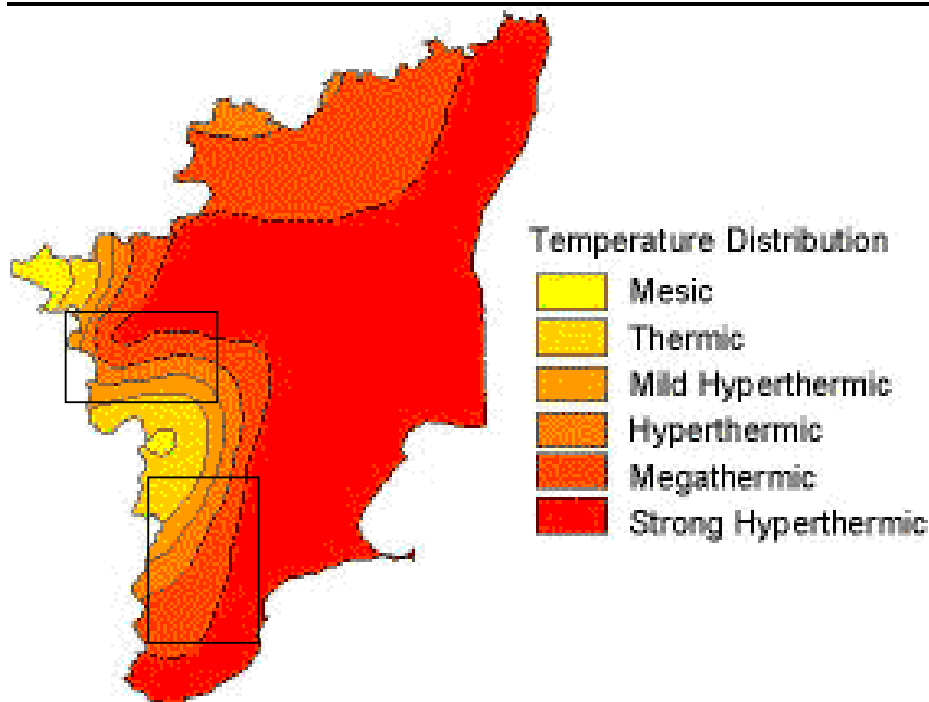
The climate is sub-tropical to tropical in both the regions, with distinct wet and dry seasons. According to the agro ecological classification, both the regions are situated semi arid climate. The climate may be broadly classified into four seasons:

- Winter : January-February
- Summer : March-May
- Southwest monsoons : June-September
- Northeast monsoons : October-December

In Tirunelveli district, between May to June, the climate is generally very hot and dry. It turns pleasant after the northeast monsoon seasons during the period from December to January. The relative humidity is on an average between 79 and 84%. The mean minimum and maximum temperature is 22.9°C and 33.5°C respectively.

Tiruppur district enjoys a tropical climate and weather patterns are similar to Tirunelveli district. The relative humidity exceeds 78% on an average. The temperature recorded varies between 11.7°C to 42.6°C.

Figure 4.4 *Temperature Distribution Map for the State of Tamil Nadu (Project Regions Highlighted)*



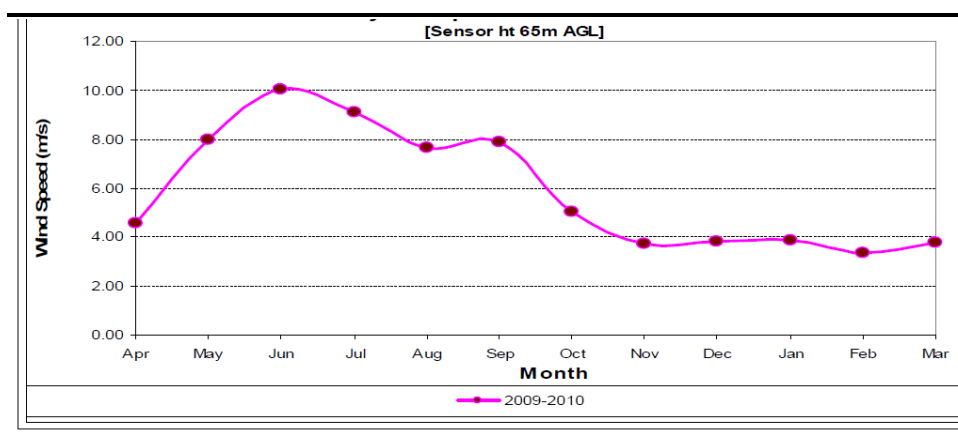
Winds

Suzlon undertakes extensive wind measurement and monitoring as part of the planning phase activity before designing larger wind farm sites. Wind masts or Met masts (Meterological Master Tower) are installed at every prospective wind farm site. Approximately, every wind mast depending upon the height of the mast, covers an aerial area of 5km radius. Based on the wind data collected over a 1-2 year period, Suzlon undertakes the micro-siting process wherein individual WTG locations are determined based on energy modelling and analysis. The following paragraphs have been culled out from one such wind mast report prepared by Suzlon which fairly gives an idea about the wind environment at project regions viz – Tirunelveli and Tiruppur Districts.

The average wind speed and wind direction data are recorded in every 10 minute intervals whereas temperature and pressure are recorded hourly for a period of 1-2 years or more. In India, the general wind flow is governed by the monsoon season. The main wind season in Tirunelveli District happens to be the southwest monsoon and it gains momentum from the month of May and peaks in June. The annual mean wind speed recorded at 80m height during Apr 2009 to Mar 2010 is 6.06 m/s with a wind power density of 250 W/sqm in one of the Suzlon wind mast locations in Tirunelveli District. **Figure 4.5**, below shows the monthly average wind speed recorded at the 65m level by one of

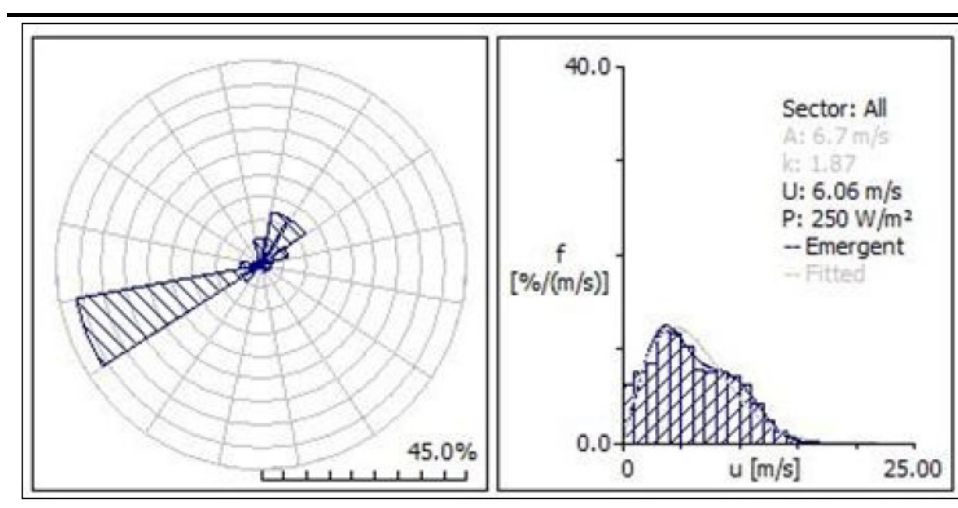
the Suzlon wind mast depicting the monthly variation in wind profile over a complete one year (Apr '09 to Mar '10) in Tirunelveli District. **Figure 4.6** presents the wind rose and distribution for Tirunelveli district.

Figure 4.5 Monthly Wind Profile at one of Suzlon Wind Masts in Tirunelveli District



Source: Suzlon

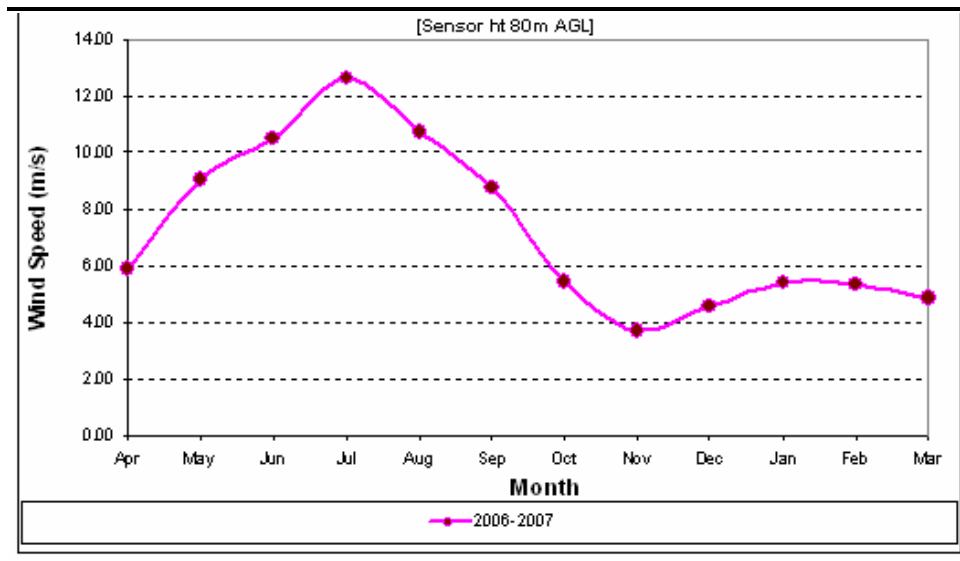
Figure 4.6 Wind Rose and Wind Distribution in Tirunelveli District



Source: Suzlon

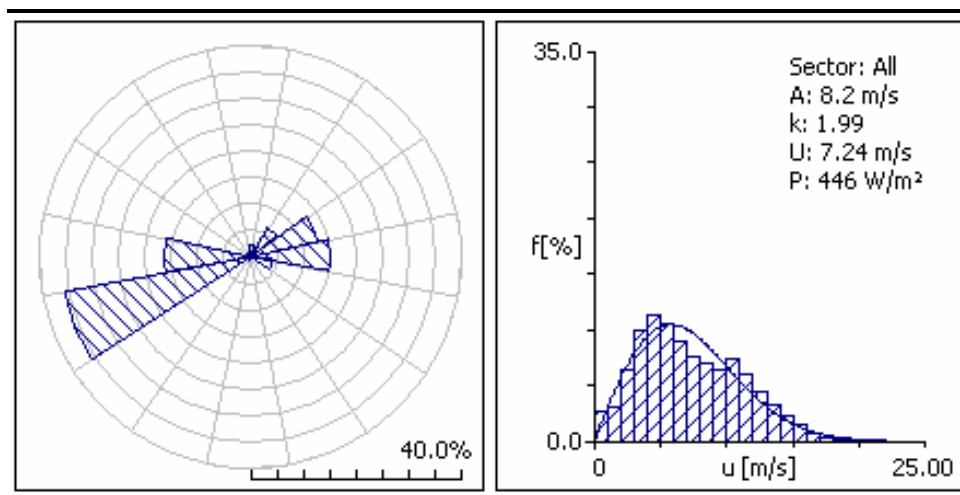
In the case of Tiruppur district, the main wind season happens to be the southwest monsoon and it gains momentum from the month of May and peaks in July. The annual mean wind speed recorded at 80m height during April 2006 to March 2007 is 7.3 m/s with a wind power density of 446 W/m² in one of wind masts of Suzlon. **Figure 4.7**, below shows the monthly average wind speed recorded at the 80m level by one of the Suzlon wind mast located in Tiruppur district depicting the monthly variation in wind profile over a complete one year (Apr '06 to Mar '07). **Figure 4.8** presents the wind rose and distribution for Tiruppur district.

Figure 4.7 Monthly Wind Profile at one of Suzlon Wind Masts in Tiruppur District



Source: Suzlon

Figure 4.8 Wind Rose and Wind Distribution in Tiruppur District



Source: Suzlon

4.3 LAND ENVIRONMENT

4.3.1 Topography of the Project Areas

Tirunelveli district wherein half of the proposed WTG projects are located is largely a plain terrain with a gentle slope toward East and Southeast, except for the hilly terrain in the west. Chittar and Tamiraparani river system drains the project areas in the middle and southern portions of the district respectively.

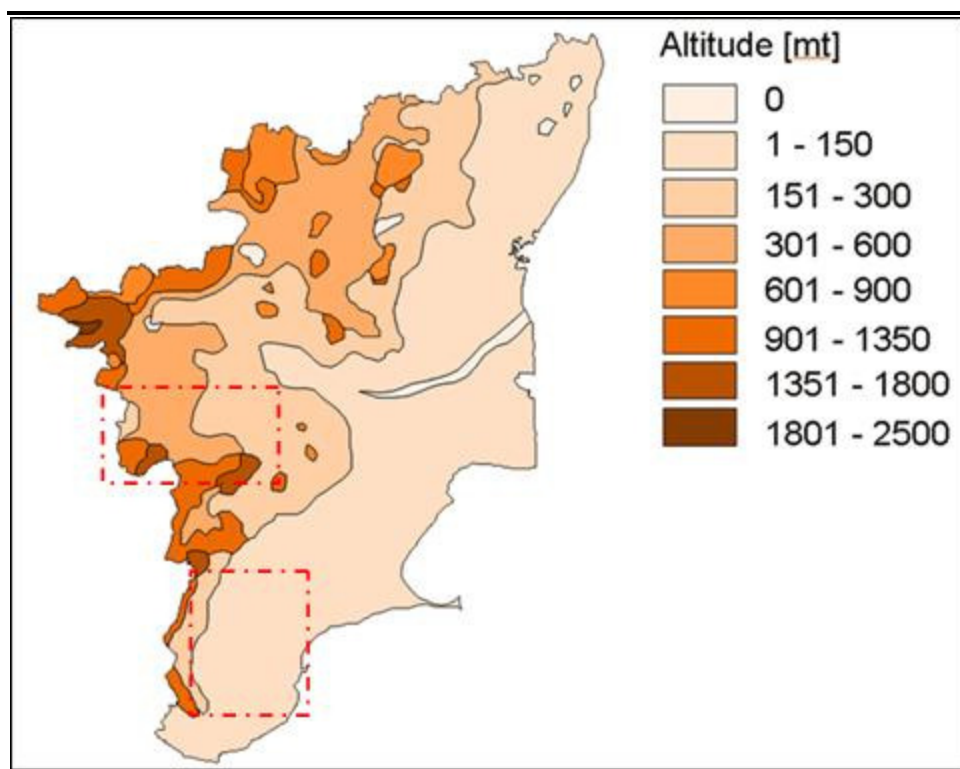
In Tiruppur district, the project sites are located in plains that are characterised by an undulating topography with a general gradient towards east and southeast. The undulating topography with innumerable

depressions, are used as tanks for storage of rainwater for agriculture. The plains are limited to the east and south-western border of the district. The plains west of Cauvery river are known as Lower Cauvery plains. River Upparu traversing through project blocks such as Kundadam, Ponnapuram and Sankarandampalayam drains the project area to River Amaravathi and flows in easterly direction. In the south of the district, River Amaravathi and its tributary River Shanmugha drains the region and flows from south west to north eastern direction into the district before flowing in easterly direction.

At both the districts, the WTG sites that were visited during primary survey and monitoring, the topography was observed to be plain with a gentle slope matching the district profile.

The topography (altitude) map for the State of Tamil Nadu is presented in **Figure 4.9** wherein project regions in the west (Tiruppur) and south (Tirunelveli) have been highlighted. As can be inferred from the map, the Tirunelveli project sites are located in largely plain lands which have an altitude range of 300-900m above MSL while the Tiruppur district project sites are located adjacent to hilly regions and hence have highly undulating topography.

Figure 4.9 Topographic Feature of Tamil Nadu State (Project Regions Highlighted)



Source: <http://mapsof.net>

4.3.2 Geology

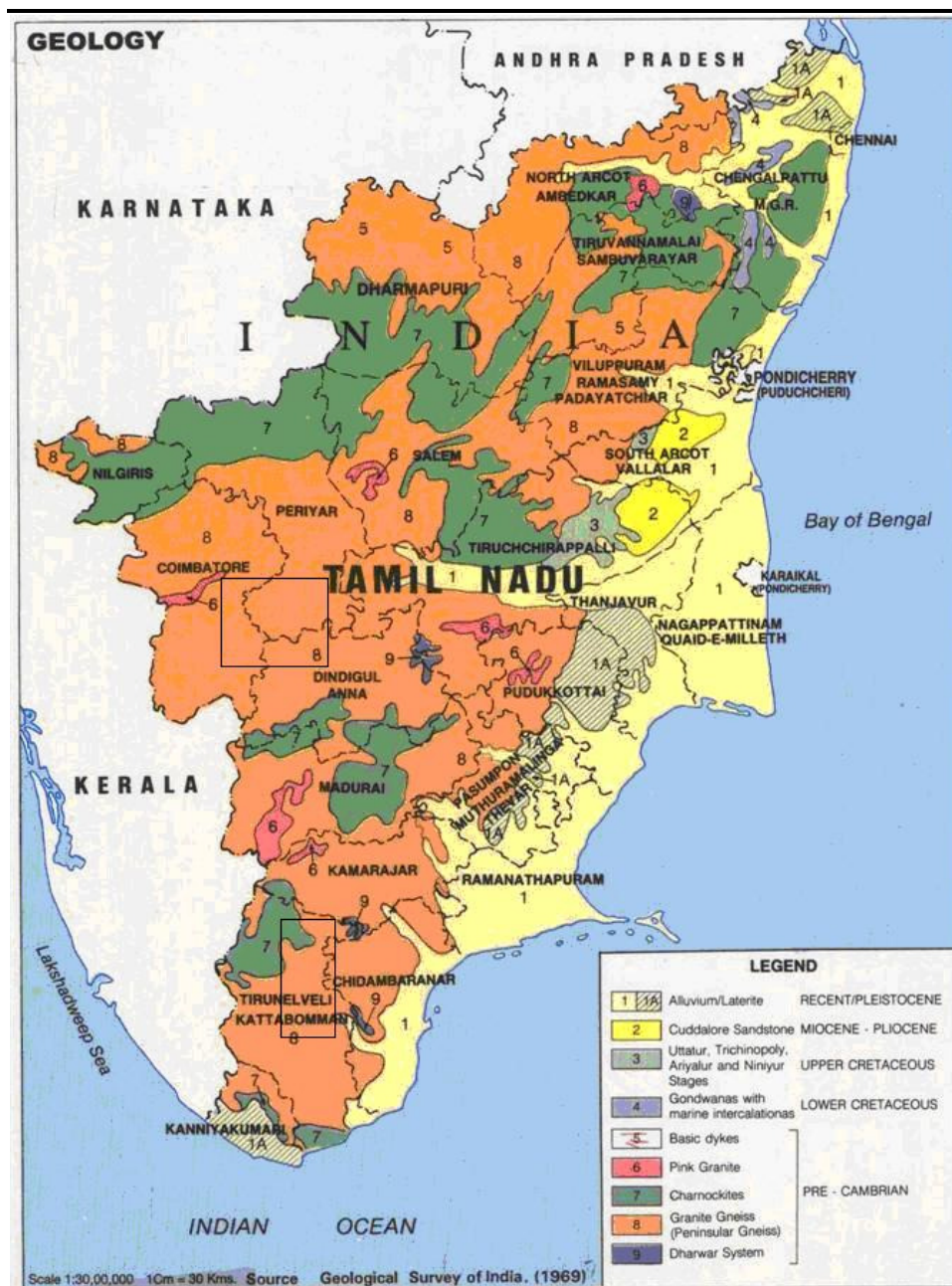
The geology of Tirunelveli district and Tiruppur district is largely consisting of granite gneiss (peninsular gneiss) of Pre-Cambrian age and Charnockites of

Pre-Cambrian age. The Tirunelveli district lies on the south of the Palghat-Cauvery tectonic zone. To the west of the district Charnockites form the massifs of the Western Ghats and the Eastern part is predominantly of gneisses. This region differs from the Northern and Central regions of the State of Tamil Nadu by the predominance of meta-sedimentary rocks such as quartzites, sillimanite quartzites, calc-granulites, garnet and cordierite bearing meta-pelites. This zone is totally devoid of dolerite dykes and banded magnetite quartzites. In the Northern part of this region calc-silicates and crystalline limestone occur as thick sequences for a few tens of metres thickness. Extensive limestone deposits are found from Palayam to Kiranur, Rajapalayam-Alangulam belt east of Varshanad hills and Talaiyuthu near Tirunelveli.

Tiruppur district which lies in the central region is marked by two prominent tectonic zones viz., East-West trending Moyar-Bhavani-Attur (MBA) on the North and Palghat-Noyyil-Cauvery (PNC) in the South. This region is largely made up of reworked gneisses carrying enclaves of older schists, amphibolites, Fuchsite quartzite, Banded magnetite quartzite, calc-granulites with limestone, and layered Anorthosite complex (Bhavani layered complex and Sittampundi complex). Dolerites are comparatively less in this zone and are exposed with many younger granites of Proterozoic age.

The geological map of Tamilnadu with project regions highlighted by a black rectangle is presented in *Figure 4.10*.

Figure 4.10 Geology of the State of Tamil Nadu (Project Regions are Highlighted)



Source: http://mapsof.net/andhra_pradesh/static-maps/jpg/geologic-map-of-tamil-nadu/large-size

4.3.3 Landuse of the Project Districts

The landuse of the project districts (Tirunelveli and Tiruppur) are predominantly agricultural with 24% and 42% land area under farming in Tirunelveli and Tiruppur (*erstwhile Coimbatore district from which the new district has been largely carved out*). Forest land use is also a major land use pattern in both the districts (17% and 21% respectively). Forests are present in specific and well defined areas in both the districts.

Notably, waste lands (including barren and uncultivable, fallows and other fallows, and cultivable waste lands) constitute 40% and 21% in Tirunelveli and

Coimbatore districts respectively. Area wise details of the landuse pattern of the project districts are given in **Table 4.3**. It is to be noted here that newly formed Tiruppur district having got land parcels largely from Coimbatore district has also got land areas from existing Erode and Dindugul district and the land use pattern could be slightly different from the one presented here.

Table 4.3 Landuse Pattern in the Project Districts

S.No	Classification	Tirunelveli Distt.		Coimbatore Distt.#	
		Area (Ha)	Area (%)	Area (Ha)	Area (%)
1	Forests	120801	17.70	158803.00	21.26
2	Barren and uncultivable lands	30961	4.54	7463.53	1.00
3	Land put to non-agricultural land use	103669	15.19	106025.24	14.19
4	Cultivable waste	47442	6.95	13996.74	1.87
5	Permanent pastures and other grazing lands	5271	0.77	85.03	0.01
6	Groves not included in the sown area	10009	1.47	3383.10	0.45
7	Current fallows	32053	4.70	84524.14	11.31
8	Other fallow lands	165481	24.25	57840.60	7.74
9	Nett area sown	166621	24.42	314957.62	42.16
	Total	682308	100.00	747079	100.00

Source: Department of Economics & Statistics, Govt. of Tamil Nadu

Note: Tiruppur was earlier part of Coimbatore District

4.4 AMBIENT AIR QUALITY

The primary ambient air quality (AAQ) monitoring was undertaken during the month of January 2011 for a period of just one week to capture the background ambient air quality levels. As the wind farm sites are not major contributors to air pollution and the project background setting is repetitive all across the project sites and districts, one week monitoring is considered adequate to assess the baseline AAQ levels.

AAQ was monitored for the National Ambient Air Quality Standard, 2009 specified parameters such as:

- Particulate Matter (PM₁₀ and PM_{2.5})
- Sulphur Di-Oxide (SO₂)
- Nitrogen-Di-Oxide (NO₂)
- Ozone (O₃)
- Lead (Pb)
- Arsenic (As)
- Nickel (Ni)
- Carbon Monoxide (CO)
- Ammonia (NH₃)
- Benzene (C₆H₆)
- Benzo(a)Pyrene (BaP)

All parameters were monitored twice in the week for a period of 24 hours except CO which was monitored 8 hourly. Air quality monitoring was undertaken at the following locations as given in **Table 4.4**.

Table 4.4 *Ambient Air Quality Monitoring Location*

Sample code	Geographic Coordinates	Village	Location	Landuse
AQ-1	N10°47' 51.3"; E 77°22' 34.1"	Sadayarpalayam	M14 Tower	Agricultural
AQ-2	N10° 33' 03.9"; E77°24' 33.0"	Pushpathoor	G407 tower near a farm dwelling unit	Agricultural
AQ-3	N08°50' 28.9"; E77°37' 09.8"	Rastha	Tower M120	WTG location
AQ-4	N09°03' 16.8"; E77°33' 06.3"	Amuthapuram	TDA 65	WTG construction

The locations were identified to give representative scenario of all possible land use scenarios in the two different project regions, project activities (construction and operational phases) and sensitive receptors near the wind energy project locations. As can be seen from above Table, AQ2 and AQ4 were selected to represent sensitive receptor and construction phase scenario respectively.

The analysis of samples were undertaken as per IS: 5182(Part-II,IV,V&VI). The results of air quality monitoring for key parameters are summarised in **Table 4.5**. The complete AAQ monitoring results are presented in *Anneure*.

Table 4.5 *Results of Ambient Air Quality Monitoring - Key Parameters*

Location	PM ₁₀	PM _{2.5}	SO ₂	NO _x
AAQ Standards	100 µg/m ³	60 µg/m ³	80 µg/m ³	80 µg/m ³
AQ-1				
Max	50.0	15.0	6.5	15.6
Min	45.0	10.0	4.7	14.6
AQ-2				
Max	85.0	32.5	4.7	15.3
Min	41.7	31.7	4.5	13.9
AQ-3				
Max	48.3	5.8	11.8	13.8
Min	41.7	5.0	11.2	12.6
AQ-4				
Max	40.0	18.6	12.5	15.4
Mi	38.7	15.7	12.4	13.2

* Applicable Standards for rural/residential areas

The ambient air quality observed is within the applicable standards for all parameters at all four locations monitored in the project regions. The monitoring station - AQ 2 was located close to WTG tower but a farm dwelling unit was observed at about 100-150m from the tower location and farm activities (loading and transporting of coconuts) were going on which could have resulted in higher PM₁₀ reading of 85 µg/m³. Else, both PM₁₀ and PM_{2.5} readings are well below 50% of the prescribed NAAQS for the parameter. SO₂ and NO₂ are well below the NAAQS values due to rural environmental setting.

The background environmental setting in both the project regions is rural in nature with farming as major land use pattern besides wind energy projects. There are no major industrial units except for few stone crushers and limestone mining (of Indian Cements near Rasta in Tirunelveli District). Poultry farming, orchard development (coconut, plantain), seasonal farming (post-monsoon season) are the typical farming activities which does not contribute much to AAQ levels. Road transport network and anthropogenic activities could be the sources of air pollution in both the regions. It is evident from baseline monitoring that wind farm projects have not contributed to AAQ levels in the region and the current quality levels are way below the prescribed National Standards (NAAQS).

4.5 WATER ENVIRONMENT

4.5.1 Hydrogeology

Tirunelveli district is underlain by both porous and fissured formations. The important aquifer systems in the district are constituted by (See *Figure 4.11*):

- weathered and fractured hard rock formations of Archaean age;
- porous sedimentary formations ranging in age from Tertiary and Recent.

The porous formations are found as small patch in the south-eastern part of the district and include sandstones, Limestones, Laterite and Clays from Tertiary to Quaternary. The yield of bore wells varies from 1-4.5 litres per second. The aquifer at the shallow depth is under unconfined condition and aquifer at depth is under semi-confined to confined condition. The shallow aquifer is developed through dug wells and deeper aquifer through tube wells. The dug well can sustain a pumping of 4 to 6 hours while the tube wells can sustain a pumping of 6-8 hours.

Pre- monsoon depth to water level is observed to range between 1.19m to 13.35 m below ground level (bgl). Post- monsoon depth to water level is observed to be in the range of 0.18m to 7.97 m bgl. During stakeholder consultations, it was revealed that drinking water bore wells have been sunk upto 300-350 feet bgl while private farm owners have gone upto 700-1000 feet bgl. The water level is available at two distinct levels of 50 feet and 150 feet bgl. Ground water depletion is said to be a major concern for the villagers in the project region as the entire area is rain dependant and there are no surface water bodies in some of the villages such as Panavadalichatram Panchayat villages.

Corroborating the stakeholder response, in Tirunelveli district, State government has identified the following blocks as over exploited from ground water abstraction perspective wherein the abstraction is more than recharging:

- Melaneelitha nallur
- Radhapuram
- Sankarankoil

- Valliyur

Significantly, wind energy projects are proposed in some of the above mentioned over exploited blocks such as Melaneelitha Nallur and Radhapuram. Central Ground Water Board has recommended that to improve and strengthen ground water resource in the district following activities will have to be undertaken:

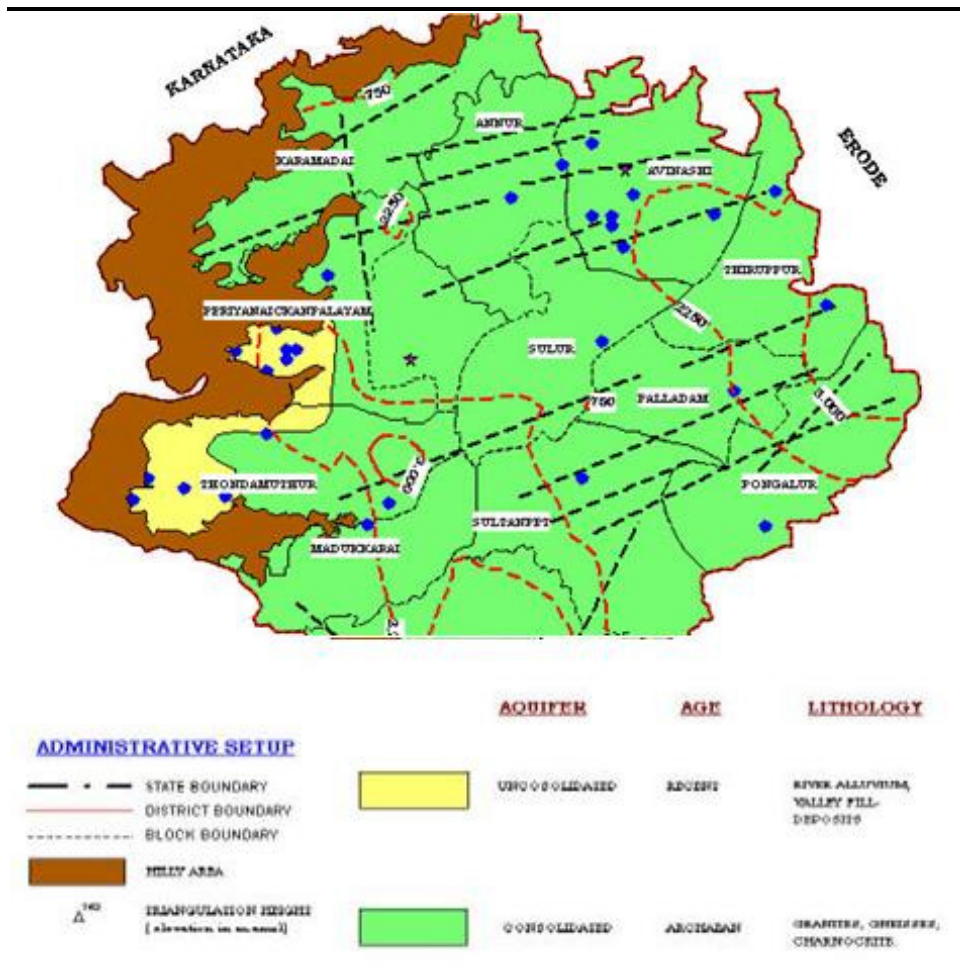
- desilting of existing tanks;
- percolation pond with recharge wells and recharge shafts;
- implementation of roof –top rainwater harvesting;
- recharge pits, shafts, trenches of suitable design are ideal structures for rainwater harvesting in over exploited areas;
- Waste land development programme and micro irrigation system has to be implemented for increasing the agricultural produces by way of more food and income per drop of water in view of the limited water resources in the district.

Figure 4.11 Hydrogeologic Profile of Tirunelveli District



Source: District Ground Water Brochure, Tirunelveli, CGWB, April 2009

Figure 4.12 Hydrogeologic Profile of Tiruppur District Showing Project Region
(Abstracted from Coimbatore District Profile)



Source: District Ground Water Brochure, Coimbatore, CGWB, Nov 2008

The hydrogeologic profile of Tiruppur region has been highlighted in *Figure 4.12* and is similar to Tirunelveli district presented earlier. The pre- monsoon depth to water level is observed to be in the range of 1.54m to 39.03m bgl and post- monsoon depth to water level is observed to in the range of 0.62m – 36.42m.

It is observed that the ground water is suitable for drinking and domestic uses in respect of all the constituents except total Hardness and Nitrate. The over exploited blocks in this district are as follow.

- Annur
- Pollachi - south
- Pollachi –North
- Avinashi
- Sarkarsamakulam
- Kinathukadavu
- Sultanpet
- Madukarai
- Sulur

- P.N.Palayam
- Thondamuthur

The blocks such as Kinathukadavu, Sultanpet, Sulur and Sarkarsamakulam are either closer to or adjoining the proposed project blocks in the region. According to CGWB, development of ground water has already reached an alarming stage in many blocks of the district and **any further development of ground water has to be carried out with extreme caution. Necessary measures for regulation of ground water abstraction from over-exploited and critical blocks have been recommended for this district.**

CGWB has recommended similar kind of groundwater resource strengthening and augmentation measures as recommended for Tirunelveli district.

4.5.2 *Drainage Pattern*

Macro drainage pattern indicates that both the project districts are drained by non-perennial river systems such as Thamarabarani, Nambiar, Chittar and Karamanar in Tirunelveli district and Amaravathi, Shanmugha and Upparu in Tirupur district.

River Thamarabarani originating from Papanasam flows through Tirunelveli district. The Nambiar river originates in the eastern slopes of the Western ghats near Nellikalmottai. Chittar originates near Courtallam and flows through Tenkasi and confluences with Thamarabarani. The hilly terrains on the western part of the district have resulted in number of falls in the district. A series of falls in Chittar River in Courtallam comprising Five Falls, Honey Falls, Main falls and Old Courtallm Falls are some of the important falls in the area. The drainage pattern in general is dendritic in Tirunelveli district. Notably, in the context of the project, Chittar and Thamaraparani river system drains the project areas in the middle and southern portions of the district respectively.

The district of Tirupur is served by Amaravathi River system. The Amaravathi River rises in the Anjanad valley in the Kerala state between the Anamalai hills and the plains and flows in the northeastern direction. Amaravathi dam is located on this river. The Amaravathi River and its tributaries drain the southern part of the district. It enters the district at about 5 km south of Salempalayam. The major tributaries to Amaravathi River are the Uppar Odai, Shanmukha Nadi, Nallathangal Odai and Vattamalakkarai.

Among the tributaries, Uppar Odai is traversing closely to project sites located at Dharapuram block such as Kundadam, Ponnapuram and Sankarandampalayam. This tributary of River Amaravathi drains the project area in easterly direction. In the south of the district, River Amaravathi and its tributary River Shanmugha drains the region and flows from south west to north eastern direction into the district before flowing in easterly direction.

Water samples were collected from seven (7) ground water sources and one (1) surface water source in both the project regions of Tirunelveli and Tiruppur district. The geographic coordinates and location of the water sampling points is provided in *Table 4.6*. The water sampling points were chosen in and around the WTG project locations representing different land use and project activities.

Table 4.6 Water Quality Monitoring Location

Sample code	Geographic Coordinates	Village	Bearing/Location
WQ-1	N10°47' 51.3"; E 77°22' 34.1"	Sadayarpalayam	Near M14 Tower: Well water (onsite); East; Distance - 15 mtr; Depth - 30 feet; Total depth - 100 feet.
WQ-2	N10°47' 51.3"; E 77°22' 34.1"	Sadayarpalayam	Near M14 Tower - Borewell (farm site); South; Distance - 250 mtr, Depth - 300 feet
WQ-3	N10° 33' 03.9"; E77°24' 33.0"	Pushpathoor	Near G407 tower: Well water; Direction - North East; Distance - 150 mtr; Total Depth - 80 ft; Sample Depth - 30 ft
WQ-4	N10° 33' 03.9"; E77°24' 33.0"	Pushpathoor	Near G557 tower: Surface water; Direction - West; Distance - 200 mtr; Depth - 1 feet
WQ-5	N08°50' 28.9"; E77°37' 09.8"	Rastha	Near Tower M120: Open well water; Direction - West; Distance - 500 mtr; Total Depth - 20 feet, Sample Taken - 3 feet
WQ-6	N09°03' 16.8"; E77°33' 06.3"	Amuthapuram	Near TDA 65: Open well water; Direction - South; Distance - 800 mtr; Total Depth - 45 Feet; Sampling Depth - 3 Feet.
WQ-7	N09°03' 16.8"; E77°33' 06.3"	Amuthapuram	Near TDA 65: Borewell water;; Direction - East; Distance - 600 mtr; Depth - 200 mtr.
WQ-8	N08°50' 28.9"; E77°37' 09.8"	Rastha	Near Tower M120: Borewell water; Direction - North West; Distance - 3000 mtr; Depth - 200 mtr

The water samples collected were analyzed for parameters as per IS: 10500 standards and the results are presented in the *Table 4.7*. The analysis was undertaken as per IS 3025 and relevant APHA standard methods. The complete water quality monitoring results are presented in *Annexure*.

Observations of the water quality indicate that the water quality in both the project regions is not potable without treatment as some parameters are above the desirable limits set in IS 10500. Especially, the water quality in Tiruppur district fails the IS 10500 standards on many parameters. It is to be noted here that samples WQ1 to WQ4 were taken from Tiruppur district and WQ4 is a surface water sample taken from a stagnant water body close to a WTG tower to check if any pollution is caused by WTG tower operations.

All the samples including samples from Tirunelveli district **fail the bacteriological parameters** such as Faecal Coliform and Total Coliform (except for WQ2 and WQ4). Faecal streptococci was observed to be present in WQ 6 sample collected from Tirunelveli district from a open well near Amudhapuram village. Again all samples fail the desirable mineral oil limits set by IS 10500 standards. Alkalinity and Total Hardness were also observed to be higher or closer to desirable limits across all samples.

Samples WQ 1 to 4 also exhibit higher Magnesium, Calcium and TDS levels. **Importantly, presence of Lead has been reported in all samples except WQ 2 and 3 at higher than desirable standard of 0.05 mg/l.** Arsenic and Fluoride levels were found to be lesser than desirable standards across all water samples but fluoride levels are closer to the desirable limits. Cadmium is found to be higher than limits in WQ5 sample. Nitrate is also found to be high in samples WQ 1 to 4 but lesser than limits set forth for Nitrates. However, WQ 2 fails the Nitrate standards. Manganese was found to be higher in sample WQ 4 which is a surface water sample.

Overall, water quality assessment indicates that water in the project regions is not potable without adequate treatment.

Table 4.7 Results of Water Quality Assessment

S.No	Parameters	Units	WQ-1	WQ-2	WQ-3	WQ-4	WQ-5	WQ-6	WQ-7	WQ-8	IS -10500 Limits - Desirable
1.	Colour	Hazen	< 1.0	< 1.0	< 1.0	15	< 1.0	< 1.0	< 1.0	< 1.0	5
2.	Odour	---	UO	UO	UO	UO	UO	UO	UO	UO	Unobjectionable (UO)
3.	Turbidity	NTU	< 0.5	< 0.5	< 0.5	0.8	< 0.5	< 0.5	< 0.5	< 0.5	5
4.	Taste	---	A	A	A	DA	A	A	A	A	Agreeable (A)/Disagreeable (DA)
5.	pH	No.	7.5	7.7	7.4	8.9	7.1	7.2	7.9	7.7	6.5 – 8.5
6.	Total Dissolved Solids	mg/l	520	527	788	613	158	151	167	347	500
7.	Chlorides (as Cl ⁻)	mg/l	36	36	128	206	16	28	21	43	250
8.	Sulphates (as SO ₄ ⁻²)	mg/l	108	151	51	84	9.3	12	6.7	12	200
9.	Calcium (as Ca)	mg/l	73	79	124	40	16	14	24	31	75
10.	Magnesium (as Mg)	mg/l	23	61	41	24	10	5.4	7.1	13	30
11.	Total Hardness(asCaCO ₃)	mg/l	277	351	475	162	81	57	89	130	300
12.	Total Alkalinity (asCaCO ₃)	mg/l	166	164	219	107	111	55	219	114	200
13.	Iron (as Fe)	mg/l	< 0.01	< 0.01	< 0.1	< 0.01	0.13	0.2	0.11	0.11	0.3
14.	Residual Chlorine	mg/l	Nil	Nil	Nil	1.5	Nil	Nil	Nil	Nil	0.2
15.	Fluoride (as F)	mg/l	0.4	0.6	0.7	0.5	0.16	0.06	0.15	0.61	1
16.	Copper (as Cu)	mg/l	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	0.05
17.	Manganese (as Mn)	mg/l	0.09	0.06	0.05	0.17	< 0.03	< 0.03	0.08	0.04	0.1
18.	Nitrate (as NO ₃)	mg/l	35	58	43	44	1.5	4.3	3	1.5	45
19.	Mercury (as Hg)	mg/l	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.001
20.	Cadmium (as Cd)	mg/l	< 0.005	< 0.005	< 0.005	< 0.005	0.01	< 0.005	< 0.005	< 0.005	0.01
21.	Selenium (as Se)	mg/l	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.01
22.	Arsenic (as As)	mg/l	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.01
23.	Cyanide (as CN)	mg/l	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	0.05

S.No	Parameters	Units	WQ-1	WQ-2	WQ-3	WQ-4	WQ-5	WQ-6	WQ-7	WQ-8	IS -10500 Limits - Desirable
24.	Lead (as Pb)	mg/l	< 0.05	< 0.005	< 0.005	< 0.05	0.19	0.13	0.07	0.13	0.05
25.	Zinc (as Zn)	mg/l	0.02	0.01	0.01	0.01	0.06	0.01	0.02	0.01	5
26.	Anionic Active Surfactant (as MBAS)	mg/l	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.2
27.	Hexvalent Chromium (as Cr)	mg/l	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.05
28.	Mineral Oil	mg/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	0.01
29.	Aluminium (as Al)	mg/l	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.03
30.	Boron (as B)	mg/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	1
31	Total coliform/100ml	MPN	14	2	8	< 2.0	9	80	33	17	10
32	Faecal coliform (E.Coli)/100ml	MPN	4	< 2.0	2	< 2.0	< 2.0	4	< 2.0	< 2.0	Absent
33	Aerobic MicrobialCount/ml	CFU	32	90	31	39	95	251	1150	198	---
34	Faecal Streptococci/250ml	----	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	---

Soils in Tirunelveli district¹ have been classified into

- Deep red soil
- Red sandy soil
- Black cotton soil
- Saline coastal alluvium
- River alluvium

Major parts of the district are covered by deep red soil and are found in Sivakasi, Tenkasi, Senkottai and Sankarankoil blocks and it is suitable for cultivating coconut and palmyrah trees. Red sandy soil also found in reddish yellow colour are found in Nanguneri, Ambasamudram, and Radhapuram blocks and it is suitable for cultivating groundnut, millets and pulses etc. The black cotton soil is found in Tirunelveli, Palayankottai and Sankarankoil blocks, and it is suitable for cultivating Paddy, Ragi, and Cholan etc.

The river alluvial soils occur along the river courses of Tamrabarani and Chittar River covering the blocks Tirunelveli and Palayankottai and it is suitable for cultivating Groundnut, Chillies and Cumbu.

The soils of Coimbatore district¹ can be broadly classified into six (6) major soils types:

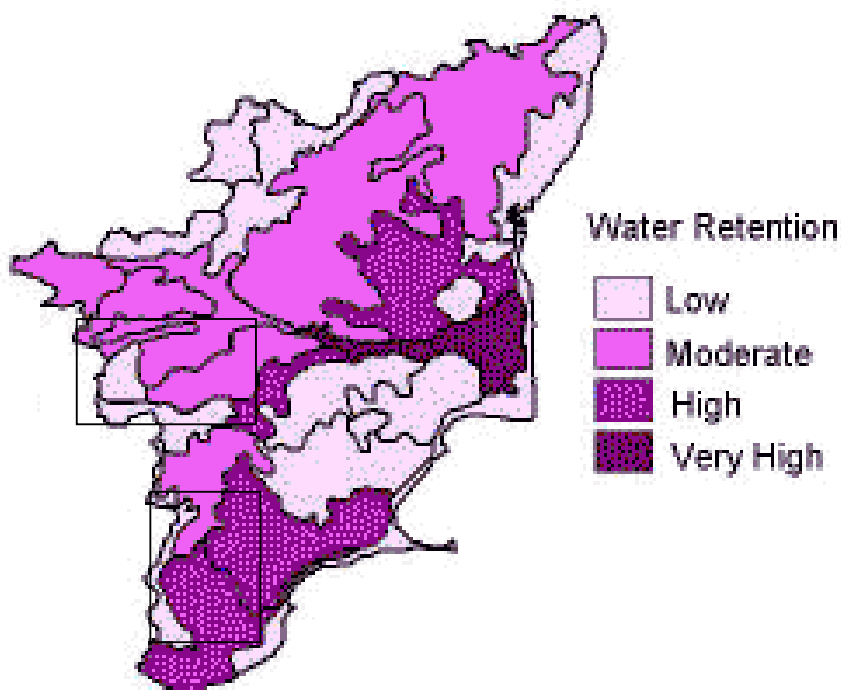
- Red calcareous soil
- Black soil
- Red non-calcareous
- Alluvial and colluvial soil
- Brown soil
- Forest soil.

About 60 per cent of the district is covered by red soils, of which red calcareous soil is predominant. They occupy most parts of Palladam, Coimbatore, Mettupalayam and Udumalpet taluks. Medium to deep red calcareous soils are found mainly in Pollachi and Udumalpet taluks. Parts of Palladam, Avinashi and Udumalpet taluks are occupied by red non-calcareous soils. The highlands in Coimbatore, Palladam and Avinashi taluks are mostly occupied by the black soils, which are dark gray to grayish brown in colour.

Based on water retention characteristics, Tiruppur district is found to have soils that have moderate water retention characteristic whereas in Tirunelveli district, the soil type exhibit high to moderate water retention characteristics (see *Figure 4.13*).

(1) ¹ Source: Abstracted from District Ground water Profile reports prepared by CGWB

Figure 4.13 Soil Type Based on Water Retention Characteristics for the State of Tamil Nadu (Project Regions are highlighted)



4.6.1 Soil Quality Assessment

Primary soil quality assessment was undertaken and soil samples were collected from eight (8) different locations in the project regions within the top one (1) feet depth. The details of sampling locations are given *Table 4.8*. The soil samples were collected in and around the WTG project sites representing different land use and project activities.

Table 4.8 Soil Sampling Locations in the Study Area

Sample code	Geographic Coordinates	Village	Bearing	Landuse
SQ-1	N10°47' 51.3"; E 77°22' 34.1"	Sadayarpalayam	North, 200 mtr from Tower M 14	Agricultural land
SQ-2	N 10°33' 03.9"; E 77°24' 33.0"	Pushpathoor	West, 100 mtr from G 557 Tower	WTG land – barren
SQ-3	N 08 50' 28.9"; E 77° 37' 09.8"	Rastha	North, 15 mtr from M 120 Tower	WTG Land – barren
SQ-4	N 08 50' 28.9"; E 77° 37' 09.8"	Rastha	East, 500 mtr from Tower M 137	Barren land
SQ-5	N 10° 33' 03.9"; E 77°24'33.0"	Pushpathoor	North – West, 100 mtr from G 407 Tower	Barren land
SQ-6	N10°47' 51.3"; E 77°22' 34.1"	Sadayarpalayam	South, 50 mtr from Near M 14 Tower	WTG lands (below tower)
SQ-7	N 09°03' 16.8"; E77° 33' 06.3"	Amudhapuram	South, 15 mtr from TDA 65	WTG land

Sample code	Geographic Coordinates	Village	Bearing	Landuse
SQ-8	N 09°03' 16.8"; E77° 33' 06.3"	Amudhapuram	East, 300 mtr from TDA 65 tower	Adjacent to tower – barren

The collected top soil samples were tested for following physical and chemical parameters as per relevant IS, USEPA and APHA standards {such as IS 2720 (Part – 4); IS 14767:2000; corresponding USEPA and APHA standards}:

Physical Parameters

- Particle Size Distribution
- Porosity
- Texture
- Lime Status
- pH
- Permeability
- Electrical conductivity

Chemicals Parameters:

- Nitrites
- Nitrates
- TPH
- Phosphorus
- Potassium
- Iron
- Lead (as Pb)
- Manganese
- Nickel
- Barium (Ba)
- Zinc
- Copper
- Cadmium
- Chromium (as Cr)
- Arsenic (as As)
- Mercury
- Total Hydrocarbons
- Cation Exchange Capacity

The results of top soil quality monitoring for key parameters are summarised in *Table 4.9*. The complete soil quality monitoring results are presented in *Annexure*.

Table 4.9 Soil Quality Assessment – Key Results

Sample code	Village	Soil Texture	Permeability, cm/sec
SQ-1	Sadayarpalayam	Sandy loam	1.73x10 ⁻²
SQ-2	Pushpathoor	Loamy sand	1.95x10 ⁻²
SQ-3	Rastha	Sandy loam	1.61x10 ⁻²
SQ-4	Rastha	Loamy sand	1.08 x10 ⁻²
SQ-5	Pushpathoor	Loamy sand	1.24 x10 ⁻²

Sample code	Village	Soil Texture	Permeability, cm/sec
SQ-6	Sadayarpalayam	Sandy loam	2.10×10^{-2}
SQ-7	Amudhapuram	Sandy loam	1.59×10^{-2}
SQ-8	Amudhapuram	Sandy loam	1.80×10^{-2}

The top soil texture in both the project sites indicate that it varies from sandy loam to loamy sand. Texture type indicates that top soil in WTG locations are highly erodible if appropriate soil erosion control measures are not taken and implemented. The permeability values indicate that top soil has pervious to semi-pervious characteristic and will enable good drainage and percolation down the ground.

Chemical parameters and heavy metals were checked for probable contamination levels in line with the groundwater target values and soil and groundwater intervention values recommended by Government of Netherlands. As Indian standards are not available for identifying contamination of ground water and soil environment, the global best practice standards formulated by Government of Netherlands has been taken for reference. The quality monitoring results indicate that chemical parameters especially heavy metals such as cadmium, copper, lead and mercury are below their respective detection limits as provided. Total petroleum hydrocarbons (TPH) and Total Hydrocarbons were not detected at any of the eight samples analysed indicating no or minor impact on soil quality due to WTG tower construction and operations.

4.7

AMBIENT NOISE LEVEL

The primary ambient noise level (ANL) monitoring was undertaken during the month of January 2011 for a period of one week to capture the background ANLs. Wind farm sites do generate and contribute to ANLs all through the day and night. As the project background setting is repetitive all across the project sites and districts, one week monitoring is considered adequate to assess the baseline ANLs.

Ambient noise level (ANL) was monitored at four different locations in both the project regions. The locations identified for ANL monitoring with details are provided in **Table 4.10**. The noise monitoring locations selected were in and around the WTG project sites representing different land use patterns, different project activities and sensitive receptors.

Table 4.10 *Noise Monitoring Locations in the Project Regions*

Sample code	Geographic Coordinates	Village	Bearing	Landuse
NL-1	N10°47' 51.3"; E 77°22' 34.1"	Sadayarpalayam	M14 Tower	Agricultural

Sample code	Geographic Coordinates	Village	Bearing	Landuse
NL-2	N10° 33' 03.9"; E77°24' 33.0"	Pushpathoor	North, 100m from G407 tower and in between two towers; also closer to a dwelling unit.	Agricultural
NL-3	N08°50' 28.9"; E77°37' 09.8"	Rastha	Tower M120	WTG location
NL-4	N09°03' 16.8"; E77°33' 06.3"	Amuthapuram	TDA 65	WTG under construction

ANL were monitored on hourly basis using hand held ANL pre-calibrated meter. The hourly maximum and minimum ANLs were recorded based on which equivalent noise levels (L_{eq}) for day, night and day-night durations were calculated.

The ANL monitoring locations were identified to give representative scenario of all possible land use scenarios in the two different project regions, project activities (construction and operational phases) and sensitive receptors near the wind energy project locations. As can be seen from above Table, NL-2 and NL-4 were selected to represent sensitive receptor and construction phase scenario respectively. At NL-2, intentionally the ANL was monitored between two WTG tower locations and closer to a sensitive receptor that was present in the form of farm dwelling unit.

The observations of noise monitoring was calculated as Leq_{Day} (averaged sound level for day) and Leq_{Night} (averaged sound level for night time). The key results of ANL monitoring are presented in the **Table 4.11**. The complete ANL monitoring results are presented in **Annexure**.

Table 4.11 Results of Ambient Noise Monitoring

Location Code	CPCB norm*	NL-1	NL-2	NL-3	NL-4
Leq Day dB (A)	55	47.8 - 50.5	47.5 - 50.7	65.0-70.5	62.7-80.2
Leq Night dB (A)	45	39.1 - 42.0	48.4 - 51.7	50.5-68.8	55.5-76.9

*Standard for rural/residential areas; Leq Day: Equivalent Noise Level reckoned from 0600 hours to 2200 hours; Leq Night: Equivalent Noise Levels reckoned from 2200 hours to 0600 hours.

The ambient noise levels observed below the WTG tower in the project region are well above the CPCB norms for rural/residential areas for day and night time in Tirunelveli district.

In the case of Tiruppur district, the ANLs monitored were within the CPCB standards except for night time standards at NL-2 location. The ANL monitoring results indicate key factors that include:

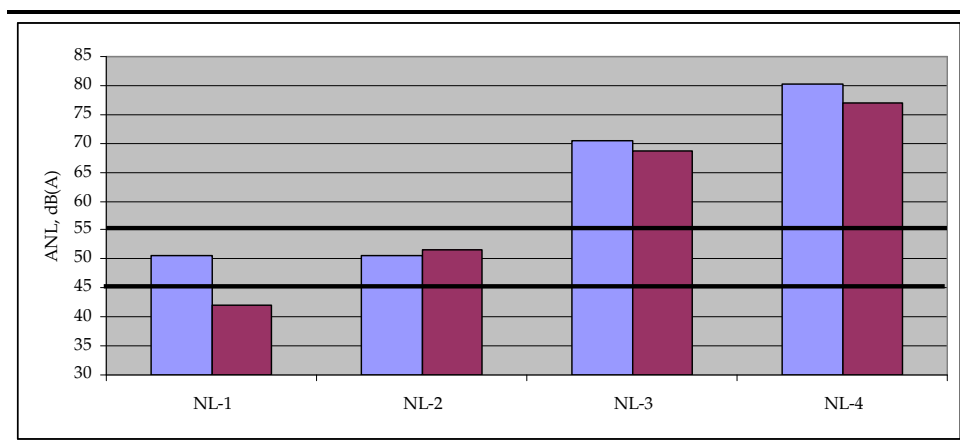
- Noise level generated at the bottom of the tower by 1.5MW and 2.1 MW WTG machines are higher than the 600 KW WTG machines;
- In a clear and open area with no physical barriers in between, there has been 6-8 dB(A) attenuation in ANLs at about 100m distance from the

bottom of the tower (*this aspect was physically checked during ANL monitoring to check the natural attenuation efficacy*);

- Considering the radial distance at which the WTG towers are placed (5d and 7d distances), there is no significant cumulative addition to background noise levels in the project region especially during day time.
- However, during night time, cumulative noise level impact could become significant due to calmer background levels or difference in wind speed between day and night times (that is higher wind speed in night when compared to day could also result in higher cumulative noise levels). This cumulative noise impact aspect was also checked by selecting the NL-1 and NL-2 monitoring stations in such a way that NL-2 represents the cumulative impact to the extent possible by placing it in between two WTG towers whereas NL-1 was placed below an operating tower in the same region. The night time L_{eq} for NL-1 and NL-2 has a significant difference of almost 10dB(A) which indicates that cumulative noise impact could be an issue during night time than day light hours on sensitive receptors, if located within 100-150m of a WTG tower or group of them.

The ANL monitoring results are depicted graphically in **Figure 4.14**

Figure 4.14 Observations of Noise Level in the Study Area



4.7.1 ANL Monitoring Undertaken by Suzlon

Suzlon as part of its HSE Management systems has instituted ANL monitoring program once in 3 months across randomly selected project operational areas and WTG towers. This monitoring program has been instituted since last two years and on request has shared with ERM one such monitoring program results that were undertaken in January 2011 at Devarkulam Operational Centre in Tirunelveli district.

The results of Suzlon monitoring program are presented in **Table 4.12**.

Table 4.12 *Instantaneous Noise Levels Measured at various Operational Areas at Devarkulam, OMS Centre of Suzlon*

SNO	Area	Noise Level, dB(A) measured as on 18 th Jan 2011
1	Area Incharge Office	53.50
2	Site Incharge Office	54.00
3	Area monitoring Center	52.00
4	BRT room	50.00
5	Conference Hall	52.00
6	Canteen - Cooking Room	60.00
7	Canteen Hall	41.00
8	SRC room	52.00
9	Area Staff room	42.00
10	Lubricant store	60.00
11	Mechanical stores	55.00
12	Mechanical SRC Room	54.00
13	HR and Admin room	52.00
14	UPS Room	55.00
	WTG Tower	
15	M/C Control Room Bottom	77.00
16	Tubular – Shell	77.00
17	Nacelle	99.00

Source: Data furnished by Suzlon on request

As can be inferred from the above data, most of the operational areas such as Suzlon OMS office buildings, stores have ANLs around or above recommended noise levels during day time i.e. 55dB(A). Considering that Suzlon OMS building and store facilities are located in the midst of WTG towers, the cumulative noise impact is minor during day-time as the noise levels at turbine location is as high as 99 dB(A). As night time ANLs are not monitored by Suzlon, the cumulative impact during night time hours could not be assessed.

4.8 *ECOLOGY*

A detailed ecological assessment of the project sites at four locations near the existing WTG towers in both the project districts was undertaken to understand the existing flora and fauna. The details of the survey are presented in the following subsections.

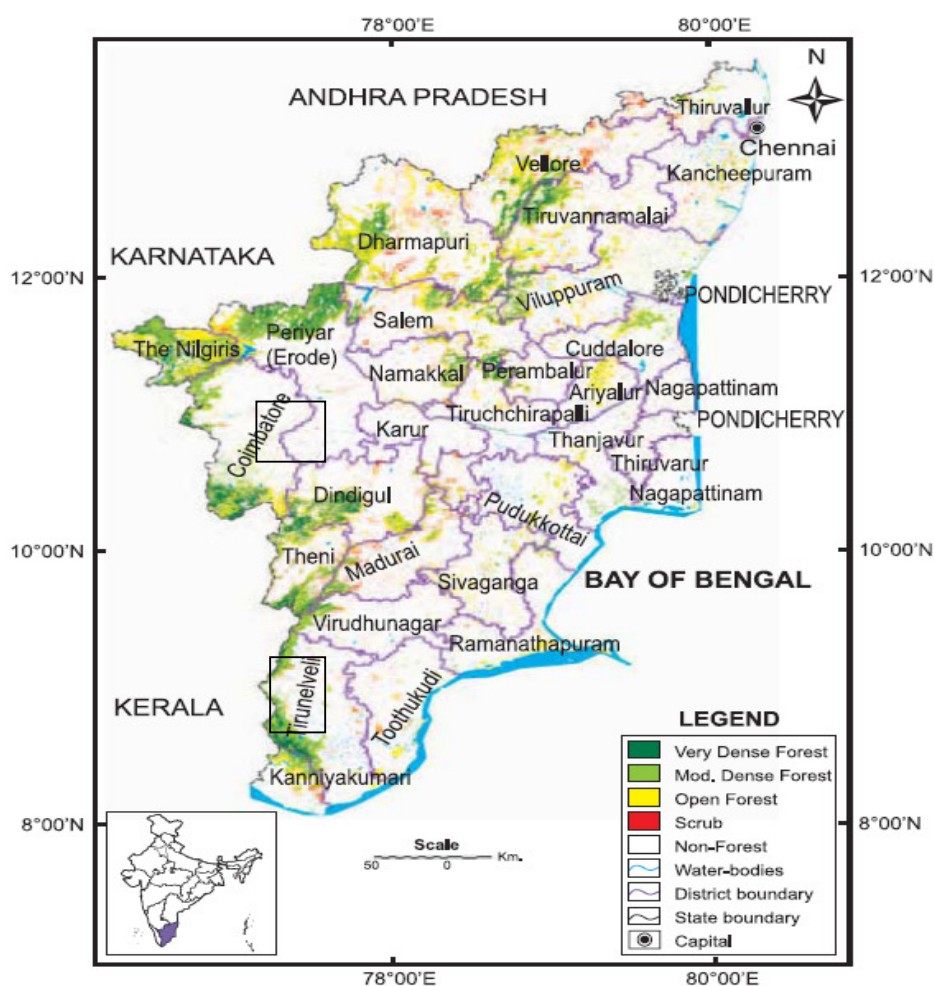
Overview of the Project Districts

The project districts of Tirunelveli and Tirupur districts have low forest cover less than the National average. Tirunelveli district has about 18% of its geographical area covered with forest. The entire forest of the district stretches along the Western ghats. Various types of forests from luxuriant tropical wet evergreen forests to southern thorn scrub forests occur in the district. Owing to its diverse geographical factors, the forests in the district are technically classified as Southern hill top tropical evergreen forests, West Coast tropical evergreen forests, Southern moist mixed deciduous forests, Ochlandra reed

forests, Carnatic umbrella thorn forests Southern Euphorbia scrub and Southern thorn scrub.

For Tiruppur district direct data on forest cover is not available as it was a newly formed district in the year 2009 from the existing Coimbatore, Erode and Dindigul districts. However, as per the FSI map (Refer Figure 4.15), the forest cover for Tiruppur district is not expected to be higher than Tirunelveli district.

Figure 4.15 Forest and Vegetation Cover of the Project Regions (Highlighted)



Source: http://www.fsi.nic.in/sfr_2009/tamilnadu.pdf

Project districts have certain ecological areas either declared as protected areas under ecological regulations of the Country/State or conserved as ecologically rich areas such as the following:

- Mundanthurai-Kalakad Wildlife Sanctuary (WLS) in Tirunelveli district is developed as a National Tiger Reserve with a total area of 817 sq. km in the south most western ghat ranges. The nearest stations are Cheranmahadevi, and Ambasamudaram which are 20kms and 15 kms

respectively from Tirunelveli. Out of 817 sq. kms, 459 sq.kms is in core zone and 358 sq.kms. is in buffer zone. This WLS is located at about 38kms distance from the nearest WTG location;

- Birds Sanctuary at Koonthankulam - A tiny village in the far south, Koonthankulam in Nanguneri Taluk of Tirunelveli District is emerging as a new favourite of the migratory birds. It is just 38 Kms. away from Tirunelveli and is in the nearby Nanguneri Taluk. Ariyakulam bird sanctuary is another neighborhood sanctuary located east of Koonthankulam at about 13kms distance. This bird sanctuary is located at about 50kms distance from the nearest WTG location;
- Indira Gandhi Wildlife Sanctuary is spread over at the altitude of 1400m in the western ghats area of Pollachi, Valparai and Udumalpet. The area of the sanctuary is 958 sqkm out of which only 387 sqkm is located within Tirupur district. From Darapuram, the WLS is located at 54kms distance and 24kms from Udumalpet which are the southern boundaries of project site;
- Part of Amaravathy RF, Anaimalai RF and Anaimalai Wildlife Sanctuary is located within Tirupur district. From Darapuram, the Amaravathy Dam is located at 47 kms distance and from Udumalpet it is located at 19kms distance;
- Grass Hills forest at a distance of 15kms from Valparai in Coimbatore district. From Darapuram, Valparai is located at 77 kms distance and from Udumalpet it is located at 42 kms distance; and
- Oothumalai RF near Sankarankovil in Tirunelveli district is located in the midst of Devarkulam project site of Suzlon. Uthumalai village is located at 10km distance from Devarkulam and the forest boundaries could be located anywhere between 5-10km distance from Devarkulam.

Other than these ecological resources which are located well away from project sites except for Oothumalai RF (where again no wind farm projects have been sited), no other significant ecological resource has been reported by the concerned stakeholders (State Forest Department) whom were consulted as part of baseline assessment.

4.8.2 Approach to Ecological Assessment

A primary ecological assessment of the project sites at four locations near the existing WTG towers in both the project districts was undertaken to understand the existing flora and fauna. The ecological assessment sites were located in the midst of proposed WTG project locations and are a fair representation of ecological environment that will be encountered at the proposed WTG locations. The approach to ecological assessment was as follows:

- Field visits were undertaken for the ecological assessment and survey of the vegetation in the project area;
- The office of the Regional Forest officer of the Tirunelveli and Tiruppur (Coimbatore office was consulted) districts was visited for studying distribution of the forest areas in the region;

- Extensive literature survey was done to review previous studies on vegetation and ecology of the region. Based upon which a list of flora and fauna was compiled; and
- The diversity of the vegetation and its distribution has been determined after field survey and data collection.

The survey was conducted over a period of four days, between 28th January and 5th February 2011. The weather was generally dry with full sunshine.

Methodology

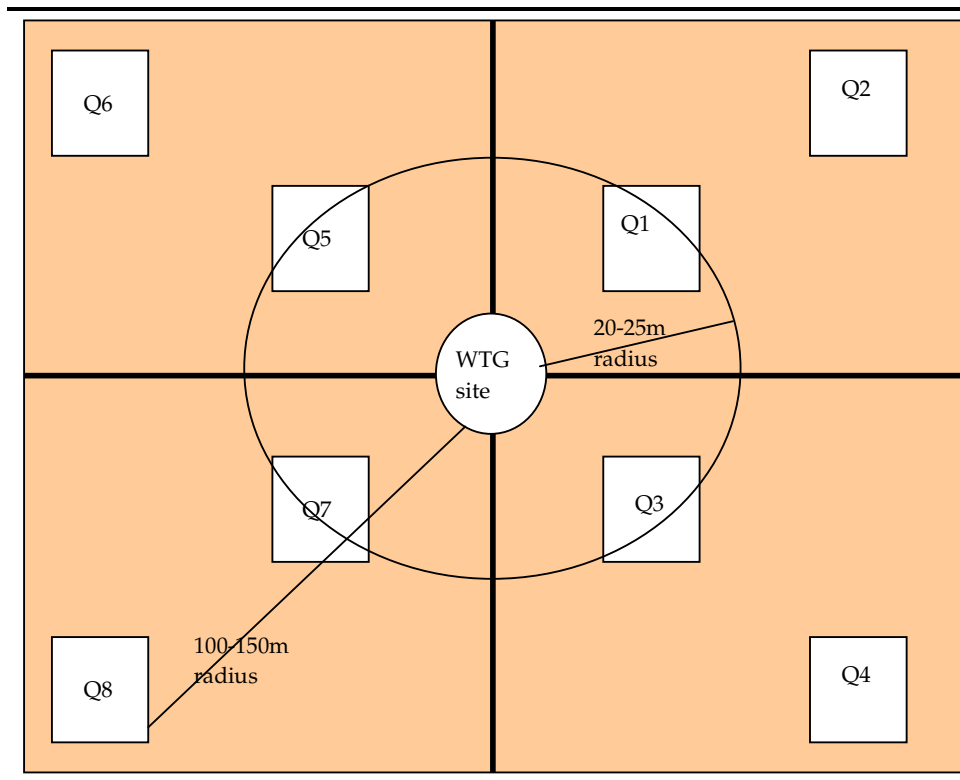
The study area at each of the assessment location (WTG site) was divided into four quadrants by two perpendicular transect lines running east - west & north – south to obtain 4 quadrants, as given in *Table 4.13* and shown in *Figure 4.16*.

Table 4.13 *Quadrants Identified for Ecological Survey*

Quadrant	Bearing to the site	No of Quadrates sampled
Q1	North – East	2
Q2	North – West	2
Q3	South – West	2
Q4	South – East	2

A total 8 quadrates were identified adjacent to WTG sites such that a range of ecosystem and land-use types were represented.

Figure 4.16 *Location for Ecological Sampling*



At each site, a study of floral diversity was carried out in the following manner:

- A quadrat of approximately 20 m x 20 m was marked. The species of trees, shrubs and large climbers, as well as the number of individuals of each species, falling within this area were noted;
- A quadrat of approximately 5 m x 5 m was marked around the centre of this larger quadrat. The number of species of herbs, both grasses and forbs, as well as the number of individuals of each species, falling within this area were noted;
- Smaller quadrats of 1m x 1 m, for the more prolifically growing larger herbs, and 10 cm x 10 cm, for prolifically growing minute herbs, were employed when required;

Quadrat analysis was then performed and phyto-sociological parameters were worked out. At each site, faunal diversity was studied through direct evidence, in the form of visual sightings, and indirect evidence such as calls, nests, burrows, droppings, scats, moults, tracks, etc. Secondary data was collected from the forest working plan of the concerned districts, and by consulting with the RFO. Observations of members of the local community, regarding local flora and fauna, were also noted.

4.8.3 *Ecological Diversity of the Project Sites*

The floral and faunal diversity analysis of the representative project sites at Amudhapuram, Rasta, Sadayarpalayam and Pushpatoor villages indicate the following:

- most of the floral species within the WTG locations were shrubs with the mean height of 0.4-0.6 mts;
- About 17 floral species were identified and none are uncommon;
- Domestic animals were prominent among the faunal population recorded during the study which includes cow, buffalo and goat; and
- Other faunal species on an average recorded include reptiles (4 species), anthropods (3 species), aves (13 species), mammals (9 species).

These observations are in line with the secondary data collected for the entire district

Reserve Forest in Project Sites

As highlighted earlier, discussions with local Forest Division Office reveals that there are no reserved forest areas in wind farm prominent sites except for Oothumalai RF in Tirunelveli district. Other RFs present in the project districts are well away from the wind farm sites.

Avifauna

The prominent species among avian fauna across the project sites recorded are presented in **Table 4.14**. Among the 13 species observed, only one Bristled Grassbird has been observed to be in vulnerable status.

Table 4.14 Details of Avifaunal Diversity

Species	Local Name	IUCN Red Data status
<i>Passer domesticus</i>	House Sparrow	Least concern
<i>Chaetornis striata</i>	Monitor Sparrow (Bristled Grassbird)	Vulnerable
<i>Cuculus varius</i>	Kite	Least concern
<i>Corvus splendens</i>	Crow	Least concern
<i>Pavo cristatus</i>	Peacock	Least concern
<i>Columba livia</i>	Pigeon	Least concern
<i>Merops orientalis</i>	Bee eater	Least concern
<i>Eudynamis scolopacea</i>	Kuail	Least concern
<i>Acriclo tritis</i>	Myna	Least concern
<i>Egretta garzetta</i>	Egret	Least concern
<i>Psittacula krameri</i>	Parrot	Least concern
<i>Dicrurus macrocercus</i>	Drango	Least concern
<i>Cinnyris jugularis</i>	Then chittu	Least concern

Source: As Surveyed

The primary data on avian population is in line with secondary information available for the districts. However, at district level there are 75 avian faunal species mainly due to western ghats region which has thick forests and offers rich ecological resources for avian fauna. The list of avian fauna found in the district is presented at Annexure.

Carcass Survey

As part of the ecological assessment, carcass survey was undertaken at all four WTG sites chosen for ecological assessment. Random walk through was undertaken at WTG site particularly along perpendicular direction to prominent wind direction as any bird carcass would have fallen along perpendicular direction to the wind. However, during the survey, no carcass could be found. Consultations with local stakeholders indicate that no bird hits were observed by them ever since the wind energy projects have come up in the region. Though bird hits cannot be completely ruled out, dead carcass could have been taken away by scavenging animals such as dogs and crow. This aspect of wind farm projects need sustained monitoring and assessment as the one week monitoring was not sufficient to analyse it appropriately.

Migratory Avifauna

As per the local forest department offices, the project sites in both the districts do not lie along the migratory path of avian fauna that are headed towards

Koonthankulam and Ariyakulam twin bird sanctuaries located south of Tirunelveli town in Nanguneri Taluk.

Koonthankulam Birds Sanctuary

Koonthankulam Birds Sanctuary is a unique sanctuary actively protected and managed by the Koonthakulam village community. The largest breeding water bird reserve in south India attracts more than one lakh birds annually. It is located 35 kms away from Tirunelveli in Tirunelveli -Thisaianvilai Road comprising of Koonthankulam and Kadankulam tanks covering an extent of 129.33 hectares and declared as sanctuary in 1994. Another neighbourhood bird sanctuary at Ariyakulam is located at 13km from Koonthankulam on its east.

It is significant that the local people have taken keen interest in protecting this sanctuary and they live together in total symbiotic relationship. The birds coming to their backyards for five generations are protected vehemently by villagers and regarded as harbingers of luck. The excreta of birds –‘guano’ is collected by villagers in summer along with silt to use as fertilizer in their fields. Chicks fallen are taken care of in the rescue centre till they are able to fly on their own.

Flora within the sanctuary

The Babul plantation of 30 ha. in Koonthakulam is the main breeding ground for birds.

Fauna within the sanctuary

More than 43 water birds both resident and migratory are visiting every year regularly in the month of January/February and used to vacate in the month of July/August after nesting, hatching and nurturing the young ones. Many large water birds especially Painted stork, Flamingos have been nesting annually around Koonthankulam village over a long period. *Accacia nilotica* trees are grown in the tank foreshores by the Social Forestry Division of Forest Department and also in village trees.

The following table lists the migratory birds that visit this area from different countries mentioned against them and their conservation status.

Table 4.15 *Migratory birds visiting the project area*

Migratory Birds	IUCN Red Data Status
Barheaded Goose (Siberia)	Anser indicus (Bar-headed Goose) Status: Least Concern
White stork (Germany)	Ciconia ciconia (White Stork) Status: Least Concern
Pintail (Siberia)	Anas acuta (Northern Pintail) Status: Least Concern
Large flamingo (Partially from Germany)	Phoenicopterus roseus (Greater Flamingo) Status: Least Concern
Spotted Sand Piper (Siberia)	Actitis macularius (Spotted Sandpiper) Status:

Migratory Birds	IUCN Red Data Status
	Least Concern
Common Sand Piper (Lower part of Ladak)	Actitis hypoleucos (Common Sandpiper) Status: Least Concern
Green Sand Piper (Siberia)	Tringa ochropus (Green Sandpiper) Status: Least Concern
Common Teal (Siberia)	Anas crecca (Common Teal) Status: Least Concern
Green Shank (Northern end of Siberia)	Tringa nebularia (Common Greenshank) Status: Least Concern
Palawan (Siberia)	Collocalia palawanensis (Palawan Swiftlet) Status: Least Concern
Coot (Central Siberia)	Fulica atra (Common Coot) Status: Least Concern

The following table lists the water birds that also play an important role in occupying the trees in and around the Koonthankulam Sanctuary during January to August of every year from other parts of our country. The table also presents their conservation status as per IUCN Red Data Book.

Table 4.16 *Avifauna of Koonthankulam bird sanctuary*

National Migratory Birds	IUCN Red Data Status
Dabchick or Little Grebe	Tachybaptus ruficollis (Little Grebe) Status: Least Concern
White Ibis	Eudocimus albus (White Ibis) Status: Least Concern
Grey or Spottedbilled Pelican	Pelecanus philippensis (Spot-billed Pelican) Status: Near Threatened
Glossy Ibis	Plegadis falcinellus (Glossy Ibis) Status: Least Concern
Large Cormorant	Phalacrocorax fuscicollis (Indian Cormorant) Status: Least Concern
Spoonbill	Eurynorhynchus pygmeus (Spoon-billed Sandpiper) Status: Critically Endangered
Lesser Cormorant	Phalacrocorax sulcirostris (Little Black Cormorant) Status: Least Concern
Spotbill Duck	Anas poecilorhyncha (Spot-billed Duck) Status: Least Concern
Little Cormorant	Phalacrocorax niger (Little Cormorant) Status: Least Concern
Cotton Teal or Pygmy Goose	Nettapus coromandelianus (Cotton Pygmy-goose) Status: Least Concern
Grey Heron	Ardea cinerea (Grey Heron) Status: Least Concern
Indian Moorhen	Gallinula chloropus (Common Moorhen) Status: Least Concern
Purple Heron	Ardea purpurea (Purple Heron) Status: Least Concern
Purple Moorhen	Porphyrio porphyrio (Purple Swamphen) Status: Least Concern
Darter or Snake Bird	Anhinga melanogaster (Oriental Darter) Status: Near Threatened
Pheasant-tailed Jacana	Hydrophasianus chirurgus (Pheasant-tailed Jacana) Status: Least Concern
Large Egret	Casmerodius albus (Great Egret) Status: Least Concern
Bronzewinged Jacana	Metopidius indicus (Bronze-winged Jacana) Status: Least Concern
Pond Heron	Ardeola grayii (Indian Pond-heron) Status: Least Concern
Brahminy Kite	Haliastur indus (Brahminy Kite) Status: Least Concern
Cattle Egret	Bubulcus ibis (Cattle Egret) Status: Least Concern
Whitebreasted Waterhen	Amaurornis phoenicurus (White-breasted Waterhen) Status: Least Concern
Smaller or Medium Egret	Mesophoyx intermedia (Intermediate Egret) Status: Least Concern
Blackwinged Stilt	Himantopus himantopus (Black-winged Stilt) Status: Least Concern

National Migratory Birds	IUCN Red Data Status
Little Egret	Egretta garzetta (Little Egret) Status: Least Concern
Redwattled Lapwing	Vanellus indicus (Red-wattled Lapwing) Status: Least Concern
Night Heron	Nycticorax nycticorax (Black-crowned Night-heron) Status: Least Concern
Pied Kingfisher	Ceryle rudis (Pied Kingfisher) Status: Least Concern
Painted Stork	Mycteria leucocephala (Painted Stork) Status: Near Threatened
Whitebreasted Kingfisher	Halcyon smyrnensis (White-throated Kingfisher) Status: Least Concern
Openbill Stork	Anastomus oscitans (Asian Openbill) Status: Least Concern
Indian Pied Wagtail	Motacilla alba (White Wagtail) Status: Least Concern
Small king fisher	Alcedo atthis (Common Kingfisher) Status: Least Concern

Among the international migratory birds, no endangered species were observed as per IUCN Red data book. However, among the local species, following four (4) species were identified as near threatened or critically endangered:

- Grey or Spottedbilled Pelican
- Spoonbill
- Darter or Snake Bird
- Painted Stork

4.9

CULTURAL ENVIRONMENT

As per World Bank Operational Policy 4.11, physical cultural resources are defined as movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Physical cultural resources may be located in urban or rural settings, and may be above or below ground, or under water. Their cultural interest may be at the local, provincial or national level, or within the international community. Physical cultural resources are important as sources of valuable scientific and historical information, as assets for economic and social development, and as integral parts of a people's cultural identity and practices.

As per IFC Performance Standard 8 on Cultural heritage, tangible forms of cultural heritage like property or site having archaeological, historical, artistic or religious value or unique natural environmental features like sacred groves and also intangible forms, such as cultural knowledge, innovations and practices of communities embodying traditional lifestyles, are also to be protected and not impacted upon by project activities. The requirements of IFC Performance Standard apply to cultural heritage regardless of whether or not it has been legally protected or previously disturbed.

In light of the above discussions, as part of baseline assessment, secondary literature review and stakeholder consultations were undertaken including local community consultations to assess the cultural environment in both the

project regions. Specifically, the following stakeholders were consulted during primary monitoring and field visits on cultural environmental issues:

- Tourist Officer, Incharge, Tirunelveli District
- State Archaeological Department, Tirunelveli District
- Deputy Tahsildar, Taluk Office, Palladam, Tirupur District
- Environmental Centre, Manonmaniam Sundaranar University, Tirunelveli District
- Panchayat members of Panavadalichatram, Tirunelveli District
- School Teachers from Darapuram Higher Secondary School, Tirupur District

Based on the consultations and review of secondary literature, it is observed that there are no archaeological and historical sites of importance in proximity to the project sites and specifically in following project blocks (Tiruppur and Tirunelveli):

- Tirupur district
 - Palladam
 - Pongalur
 - Kundadam
 - Dharapuram
 - Kudimangalam
 - Madathukulam
 - Udumalapet
- Tirunelveli district
 - Manoor
 - Papakudi
 - Alangulam
 - Melaneelithanalloor
 - Sankarankovil

Some of the cultural properties that are declared as protected monuments by the State Government¹ and located in the project districts but well away from the project regions include:

- Poola Udaiyar Kalvettu, Seevalapperi, Palayamkottai
- Iranyankudiyiruppu, Rajakkalmangalam, Nanguneri
- Tiruneelakandar, Pananjadi, Ambasamudram
- Kugaikoil, Chinna Ivarmalai Sculptures, Dhathanyakkanpatti, Palani

Other notable cultural properties include:

- Adichanallur - an archaeological site near Tirunelveli
- Pulithevan Palace near Nelkattumsevvai or Avudaiyapuram, situated in Sankarankoil taluk
- Pottalpudur Dargha
- Kappal Matha Church, Uvari
- Bhaktavatsala Temple, Seranmadevi, Tirunelveli

(2) ¹ Source: www.tnarch.gov.in

- Valisvara Temple, Tiruvalisvaram, Tirunelveli
- Two rock cut temples with inscriptions in Varunachimalai, Thirumalapuram, Tirunelveli
- Ancient Site, Kunnathur, Tirunelveli

In conclusion, no cultural property having archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance has been reported at the project blocks/taluks. Few local religious sites, village temples/religious structures and other community properties (graveyards, sacred groves) of importance to the local community are present in the project areas but well away from WTG locations as these are avoided during the micro-siting process of Suzlon.

4.10 ROAD NETWORK

4.10.1 Local Road Network in Project Areas

The project regions in both the districts are well serviced by existing network of National Highways, State Highways, Major District Roads, Other District Roads and Village Roads. The key road networks that service the project area include, but not limited to, the following:

- SH-19 between Avinashi - Tirupur - Palladam - Pollachi
- SH-87 between Udumalpet - Dharapuram Road
- SH-97 between Udumalpet - Palladam Road
- SH-41 between Rajapalayam - Sankarankoil - Tirunelveli Road is the backbone of WTG projects located in Tirunelveli district.
- SH 37 between Oddanchatram - Palani - Dharapuram Road
- National Highway 209 between Dindigul in Tamil Nadu with Bangalore in Karnataka.
- National Highway 67 between Coimbatore and Palladam
- National Highway 47 between Avinashi and Palakad
- National Highway 7 between Madurai and Tirunelveli

Road network map pertaining to project regions in the district of Tirunelveli and Tiruppur is presented in *Figure 4.17 and 4.18* respectively.

4.10.2 Traffic Volume Assessment

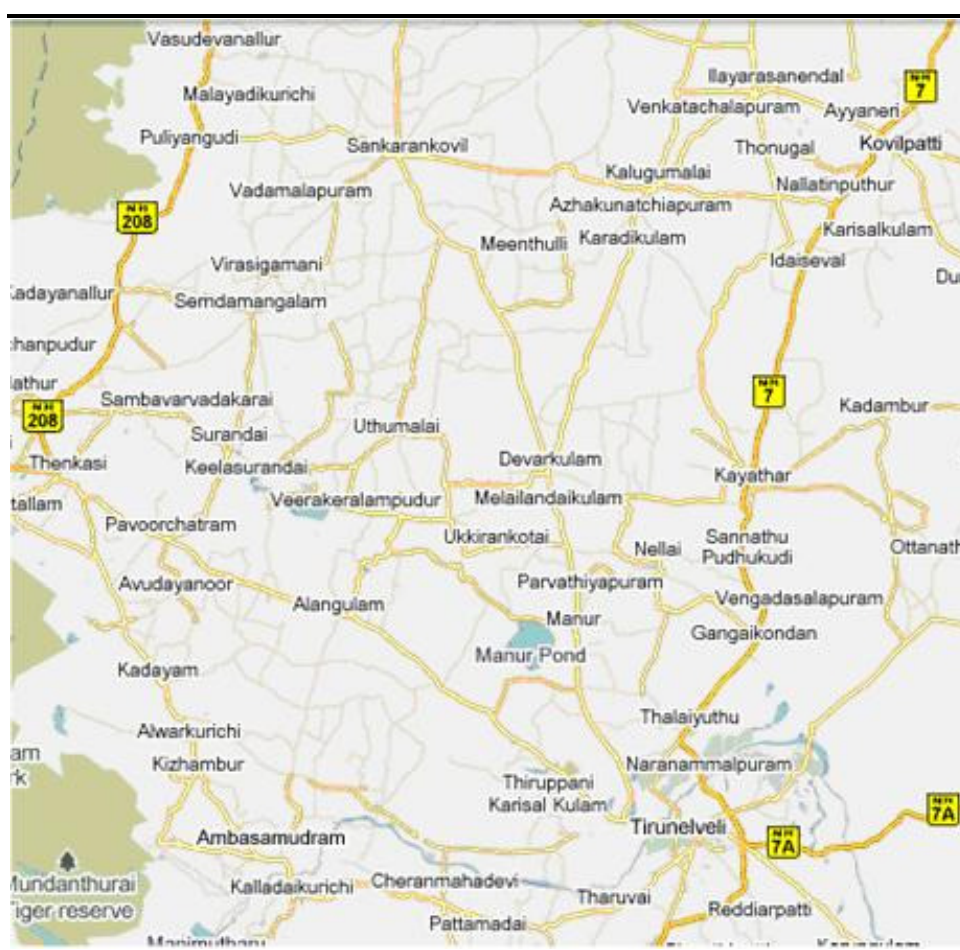
As part of the baseline monitoring, traffic volume count limited to wind farm project vehicles was undertaken at two of the key entry points on National Highway 7 to both the project areas near Madurai as suggested by Suzlon and SIMRAN. As the WTG parts and other vehicles come from Pondicherry, Gujarat and Maharashtra factories of Suzlon, NH7 is the main entry road used by the wind farm vehicles and they divert to Tiruppur or Tirunelveli from Madurai. Hence, traffic volume count pertaining to WTG part carrying vehicles were undertaken at Madurai for a period of 2 days per site. The

results of the traffic volume count limited to wind farm vehicles are presented at *Table 4.17*.

Table 4.17 *Traffic Volume Assessment Limited to Wind Energy Project Vehicles*

SNo	Time	Shanti Nagar, Kappalur		Tafe Main Gate, Near Pandiarajapuram	
		Day 1	Day 2	Day 1	Day 2
1	Day time (6am-6pm)	4	2	3	2
2	Night time (6pm -6am)	2	3	3	3
	Total WTG vehicle Traffic	6	5	6	5

Figure 4.17 Road Network Map of Project Region in Tirunelveli District



Source: <http://maps.google.co.in>

It can be observed that traffic volume pertaining to wind farm project is limited to 5-6 vehicles per day on National highway. Compared to overall traffic volume on the National Highway which is a key network road connecting major South Tamil Nadu urban centres, this is very miniscule volume. It is also notable that traffic volume pertaining to wind farm project

will increase during off-wind seasons and reduce during monsoon seasons when there will be no construction activity across all wind farm sites.

During stakeholder consultations with Highways Department in both Tiruppur and Tirunelveli districts, the Assistant Divisional Engineer of Tirunelveli district furnished the latest (Year 2008) traffic count census data pertaining to following two major road networks in the district which provides an idea about the prevailing traffic volume in the project region in Tirunelveli district:

- MDR between VK Pudur-Shanmughanallur at Km 13/2
- Sankarankovil-Tirunelveli Road (SH 41) at Km 82/8

The traffic count census data is presented in *Table 4.18*.

Figure 4.18 Road Network Map of Project Region in Tiruppur District



Source: <http://maps.google.co.in>

Table 4.18 Traffic Census – Average Weekly and Daily Traffic, Tirunelveli District

Mode of Transport	MDR between VK Pudur-Shanmughanallur at Km 13/2		Sankarankovil-Tirunelveli Road (SH 41) at Km 82/8	
	Weekly	Daily	Weekly	Daily
Cars, Jeeps, Vans, 3 wheelers etc	1710	244	9157	1308
LCV	62	9	263	38
Buses	425	61	2458	351
Trucks	1992	285	5110	730
Multi axle vehicles (Truck, trailers, agri tractor)	70	10	281	40
Motor cycles and scooter	2145	306	12482	1783
Total (Fast moving)	6404	915	29751	4250

	MDR between VK Pudur-Shanmughanallur at Km 13/2		Sankarankovil-Tirunelveli Road (SH 41) at Km 82/8	
Animal drawn - Horse	-	-		
Animal drawn – Bullock cart	659	94	59	8
Cycle	3571	510	11358	1623
Cycle rickshaw and tricycle	20	3	71	10
Others (JCB)	-	-	11	2
Total (slow moving)	4250	1700	11499	1643

Source: Assistant Divisional Engineer's Office, Highways Department, Tirunelveli. Data pertains to 2008 traffic census undertaken by Department.

Traffic census data indicates that SH 41 and MDR road have very high traffic volume including slow moving vehicles. Fast moving vehicles account for 4250 vehicles/day on SH 41 and 915 vehicles/day on MDR. On SH 41, out of the 4250 vehicles, 770 vehicles are trucks and multi-axle vehicles which is about 18% of total traffic volume. Contribution to this 18% of heavy vehicle traffic on SH 41 by the wind farm project could not be ascertained due to non-availability of data but an inference can be drawn from the information provided by Suzlon and SIMRAN on typical vehicle requirements per WTG project (*See Table 4.19*).

Table 4.19 *Approximate Number of Vehicles Required per WTG Project*

SNO	Vehicle Purpose	Number of Vehicles
01	Turbine Blades	03
02	Hub	01
03	Nose	01
04	Tubular tower structure	04
05	Transformer	01
06	Control panel	01
07	Cables and accessories	01
	Total vehicles carrying WTG and its parts	12
	Erection Equipments	
01	Hydra	02
02	Small crane	01
03	Big crane	01
04	Boom assembly, counterweight and accessories	14
	Total vehicles carrying erection equipments	18
	Vehicles required for hauling construction materials – sand, aggregates, cement, bricks, water etc	10
	Other Miscellaneous vehicle requirements	10
	TOTAL VEHICLE REQUIREMENT	50

Source: Stakeholder consultations with Suzlon and SIMRAN

According to Suzlon, about 50 heavy vehicles (including trucks and multi-axle vehicles) could be used per WTG project during construction phase. As there are many WTG projects under construction phase at given point of time, it can be safely estimated that about 200-300 vehicles per day could be contributed by wind farm projects in the area. However, all these vehicles may not be using the same road link and could be plying along different road links in the

road network thus distributing the impact. Thus, contribution to local traffic volume could be varying as indicated below:

- Contribution from wind farm projects to traffic volume on State Highway network roads could be less than 10%;
- Contribution from wind farm projects to traffic volume on Major District roads (MDR) could be as high as 25%;
- Contribution from wind farm projects to traffic volume on Other district roads (ODR) and village roads could be as high as 50%;

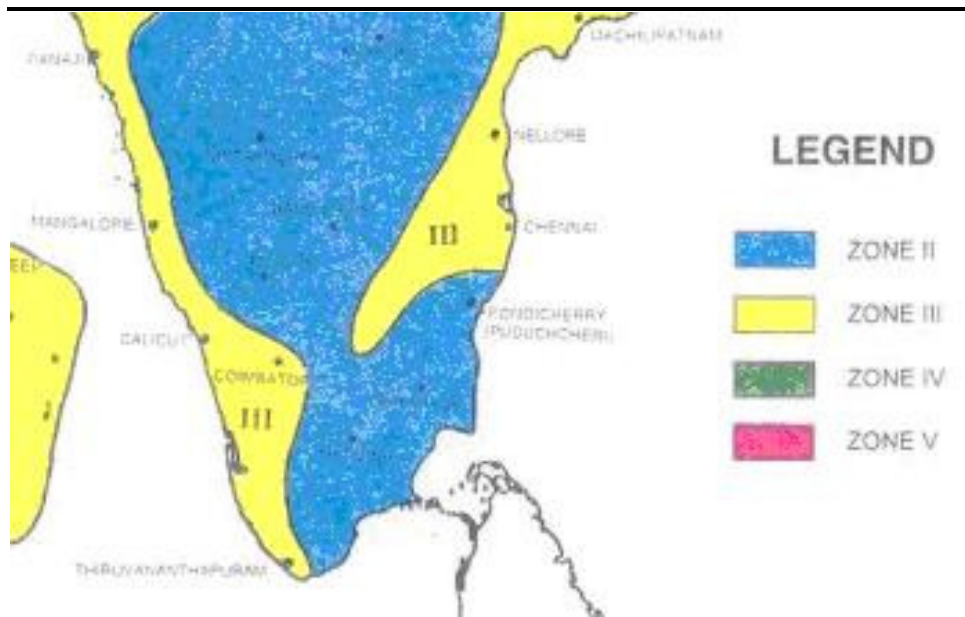
It is to be noted that above mentioned inferences are subjective and conservative assumptions as there is no direct data available to verify the traffic volume contributions made by wind farm projects on local road network.

4.11 NATURAL DISASTERS

4.11.1 Seismicity

As per the seismic map drawn for the Country, both project site area falls in earthquake zone II, which is a low risk zone and can be considered safe. The IS code assigns zone factor of 0.10 (maximum horizontal acceleration that can be experienced by a structure in this zone). Some parts of project region close to Coimbatore can be classified under moderate risk zones (Zone 3). Seismic map pertaining to project regions are presented in *Figure 4.19*

Figure 4.19 Seismic Map pertaining to Project Regions



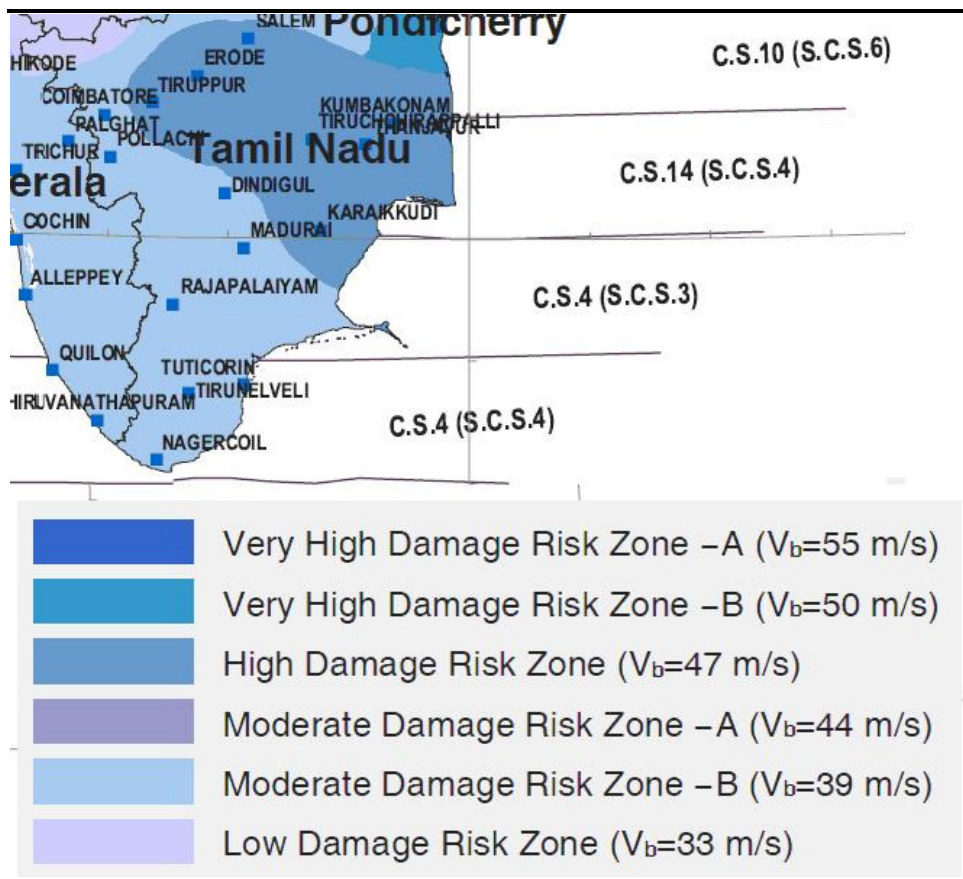
Source: <http://www.imd.gov.in/section/seismo/static/seismo-zone.htm>

4.11.2 Cyclones

Both the project regions are located well inside the hinterland and well away from eastern and southern coasts which face the brunt of annual cyclonic cycles that are significant in terms of physical destruction they cause. Out of the 62 events recorded in the State of Tamil Nadu between 1891-2000, only two (2) events occurred along Tirunelveli district coastal areas.

However, as per the wind and cyclone hazard map (*Refer Figure 4.20*) prepared by Building Materials & Technology Promotion Council (BMTPC) of Government of India, the project regions fall under very high damage risk zone B where wind velocity up to 50m/sec could be experienced especially the Tiruppur district sites whereas Tirunelveli district sites fall under moderate damage risk zone A where wind velocity upto 44m/sec could be experienced.

Figure 4.20 Wind and Cyclone Hazard Map pertaining to Project Regions

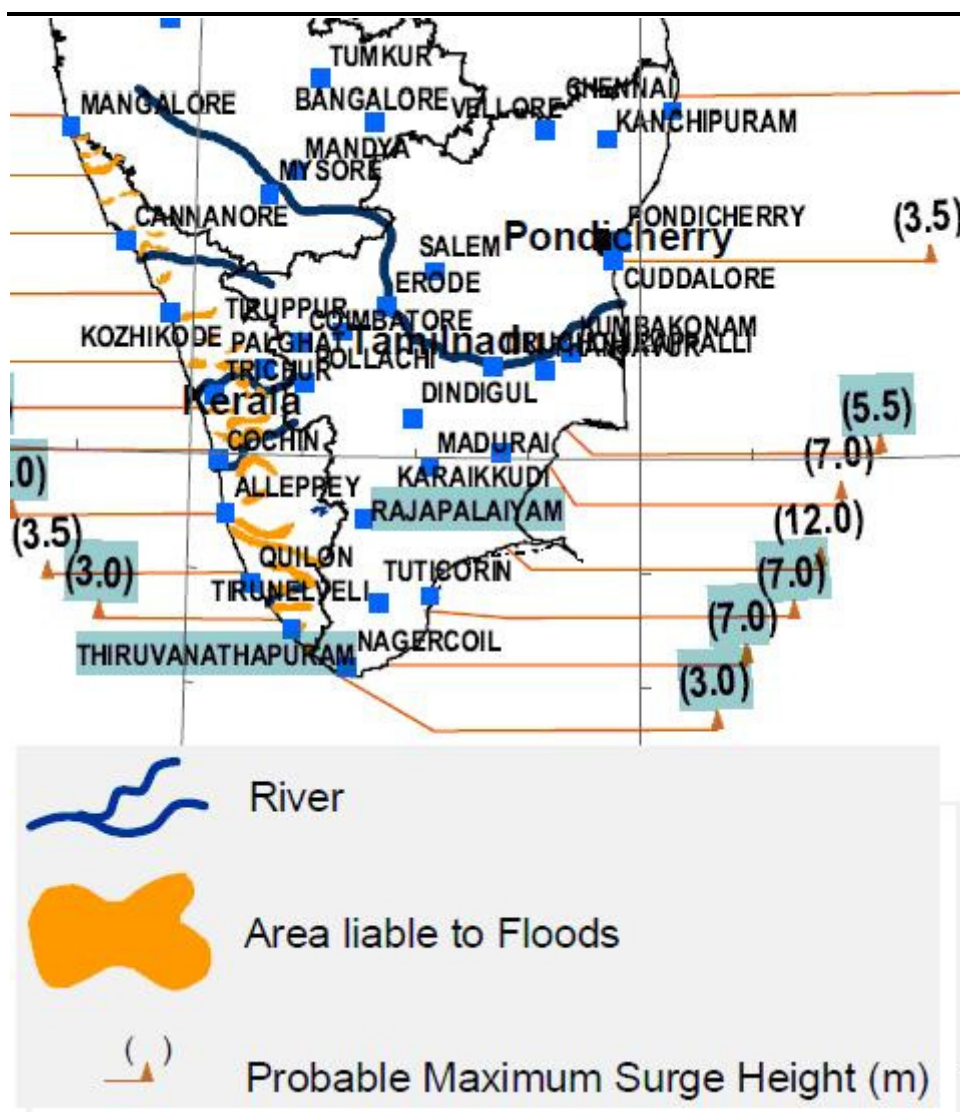


Source: <http://www.bmtpc.org/pdf-misc/wind-india.pdf>

4.11.3 Floods

According to the flood hazard map prepared by BMTPC (*Refer Figure 4.21*) the project regions are not liable to floods. The probability of lightning/thunderstorm and flood events in the project districts is low to moderate.

Figure 4.21 Flood Hazard Map pertaining to Project Regions



Source: <http://www.bmtpc.org/pdf-misc/flood.pdf>

4.12 SOCIO-ECONOMIC

Social baseline has been presented here keeping in view the nature of the project in terms of its geographical spread and the type of anticipated impacts. Hence, only most relevant social indicators are being discussed here. A more detailed, village level, baseline information in terms of physical infrastructure and other amenities is provided in the tabular format in annexure at the end of the report.

The socio-economic baseline profile of the study area is a representation of the primary survey done in the sample villages in and around the existing and proposed WTG locations in the three taluks. Data from secondary sources like the Primary Census Abstract and Village Directory of 2001, Human

Development Report of Tamil Nadu, 2004 have also been utilised to profile the socio-economic condition of the community.

4.12.1 *Social Footprint Area of the Project*

In terms of social footprint of the projects, the Simran WTGs are located in Sankarankoil and Tirunelveli taluks of district Tirunelveli and Dharapuram taluk of district Tiruppur. Tiruppur district was carved out of Erode, Coimbatore and Dindigul districts on 22nd February 2009. Due to this reorganization of administrative divisions, among others, the Dharapuram taluk of Erode district became a part of Tiruppur district. Table below presents the total number of households and the population of these three taluks.

Table 4.20 *Population details of project taluks*

Taluk	Total Households		Total population	
	Rural	Urban	Rural	Urban
Dharapuram	47523	30348	162321	116462
Tirunelveli	26733	99676	105975	433352
Sankarankoil	70711	14048	281625	60959

Census of India, 2001

It can be seen from the table above that Sankarankoil taluk is predominately rural in setting while Tirunelveli taluk is predominately urban. Dharapuram taluk has more or less an equal distribution of population in term so rural and urban set up.

4.12.2 *Administrative Profile*

Tirunelveli district is located in the southern part of Tamil Nadu and is surrounded by Virudhunagar District on the north, Western Ghats on the West, Kanniyakumari District on the south, Tuticorin District on the East. Tirunelveli district comprises 9 taluks, 19 blocks and 1717 villages. The administrative arrangement includes 1 corporation, 6 municipalities, 37 Town Panchayats and 424 village panchayats in the district.

Tahsildar is the in charge of Revenue administration at taluk level. He is assisted by Head Quarters Deputy Tahsildar, Taluk Supply Officer and Zonal Deputy Tahsildars. Each taluk is divided into a number of firkas which comprises a number of Revenue villages. Revenue Inspector at firka level and Village Administrative Officer at Village level assist the Tahsildar.

4.12.3 *Demographic Profile*

The demography of the area shows a positive sex ratio in Sankarankovil and Tirunelveli taluks and slightly negative in Dharapuram taluk. The population density and average household size suggests a spread out population distribution.

Table 4.21 profiles the demographic pattern in the study area on the basis of census data of 2001. More details at village level are provided in the annexure.

Table 4.21 Basic demographic details of the project taluks

Taluk	Total Population	Sex Ratio	Population Density (population per Sq km)	Average Household Size	(%)SC Population	(%)ST Population
Dharapuram	382,479	983	181	4	1%	0.1%
Tirunelveli	105,975	1059	211	4	32%	0.2%
Sankarankoil	281,625	1032	262	4	2.6%	0.0%

Census of India, 2001

Majority of the population is Hindu. However, certain pockets of the population in Tirunelveli taluk, particularly the scheduled castes (SCs) practice Christianity. The predominant community in the area comprise of the Most Backward Classes and the Backward Classes (the *Agamudiars*, *Sethiar*, *Kullar*, *Thevars*) and SCs (*Pariyars* and *Gavaras*).

Although the prevailing literacy levels are fairly good, the lack of industrialization and urbanization in the district has contributed to low awareness and skill levels.

Table 4.22 Literacy rates (rural) in project taluks

Taluk	Total literacy	Male literacy	Female literacy
Dharapuram	54	66	42
Sankarankoil	57	68	47
Tirunelveli	59	68	51

Census of India, 2001

4.12.4 Livelihood Profile

Agriculture and land-based livelihoods is the mainstay of the project taluks, except for Tirunelveli, which has more proportion of urban population.

Tirunelveli has fertile soils only in scattered regions. Less fertile red soils are found distributed over most of the region. The cropping pattern of the district characterises single crop dry land farming where wet cultivation is essentially paddy cultivation. Dry cultivation includes millet and cash crop cultivation like cotton. Even in dry regions wherever water is available, paddy is preferred by the farmers. Paddy, therefore, occupies the largest area of cultivation, followed by cotton. Paddy is cultivated mainly in Tirunelveli, Palayamkottai, Tenkasi, Shencottai, Ambasamudram and Nanguneri Taluks.

Other crops grown in the district are *cumbu*, *ragi*, pulses, groundnut, coconut and chillies. Portions of Sankarankoil Taluk have the rich, fertile black soil which are highly suitable for cotton cultivation. Factors such as type of soil, climatic conditions, irrigation facilities, etc., determine the cropping pattern in a region.

Tiruppur

The total area of cultivation is around 2,28,556 hectare, mainly food and commercial crops. The chief food crops are paddy, millets and pulses. The non food or commercial crops of the district are cotton, oil seeds and coconut.

In the project area, a majority of the land mainly belongs to the higher caste groups. The scheduled caste communities in villages work as agricultural labourers in the agricultural fields of higher caste. There is no set pattern of land holding as the land holdings range from as low as 2 acres to as high as 70-80 acres. An overview of the land-use pattern is provided in *Table 4.23*.

Table 4.23 Land use in Project taluks

Taluk	Total Area (hectares)	Agricultural land		Culturable wasteland ¹	Area not available for cultivation ²	Forest
		Total agricultural area	Irrigated (% of agricultural land)			
Dharapuram	211,508	83,873	60%	52%	8%	0.5%
Tirunelveli	50,281	10,763	56%	50%	27%	1.7%
Sankarankoil	107,294	31,246	34%	56%	15%	0.0%

Census of India, 2001

Occupational Profile

The worker participation rate is more than 50% for all three taluks. It is important to note that out of the total working population; more than 85% is engaged in employment for more than 183 days in a year. A considerable proportion of working population comprises agricultural labourers, although limited community consultations done during the study revealed lower prevalence of the same.

Main small industries which provide employment avenues in the project area include the textile and spinning mills and the operating wind farm project. A very small section of population is engaged in household level employment activities.

Table 4.24 profiles the occupational patterns in the project area.

1 Culturable Wasteland includes lands available for cultivation, whether not taken up for cultivation or taken up for cultivation once but not cultivated during the current year and the last five years or more in succession for one reason or other. Such lands may be either fallow or covered with shrubs and jungles which are not put to any use.

2 This includes all lands occupied by buildings, roads and railways or under water, e.g. rivers and canals and other lands put to uses other than agriculture including mineral extraction

Such land may be assessed or unassessed and may lie in isolated blocks or within cultivated land holdings. Land once cultivated but not cultivated for five years in succession is also included in this category at the end of the five years.

Table 4.24 Working population profile in project taluks

Taluk	WPR ¹	Category of Workers	% of total working population	Cultivators	Agricultural labour	Household industry	Other occupation
Dharapuram	67%	² Main workers	89%	42%	38%	3%	16%
		Marginal workers	11%	11%	76%	4%	9%
Tirunelveli	51%	Main workers	85%	17%	34%	18%	30%
		Marginal workers	15%	8%	55%	19%	18%
Sankarankoil	55%	Main workers	85%	20%	43%	9%	28%
		Marginal workers	15%	6%	62%	14%	18%

Source: Primary Census Abstract, 2001

Table 4.25 Household and other occupation sources

Taluk	Main commodity manufactured
Dharapuram	Cloth material, Coconut oil, Jaggery
Tirunelveli	Safety Match, Coir
Sankarankoil	Beedi, Bricks, Blue metal

Source: Primary Census Abstract, 2001

(1) ¹ WPR is the ratio of working population (both main and marginal workers) to the total population (both working and non working population) of the town/village.

(2) ² Main workers are those people who had worked for atleast 183 days in the preceding year, while marginal workers are those who had worked for more than one day but less than 183 days

Stakeholder consultations were undertaken by ERM in both the project districts to understand their concerns regarding the activities of a wind farm project. In order to understand the operational issues, consultations were held at locations where WTGs were already operational. Similarly, locations where WTGs were proposed to be erected in future were also covered.

Various stakeholders that were consulted include:

- State Pollution Control Board, Tirunelveli;
- Tourism Office, Tirunelveli;
- State Archaeological Office, Tirunelveli;
- All India Radio, Tirunelveli;
- Doordarshan, Tirunelveli;
- Bharat Sanchar Nigam Limited (BSNL) office, Palladum
- Air Traffic Controller office, Coimbatore Airport
- Public Works Department (Tiruppur division, Highways section)
- Town & Country Planning office, Tirunelveli;
- Centre for Environmental Sciences, MS University;

- Project Truck Drivers, Tirunelveli;
- DGM Land, Suzlon
- Forest department- Working Plan Circle;
- Enviro Care Private Limited, a National Accreditation Board for Testing and Calibration Laboratories (NABL) certified and MoEF approved Laboratory for baseline monitoring;
- Economics and Statistical Records Office, Tiruppur.

- Project Proponents:
 - Representatives from SWPPL- onsite and in *Kolkata*;
 - Representatives from Century Consulting Group.
- Local Community:
 - Panawadi Panchayat
 - Vannikonendal Panchayat President
 - Landlosers- Thirumalapura, Village
 - Land broker- Oothumalai village;
 - Land broker- Nelkatancheval villages;
 - Retired Village Administrative Officer
 - Madhavkurichi panchayat
 - Land broker (promoter)
 - Poultry farm owners
 - Pushpattur Village
 - SC community

Table 5.1 presents the stakeholder and their concerns/responses in a tabular format.

Table 5.1 Stakeholders opinions

Stakeholder	Profile	Opinion
Local Community	<u>Land sellers</u>	1. Lack of awareness and information about the project details, sometimes due to non sharing of information by the land promoter;
	The land owners who have sold /are in process of selling land to Suzlon primarily belong to Hindu (Tamil) community. Land and land based livelihoods are the mainstay of the local economy in both the districts. With the limited availability of irrigation avenues, the agriculture mainly depends on rain and is characterised by dryland agriculture crops.	<u>Expectation</u> 1. Employment opportunities from the project; 2. Good rates for land being acquired; 3. Facilities like schools, college, ITI, dispensaries, access roads etc should be provided by the project.
	There has been no physical displacement due to the project and the land has been purchased through direct negotiation with the willing sellers. However, the land was under possession with few land brokers who had already purchased land from local community in anticipation of selling it later to project developers like Suzlon.	
	Consultation with local community revealed that people have sold only excess land and that no one has become landless due the Windfarm projects. <u>Agricultural labourers</u> Agricultural labourers in project area are not common and are limited to local labourers from SC community, who do not have any land of their own. They mostly work on fields of large farmers.	SC community in village Manurpally, s apprehensive of loss of livelihood in case landowners start selling land to wind energy projects for proposed wind project in Tirunelveli district.
Govt departments	In limited consultations, no case of outward migration due to loss of livelihood resulting from selling of land by land owners has occurred so far.	
	<u>Forest Department (FD)</u>	None
	Forest department implements schemes of forest development, afforestation, watershed schemes etc. Apart from these schemes, FD also ensures the compliance to conditions outlined in the forest clearances (FC).	
	No forest area is getting impacted due to the wind farm projects in the two districts. <u>State Pollution Control Board</u>	SPCB maintains that there is no requirement of obtaining any Consent to establish or consent to operate under the Air Act and Water Act. however, due to storage and use of hazardous material at locations such as storage yard, CSM etc

Stakeholder	Profile	Opinion
Other institutions	<u>BSNL</u> <u>All India Radio</u> <u>Doordarshan</u> <u>Airport Authority of India</u>	None of these stakeholders is aware of any impact due to the wind energy projects on their own transmission systems. However, globally there have been researches indicating adverse impact of wind energy projects on the radar transmissions

More detailed minutes of meetings is provided in the annexure.

6.1 INTRODUCTION

This section presents the environmental, socio- economic, demographic and cultural context in which the proposed project is to be implemented and made operational. While identifying the above key features, the section also discusses the type and range of impacts likely to result from the different project activities, measuring its extent and severity. The specific purpose of this section is to identify and assess the range of potential impacts and extent of their severity and explain the ways in which the project might affect environment, ecology, and socio-economic resources. Suggested viable mitigation measures formulated for the identified impacts are presented in Section 8.

Potential impacts have been identified through field surveys, onsite primary monitoring, secondary data and literature review pertaining to project area, review of international best practice guidelines and wide-ranging stakeholder consultation. Discussions with project developers (Suzlon), government service providers, regulators, district administration officials, village representatives, land sellers, local community stakeholders and other civil society groups also were undertaken along the study area. A mix of quantitative and qualitative methods i.e. sampling, monitoring, interviews, unstructured interviews, oral histories, and indirect and unstructured observations have been used to derive these impacts. Potential impacts have also been predicted based on the understanding of the site and the processes involved in construction and operation of the wind energy based power project.

6.2 SUMMARY OF PROJECT ACTIVITIES

The proposed wind farm project is located in many small (2-3 WTG projects at one area) to medium clusters (15-20 WTG projects at one area). Many clusters are essentially located in the districts of Tirunelveli and recently formed Tiruppur district (which has been carved out of Coimbatore, Erode and Dindugal districts). The group of clusters located in Tirunelveli is known as Amuthapuram/Rastha project site (or project 1) wherein Simran Wind Power Private Limited (SWPPL) is investing in 75.90 MW (2.1 MW X 12 WTGs at Amuthapuram and 1.5 MW X 17 WTGs and 2.1 MW X 12 WTGs at Rastha). The clusters located in Tiruppur district is known as Darapuram / Muthiampatti project site (or project 2) wherein SWPPL is investing in 51.00 MW (1.5 MW X 34 WTGs).

All these clusters are being developed by Suzlon along with many more WTG projects as part of a larger wind farm site. Hence, besides SWPPL there are

many more private investment companies that have invested in wind energy projects. The entire Operation and Maintenance (O&M) of the wind farm will be done by Suzlon, while SWPPL will only have a supervisory/management role. WTG projects are being developed on turn key basis, which involves Suzlon undertaking prime responsibility for the whole gamut of wind energy project life cycle activities starting from planning to operation and maintenance for a 20 year period. All the WTG projects proposed for SWPPL are expected to be commissioned progressively before December 2011.

Associated ancillary facilities and utilities such as the following will be required as part of larger wind farm site planning:

- Transmission line for power evacuation from individual WTG sites;
- Metering point for measuring production from each WTGs;
- Pooling substation;
- Pathways and access roads – both inter-site and intra-site;
- Material storage yards and stores;
- Scrap yards;
- Parking bays;
- Transit storage areas; and
- Central Monitoring Station (CMS) building and facilities.

Discussions with Suzlon teams responsible for developing the wind farm projects indicates that a typical wind farm project consists of following key activities under three distinguishable phases :

Planning phase activities

- Wind Master/ Meteorological Master Installation
- Wind Master/ Meteorological Master - Data collection and analysis
- Micrositing of Wind Turbine Generator (WTG) locations
- Power evacuation planning process
- Road capacity assessment leading to wind farm sites
- Pathway planning (Access roads) to intra-site WTGs
- Land acquisition process
- Tamilnadu Electricity Board (TNEB) approval process
- Ancillary facilities planning – yards, stores, CMS building facility

Construction phase activities

- Pathways and access road construction
- WTG location preparation – site clearance
- Construction material transport and storage
- Mobilising DG sets and onsite concrete mixers
- Foundation excavation and construction
- WTG parts and other equipments – transit storage yards
- WTG parts transport to site
- Erection and commissioning equipments transport
- Transformer yard construction and erection
- Transmission line – Pole laying and line erection

- WTG project commissioning

Operation and maintenance phase activities

- Half yearly and Annual maintenance scheduled activities at each WTG location
- Routine inspection of all WTGs
- Operation and maintenance of ancillary facilities such as yards, stores, CMS building facilities
- Inspection and maintenance of transmission lines
- Inspection and maintenance of intra-site pathways/access roads

Decommissioning phase activities

- Replace operating WTG turbine with new one of higher capacity or superior technology
- Abandon the project operations and remove WTG parts and ancillary facilities
- Remove transmission lines
- Return intra-site access roads

Environmental and social impact assessment of the proposed wind energy project has been based on the project activities listed above.

6.3

SOCIAL AND ENVIRONMENTAL IMPACT EVALUATION CRITERIA

The criterion that has been used to evaluate impacts on various environmental and social aspects is as following:

Context

The context refers to spatial or geographical extent of impact due to proposed project. In this study, impacts were classified as per the following context:

- Local (low spread), when an impact is restricted within 500m of the project site;
- Medium (medium spread) when an impact is spread from 500m to 3km of the project site ; and
- Regional (high spread) when impact is spread beyond 3km of the project site.

Duration

The duration of impact considers whether the impact would be short-term, medium-term or long-term and has been assessed based on the time taken to recover back to its pre-project state. For the proposed project, impacts were classified based on their existence in temporal scale as follows:

- Short term (*low duration*) when impacting for a duration of six months (other than for ecology); this will result in the recovery of the effected environmental component (other than for ecology) within a year;

- Medium (*medium duration*) when impacting between six months and two years; this will result in the recovery of the effected environmental component (other than for ecology) within 1 to 3 years; and
- Long term (*high duration*) when impacting beyond two years (other than for ecology); and will result in recovery of prevailing conditions beyond 3 years.

For ecology - faunal species or floral species of ecological significance and trees (of girth size 30 cm or more), impacts will be short term if limited to less than one generation, while impacts will be medium if limited to one generation and long term if limited to more than one generation.

Intensity

Indicators of the intensity of an impact, whether it is insignificant, minor, moderate, or major, was based on the following criteria:

- Insignificant intensity when resulting in changes in the environmental baseline of less than 20% in regional context or 20 to 30% in medium context or up to 30% in local context but for short duration;
- Minor intensity when resulting in changes in the baseline up to 20% in regional context or up to 30% in medium context or more than 30% in local context or for ecology minimal changes in the existing ecology in terms of reproductive capacity, survival or habitat suitability;
- Moderate intensity when resulting in changes in the baseline for up to 30% in regional context or more than 30% in medium context or for ecology changes are expected to be recoverable in terms of medium duration; and
- Major intensity when resulting change in the baseline beyond 30% in regional context or for ecology changes serious impairment to species, productivity or their habitat.

Type

The type of impact refers to whether the effect is considered beneficial or adverse. Beneficial impacts would improve resource conditions. Adverse impacts would deplete or negatively alter resources. The significance assessment matrix is provided in **Table 6.1**.

Table 6.1 *Impact Significance Criteria for Environmental and Social Components (other than for Ecology)*

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

Significance		Context	Duration	Intensity
		Local	Long	Moderate
		Medium	Short	Moderate
		Medium	Medium	Low
		Medium	Medium	Moderate
		Medium	Long	Low
		Medium	Long	Moderate
		Regional	Short	Low
		Regional	Short	Moderate
		Regional	Medium	Low
		Regional	Medium	Moderate
Major		Local	Medium	High
		Local	Long	High
		Medium	Short	High
		Medium	Medium	High
		Medium	Long	High
		Regional	Short	High
		Regional	Medium	High
		Regional	Long	Low
		Regional	Long	Moderate
		Regional	Long	High

Note: Positive impacts are termed as beneficial while negative ones are adverse

6.4

SOCIAL AND ENVIRONMENTAL IMPACT IDENTIFICATION

The assessment process is based on available information, including the project description (as provided by SWPPL), proposed activities, and social and environmental baseline data. The assessment considers all relevant social and environmental impact/risks, including issues identified in IFC Performance Standards 2 through 8, and the concerns expressed by those who will be affected by such risks and impacts. The potential environmental and social impacts that are anticipated during various phases of the project life cycle is listed at *Table 6.2*.

Table 6.2 Identified Social and Environmental Impacts through Wind Project Life Cycle

Social and Environmental aspects	Land use	Ambient Air Quality	Surface water	Soil and ground water	Ambient Noise levels	Ecology	Cultural	Visual	Socio-Economic	Road network	Health and Safety	Natural disasters
Project Activities												
Planning Phase (Impacts envisaged during life cycle)												
Wind Master/ Meteorological Master Installation	✓	-	-	-	-	✓	✓	-	-	-	✓	✓
Wind Mast - Data collection and analysis	-	-	-	-	-	-	-	-	-	-	-	-
Micrositing of WTG locations	✓	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Power evacuation planning process	✓	-	✓	✓	-	✓	✓	✓	-	✓	✓	✓
Road capacity assessment leading to WTG sites	-	-	-	-	-	-	-	-	-	✓	✓	-
Access road planning to intra-site WTGs	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	✓	-
Land acquisition process	✓	-	-	-	-	-	✓	-	✓	-	-	-
TNEB approval process	-	-	-	-	-	-	-	-	-	-	-	-
Ancillary facilities planning – yards, stores, CMS	✓	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	✓
Construction phase												
Pathways and access road construction	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-
WTG location preparation – site clearance	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	✓	-
Construction material transport and storage	-	✓	✓	✓	✓	-	-	-	✓	✓	✓	-
Mobilising and operating DG sets and onsite concrete mixers	-	✓	✓	✓	✓	-	-	-	✓	-	✓	-
Foundation excavation and construction	-	✓	✓	✓	✓	-	✓	-	✓	-	✓	-
WTG parts and other equipments – transit storage yards	✓	-	✓	✓	-	✓	✓	✓	✓	✓	✓	-
WTG parts transport to site	-	✓	-	-	✓	-	-	-	-	✓	✓	-
Erection and commissioning equipments transport	-	✓	-	-	✓	-	-	-	-	✓	✓	-
Transformer yard construction and erection	-	-	-	-	-	-	-	✓	✓	-	✓	-
Transmission line – Pole laying and line erection	✓	-	-	-	-	✓	✓	✓	✓	-	✓	✓
WTG project commissioning	✓	-	-	-	✓	✓	-	✓	-	✓	✓	-
Operation and maintenance phase												
Half yearly and Annual maintenance scheduled activities at each WTG location	-	-	-	✓	-	-	-	-	-	-	✓	-
Routine inspection and operation of all WTGs	-	✓	-	-	✓	✓	-	✓	✓	-	✓	✓
Operation and maintenance of ancillary facilities such as yards, stores, CMS building facilities	✓	-	✓	✓	-	✓	-	✓	-	-	✓	-

Social and Environmental aspects	Land use	Ambient Air Quality	Surface water	Soil and ground water	Ambient Noise levels	Ecology	Cultural	Visual	Socio-Economic	Road network	Health and Safety	Natural disasters
Inspection, maintenance and operation of transmission lines	-	-	-	-	-	✓	-	✓	✓	-	✓	✓
Inspection, maintenance and operation of intra-site pathways/access roads	✓	✓	-	-	✓	-	-	✓		✓	✓	-
Decommissioning												
Replace WTG turbines with new ones	-	✓	-	-	✓	-	-	-	✓	✓	✓	-
Remove WTG parts and ancillary facilities	✓	✓	✓	✓	✓	✓	-	✓	✓	✓	✓	-
Remove transmission lines	✓	-	-	-	✓	✓	-	✓	✓	-	✓	-
Return intra-site access roads	✓	-	✓	✓	-	✓	-	✓	✓	-	-	

6.5 SOCIAL AND ENVIRONMENTAL IMPACT ASSESSMENT

6.5.1 Land use

Impacts

During planning phase, as soon as the wind master is installed in a particular area by the Wind Resources Department (WRD) of Suzlon, the land values starts appreciating and expectations of an impending wind energy project sets in among local community stakeholders. There are some wind energy developers who sense wind energy potential due to mere installation of Suzlon's wind mast and go-ahead with purchasing lands before Suzlon completes its planning phase activities. The issue of real estate agents and investors making quick money by purchasing land at low cost from farmers and reselling the same to WTG projects at a higher cost within short duration of time is not significant in the project area as the local community is well aware of wind energy projects and the appreciation that it brings to land values.

During construction phase, locating infrastructure components of a wind energy project such as WTG tower location, intra-site access pathways, transmission line, substation, associated ancillary facilities (such as material storage yards, scrap yards, CMS buildings) result in land use change that sets in during planning stage and gets fructified during construction phase. Land values have shot up almost one hundred times across all wind energy project sites within the last 2-5 years. As a result, most of the land owners are willingly coming forward to sell their lands for WTG projects and associated facilities. Significantly, most of the farmers are selling only their scrub and dry waste lands where one season of farming (post-monsoon season) was practiced. Even Suzlon has not come forward to locate WTG projects in irrigated wet lands. Generally farming practice is on the vane in the region due to lack of water source and labour problems and when WTG projects arrived in the region, this has only hastened the process of farmers quitting agriculture. This is slowly resulting in a major change in the way the local community is pursuing their livelihood.

Till date, government lands (*poromboke* lands), forest lands and wet irrigated lands have not been sought by developers for installing wind energy projects. Only privately owned patta lands that have gone dry and waste are being negotiated for the project.

At the wind energy project sites that are located close to metropolitan and urban areas (such as Bogampatti village near Coimbatore which is proposed to come under Coimbatore Master Plan area) the land parcels between WTG towers are seeing a major spurt in real estate business. Land costs advertised at these residential layouts are as high as Rs 35,000 per cent (100 cents = 1 acre).

Till date no decommissioning of wind energy project has happened and hence it is difficult to predict the impacts on land use pattern. According to Suzlon, old towers if at all are to be decommissioned, they would be used again to re-erect higher capacity or new technology WTGs and will not be abandoned in a hurry as the design life of WTG projects are around 20-30 years. Hence, the impact on land use pattern at WTG locations due to decommissioning will be largely dependant on adjacent land use pattern in the future.

A sample of proposed WTG locations were observed during the site visit and were found to be either of category of dry agricultural land or single season rainfed land. Community response (as well as discussions with land seller) was also used to corroborate this. Few of the locations were also falling in the category of wasteland. It can be construed that more than 80% of the proposed locations would either be dry agricultural land / rainfed single crop agricultural land. A location wise presale land use will be supplemented in the Annexure.

Key impacts are summarised in *Table 6.3*.

Table 6.3 *Summary of Anticipated Impacts on Land Use*

Impacts During Construction Phase	Impacts During O&M Phase	Impacts During Decommissioning
Land use change at WTG locations, along access roads and associated facilities.	Induced change in adjacent lands	Abrupt change in land use
Land values shoot up in short term	Farming on wane hastened	Adjacent land use will dictate its use
More land owners give up farming and sell to WTG projects/other projects	More land owners give up farming owing high land values	Land values could be on higher side if near to urban areas.
Change in livelihood pattern of local community	Change in livelihood pattern of local community	-
Spurt in real estate business	Even wet, irrigated lands could be on sale	-
Intermediates (brokers, investors) benefit by purchasing at lower price from farmers and selling at higher price to WTG projects	Land parcels between 2 WTG towers may lose value and bargaining potential	-

Significance of Impact

The impact on land use will have moderate intensity with a medium spread for a long duration (considering the project life of 20-30 years) which will result in an overall moderately adverse impact both during construction and operation phases. During decommissioning, it is assumed that only select few WTGs will be decommissioned and not in enmasse. This would result in insignificant impact in future on land use pattern. The impact significance assessed is summarised in *Table 6.4*.

Table 6.4 *Impact Significance – Land Use*

Factors	Significance – Construction Phase	Significance – O&M Phase	Significance – Decommissioning
Context	Medium	Medium	Local
Duration	Long	Long	Short
Intensity	Moderate	Moderate	Low
Overall	Moderately adverse	Moderately adverse	Insignificant

6.5.2 *Ambient Air Quality*

Wind energy projects do not contribute much to degradation of ambient air quality (AAQ) levels during its project life cycle. Whatever be the impact, the most air emissions is expected to happen during construction phase of the project. During planning phase, it is necessary to include AAQ as a factor while constructing access pathways and material storage yards/stores as fugitive dust emission could be more during construction and later due to movement of vehicles on unpaved surface.

During construction phase almost all the activities envisaged will adversely contribute to AAQ levels essentially due to fugitive dust, on-road vehicular emissions and off-road construction & erection equipments.

During O&M phase, use of unpaved, intra-site access pathways and OMS staff vehicles will adversely contribute to AAQ levels. During decommissioning, depending upon the number of WTG machines to be decommissioned, the impacts will reflect almost like the construction phase.

Key impacts are summarised in *Table 6.5*.

Table 6.5 *Summary of Anticipated Impacts on AAQ*

Impacts During Construction Phase	Impacts During O&M Phase	Impacts During Decommissioning
Fugitive dust generation during access road construction, WTG site clearance, associated facility area clearance	Fugitive dust generation due to use of earthen access pathways intra-site	-
Exhaust emissions from construction equipments and vehicles	Vehicular emission from O&M team vehicles carrying out routine/scheduled inspections	-
Exhaust emissions from off-road erection equipments such as heavy tonnage capacity cranes, hydraulic equipments, earthmovers, small cranes,	-	Exhaust emissions from off-road erection equipments such as heavy tonnage capacity cranes, hydraulic equipments, earthmovers, small cranes,
Exhaust emission from DG sets, concrete mixers	-	-
Vehicular emission from WTG part transportation trucks	-	Vehicular emission from WTG part transportation trucks

Impacts During Construction Phase	Impacts During O&M Phase	Impacts During Decommissioning
Dust emission from construction material transport	-	-

Significance of Impact

The maximum impact on AAQ levels will occur during construction phase of the project life cycle and is anticipated to be minor adverse. Else, during O&M and decommissioning, AAQ levels will not be impacted significantly by the project. The impact significance assessed is summarised in *Table 6.6*.

Table 6.6 *Impact Significance – AAQ*

Factors	Significance – Construction Phase	Significance – O&M Phase	Significance – Decommissioning
Context	Medium	Local	Local
Duration	Short	Short	Short
Intensity	Low	Insignificant	Insignificant
Overall	Minor adverse	Insignificant	Insignificant

6.5.3 *Surface Water Environment*

The project sites in both the districts of Tirunelveli and Tiruppur are located in dry and waste lands where surface water bodies and drainage channels come alive during monsoon and post-monsoon season (and for a maximum of 6 months as informed by local stakeholders). During summers, local surface water bodies become dry altogether except for few local ponds and cesspools.

In this context, during planning phase, impacts that will be caused on surface water environment should be taken into while creation of permanent infrastructure facilities over land such as WTG locations, intra-site access pathways, transmission lines, pooling substation and associated facilities (such as yards, stores and CMS buildings). Anticipated impacts during construction phase will be caused by almost all of the construction stage activities envisaged and the impacts will include: increased soil erosion; micro level changes in drainage pattern; soil disturbance leading to alteration in surface runoff and percolation co-efficients locally; and quality issues due to soil contamination and pollution.

During operational phase, soil contamination and resultant polluted storm water runoff from yard locations, scrap yards, material stores are anticipated. During decommissioning phase, depending upon the scale and number of WTGs to be decommissioned, the impacts almost will mirror construction phase.

Key impacts are summarised in *Table 6.7*.

Table 6.7 *Summary of Anticipated Impacts on Surface Water Environment*

Impacts During Construction Phase	Impacts During O&M Phase	Impacts During Decommissioning
Increase in soil erosion leading to deterioration in water quality		Increase in soil erosion leading to deterioration in water quality
Fuel, oil, lubricants and other such hazardous material spills, leaks and seeps (from storage locations, vehicles, equipments etc) will lead to deterioration in water quality	Fuel, oil, lubricants and other such hazardous material spills, leaks and seeps (from storage locations, vehicles, equipments etc) will lead to deterioration in water quality	Fuel, oil, lubricants and other such hazardous material spills, leaks and seeps (from storage locations, vehicles, equipments etc) will lead to deterioration in water quality
Change in local drainage pattern		Change in local drainage pattern
Increase or decrease in surface storm water runoff and percolation into ground during rains		Increase or decrease in surface storm water runoff and percolation into ground during rains

Significance of Impact

The impact on surface water environment will be minor adverse during construction phase and that too for short duration of less than 6 months. Else, during other project life cycle stages, insignificant adverse impact is anticipated. The impact significance assessed is summarised in **Table 6.8**.

Table 6.8 *Impact Significance – Surface Water Environment*

Factors	Significance – Construction Phase	Significance – O&M Phase	Significance – Decommissioning
Context	Medium	Local	Local
Duration	Short	Short	Short
Intensity	Low	Insignificant	Insignificant
Overall	Minor – adverse	Insignificant	Insignificant

6.5.4 *Soil and Ground Water Environment*

In both the project districts, the soil type is mostly deep red, black cotton and red sandy soil with alluvium type found along river bodies. Due to gentle to rolling slope in most project locations, soil is erodible during heavy downpour.

The groundwater availability is scanty and is overly depended upon by local community for meeting their farming and domestic needs especially in Tirunelveli district where over exploited blocks and semi-critical blocks fall within project area (*Melaneelitha nallur, Radhapuram, Sankarankoil and Alangulam* blocks). In Tirupur district, rainfall is less than 600mm per year and average ground water level is between 17 – 35m bgl. *Kundadam* and *Dharapuram* fall under safe blocks with respect to ground water development but the falling GWL trend is a concern.

From quality perspective, both surface water and ground water resources in the project sites in both the districts is found to be not suitable for drinking and domestic uses without adequate treatment. Especially, the water quality in Tiruppur district fails the IS 10500 standards on many parameters.

Amount of water expected to be consumed during construction phase is around 145,000 litres per WTG site. This water demand will be met through nearby rivers and local surface water bodies or groundwater wells after taking permission from local panchayat/well owner. Water consumption during operation stage is limited to domestic purposes only as wind energy projects do not need water at WTG site level. At CMS facilities which is by far the largest O&M facility, domestic water consumption could be maximum 6000 litres per day (150 staff @ 40 lpcd) which will be met through tube wells installed within the facility.

In this context, the impacts anticipated during project life cycle on soil and groundwater environment is almost to surface water environment and accordingly needs to be taken into account during planning phase.

Key impacts are summarised in *Table 6.9*.

Table 6.9 *Summary of Anticipated Impacts on Soil and Groundwater*

Impacts During Construction Phase	Impacts During O&M Phase	Impacts During Decommissioning
Increase in soil erosion leading to loss of top soil and change in soil texture	-	Increase in soil erosion leading to loss of top soil and change in soil texture
Fuel, oil, lubricants and other such hazardous material spills, leaks and seeps (from storage locations, vehicles, equipments etc) will lead to deterioration in soil and groundwater quality	Fuel, oil, lubricants and other such hazardous material spills, leaks and seeps (from storage locations, vehicles, equipments etc) will lead to deterioration in soil and groundwater quality	Fuel, oil, lubricants and other such hazardous material spills, leaks and seeps (from storage locations, vehicles, equipments etc) will lead to deterioration in soil and groundwater quality
Change in local drainage pattern leads to impact on surface runoff and percolation components of a rainfall event.	-	Change in local drainage pattern leads to impact on surface runoff and percolation components of a rainfall event.
Water sourcing from surface and groundwater resources in the project regions that are already depleted.	Water sourcing from surface and groundwater resources in the project regions that are already depleted.	-

Significance of Impact

The impact on soil and groundwater environment will have moderately adverse impact limited to local context for a longer duration especially at scrap yards and other such hazardous materials/ waste storage locations during the operational phase. Water abstraction in depleted water resource regions will also cause moderately adverse impact in local context. During

construction and decommissioning phase, adverse impact anticipated is insignificant. The impact significance assessed is summarised in *Table 6.10*.

Table 6.10 *Impact Significance – Soil and Groundwater Environment*

Factors	Significance – Construction Phase	Significance – O&M Phase	Significance – Decommissioning
Context	Local	Local	Local
Duration	Short	Long	Short
Intensity	Low	Moderate	Low
Overall	Insignificant	Moderately adverse	Insignificant

6.5.5 *Ambient Noise levels*

The background noise levels measures at various locations indicate that higher capacity WTG turbines generate more noise than lower capacity ones. In Tirunelveli district, where mix of 1.5 MW and 2.1 MW machines are installed at Amuthapuram and Rasta sites, noise levels below the tower is measured to be more than National ambient noise standards. The 1.5 MW turbine seems to generate noise levels in the range of 64 dB (A)-68 dB (A) below the tower while 2.1 MW turbines generates in the range of 64 dB (A)-80 dB (A). It is to be noted that in Tirunelveli, noise levels present the construction phase levels as construction was going on at one of the adjacent towers which shares the access pathway.

In Tiruppur district as the installed WTGs are of 0.6MW capacity, the noise generation below the tower is much lower, at 48 dB (A) – 52 dB (A) range. At about 100m distance, instantaneous noise readings indicate about 5-8 dB (A) reduction in ambient noise levels (ANLs).

In this context, the project is expected to adversely contribute to increased ANLs during construction phase essentially due to vehicular noise, noise from construction plants and equipments, noise generated from erection equipments. The ANLs is anticipated to increase around all infrastructures and associated facilities that are to be constructed along with WTG locations. As found during monitoring, the ANLs could be as high as 75-80dB (A) near construction areas which is breaching the residential area ANLs prescribed by the National regulation.

During operation phase, noise is expected to be generated at WTG locations and vehicular movement across intra-site access roads. At WTG locations, wind cutting noise will be generated by rotating blades which will increase with wind speed and higher turbine capacity (as inferred from primary monitoring data). Besides, the mechanical noise generated by turbines when (the rotating blades comes to an abrupt halt) the power evacuation line is shut off by TNEB and sound generated when turbine changes direction in line with wind direction automatically also add to ANLs.

During decommissioning phase, depending upon scale of the operations, the ANLs will be impacted almost similar to construction phase as the activities will be almost similar.

Noise level at the nearest habitation

Based on the noise level recorded at the different types of WTGs (i.e. 2.1 MW and 1.5 MW) at different locations, the level of decay in sound pressure level at the nearest habitation was also calculated.

As per data provided by Suzlon for sound pressure levels at nacelle/hub height (assumed as 88 meters) for S-82 and S-88 type WTGs for 8m/sec wind speed, the sound pressure at ground level was calculated using the following Inverse Square law.

$$SPL_2 = SPL_1 - 20 \log_{10} (r_2/r_1)$$

Where, SPL_1 , and SPL_2 are Sound pressure levels [dB (A)] at distance r_1 and r_2 metres respectively.

SPL_1 : is the Sound Pressure Level recorded at hub height (i.e. 88 m)

r_1 : is taken as 88 m

r_2 : is taken as 3 meters (considered as the ground level height)

SPL_2 : is the Sound Pressure Level recorded at the ground level

For the above equation SPL_1 is taken as 104.2 dB (A), which is the sound pressure level for S-82 WTG (*and which is higher than sound pressure level of S-88, i.e. 103.6 dB (A), thus considering the worst case scenario*)

The SPL_2 thus calculated is 74.85 dB (A)

To calculate noise level at nearest habitation, the above has been used as SPL_1 (i.e. at generation source). SPL_2 in this case has been considered as 45 dB (A) which is the night time noise standard for residential area (*Refer Table 3.6*). Again using the same inverse square law the distance is calculated as:

$$\log r_2 = (SPL_1 - SPL_2 / 20) + \log r_1$$

Thus $r_2 = 95$ meters

Where,

SPL_1 : is the Sound Pressure Level recorded at WTG base

r_1 : is taken as 3 m (i.e. height at ground level at which SPL_1 is recorded, in this case 3 m from WTG base)

r_2 : is the distance of nearest habitation from the location of SPL_1

The assumption take for calculating the sound pressure level at the nearest habitation is that the noise level generated from a source will decrease with distance from source as per the above equation.

Hence, it can be construed from the above equations that the sound pressure level of 104.2 dB (A) at nacelle level will come down to 74.85 dB(A) at 3 meter height from WTG base which will inturn decay down to the national noise standard level of 45 dB(A) at night time for residential areas at a distance of more than or equal to 95 meters.

Cumulative noise level

Using an online model (<http://resource.npl.co.uk/acoustics/techguides/wtnm/>), the cumulative noise level was calculated for few locations. The online model uses the following formula to calculate the cumulative noise level:

$$L_p = L_w - 10 \log_{10}(4\pi r^2) - ar$$

Where:

L_p is the cumulative noise level at the nearest habitation/household
 L_w is the noise level at various WTGs which are to be considered for calculating the cumulative noise (taken as 104.2 dB (A), i.e. SPL at 8m/sec wind speed.

r is the distance from each WTG to the nearest habitation/household

a is the absorption due to the atmosphere (dB/m), which is taken as zero for calculation in this ESIA

The calculation is real time and online and data input includes, coordinates of the noise sources (*WTGs in this case*) and the receptor (*nearest household in this case*). The result of this online calculation is presented in **Table 6.11**.

Table 6.11 Cumulative noise generated by WTGs

#	WTG contributing to cumulative noise	Coordinates of contributors	Coordinates of nearest receptor	Cumulative noise level dB(A) of WTGs
		1.5 MW at Rastha		
1	Sf no 257, 258	N8 51 54.4 E77 37 22.9	N8°51'50.58" E77°37'4.37"	41.15
2	M046 (Sf no 231)	N8 52 12.5 E77 37 12.8		
3	M079 (Sf no 158, 159)	N8 51 26.1 E77 37 19.8		
4	M080 (Sf no 117, 118)	N8 51 08.2 E77 36 53.7		
5	Sf no 45	N8 51 35.2 E77 36 23.1		
1	M122 (Sf no 1719)	N8 50 14.6 E77 36 53.6	N8°49'57.80" E77°36'7.51"	37.1
2	M098 (Sf no 137, 138)	N8 50 05.6 E77 36 41.6		
3	M095 (Sf no 386, 387)	N8 49 53.4 E77 35 16.8		
4	M 100	N8 50 34 E 77 36 35.5		
5	M 133 (Sf no 180)	N8 49 35.4 E77 36 43.6		
1	M168 (Sf no 1519)	N8 49 25.3 E77 37 59.2	N8°49'11.76" E77°38'20.27"	41.92
2	M 187 (Sf no	N8 49 4.5 E77 38 3.4		

#	WTG contributing to cumulative noise	Coordinates of contributors	Coordinates of nearest receptor	Cumulative noise level dB(A) of WTGs
3	M188 (Sf no 1333, 1334)	N8 48 55.5 E77 37 51.4		
4	M197 (Sf no 341)	N8 48 57.6 E77 38 33.2		
2.1 MW at Rastha				
1	M056	N8 50 17.4 E77 33 35.9	N8°50'47.88" E77°33'52.94"	43.86
2	M057	N8 50 1.5 E77 33 56.9		
3	M058	N8 50 9.9 E77 34 11.7	N8°49'32.55" E77°34'10.93"	42.42
4	M090	N8 49 54.1 E77 34 32.7		
5	M091	N8 49 45.7 E77 34 17.9	N8°50'41.84" E77°33'59.07"	46.00
6	Sf no 477	N8 51 4.4 E77 34 6.7		
7	Sf no 451	N8 51 2.1 E77 33 41.3		
8	Sf no 500	N8 50 33.2 E77 34 0		
1	M020 (Sf no 7)	N8 52 15.2 E77 35 10.8	N 8°49'23.03" E77°43'12.70"	44.50
2	M327 (Sf no 205)	N8 50 20.7 E77 42 46.9		
3	M349 (S no 180)	N8 50 11.6 E77 43 29.1	N8°49'56.54" E77°42'26.10"	40.41
4	M351 (Sf no 174)	N8 49 48.2 E77 43 19.2		
5	M352 (Sf no 159)	N8 49 33.4 E77 43 9.5	N8°50'10.27" E77°42'18.26"	38.62
6	Sf no 183/184	N8 49 49.2 E77 42 56.2		
7	Sf no 209, 210	N8 49 30 E77 42 39.3	N8°49'11.23" E77°42'7.19"	44.18
8	Sf no 221	N8 49 11.6 E77 42 28.8		
9	Sf no 253	N8 49 2.4 E77 42 13.3		
2.1 MW in Amuthapuram				
1	TDA142 (Sf no 719, 720)	N9 04 41.4 E77 35 27.7	N9° 4'5.63" E77°35'53.03"	41.93
2	TDA156 (Sf no 66)	N9 04 26.7 E77 36 06.6	N9° 3'52.54" E77°35'27.55"	43.04
3	TDA129 (Sf no 445)	N9 03 34.5 E77 35 04.1		
4	TDA139 (Sf no 465)	N9 03 19.2 E77 35 26.6		
5	SF no 352, 353	N9 3 26 E77 35 46		
6	Sf no 209, 210	N9 4 9.3 E77 35 31.7		
7	TDA140 (Sf no 370)	N9 3 41.5 E77 35 46.4		
1	VL309 (Sf no 1473, 1495)	N9 02 22.2 E77 37 11.3	N9° 2'7.87" E77°36'53.59"	31.67
2	Sf no 645, 664	N9 2 20.5 E77 36 16.6		
3	Sf no 1515	N9 2 7.7 E77 37 11		
4	VL307 (Sf no 1529)	N9 1 55.6 E77 37 8.6		
1.5 MW at Muthiampatti				
1	M-14(Sf no.251)	N10 47 46.90 E77 22 33.20	N10 47 18.78 E77 21 44.98	39.01
2	M-18(Sf no.198)	N10 46 48.00 E77 22 20.60		
3	M-22	N10 47 58.40 E77 21 57.20		
4	M-40(Sf no.2)	N10 47 20.50 E77 21 10.10		
5	Sf no.754	N10 47 31.60 E77 21 04.60		
6	Sf no-184/2	N10 47 01.20 E77 22 05.40		
1	M-28	N10 50 09.50 E77 21 44.30	N10 49 52.33 E77 22 5.94	42.18
2	M-3(Sf no.418)	N10 49 36.00 E77 22 23.00		
3	Sf no.403	N10 49 52.60 E77 22 37.90		

#	WTG contributing to cumulative noise	Coordinates of contributors	Coordinates of nearest receptor	Cumulative noise level dB(A) of WTGs
4	Sf no.684	N10 49 47.70 E77 21 46.40		
5	Sf no-389/2	N10 50 07.40 E77 22 22.50		
1	Sf no.1004	N10 49 29.90 E77 20 02.50	N10 49 36.95 E77 19 24.25	38.33
2	Sf no.1054	N10 49 16.70 E77 18 57.40		
3	Sf no.817(Option-2)	N10 50 07.80 E77 19 51.00		
4	Sf no.939	N10 49 00.00 E77 19 11.90		
5	Sf no.961	N10 49 04.60 E77 19 43.00		
1	KD-97(Sf no-90b)	N10 47 36.10 E77 25 31.50	N10 47 47.51 E77 24 49.43	39.06
2	KD-100(Sf no.108)	N10 48 11.60 E77 25 15.20		
3	KD-125(Sf no.268)	N10 49 35.30 E77 24 26.00		
4	KD-133(SF No-202)	N10 47 37.50 E77 25 05.05		
1	KD-244(Sf no.258)	N10 49 12.40 E77 24 02.04	N10 49 33.77 E77 23 31.32	44.1
2	KD-245(Sf no.311)	N10 49 25.40 E77 23 45.06		
3	KD-246(Sf no.295)	N10 49 44.10 E77 23 35.02		
4	KD-268	N10 49 26.80 E77 23 04.04		

The above table, shows the cumulative noise level at (8 m/sec wind velocity) generated by two or more (upto nine WTGs, based on distance criteria) WTGs of different capacity (1.5 as well as 2.1 MW).

With the background noise at these locations (recorded in baseline monitoring at village *Pushpatoor* and taken as representative of all locations) was found to be-

Day time max – 53.6 dB (A)

Night time max - 53.1 dB (A)

The cumulative noise at the receptor will therefore be a logarithmic sum of cumulative noise of the WTGs as in **Table 6.11** above and the Day and Night time *Max* as recorded in baseline monitoring. The cumulative noise is calculated as described in the **Box 6.1** below

Box 6.1 *Addition of Decible levels*

Numerical difference between two noise levels [dB(A)]	Amount to be added to the higher of the two noise levels [dB or dB(A)]
0	3.0
0.1 - 0.9	2.5
1.0 - 2.4	2.0
2.4 - 4.0	1.5
4.1 - 6.0	1.0
6.1 - 10	0.5
10	0.0

Step 1: Determine the difference between the two levels and find the corresponding row in the left hand column.

Step 2: Find the number [dB or dB(A)] corresponding to this difference in the right hand column of the table.

Step 3: Add this number to the higher of the two decibel levels.

http://www.ccohs.ca/oshanswers/phys_agents/noise_basic.html

From the above methodology and the noise levels as presented in *Table 6.11*, the following can be construed.

The max cumulative noise level in *Table 6.11* is 46.00 dB (A) and the background noise level (max) is 53.6 dB (A). The difference of these two is 7.3 dB (A), which according to the *Box 6.1* above will be in the range of 6.1 to 10.0 and hence the addition to the higher noise level (i.e. 53.6 dB (A)) will be only 0.5 dB(A) thus meeting the IFC EHS guideline standard (for wind projects) of 3.0 dB(A).

The cumulative noise level at receptor in this case will therefore be equal to 54.1 dB (A). For any case it will not reach 3.0 dB (A) since the cumulative noise level of WTGs is not equal to background noise.

Key impacts therefore, are summarised in *Table 6.12*.

Table 6.12 *Summary of Anticipated Impacts on ANLs*

Impacts During Construction Phase	Impacts During O&M Phase	Impacts During Decommissioning
Noise emission from construction equipments (DG sets, concrete mixers) and vehicles	Noise emission from O&M team vehicles carrying out routine/scheduled inspections	Noise emission from equipments and vehicles
Noise emission from off-road erectioning equipments such as heavy tonnage capacity cranes, hydraulic equipments, earthmovers, small cranes etc	Wind cutting noise generated by turbine blades especially during high winds.	Noise emission from off-road erectioning equipments such as heavy tonnage capacity cranes, hydraulic equipments, earthmovers, small cranes etc
Noise emission from WTG part transportation trucks	Noise emission from WTGs during power evacuation stoppages	Noise emission from WTG part transportation trucks

Impacts During Construction Phase	Impacts During O&M Phase	Impacts During Decommissioning
	Noise emission from WTGs during change in direction of turbines	

Significance of Impact

The impact on ANLs will be moderately adverse in the medium context both during construction and operation phases at moderate and minor intensity respectively. During operation phase, the contribution from WTG towers to cumulative ANLs (*Refer Table 6.15 above*) is not expected to be more than 30% of baseline ANLs. However, the operational phase impact will be longer during the entire operational phase and hence needs to be managed at sensitive receptor locations that are close by besides controlling the source. During decommissioning, impact on ANLs is expected to be minor adverse in the local context. The impact significance assessed is summarised in **Table 6.13**.

Table 6.13 *Impact Significance – ANLs*

Factors	Significance – Construction Phase	Significance – O&M Phase	Significance – Decommissioning
Context	Medium	Medium	Local
Duration	Short	Long	Short
Intensity	Moderate	Minor	Moderate
Overall	Moderately adverse	Moderately adverse	Minor – adverse

6.5.6 *Ecology*

The baseline assessment of ecological environment in the project sites indicate that the area is devoid of dense vegetation and forest cover except at *Oothumalai* RF in Tirunelveli district which is the closest forest area to wind energy projects in the district. As a policy in Tamil Nadu, the government does not allow wind energy projects and associated infrastructure in forest areas and hence adverse impacts on forest resources are not envisaged.

Baseline assessment of ecological resources indicates that almost all flora and faunal species are common in the local environment, there are some rarely found species which needs to be conserved and protected during project life cycle. Specific details and results of the ecological assessment have been already presented under Section 4 of this report.

Ecological impact is anticipated to mainly occur during construction phase due to clearing and grubbing of project sites and associated facility locations, tree felling and trimming at various project sites/areas, loss of common floral species and introduction of alien and invasive species in the local ecosystem. Hence, planning phase needs to take into account the ecological aspects of environment while planning WTG projects and ancillary facilities/ utilities.

During operational phase, tree felling and trimming besides/ beneath transmission lines and electrical utilities as part of routine operations is expected to cause adverse impact while the Suzlon's initiatives to plant more trees as compensatory and green initiatives in the local area is expected to add more value to local ecological environment.

Wide spread stakeholder consultations with local community members, academicians and Suzlon O&M team staff indicate that the avian faunal species found in the project sites are very commonly encountered species and mostly do not fly at turbine blade height and they have not come across any bird hit incidents/ accidents resulting in fatal injury to avian fauna. Wind energy projects are in operation in these districts for than one decade now and no bird hit incidents have been observed by either the local community or wind energy project developers and operators. However, one of the reasons is also a lack of established system for recoding bird hits.

Box 6.2 ***One view on bird hits***

The 1.5 MW or higher rated turbines, have a very large surface area of blade exposed to the wind and the gearbox turns the dynamo quickly while the blades move slowly and as a result the birds are able to dodge these slow moving blades relatively easily.

Mortality equals hazard times exposure, or $M = H * E$.

"E" is highest where birds migrate, breed, and feed in flocks near wind farms.

http://www.treehugger.com/files/2006/04/common_misconce.php#

Since the region is monsoon dependant and becomes dry post-monsoon, there are no large water bodies creating favourable ecosystem for migratory birds as well and hence migratory bird routes do not pass through the project regions in both the districts of Tirunelveli and Tiruppur.

Decommissioning of WTG projects depending on scale is expected to free more land space for ecological improvement erstwhile occupied by them and add positive value to the environment.

Key impacts are summarised in **Table 6.14**.

Table 6.14 ***Summary of Anticipated Impacts on Ecology***

Impacts During Construction Phase	Impacts During O&M Phase	Impacts During Decommissioning
Tree felling and trimming during construction of WTGs, Power evacuation lines and substations, yards, pathways, CMS building facility etc.	Tree felling and trimming beneath/besides power evacuation lines and substations.	Returned land and removed transmission line and pathways will enable more plantation or least disturbance to tree growth adding value to ecological environment.

Impacts During Construction Phase	Impacts During O&M Phase	Impacts During Decommissioning
Clearing and grubbing of ground vegetation at WTGs, Power evacuation lines and substations, yards, pathways, CMS building facility etc.	Bird hits on turbine blades and electrocution of peacocks and birds.	
Loss of common and local floral specie	No migratory bird routes are located across project sites – hence no impacts are envisaged.	
Introduction of alien and invasive species as part of compensatory plantation	Compensatory afforestation efforts will add ecological value to local ecosystem.	

Significance of Impact

The impact on ecological environment is anticipated to be major adverse specifically during operational phase essentially due to bird hit issue. Though baseline assessment does not indicate major impacts due to wind projects in the region, this study would downgrade the impact based on long term monitoring and assessment which has been built into the mitigation strategies. The impact significance assessed is summarised in *Table 6.15*.

Table 6.15 *Impact Significance – Ecology*

Factors	Significance – Construction Phase	Significance – O&M Phase	Significance – Decommissioning
Context	Local	Regional	Local
Duration	Short	Long	Long
Intensity	Low	Low	Low
Overall	Insignificant	Minor	Minor - Beneficial

6.5.7 *Cultural Environment*

Based on the data collected from state departments of archaeology and tourism and based on local consultation as well as review of secondary literature, it is observed that there are no archaeological and historical sites of importance in proximity to the sites (Tiruppur and Tirunelveli). There are no temples, religious symbols or related cultural activities in and around the site. Few local religious sites, village temples/religious structures and other community properties (graveyards, sacred groves) of importance to the local community are present in the project areas but well away from WTG locations as these are avoided during the micro-siting process of Suzlon. There will not be any adverse impact on such religious or cultural sites, structures of monuments due to the project at any stage.

There is potential for cultural differences between workers engaged at site based on behavioural, traditional, and religious aspects as well as hostility between the outside labour force and local community.

Key impacts are summarised in *Table 6.16*.

Table 6.16 *Summary of Anticipated Impacts on Cultural Environment*

Impacts During Construction Phase	Impacts During O&M Phase	Impacts During Decommissioning
Secondary impacts caused by air quality deterioration and high noise levels	Secondary impacts caused by high noise levels from WTGs	Secondary impacts caused by air quality deterioration and high noise levels
Chance finds of archaeological, historical and cultural remains of previous civilisations	-	-
Conflict with local cultures, values and religious/societal sentiments	Conflict with local cultures, values and religious/societal sentiments	Conflict with local cultures, values and religious/societal sentiments

Significance of Impact

The impact on cultural environment will have local context and for a short duration. As such the impact on cultural environment during all phases of project life cycle is expected to be insignificant. The impact significance assessed is summarised in **Table 6.17**.

Table 6.17 *Impact Significance – Cultural Environment*

Factors	Significance – Construction Phase	Significance – O&M Phase	Significance – Decommissioning
Context	Local	Local	Local
Duration	Short	Short	Short
Intensity	Insignificant	Insignificant	Insignificant
Overall	Insignificant	Insignificant	Insignificant

6.5.8 *Visual Aspects*

Currently the site setting is essentially rural environment with vast expanse of open lands that are waste, untilled, dry with tall grass and bush growth or completely barren. This vast open land horizon is marked by the intermittent presence of orchards (coconut, plantain, mango), farm houses, poultry units, rural settlements, semi-urban settlements etc. The project sites are also marked by presence of large number of WTG projects already at most locations except at few villages.

In this context, the visual and aesthetic impact anticipated is essentially due to addition of tall WTG structures, transmission lines, locating yards/ stores/ CMS buildings etc. Key impacts through project life cycle are summarised in **Table 6.18**.

Table 6.18 *Summary of Anticipated Impacts on Visual Environment*

Impacts During Construction Phase	Impacts During O&M Phase	Impacts During Decommissioning
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Impacts During Construction Phase	Impacts During O&M Phase	Impacts During Decommissioning
Construction vehicles and equipments moving around all the time will have adverse visual impact	Concurrent operation of all WTGs with rotating blades inherently alters the visual environment	Removal of WTGs and associated facilities such as transmission lines, pathways, yards, stores etc will again alter the visual environment
Altering the landscape to construct pathways	Presence of yards, stores and CMS building in a rural landscape inherently alters the visual environment	-
Altering the landscape to install WTGs	Presence of transmission lines criss-crossing the rural environment inherently alters the visual environment	-
Altering the landscape to install power evacuation lines and associated facilities such as yards, stores, CMS etc	Presence of access pathways criss-crossing the rural environment inherently alters the visual environment	-

Significance of Impact

The maximum impact on visual and aesthetic aspects will be major adverse on a regional context during operational phase. The impact significance assessed is summarised in **Table 6.19**.

Table 6.19 *Impact Significance – Visual Environment*

Factors	Significance – Construction Phase	Significance – O&M Phase	Significance – Decommissioning
Context	Regional	Regional	Local
Duration	Short	Long	Short
Intensity	Moderate	Moderate	Insignificant
Overall	Moderate – Adverse	Major – Adverse	Insignificant – Beneficial

6.5.9 *Road Network*

Baseline assessment of traffic volume count indicates that about 5-6 vehicles carrying WTG parts move in the National (NH) and State Highway (SH) network per day in the project region. In the road network, WTG project traffic does not add much to overall traffic volume but could impact the traffic speed and associated high risks of accidents/ incidents involving these trucks.

During construction phase, there will be marginal increase in traffic volume in the local road network due to transportation of construction material, WTG parts and erection equipments (about 50 trucks per WTG location and out of which about 30 odd trucks will be of heavy duty, multi-axle and trailer mounted ones), which will increase the risk of traffic related accidents and injuries to local community and to workers. Besides, impact on road network will also occur at transmission line, pooling substation and associated facilities (yards, stores and CMS buildings) construction sites as well. Also increase in traffic movement will increase disturbance to the local community by means of congestion on road or increased noise levels.

During operational phase, impact on road networks will be minimal which arise essentially due to O&M staff vehicle movements, WTG parts transport for repair/ replacement etc. The decommissioning phase impacts will mirror the construction phase depending upon the scale of operations.

Key impacts are summarised in *Table 6.20*.

Table 6.20 *Summary of Anticipated Impacts on Road Network*

Impacts During Construction Phase	Impacts During O&M Phase	Impacts During Decommissioning
WTG parts and crane equipments transport through cross country road network leading to traffic volume, slackness in overall traffic speed, safety risks etc.	Movement of O&M vehicles on local road network adding to traffic volume	Removed WTG parts and crane equipments transported back through cross country road network leading to traffic volume, slackness in overall traffic speed, safety risks etc.
Damage to road surface and CD structures reducing their design life	Movement of replacement parts of WTG equipment, transformers, transmission line poles etc causing safety and accident risks on road network	Damage to road surface and CD structures reducing their design life
Safety and accident risks when the heavy vehicles, equipments are transported through congested urban and rural stretches	-	Safety and accident risks when the heavy vehicles, equipments are transported through congested urban and rural stretches
Safety and accident risks at road junctions where heavily loaded project vehicles enter or exit	-	Safety and accident risks at road junctions where heavily loaded project vehicles enter or exit
Safety and accident risks at entry /exit points on metal roads from project site; yard locations; offices etc.	Safety and accident risks at entry /exit points on metal roads from project site; yard locations; offices etc.	Safety and accident risks at entry /exit points on metal roads from project site; yard locations; offices etc.
Construction materials transported to site creating hazardous conditions on road network	-	-
Overhead cables (power, telephone, TV cables etc) snapped by heavily loaded project vehicles in congested rural and semi-urban areas	-	Overhead cables (power, telephone, TV cables etc) snapped by heavily loaded project vehicles in congested rural and semi-urban areas
Safety and accident risks caused by roadside parking of heavily loaded project vehicles especially during night	-	Safety and accident risks caused by roadside parking of heavily loaded project vehicles especially during night
Safety and accident risks to local community stakeholders especially sensitive receptors such as schools and hospitals	-	Safety and accident risks to local community stakeholders especially sensitive receptors such as schools and hospitals

Significance of Impact

The maximum impact on road network will be moderately adverse during construction phase with regional context for a short duration. Else, during operation and decommissioning phases, impact is envisaged to be insignificant though adverse. The impact significance assessed is summarised in *Table 6.21*.

Table 6.21 *Impact Significance – Road Network*

Factors	Significance – Construction Phase	Significance – O&M Phase	Significance – Decommissioning
Context	Regional	Medium	Regional
Duration	Short	Short	Short
Intensity	Low	Insignificant	Insignificant
Overall	Moderately adverse	Insignificant - adverse	Insignificant – adverse

6.5.10 *Health and Safety*

Impact on health and safety (H&S) aspects has been categorised into occupational H&S and community H&S aspects. Due to inherent nature of WTG projects, almost all construction (including transport and handling), erection and commissioning, operational and decommissioning activities will have high risks on both occupational H&S and community H&S aspects.

As per IFC EHS guidelines for Wind energy projects, the occupational and community health and safety hazards during the construction, operation, and decommissioning of onshore wind energy conversion projects are generally similar to those of most large industrial facilities and infrastructure projects. They may include physical hazards such as working at heights, working in confined spaces, electrical safety, working with rotating machinery, structural safety of project infrastructure, life and fire safety, public accessibility, emergency situations and falling objects.

According to IFC EHS guidelines, community health and safety hazards specific to wind energy facilities primarily include the following:

- Shadow flicker
- Blade glint
- Aircraft and marine navigation safety
- Blade throw
- Electromagnetic interference and radiation
- Public access

As part of this assessment, wide-ranging consultations were held with concerned stakeholders on above mentioned community H&S aspects such as: local community members; Coimbatore ATC Management; IMPCS Wing of BSNL at Coimbatore; Station Engineer of All India Radio, Tirunelveli; and Assistant Station Engineer's office in High Power Transmitter centre of Doordarshan, Tirunelveli. Awareness about these issues among the

concerned stakeholders was low and emerging and hence no stakeholder has apportioned any amount of community H&S risk due to WTG projects in the region.

Shadow flicker Analysis

A shadow flicker phenomenon may be considered an adverse impact for every household falling within 400 m of the WTG. However, the distance given in the above tables from nearest WTG does not take into consideration the orientation of houses/habitation with respect to the duration and direction of sunlight. Hence all WTGs located within 400m of a sensitive receptor cannot be causing shadow flicker impact on that receptor.

As per the distance from nearest habitation to the proposed WTG location, Simran has certified that the WTG locations in Amuthapuram and Rastha are at more than 400 meters distance from the nearest habitation. Also, at the Muthiampatti site, Simran shall ensure that the WTG locations vis-à-vis their distance from the nearest habitation will be recorded and a distance criteria of 400 meters will be maintained. Construction shall commence only once this criteria is met.

As per the distance data calculated by Simran for Amuthapuram and Rastha sites, the habitations have been reported to be at more than 400 m, while at Muthiampatti site, out of total 41 potential locations (of which Simran will be offered 34 locations) 9 locations have been reported to be at more than 300 m distance from the nearest habitation, while 27 locations have been reported to be at more than 500 m. Around 5 locations were not approachable.

Impact due to shadow flickering has to be analysed in field after implementing the project and in consultation with concerned stakeholder, appropriate mitigation measures such as installing vegetative screens should be explored during construction or O&M phases.

Other Community H&S Issues

Blade glint issue has been effectively addressed by Suzlon as the WTG parts are coated with a low reflectivity treatment paint that prevents reflective glint from the surface of the blade, nacelle, hub and tower. During field visits, no blade glint was observed at any of the Suzlon sites that are currently operating at any hour of the day.

Aircraft navigation safety is not a major issue as the proposed WTG project sites are located away from Coimbatore airspace (26kms away) and Sullur defence airspace (14kms away). Scheduled air traffic routes are not located above WTG project sites and height restrictions have not been imposed by Airports Authority of India (AAI) on any WTG projects till date as they are located well away from the conical area of interest to AAI.

Blade throw issue has been addressed through two ways. Firstly, setback distance directed by TNEB is strictly followed. Suzlon adheres strictly to TNEB guidelines of minimum physical distance (1D+10m) between WTG towers and nearby structures. No structure will be allowed to be located within 100m of WTG tower location in all cases. The central 2.5 acres is preserved and no human activity is permitted except for cattle grazing and access.

Electromagnetic interference (EMF) and radiation impacts due to WTG projects has not been realised to be significant by the concerned stakeholders though the wind energy projects are in operation for the last decade or so. The EMF impact due to HT transmission lines have been identified as more important relatively when compared to WTG towers. Considering the rural environment and dry, barren land use nature, EMF and radiation issues are not significant in both the project districts.

Public access is not an issue in the project as the WTG sites are located in rural, dry land areas that are thinly populated. Settlements are not located closer to WTG sites and separate access roads are available for each of them. Suzlon encourages local community to use the access pathways created for the project and hence local community does not have to enter or pass-through any of the WTG site specifically. No accidents or incidents involving local community below WTG tower or HT line transmission has been reported by community stakeholders. Besides, each of the WTG site is guarded all through the day by security guards engaged from local community itself.

Key impacts are summarised in *Table 6.26*.

Table 6.22 *Summary of Anticipated Impacts on Health and Safety Aspects*

Impacts During Construction Phase	Impacts During O&M Phase	Impacts During Decommissioning
Occupational health and safety aspects such as working at heights, electrical safety, use of job appropriate PPEs etc.	Occupational health and safety aspects such as working at heights, electrical safety, use of job appropriate PPEs etc.	Occupational health and safety aspects such as working at heights, electrical safety, use of job appropriate PPEs etc.
Community health and safety aspects such as: exposure of local community to heavily loaded traffic; increased traffic volume in local area; deterioration of air quality and noise levels; potential soil and groundwater pollution risks; safety risks due to unclosed borrow pits etc	Community health and safety risks such as: Aircraft navigation safety; Blade throw; Electromagnetic interference and radiation; Public access; Shadow flickering; and Blade glint	Community health and safety aspects such as: exposure of local community to heavily loaded traffic; increased traffic volume in local area; deterioration of air quality and noise levels; potential soil and groundwater pollution risks; safety risks due to poorly closed WTG sites.

Impacts During Construction Phase	Impacts During O&M Phase	Impacts During Decommissioning
-	Community health and safety aspects such as: exposure of local community to increased noise levels; potential soil and groundwater pollution risks; safety risks due to unclosed borrow pits; risk of electrocution besides/beneath transmission lines etc	-

Significance of Impact

The maximum impact on health and safety aspects will be moderately adverse in the medium context for a long duration during operational phase. Though stakeholder consultations does not indicate major impacts due to wind projects in the region on community H&S aspects highlighted by international guidelines and IFC EHS guidelines, this study could downgrade the impact envisaged based on long term monitoring and assessment which has been built into the mitigation strategies. The impact significance assessed is summarised in *Table 6.27*.

Table 6.23 *Impact Significance – Health and Safety Aspects*

Factors	Significance – Construction Phase	Significance – O&M Phase	Significance – Decommissioning
Context	Medium	Medium	Medium
Duration	Short	Long	Short
Intensity	Insignificant	Low	Insignificant
Overall	Insignificant – adverse	Moderately adverse	Insignificant – adverse

6.5.11 *Natural Disasters*

In the worst case scenario of natural calamities such as floods, cyclone, lightning strikes and earthquake hitting the project area, the WTG project and its associated infrastructure facilities and utilities will cause adverse impact on local community stakeholders and environment.

As per baseline assessment, the project regions are located in low to moderate risk zones with regards to earthquake event (Zone 2 or 3). With regard to cyclone events, out of the 62 events recorded in the State of Tamil Nadu between 1891-2000, two (2) events occurred along Tirunelveli district coastal areas. The probability of lightning/thunderstorm and flood events in the project districts is low to moderate.

All of these natural disaster, if occurs in the project region, the adverse impact on the project infrastructure, local community and environment will be devastating and might adversely change the community perception of wind energy projects in the long run.

Key impacts are summarised in *Table 6.28*.

Table 6.24 *Summary of Anticipated Impacts on Natural Disasters*

Impacts During Construction Phase	Impacts During O&M Phase	Impacts During Decommissioning
Health and safety risks to project construction team such as exposure to deleterious effects of natural disasters that occur instantly.	Health and safety risks to project operational team such as exposure to deleterious effects of natural disasters that occur instantly.	Health and safety risks to project decommissioning team such as exposure to deleterious effects of natural disasters that occur instantly.
Health and safety risks to community stakeholders that are closer to construction sites and exposed to deleterious effects of natural disasters that occur instantly.	Health and safety risks to community stakeholders that are closer to WTG sites and associated facilities and are exposed to deleterious effects of natural disasters that occur instantly.	Health and safety risks to community stakeholders that are closer to abandoned WTG sites and associated facilities and are exposed to deleterious effects of natural disasters that occur instantly.
Damaging impacts on environmental factors such as soil, ecology, surface water and ground water aspects especially in the case of flooding.	Damaging impacts on environmental factors such as soil, ecology, surface water and ground water aspects especially in the case of flooding.	Damaging impacts on environmental factors such as soil, ecology, surface water and ground water aspects especially in the case of flooding.

Significance of Impact

The impact on local environment due to the worst case scenario of natural disasters occurring in future in the project region will be moderately adverse in the regional context for a short duration (spanning disaster event period). The impact significance assessed is summarised in *Table 6.29*.

Table 6.25 *Impact Significance – Natural Disasters*

Factors	Significance – Construction Phase	Significance – O&M Phase	Significance – Decommissioning
Context	Local	Regional	Local
Duration	Short	Short	Short
Intensity	Insignificant	Moderate	Insignificant
Overall	Insignificant – adverse	Moderately adverse	Insignificant

6.5.12 *Socio-Economic Aspects- construction phase*

a) Land Purchase

Land purchase for the wind power project in Tirunelveli and Tiruppur districts has been undertaken by Suzlon. Both in Tiruppur and Tirunelveli districts the land has mostly been purchased through a willing buyer-seller agreement. However, there are few cases in Tirunelveli where landowners have entered into lease agreement for 30 years.

The land rates offered by Suzlon have been higher than the prevailing market rate and atleast 3-4 times higher than the government registered rate. All the WTGs will be constructed on dry agricultural lands (*Punsei* lands) or wastelands and never on wet, irrigated lands (*Nansei* lands). So far, as revealed in the community consultations, there has been no case of absolute

landlessness due to the wind power project. The main reasons cited for this are:

- People have not sold off all the land;
- Prime agricultural (irrigated) land has not been sold;
- Only surplus land and unirrigated dryland has been sold; and
- People have reinvested in land purchase in most of the cases.

At the same time, based on consultations with landlosers, land promoters of Suzlon and land department of Suzlon, the following main reasons for selling land have been cited:

- Good value for land;
- Surplus land;
- Rainfed dryland and low productivity;
- Non-availability of labour to work in field; and
- Distress sale, loan pay off, daughter's marriage;

However, there are few potential cases (e.g. village Mannurpally, Tirunelveli) where the backward SC community depended on agricultural labour in the field of higher caste community will lose its livelihood. With a potential sale of land (*wind power project has not yet been set up in this village but there is a chance of this happening in next 5-6 months*) in this village, there is a threat of loss of livelihood of this SC community.

On average, per WTG around 5 Acres of land has been purchased. This includes the land for WTG tower and the transformer.

Box 6.3***Land purchase process in Tamil Nadu***

For purchasing land, Suzlon has involved a third party, acting as a broker, who first purchases land from the different titleholders and then sells all that land to Suzlon. This process is called a land consolidation and the third party is called as land promoter. The third party is individual from the local area (restricted to local panchayat where land has been bought) who is paid a fixed commission for this process. This process of land purchase is common to both Tiruppur and Tirunelveli districts.

To arrive at a rate for negotiation, Suzlon first undertakes a survey of land rates (registered rate and prevailing market rate) in the area and then fixes a range for negotiation depending upon the attributes of land like access to nearest road head and market value of land by land category. This range is then communicated to the land promoter who then negotiates on behalf of Suzlon.

There is no forceful purchase of land and only if the landowner is willing to sell, a sale agreement is made, else alternate land is looked for. In cases where the land promoter is not able to find the land parcel suitable for WTG location, he has the freedom to look out for land within 1D distance of that land (D is the diameter or WTG rotor, which is 80 meters for a 2.1MW WTG). In case he gets land within 1D but due to new location, possible additional expenses like building a longer access road or more earth work etc are calculated. These additional expenses are then added to the land value offered to the previous (previous failed negotiation) landowner and another attempt is made to negotiate at this new value. Sometimes it works sometimes it do not.

However, if he is not able to purchase land even within 1D distance, then he has to report back to Suzlon, who then refers the matter to its wind resource team. The wind resource team then identifies new location and communicates back to the land promoter.

A back of the hand calculation made by Suzlon indicate that on average if 100 potential locations are indicated by its wind resource department, only 40% of them gets converted into successful land purchases. Rest of them fall off during negotiations, legal due diligence, no sale or due to issues with land titles. Suzlon does not take land on lease for core project components (WTG and transformer), since the investors, like Simran etc, do not invest in a leased land.

In both Tiruppur and Tirunelveli districts, Suzlon purchases land only through land promoter system. Landowners approaching directly to Suzlon for land sale are not entertained and are asked to come through respective land promoter.

The average time taken for land purchase per WTG take 2-3 months while faster transactions may take as less as one month and slower ones take upto 2 years.

Box 6.4***Inadequate prior information and communication***

As communicated by Suzlon, one of the major activities it undertakes prior to land purchase is that of interacting with the local panchayat and giving information about the project and its benefits. Suzlon sometimes does it on its own and sometimes the land promoter is given this responsibility. Consultations with local community that many a times the land promoter does not give full information about the purpose of land purchase, the project details or information about the project developer.

Suzlon also has a CSR wing, the Suzlon Foundation which is mandated to undertake social development activities in project sites. However, there is a disconnect between the project construction team of Suzlon and the Suzlon foundation and both work independently of each other even in the same area. There is no sequencing or synchronising of activities undertaken by project team and Suzlon foundation.

Consultations with landlosers indicated that in some cases the land promoter negotiated differential rates for land of same quality. However, such cases are rare and only in occasions where the land sale is out of distress of immediate need of money (thus reducing the negotiation power of the landowner). One of the opinions of the local community was that the land promoter offers a better deal to his friends and relatives as compared to others. Even one of the land promoter agreed to this and said that it is easiest for them to convince their relatives or friends to sell land at a good rate and once the sale in an area begins, it has a ripple effect and the process speeds up. However, due to increasing number of wind power projects in Tamil Nadu, local community has, over the years, become aware of the land rates as well as issues related to the project like noise, shadow flicker etc.

Suzlon adopts an unwritten policy of providing employment opportunities to the local people, uneducated (drop outs) but skilled youth in mechanical, electrical shops or with its subcontractors. Since each WTG requires one person as security guard, this opportunity is also given to the respective landlosers. Depending on the financial condition of the landlosers, some opt for this opportunity while others do not prefer such a job. In that case, someone else from the village or outside is given the job of security guard.

Discussion with Suzlon indicated that sometimes the land promoters make false promises of employment to land sellers.

Another issue, which restricts the negotiation power of the land owner, is that the land promoter carries some cash money with him and at the time of negotiation as soon as some level of agreement is reached he immediately offers the cash money as advance amount to close the deal. This does not give the landowner a chance to think over the offer or to discuss it with his/her family members, relatives or friends.

Land for Access route

An exclusive access to the WTG site is required prior to mobilization of manpower and machinery. The land for access roads has also been purchased. The requirement is of a 10 meter wide passageway, of which Suzlon uses only 7-8 meter width while it leaves one meter width on each side to avoid any boundary disputes. In many cases, the existing *kutcha* roads or village roads connecting to the WTG locations are used after necessary upgradation and strengthening. Only gravel, stone aggregates and red soil is used; metalled road is not required. The access to this road is not restricted and thus it becomes a public utility, barring the core of WTG area.

As a precautionary measure of avoiding land fragmentation, the access roads or passageways are planned along field boundaries. Hence, Suzlon seldom gets a straight access route.

At junctions where these access roads meet the metalled road, a 30m X 30 m triangular block is usually required for allowing a turning radius for vehicles and long trucks. Landowners usually do not sell this important parcel of land due to its strategic location (future development and value appreciation). In such cases Suzlon either pays them more value for this land or enters into a long term lease agreement instead of direct sale.

Land for Transmission line

The power generated by the project is evacuated through intrafarm transmission lines which connect to the nearest substation. The voltage generated at WTG is of 690 volts which is stepped up to 11 or 33 kV depending on the substation capacity, this is done by using a step up transformer (*land for transformer is included within the 5 Acres*).

From the transformer until the nearest substation (*in case of parallel evacuation or lesser number of WTGs*) or next WTG's evacuation line (*in case of series evacuation or more number of WTGs*) the land for tower footings is also purchased. This land area is very miniscule at 2 ftX2 ft and is purchased by paying a one time compensation (*which includes the compensation for crops in the Right of Way*).

Significance of Impact

The social impact on land purchase will be moderately adverse, mainly on account of large scale change in land use, which may result in change in livelihood and occupation patter in long run and regional expanse.

b) Labour camps

During construction period when labour will be deployed there may be a requirement for setting up labour camp depending on the size of the project and scale of operations. Generally, the labour coming from outside lodges in rented accommodation in the nearest town areas. In case such an accommodation is not available or is far off from the site there will be a need for setting up labour camp. In all such cases, Suzlon will take land on lease as it does for, temporary stockyard and temporary storage of material.

c) Access to Common Property Resources

Majority of the WTG locations supports only one season (monsoon) dryland crop comprising minor millets, pulses and seasonal vegetables. The productivity of these crops is very less and constitutes only sustenance farming. Off season land use is cattle grazing on fallow land. In both the districts of Tiruppur and Tirunelveli, almost entire land is *patta* land with negligible common lands or panchayat land. Moreover, the wind power project imposes no restriction on cross access. Apart from the transformer yard there is no access restriction for general public.

As was confirmed in local consultations as well as by visual observations, Suzlon allows free grazing anywhere in the unrestricted area of the Windfarm. Although it prefers an area of 2.5 acres to be free from any encumbrances like crops and vegetation, it still allows the past land use to continue. Hence cultivation is being allowed at all WTG locations in both the districts.

Significance of Impact

The impact on access to CPRs will be insignificant as there will be no restriction on access through the wind farm sites.

d) Community Expectations

The major expectations from the project as informed by Panchayats are regarding infrastructural investments like roads, temples and schools. All these are offered by Suzlon as part of its engagement process with the local panchayat.

At individual levels, the expectations are on account of better land rates, possibility of employment and contract work during construction period. Suzlon accommodates all these expectations to the extent possible.

Significance of Impact

Community expectations have, over a period of time, been diluted due to wind power projects increasingly becoming a common phenomenon. In a self sustaining wind farm project, the on-site presence of developer is limited and hence the expectations of community also reduce. The significance of this impact is therefore assessed as low

e) Impacts on adjacent land

Land area of 5 Acres is large enough to contain all construction activities. In general there is no impact on adjacent land. However, as discussed earlier, there may be a requirement for setting up labour camps.

If adequate control is not exercised over the labour, its interaction with local community, management of waste generated in labour camps and if adequate facilities are not provided for drinking water and sanitation, there could be adverse impacts on adjacent land- like spillage of waste, dumping of waste, loitering, damage to crops or assets etc. Such adverse impacts may develop into a community conflict.

Significance of Impact

Impact on adjacent land will also be low since all construction related activities will be restricted to the purchased land only. However, there is some likelihood of spillage of impacts to adjacent lands, especially in construction phase.

f) Influx of Migrant Workers

The construction phase of the wind power project does not require a long term presence of migrant workers at one site. All construction activities are

completed within a span of 3-5 months and the labour moves from one WTG location to other.

During this time frame maximum 40 construction workers are likely to be employed with diverse skill sets at each WTG location at any given time. Simultaneous work on more than one WTG is not common and hence after completing one activity (e.g. site preparation) at one location the same set of workers move to other WTG location (for site preparation) while another set of workers arrive at the first location for new activities (e.g. excavation and foundation).

Around 50% of these workers would be semi-skilled or skilled workers from outside the local area and these are likely to be accommodated within the project vicinity in the construction period. The EPC contractor for the project will bear the responsibility to construct temporary labour camps and provide the workers with water supply, electricity, sanitary facilities and medical aid. Due to the proximity of village and urban settlements, the influx of these workers can lead to social, health as well as short term economic impacts as illustrated subsequently.

g) Socio-cultural Impacts

Socio-cultural impacts from the influx of migrant workers may include:

- Pressure on existing local resources of drinking water, power supply and local provisions in the hamlets;
- Potential of social evils like alcohol, gambling, community and worker conflicts, prostitution is likely to increase due to interactions in the local hamlets;
- Frequent movement of migrant workers may cause accidents due to increased congestion on roads as well as negligence of traffic rules and drunken driving.

h) Health Impacts

Health impacts to the migrant workers and local community may include:

- Spread of communicable diseases due to sexual transmission and vector-borne infections due to higher incidences of community interactions in the project vicinity;
- Incidences of common health ailments related to poor sanitation and living conditions as well as natural environment conditions such as stagnant water in the labour camp such as diseases like malaria, gastroenteritis and viral fever can increase.

i) Economic Impacts

The local economy is likely to be impacted from the influx of migrant workers in the following ways:

- Increase in temporary demands of goods and services as well as other provisions in the immediate vicinity of the project area;
- Potential income generating opportunities for the locals from rent sources as well as local trading opportunities;
- Increase in the local wage rates for non-agricultural labour as well as agricultural labour and also a marginal exchange of skill levels due to community interactions of migrant workers with local laborers.

Significance of Impact

Due to migration of construction workers, the impact of influx, socio cultural impacts arising out of interaction with local community and health impacts due to the above are assessed to be of moderate intensity for a short time period but with regional spread.

j) Community health, safety and security

The construction phase activities may affect local communities and people who are using the land in the Project area. These impacts would be the increased nuisance level from air emissions and noise due to transportation of material and equipment as well as labourers. There is also likely to be temporary traffic impacts like accidents, diversions or blockage of access due to disobedience of traffic rules.

Significance of Impact

The impact on health, safety and security of local community is assessed to be adverse type but of low intensity and for a short duration.

6.5.13 Socioeconomic aspects- O&M phase

Land

Of the 5 Acre land purchased per WTG location, not all of this land is required for the WTG during operation phase. Only a central parcel of land square in shape with side measuring **rotor diameter + 10 meter** (roughly 100 m X 100 meter i.e. 2.5 Acres) is required for routine operation and maintenance activities. This is retained for routine maintenance activities as well as from safety point of view in case of accidental breakoff of the blades or any other part of WTG. This area is kept sacrosanct and normally no agricultural activities are allowed in this area.

Remaining 2.5 acres remains mostly unused, and in majority of cases is left open for grazing or minor cultivation. In cases of any emergency fault where rotor blades need to be replaced, a main crane (110 m boom length and 500 ton weight) or an auxiliary crane (250 ton weight) is required and in that case, this 2.5 Acres may be used. Suzlon purchase the 5 Acre area and once WTG is commissioned, the central 2.5 Acre is transferred to Simran while the outer 2.5 Acre is retained for emergency O&M activities. However, as a general trend

and due to remote chances of emergency operations, the land is mostly left for grazing or cultivation purpose i.e. the past land use is allowed to continue.

Significance of Impact

Due to the flexibility of the land been continued to be used as pre project land use, the overall impact will be positive with low intensity and a local spread.

Impacts on Local Economy

During the operational phase of the project, impact on the local economy is not likely to be highly positive. This is because, the operations of windpower project do need only limited manpower and an entire wind farm can be managed remotely through SCADA system at the Central Monitoring Station (CMS).

The economic boost is therefore only around areas where CSM, storage yard or maintenance facility is located.

Upgrades to Local Infrastructure

Although the project is not likely to involve any creation of additional infrastructure with the exception of its private access road, Suzlon engages in community development activities like improvement of the school, support to the health centre and other such activities through Suzlon foundation. Simran will also have its own CSR activities in the project site. This will lead to a beneficial impact on the upgrading of local infrastructure.

Significance of Impact

The impact on socio-economics will have low intensity with a local spread for a long duration which will result in an overall minor positive impact which with engagement of community can be enhanced into a moderate positive impact.

An analysis of alternative options that were considered during project conception and planning phase is discussed in the following section. The options that are analysed include:

- No project scenario;
- Alternate location during micro-siting of individual WTGs and associated facilities;
- Alternate technology;
- Alternate process; and
- Alternate methods of power generation.

7.1 NO-PROJECT SCENARIO

According to the policy note 2009-2010 released by TNEB, the total installed power generation capacity of Tamil Nadu is 15,100 MW (as on 30 April 2009), of which 10,214 MW is from conventional sources and 4,886 MW from Non conventional sources. The peak demand for power in 2008-09 was 9,567MW, which indicates an appreciable growth in peak demand over the last five years.

The pattern of growth (excluding non conventional sources) of installed capacity and sustained peak demand for the past five years is as given the *Table 7.1*.

Table 7.1 *Tamil Nadu Power Supply-Demand Scenario 2004-05 to 2008-09*

Period (ending)	Installed Capacity (MW)	Sustained Peak (MW)
2004-05	9,531	7,473
2005-06	10,031	8,209
2006-07	10,098	8,803
2007-08	10,122	8,969
2008-09	10,214	9,459

As of now there is surplus supply with respect to the demand from conventional sources however as per the compounded annual growth rate projection of 17th Engineering Power Survey provided by TNEB policy note 2009-2010 shows a deficit in supply starting from year 2009-2010 up to 2013-14. The projections of the 17th Engineering power Survey is as given in *Table 7.2*.

Table 7.2 *Projections of 17th Engineering Power Survey*

Year	Installed Capacity (MW)	Capacity Added during the Year (MW)	Availability During the Year (MW)	Total Net Availability in (MW)	Projected Demand as per CAGR 17 th EPS	Surplus/ Deficit (MW)
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Year	Installed Capacity (MW)	Capacity Added during the Year (MW)	Availability During the Year (MW)	Total Net Availability in (MW)	Projected Demand as per CAGR 17 th EPS	Surplus/ Deficit (MW)
	A	B	C	D	E	F
2008-09	10,214	-	-	9,459	-	-
2009-10	11,371	1,157	984	10,443	11,675	-1232
2010-11	12,830	1,459	1,104	11,547	12,860	-1313
2011-12	15,167	2,292	1,629	13,176	14,224	-1048
2012-13	16,014	847	720	13,896	15,517	-1621
2013-14	19,194	1,360	1,156	15,052	16,927	-1875

*Spinning reserve is considered as at least 5% of the installed capacity

The above gap in the demand and supply is proposed to be met by utilizing renewable/non conventional sources of power. The proposed project being a non conventional source of power generation intends to contribute towards bridging the demand supply deficit as projected.

An alternative without the project is obviously undesirable, as it would worsen the power supply-demand scenario, which would be a constraint on economic growth.

7.2

ALTERNATE LOCATION FOR WTGS AND ASSOCIATED FACILITIES

Wind energy projects are non polluting energy generation projects which are site specific and dependent on the availability of wind resource. Wind resource mapping and power potential assessment is done by C-WET based on which potential areas are notified by C-WET. Hence, the option of choosing an alternative area is not available to a project developer.

However, within the potential area, there is a possibility as well as flexibility of moving the individual WTG locations (micrositing) to avoid any potential E&S issue or risks like:

- Total landlessness of a landowner;
- Impact on tribal population;
- Impact on environmental sensitive receptors like prime agricultural land, vegetation and tree cover, wetlands, surface water bodies, forests and cultural sites (including historical, archaeological, religious sites) etc; and
- Impacts on social sensitive receptors like schools, hospitals, human habitation, individual dwellings, irrigated wet lands, government lands (*poromboke* lands), common property resources etc.

Suzlon's Wind Resource Department (WRD) as part of the micrositing process during the planning phase, undertakes extensive analysis of E&S sensitivities based on satellite imagery, remote sensing data and GIS tools. This procedure has been incorporated into the planning process since last two years based on the experience gained over the years. Besides, as a further safeguard, ground truthing is done jointly with other teams of Suzlon before releasing the land purchase indent (LPI) of individual WTG location's GPS co-ordinates.

WRD also provides further flexibility of shifting the individual WTG locations upto 1D (i.e. a distance equivalent to the diameter of blade sweeping area) to the Land Department. The land team can shift the location based on site exigencies and inform WRD team about the shifting. Any further shifting requires the approval of WRD which will then re-do the micrositing analysis and energy modelling for the wind mast site. As a policy, Suzlon does not acquire following lands:

- Irrigated wet lands that have water source and practice at least more than one season of farming;
- Land parcels whose title documents and legal heirs are not clear or untraceable;
- WTG locations where land owners just refuse to sell;
- WTG locations that have no feasible access;
- Land parcels that are closer to settlements, religious sites and other common property resources; and
- Micrositing locations that fall on drainage channels, near surface water bodies, forest areas and government lands.

According to Suzlon's land team, based on past experience in land acquisition, up to 20% of WTG locations have been abandoned or could not be converted into project because of above reasons where alternate locations could not be found. Suzlon's conversion rate of planned WTG locations during micrositing into projects is as low as 30-40% in Tirunelveli district and slightly better in Tiruppur district but not more than 60% anywhere.

As for associated facilities such as transmission lines, access pathways, pooling substation, yards, stores and CMS building sites, land department undertakes identification of alternate sites in consultation and joint field visits held with Power Evacuation team, Projects team and OMS teams which are the concerned internal stakeholders. As for access pathways, land team is careful to choose an alignment that runs along the boundaries of each individual land owners to avoid asset bifurcation of land plots. This process has enabled Suzlon to choose the best possible alternative to locate the WTG project associated facilities as well.

7.3

ALTERNATE TECHNOLOGY

Suzlon has proposed to install two of its proven wind turbines viz. S82 and S88 type WTG turbines for the project. The S82 type turbine has been installed at about 1160 towers with a generating capacity of 1740MW. This is about 33% of total installed capacity erected and operated by Suzlon in India till date.

The other turbine - S88 type - is recently introduced and has been successfully installed and operated at 64 towers with an installed capacity of 134.4MW. Suzlon is one of the market leaders in the wind power generation business and has installed turbines at 4918 towers with an installed capacity of

5255MW which is about 45% of wind power generated in the country and about 27% of total number of towers erected in the country¹.

The technology and expertise of Suzlon in designing, erecting and operating wind farm projects is well proven over the last 16 years of its operations across 25 countries and is currently rated as the third largest wind turbine manufacturing company in the world with a 9.8% market share. It has wind farm operations across the Americas, Asia, Australia and Europe with integrated supply chain and manufacturing facilities in three continents. The company has also set up R&D capabilities in Belgium, Denmark, Germany, India and The Netherlands.

Salient features of the two turbines proposed for the project is presented in *Table 7.3* and the power curves for both the turbines are presented at *Figures 7.1 and 7.2*.

Table 7.3 *Salient Features of Suzlon Turbines Proposed for the Project*

Salient Features	Typical Design Values of S82 Type WTG Turbine	Typical Design Values of S88 Type WTG Turbine
Rated power	1500KW	2100KW
Cut-in wind speed	4m/sec	4m/sec
Rated wind speed	14m/sec	14m/sec
Cut off wind speed	20m/sec	25m/sec
Survival wind speed	52.5m/sec	59.5m/sec

Source: www.suzlon.com

Both the turbines have a well-suited ratio between rotor diameter and generator and are ideal for medium wind speed regime. The wind turbine concept is based on a robust design with pitch regulated blade operation, a 3-stage gearbox and flexible coupling to the asynchronous induction generator. Resolution of 0.1 degrees special fast-pitching mode - flexi-slip system provides efficient control of load and power. These technologies are all well-known in the wind power industry and have proven themselves over time. The turbines are designed to withstand extreme conditions and operate effectively with lower maintenance cost. As per CWET reports, the expected maximum wind speed at both sites is about 7 – 10m/sec and the proposed Suzlon turbines are capable of handling the expected wind speed at the wind farm sites. However, Suzlon has reported wind speed as high as 22 m/sec in peak season.

(1) ¹ http://www.cwet.tn.nic.in/Docu/Manufacturers_as_on_31_03_2010.pdf

Figure 7.1 Power Curve for S82 Type WTG Turbine

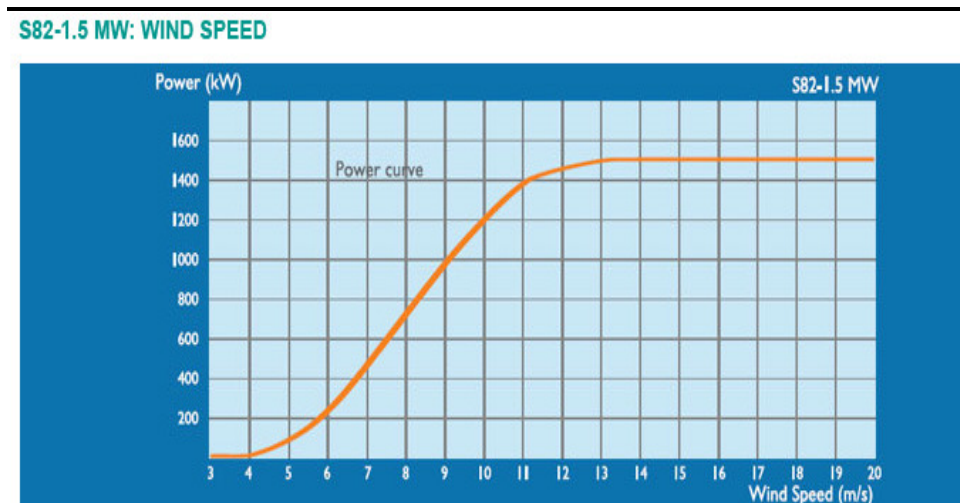
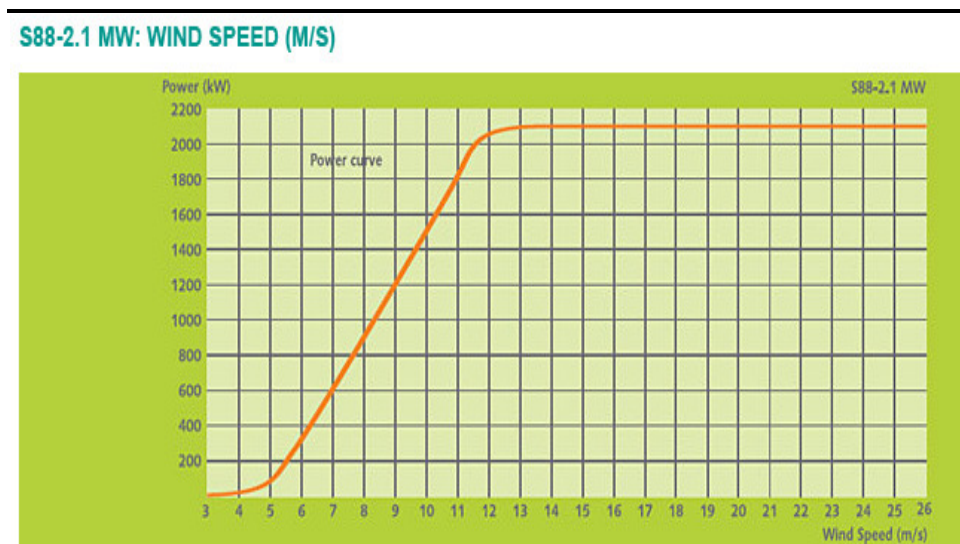


Figure 7.2 Power Curve for S88 Type WTG Turbine



Research indicates that by increasing the cut-in speed of wind turbines – the minimum wind speed necessary for turbines to begin spinning and producing electricity – from 3.5 m/s to 5.0 or 6.5 m/s, bat mortality and bird hits decreased by 44 - 93%. The turbines proposed have a slightly higher cut in speed of 4m/sec and should be able to reduce the bird hits to some extent. Significantly, no major bat or bird activity has been reported in the project sites.

7.4 ALTERNATE PROCESS

Suzlon has been continually improving upon its internal systems and procedures to meet the demands of the sector. Some of the notable process

modifications undertaken by Suzlon in its construction and operational procedures include:

- Use of multiple sub-contractors in a single WTG project has reduced the construction period to hardly over a month or two. Erection and commissioning of mechanical and electrical components of the WTG tower and turbine components is completed in 48 hrs. Hence, a swift construction process reduces the environmental impacts significantly;
- Tubular steel structure is now being used as tower material and lattice structure or concrete is not preferred to reduce construction time and enable safe working conditions during O&M phase as well;
- Fibre optic cable and SCADA based CMS has reduced O&M trips to individual WTG towers to almost zero as everything can be monitored at the control centre within CMS. This process has greatly reduced the associated H&S hazards as also the carbon footprint due to vehicle drives. Only 6 monthly and annual maintenance visits are necessary to individual WTG;
- Active project planning and management systems of Suzlon are evident at the field. Planning is done almost a year ahead. By 1st April of new financial year (FY), the entire project schedule/ calendar is prepared and delivered to various teams;
- The dispatch clearance (DC) issued by Central Office to go ahead with a WTG project is shared with all Suzlon teams including manufacturing plants and sub-contracted vendors. Material starts moving to construction site from manufacturing plants only after DC is issued and this process has reduced all inventory related issues at storage yards and construction sites which will cause associated H&S hazards; and
- Project contractors are appointed well in advance and post dated work orders are issued at the start of every FY and hence no time is lost in mobilisation of labour and equipments as soon as a project clearance and DC is issued. Appointment of contractors and vendors are again centrally managed by a separate SCM (Supply Chain Management) vertical.

7.5

ALTERNATE METHODS OF POWER GENERATION

Wind energy is the most eco-friendly mode of power generation as it avoids any kind of emissions from the operation. There are no fuel requirements or large quantities of water for operation of the plant. The conventional sources of power (thermal power plants) have a very high environmental cost compared to non conventional sources. The gestation time required for thermal power plants are also longer than that of wind energy projects which requires short lead time to design, install, and start up – a maximum of 2 months after micro-siting, approvals and land purchase.

Manufacturing of WTG parts, related up-stream and downstream activities in a typical wind farm development projects, are associated with emissions due consumption of fossil fuels which contributes to Green House Gases (GHGs). However, as per the estimations of International Atomic Energy Agency

(IAEA) the grams of carbon-equivalent (including CO₂, CH₄, N₂O, etc.) per kilowatt-hour of electricity (gCeq/kWh) for wind energy project are lowest (*only nuclear power is much better to wind energy projects in this regard*). Wind energy has better values among non-conventional source of power generation including other energy sources such as solar; biomass etc. This is depicted in *Figure 7.3*.

The environmental advantages and disadvantages of power generation systems prevalent in India are as provided in *Table 7.4*.

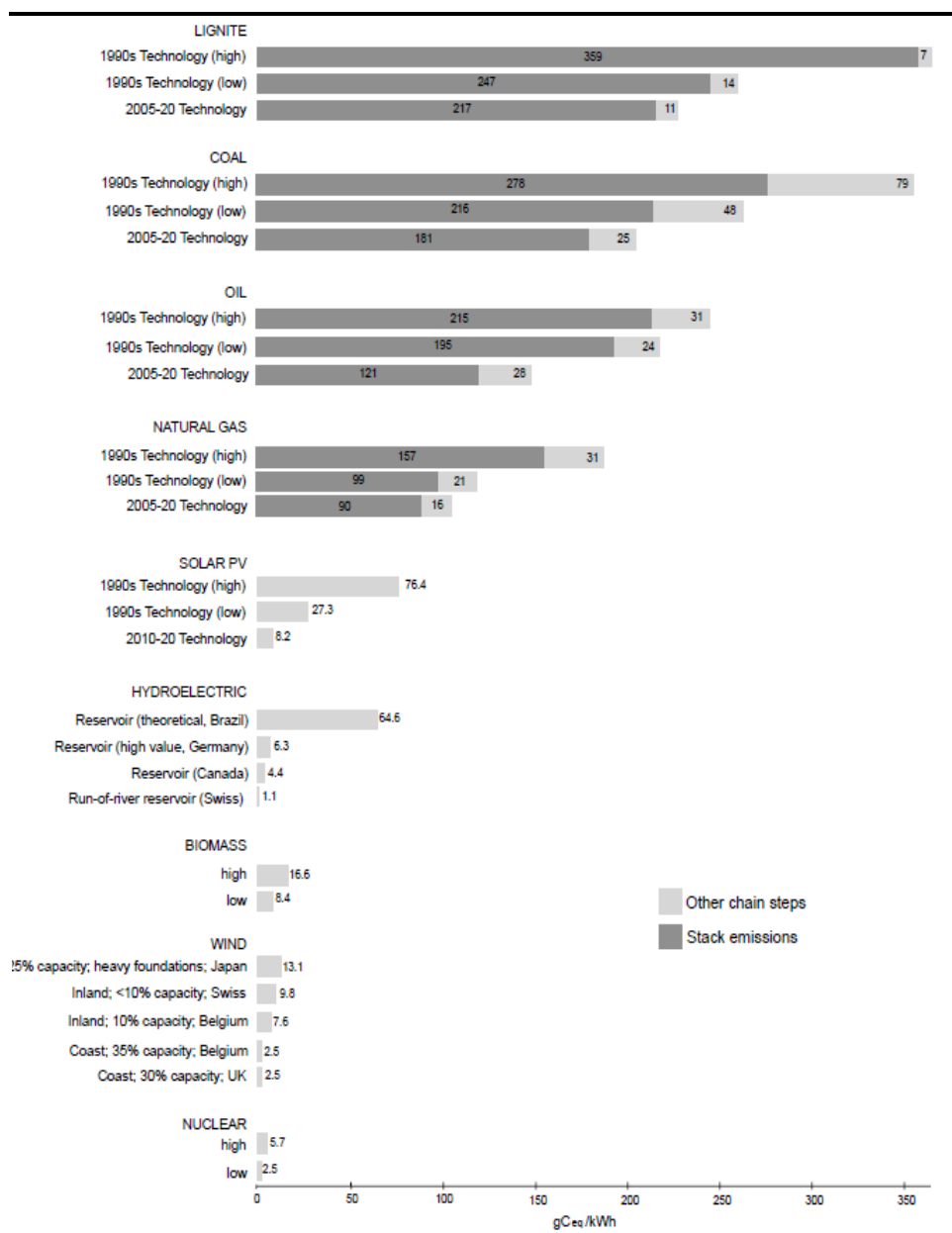
Table 7.4 *Environmental Advantages and Disadvantages of Power Generations Systems*

Mode	Disadvantage	Advantage
Thermal Power Plant	• Consumption of large quantities of fossil fuel • Large quantities of water requirement for cooling • High volume of emissions from operation • Accumulation of flyash (for coal powered) • Up stream impact from mining and oil exploration • GHG emission estimated as 228 gCeq/kWh	• Large scale production potential • Moderate gestation period • Relatively inexpensive • Wider distribution potential
Hydropower Plant	• Site specific, dependent on reservoir/river etc. • Down stream impact on flow • Long gestation period • Social and Ecological impacts	• Inexhaustible fuel source • Limited environmental impact • Relatively useful levels of energy production • Can be reproduced on small scale • GHG emission estimated as low as 1.1gCeq/kWh for run of river projects
Nuclear Power	• Availability of fuel source • Hazards associated with radioactive material • High cost of project • Long gestation period	• Cheaper power generation • GHG emissions as low as 2.5gCeq/kWh
Wind Power	• Land requirement of about 20 to 25 acres per MW¹ • Site specific (associated to wind pattern) • Expensive installation	• Pollution levels are insignificant • Inexpensive power generation • Inexhaustible source • GHG emissions as low as 2.5gCeq/kWh for the Production Chain
Solar Power	• Land requirement • Site specific to solar insolation • Expensive installation	• Pollution levels are insignificant • Inexpensive power generation • Inexhaustible source • GHG emissions as low as 8.2gCeq/kWh for the Production Chain

Source: International Atomic Energy Agency (IAEA)

(1) ¹ It has come down to 2.5 – 5.0 acres per MW even if associated facilities are taken into account

Figure 7.3 Green House Emissions from Different Electricity Production Chains



Source: IAEA

Considering various factors such as- proven wind resource potential in the project districts; favourable environmental and social settings; lowest GHG emissions in the project life cycle; availability of dry, waste lands, governmental support, and local community's acceptance of wind energy projects over the last decade in the region wind energy based power generation is the most appropriate alternative in the region of Tirunelveli and Tiruppur districts.

IFC Performance Standard-1 underscores the importance of managing social and environmental performance throughout the life of a project (*any business activity that is subject to assessment and management*). An effective social and environmental management system (SEMS) is a dynamic, continuous process initiated by management and involving communication between the client, its workers, and the local communities directly affected by the project (the affected communities). Simran Wind Power Private Limited (SWPPL or SIMRAN) has proposed to develop a comprehensive SEMS at its corporate level and is fully committed to implement the same in the currently operating as well as proposed wind farm projects across the country. A draft SEMS has been prepared in parallel to this study by ERM India and is currently under review by SWPPL.

In the current context, wherein around 100MW of wind farm projects are proposed in the State of Tamil Nadu, Simran Wind Power Private Limited (SWPPL or SIMRAN) is committed to execute all construction and operation related mitigation plans for the proposed wind energy project as per the best established environmental, health and safety (EHS) standards.

8.1

PROJECT SOCIAL AND ENVIRONMENTAL MANAGEMENT PLAN (SEMP)

In compliance of SWPPL's Corporate SEMS, a Social and Environment Management Plan (SEMP) has been formulated for implementation during the project life cycle. The SEMP presented here comprises of project-specific mitigation measures, monitoring and training management elements. The project SEMP also meets the requirements of the IFC/ World Bank's OP 4.01 – Annex C on Project's environmental management plan.

The project SEMP is presented in *Tables 8.1 through 8.3* pertaining to Planning, Construction and Operational phases respectively of the proposed wind farm project.

Table 8.1 Social and Environment Management Plan for the Planning Phase

Issues	Suggested Mitigation	Monitoring / Training	Management Responsibility
Wind Master Installation	- Integrate and include environmental and social sensitivities while determining the wind master installation location in a large wind resource area/region; - Avoid legally protected forest areas such as reserved and protected forests, wildlife sanctuaries, buffer zones, migratory bird routes, historical/cultural/religious and archaeological sites, habitations, irrigated farm lands and other such sensitive physical features present in the regional environment; - Undertake satellite imagery based GIS analysis to classify and categorise E&S sensitivities as mentioned above and prioritise potential wind farm areas that will have least impact on the regional environment; - Document these analysis to integrate E&S sensitivities in Wind Master Locational planning for internal and external auditing purposes; - Develop a Standard Operating Procedure (SOP) to guide the Wind Resource Planning and Design team in this regard.	- Once in a year, subject the wind master location planning procedures to internal/external auditing system. - Annually once train the Wind Resource Planning team on SOP developed for Wind Master Installation issues.	SIMRAN

Issues	Suggested Mitigation	Monitoring / Training	Management Responsibility
Micrositing – Integrate E&S sensitivities	- In the case of fresh micrositing, use remote sensing and satellite imagery data to avoid regional/local environmental and social (E&S) features. The E&S features that could be avoided include: legally protected forest areas (Protected forests, Reserved forests, Wildlife sanctuaries, eco-parks, buffer zones etc that are in administrative possession and control of Forest Department); other legally protected areas (such as archaeological, cultural, historical, tourism and religious sites); migratory bird routes; endangered flora and faunal population in the area that are to be preserved and protected; rivers and local surface water body flood plains; irrigated lands; habitations and individual settlements; and common property resources (such as ponds, lakes, graveyards, playgrounds, grain thrashing/drying platforms, wells etc); community health and safety aspects as highlighted in IFC EHS guidelines for wind farm projects; and aesthetics and visual impacts - During micrositing, using time-series remote sensing data that provides historical land use information, undertake a temporal analysis (ranging from 3-5 years in the immediate past) of land use pattern in a wind master location. Based on the analysis, identify perennially dry and unused land parcels that remain fallow all through the year for micrositing of WTGs on a priority. Following exhaustion of such land parcels, locate the WTGs on least to moderately used land parcels in the same order of priority. As a principle, micrositing of WTG at a given location should not catalyse or hasten massive land use change in the immediate locality and hence unused dry lands should be accorded priority. - Document these analysis to integrate E&S sensitivities in micrositing for internal and external auditing purposes. - Develop a Standard Operating Procedure (SOP) to guide the Wind Resource Planning and Design team in this regard.	- Once in a year, subject the micrositing procedures to internal/external auditing system. - Annually once train the Wind Resource Planning team on SOP developed for micrositing issues.	SIMRAN

Issues	Suggested Mitigation	Monitoring / Training	Management Responsibility
Micrositing – Shadow flickering	- Undertake an assessment to identify shadow flickering zones of each individual WTG locations. Identify the WTG locations that could cause shadow flickering on nearby sensitive receptors (such as habitation, individual dwelling units, animal rearing sheds, schools, hospitals, temple etc) and other areas as identified by local community stakeholders. - At each WTG location that could cause shadow flickering on sensitive receptors at any point of time during the year, shift the location of WTG away from the receptor such that it does not cause shadow flickering or abandon the location. If that is not feasible, undertake mitigation measures in consultation with affected stakeholder. Measures such as planting a dense orchard of tree species that can grow tall and have dense foliage (such as coconut, mango, jackfruit, neem, teak etc) between the receptor and WTG at the closest location possible near the receptor will cut down the flickering impact in the long term while the orchard proves beneficial asset to the receptor as well. - Document the shadow flicker analysis as part of wind master reporting and subject them for internal and external auditing purposes. - Develop a Standard Operating Procedure (SOP) to guide the Wind Resource Planning and Design team in this regard.	- Once in a year, subject the micrositing procedures including shadow flicker analysis to internal/external auditing system. - Annually once train the Wind Resource Planning team on SOP developed for micrositing issues related to shadow flicker analysis.	SIMRAN

Issues	Suggested Mitigation	Monitoring / Training	Management Responsibility
Micrositing – Cumulative Noise Impacts	- Undertake cumulative impact assessment on ambient noise levels (ANLs) due to concurrent operation of all WTGs at every wind master location. The assessment should take cognisance of other competitor WTGs operating around the wind mast location. - The cumulative noise impact assessment should include the worst case scenario (such as peak wind speed seasons or abrupt shut off of power evacuation lines by TNEB when WTG blades come to a halt almost instantly) during which maximum noise generation could be expected from WTGs to predict the impact on ambient noise levels. - Based on the noise modelling assessment, identify the sensitive receptors that could be adversely impacted and try to readjust the nearest WTG location or abandon it to reduce the noise impact on the receptor. If that is not feasible, undertake noise mitigation measures such as sound proofing of the affected receptor locations or planting an orchard of trees as suggested earlier under shadow flickering issue above. - Simran will ensure that none of the proposed WTGs is within 100 m of any habitation or other sensitive receptor like school, hospital, temples etc so that the noise generated from WTGs do not have any adverse impact on the sensitive receptors. - Document the cumulative noise impact analysis as part of wind master reporting and subject them for internal and external auditing purposes. - Develop a Standard Operating Procedure (SOP) to guide the Wind Resource Planning and Design team in this regard.	- Once in a year, subject the micrositing procedures including cumulative noise impact analysis to internal/external auditing system. - Annually once train the Wind Resource Planning team on SOP developed for micrositing issues related to cumulative noise impact analysis.	SIMRAN
Micrositing – Aesthetics and visual impact	Follow IFC's EHS guideline recommendations in this regard such as the following: - Consult the community on the location of the wind farm to incorporate community values into design; - Consider the landscape character during turbine siting; - Consider the visual impacts of the turbines from all relevant viewing angles when considering locations; and - Maintain uniform size and design of turbines (e.g. direction of rotation, type of turbine and tower, and height).	- Review the measures undertaken for addressing visual and aesthetic impacts - Train the IPD, WRD and Design teams of the developer, annually once regarding visual and aesthetic impacts.	SIMRAN

Issues	Suggested Mitigation	Monitoring / Training	Management Responsibility
Blade glint	In order to avoid blade glint related impacts, use non-reflective coating paint on the wind turbine tower and blades as suggested in the IFC and other international guidelines.	Annually once as part of internal and external auditing systems, monitor the blade glint issue on at least 10% of new and old WTG installations. Also take local community stakeholder feedback on this issue.	SIMRAN
Stakeholder Consultation	- The communication process of Simran/Suzlon will be upgraded and Simran/Suzlon will ensure that all relevant information about the project, purpose of land take, potential benefits as well as inherent issues and mitigation strategies for adverse impacts, future development activities will be communicated in an effective manner before initiating the land purchase process; - Stakeholder consultations shall be undertaken at an early planning stage of the project, followed by continued engagement over the project life time in form of CSR and other developmental activities; - Stakeholders analysis and screening shall be done prior to engaging in consultation and the list of stakeholder shall have representation from local community, Panchayats, institutions like schools, hospitals, govt departments like roads and highways, PWD, forest, telecommunication tower operators, defence installations, air force and civil aviation bases, etc; - The aim of first level of stakeholder consultation shall be to disclose project potential, identify perceptions, apprehensions and possible impacts of a wind power project; - Second level of discussion/consultation shall focus on alternate sites, mitigation measures, project benefits etc; - Third level of consultation shall focus on negotiations and bargaining around land rates, project benefits, employment opportunities-short term and long term, project grievance redressal process etc.; - Presence of senior company officials in some of these consultations shall be ensured so as to win the trust of local community and other stakeholders.	- All stakeholder consultations shall be recorded and archived in safe repository and be made available for any audit and inspection; - Orientation training shall be given to the local liaisoning team on effective communication skills; - Grievances shall be addressed timely and closure should be communicated back to the grievant;	SIMRAN

Issues	Suggested Mitigation	Monitoring / Training	Management Responsibility
Land purchase	• A land purchase policy shall be drafted for all future project developments; • Replacement value of the land shall be give to the landloser; • Standing instructions shall be issued to all landbrokers on land deals and minimum land compensation; • Land area not required in O&M phase will be allowed to grazing, cultivation or any other usufruct purpose of local community with first preference to the landloser. • Simran will ensure that land promoters do not make false promises of employment etc to landowners at the time of purchase; • Simran will also ensure that landowners are not put under undue pressure to sell off the land and are allowed a comfortable time gap to discuss about land sale back in their family, with friends and relatives before making a final sale; • Simran will ensure this through random audit checks on the sale made by the land promoter; • Simran will also retain all documents related to land sales, including the list and details of land owners affected by the project.	• Random consultations with landloser to check integrity of the process followed by the landbroker; • All grievances related to land purchase process shall be individually resolved;	SIMRAN

Issues	Suggested Mitigation	Monitoring / Training	Management Responsibility
Final WTG locations – E&S Screening assessment	- Undertake a comprehensive environmental and social (E&S) screening assessment at each individual WTG location and their access roads to identify and assess location-specific E&S issues. - E&S screening assessment should include: an assessment of available topography; soil texture and erosion potential; land use pattern over the last 3-5 years; vegetation and tree cover; tree felling and trimming requirement; endangered flora and faunal population in the area that are to be preserved and protected; shadow flicker and noise issues (if already identified during micro-siting process); road access, road capacity and accident prone hotspots; probability of flooding and other natural disasters occurring (earthquakes, cyclones, thunderstorm events); natural drainage channels; presence of sensitive receptors (such as habitation, individual dwelling units, animal rearing sheds, archaeological, cultural, historical, tourism and religious sites) within 500m of WTG location or access roads; community health and safety aspects as highlighted in IFC EHS guidelines for wind farm projects; and aesthetics and visual impacts; - Based on the E&S screening assessment, identify and implement appropriate mitigation measures from this EMP or formulate location-specific mitigation strategies. Trigger the implementation of such mitigation measures at an appropriate time during the project life cycle. - Document the E&S screening assessment findings and location-specific E&S Management Plan per WTG location and subject them for internal and external auditing purposes. - Develop a Standard Operating Procedure (SOP) to guide the Wind Resource Planning and Design team in this regard.	- Once in a year, subject the WTG location specific E&S screening procedures to internal/external auditing system. - Annually once train the Wind Resource Planning team on SOP developed for WTG location specific E&S screening procedures.	SIMRAN
Stakeholder disclosure	- Project brochures detailing all social and environmental impacts and risks as well as benefits of the project shall be provided extensively in the project area; - Mitigation measures, grievance mechanism, CSR activities etc shall also be highlighted through these brochures but not in a manner to suppress the E&S risk and impacts; - Every misconception, unscientific apprehension shall be mitigated through disclosure process, including tours and site visits of stakeholders to project sites and open house discussions with independent E&S risk specialists;	All communications shall be documented and archived	SIMRAN

Issues	Suggested Mitigation	Monitoring / Training	Management Responsibility
Design of WTGs for withstanding natural disasters (such as earthquakes, cyclones, thunderstorm and lightning events)	- Planning phase of a wind farm project per wind master site should include an assessment and certification by independent third party agencies/technical experts/regulatory bodies on the design aspects of WTG parts including the civil works (foundation design) to withstand historical natural calamities such as earthquakes, cyclones, thunderstorms, lightning events etc. - Only independently verified and certified designs of WTG equipments and foundation designs should be proposed for project implementation phase.	- Submit design appropriateness certificates issued by competent third party agencies/regulators per wind master site and periodically update the certificates, if necessary. - The Planning team staff should be annually trained and oriented on natural disaster elements that could adversely cause wide ranging community health and safety aspects besides asset destruction.	SIMRAN

Issues	Suggested Mitigation	Monitoring / Training	Management Responsibility
Transport of WTG parts, Balance of Plant equipments and lifting machinery	- Undertake road capacity assessment to identify adverse impacts on road users and other community health and safety issues. The impacts could arise due to movement of vehicles carrying WTG parts and erection & commission phase machineries. The scope of the road capacity assessment should cover the entire road network from vehicle origin to destination and include the following issues: road capacity; traffic volumes and density; turning radius at various horizontal curves and bends; vertical curves in the alignment; accident prone hotspots; traffic diversion stretches; local traffic regulations/restrictions; integrity of cross drainage structures and bridges; integrity of road pavement surface; and presence of sensitive receptors etc. - Assessment should include stakeholder consultations covering road network O&M agencies, traffic police, WTG parts transportation fleet operators and local community stakeholders. - Based on the road capacity assessment, formulate traffic management and movement strategies. Some of the suggested strategies could include: conducting periodical driver training and certification programs; emergency management procedures and training; GPS technology based vehicle tracking systems; round the clock communication centres for the benefit of vehicle fleet operators; local teams to support and help vehicles navigate the hotspots; feedback session with fleet drivers/operators; fleet movement during off peak hours; loaded materials to be checked daily for their integrity and strapped position till reaching the destination point; and SOPs formulated for different set of stakeholders and they be trained on their respective SOPs etc. - Document the road capacity assessment and traffic management strategies per traffic network and periodically update the same (not later than 3-5 years). - Develop an SOP to guide the Wind Resource Planning and Design teams in this regard.	- Once a year, subject the road capacity assessment related documents and management strategies to internal/external auditing system. - Annually once train the Wind Resource Planning team on SOP developed for road capacity assessment and traffic management strategies.	SIMRAN

Issues	Suggested Mitigation	Monitoring / Training	Management Responsibility
Transport of WTG parts, Balance of Plant equipments and lifting machinery	- Data pertaining to accidents and incidents involving vehicle fleets of WTG project should be maintained, updated and analysed to formulate appropriate corrective actions. - In order to enable sustainability reporting, data pertaining to diesel consumption, distance travelled, load hauled in terms of tonnage etc should be maintained on a monthly and yearly basis.	- Monitor and audit the documents pertaining to accidents and incidents involving vehicle fleets of WTG project and the corrective actions taken by the management at least once in a year. - Review the sustainability parameters such as diesel consumption, distance travelled, load hauled in terms of tonnage etc as part of annual auditing systems and compare them to sector equivalent benchmarks.	SIMRAN
Intra-site access road connecting WTG locations – Planning	- Select the best possible alignment of intra-site access roads that connect WTG locations in a given wind farm site. Use available metalled roads to the extent possible in consultation and agreement with local community stakeholders. - The ratio of number of WTG locations connected in a site to the total length of intra-site access road in kms will give an indication to the optimal selection of access road alignment. Keep this ratio closer to the theoretically possible ratio to the extent possible. - While selecting the alignment of access road, follow the existing practices such as: avoiding irrigated lands; avoid bifurcation of cultivable/under use lands of same owner; avoid existing roads that are narrow, have low structural capacity and besieged with sensitive receptors; always align the access roads along the boundaries of the land owned by single owner etc.	Monitor and review the intra-site road alignment drawings superimposed on land holding maps to check if the best possible alignment has been chosen. Verify and approve the same at ground as well.	SIMRAN

Issues	Suggested Mitigation	Monitoring / Training	Management Responsibility
Material storage and/or Scrap yards (Permanent & Temporary) – E&S Screening assessment	- When selecting a virgin location for setting up temporary or permanent materials storage or scrap yard, undertake a E&S screening assessment of probable alternate locations and choose the best location that could cause least damage to E&S aspects. - E&S screening assessment will include: an assessment of available topography; land use pattern over the last 3-5 years; soil texture and erosion potential; vegetation and tree cover; tree felling and trimming requirement; road access, capacity and accident prone hotspots; probability of flooding; natural drainage channels; presence of sensitive receptors (such as habitation, individual dwelling units, animal rearing sheds, archaeological, cultural, historical, tourism and religious sites) within 500m of yard location or access roads; - Based on the E&S screening assessment, identify and implement appropriate mitigation measures from this EMP or formulate location-specific mitigation strategies. Trigger the implementation of such mitigation measures at an appropriate time during the project life cycle. - Document the E&S screening assessment findings and location-specific E&S Management Plan per yard location and subject them for internal and external auditing purposes. - Develop a Standard Operating Procedure (SOP) to guide the Projects, Land and OMS teams in this regard.	- Once in a year, subject the E&S screening procedures for locating the yards to internal /external auditing system. - Annually once train the Projects, Land and OMS team on SOP developed for E&S screening procedures for locating the yards.	SIMRAN
Regulatory Approvals and local clearances	Identify and obtain all regulatory clearances/ approvals/registration/NOCs whichever is applicable from respective agencies such as TNEB, Local Panchayat, Groundwater authorities, Revenue Department, Forest Department, Highways Department etc.	- Organise and conduct regular training program covering regulatory framework applicable on the project activities and the regulatory process/ procedures to be followed by Project Management teams. - Periodically audit (annually at least once) and verify the regulatory compliance status of each and individual WTG projects and their associated facilities.	SIMRAN

Issues	Suggested Mitigation	Monitoring / Training	Management Responsibility
Power Evacuation Utility (Transmission line and Pooling Substation) - Planning procedures to include E&S sensitivities	- As government agencies such as TNEB have allowed the wind farm developer to plan and propose the Power Evacuation utilities from their Wind Farm projects, the onus of sustainable planning them lies on the developer of wind farm even if the utility is ultimately owned and operated by TNEB. - In this context, the Power Evacuation planning team shall undertake a brief E&S screening assessment of alternate location/alignment options and the location/alignment that causes least damage to E&S aspects shall be chosen for construction phase. - E&S screening assessment with regards to siting of substation will include: an assessment of available topography; land use pattern over the last 3-5 years; soil texture and erosion potential; vegetation and tree cover; tree felling and trimming requirement; road access, capacity and accident prone hotspots; probability of flooding; natural drainage channels; presence of sensitive receptors (such as habitation, individual dwelling units, archaeological, cultural, historical, tourism and religious sites) within 500m of substation location or access roads. - As for fixing the alignment of transmission lines, E&S screening assessment will include: community health and safety issues; landowner/ stakeholder consultations and feedback; tree felling and trimming requirement; optimal grid alignment to reduce visual impacts; presence of sensitive receptors (such as habitation, individual dwelling units, schools, hospitals, archaeological, cultural, historical, tourism and religious sites) within 50m of line alignment on either side and risk assessment and emergency management plans etc.		
Power Evacuation Utility (Transmission line and Pooling Substation) - Planning procedures to include E&S sensitivities	- Based on the E&S screening assessment, identify and implement appropriate mitigation measures from this EMP or formulate location-specific or alignment-specific mitigation strategies. Trigger the implementation of such mitigation measures at an appropriate time during the project life cycle. - Document the E&S screening assessment findings and E&S Management Plan per substation location/line alignment and subject them for internal and external auditing purposes. - Develop a Standard Operating Procedure (SOP) to guide the Projects, Power Evacuation, Land and OMS teams in this regard.	- Once in a year, subject the E&S screening procedures for locating substations and transmission line alignment to internal/external auditing system. - Annually once train the Projects, Power Evacuation, Land and OMS team on SOP developed for E&S screening procedures in this regard.	SIMRAN

Table 8.2 ***Social and Environment Management Plan for Construction Phase***

Issue	Suggested Mitigation	Monitoring / Training	Management Responsibility
Intra-site access road between WTG locations - construction and operation	- Before initiating clearing and grubbing activity, protect, conserve and transplant any endangered floral species as identified during the ecological assessment in the planning phase. - Top soil from access roads can be used to re-vegetate areas that are barren and prone to fugitive dust generation and soil erosion. Scrap the top 100mm thick top soil layer and store them within site premises or use them at locations where ground cover vegetation is being attempted. If the chosen site is barren (not even a tinge of grass growth on surface) and rocky, there is no need to implement this measure. - Do not alter the ground contours drastically to the extent possible. Wherever major cut or fill section has been proposed, undertake slope stabilisation and soil erosion control measures. - Do not open borrow pits indiscriminately and leave it unattended after the road construction is completed. All borrow pits should be approved by land owner or the local government authority. Once the construction is complete, all borrow pits should be closed safely and reclaimed to original contour levels. No borrow pits should remain open along the edge of access roads or at any location as they will be a major health and safety hazard. - Wherever the access road cuts through natural drainage channels, appropriate pipe culverts should be constructed to enable free flow of storm water. The pipe culverts should be maintained clear of dirt, muck, vegetation etc through the project life cycle. No attempt should be made to divert the local drainage pattern	- Monitor indicative parameters suggested in the mitigation such as: endangered floral species preservation; top soil reuse; borrow pit management; road alignment to follow prevailing ground contours; soil erosion; road side and cross drainage structures; tree felling and compensatory plantation; and health and safety hazards during field inspection visits on a weekly basis at the least. - Undertake training on E&S aspects covered in the mitigation plan for constructing access roads at least once in a year to Projects team and Sub Contractor staff	SIMRAN

Issue	Suggested Mitigation	Monitoring / Training	Management Responsibility
Intra-site access road between WTG locations - construction and operation	- Construction of access roads should be undertaken with no tree felling or trimming requirement to the extent possible. If that is not feasible, project should undertake compensatory plantation in the same locality with same species but 2-3 times in number that has been cut to the extent possible. - Before mobilising road construction equipments and vehicles, health and safety hazards at each stretch under construction should be assessed and mitigated to avoid fatal accidents/ incidents. Overhead electrical lines, telephone cables, TV cables or other such transmission cables and underground utilities (including private utilities) if any should be inspected for safety risks and appropriate mitigation measures should be taken.	-	-
Ambient Air Quality	- Dust generating activities to be avoided in conditions of very high wind and covers to be provided for loose construction material or excavation material at construction site. - It is to be ensured that construction equipments are properly maintained to minimise smoke in the exhaust emissions. - Machinery to be turned off when not in use. - Housekeeping of the area to be maintained - The impact of emissions from vehicles bringing construction material to be minimised by proper upkeep of maintenance of vehicles, sprinkling of water on unpaved roads (if there are sensitive receptors) at the construction site and planned movement of such vehicles.	- Undertake ambient air quality monitoring at one of the construction locations when construction work is ongoing. Conduct the monitoring through the construction phase at a frequency of 2 days in a week and on the days when construction work/ or erection work is scheduled. Monitor the pollution levels at the nearest sensitive receptor or 50m whichever is nearer on the downwind side. Compare the results with baseline monitoring results to estimate the pollution intensity. Conduct such monitoring annually once at 5% of proposed project locations. - Undertake training on ambient air quality aspects at least once in a year to Projects team, Vehicle fleet operators and Sub Contractor staff	SIMRAN

Issue	Suggested Mitigation	Monitoring / Training	Management Responsibility
Ambient Air Quality	- Vehicle speed to be restricted to 15km/hour at site to minimize potential for dust generation in the surroundings - Trucks /dumpers to be covered by tarpaulin sheets during off site transportation of friable construction materials and spoils - All the construction vehicles, cross country fleet vehicles which bring WTG parts and off-road equipments entering the site should have updated PUC (Pollution under control) certificate. - Generator to be optimally used with proper orientation and adequate stack height avoiding plume hitting the nearest sensitive receptors on the downstream.	- Undertake ambient air quality monitoring at one of the construction locations when construction work is ongoing. Conduct the monitoring through the construction phase at a frequency of 2 days in a week and on the days when construction work/ or erection work is scheduled. Monitor the pollution levels at the nearest sensitive receptor or 50m whichever is nearer on the downwind side. Compare the results with baseline monitoring results to estimate the pollution intensity. Conduct such monitoring annually once at 5% of proposed project locations. - Undertake training on ambient air quality aspects at least once in a year to Projects team, Vehicle fleet operators and Sub Contractor staff	SIMRAN
Ambient Noise levels	- Use inherently quiet plants and equipments (such as DG sets and concrete mixing units) as far as reasonably practicable. Regularly maintain them to ensure noise emissions are maintained at design levels. - Integral noise shielding to be used where practicable and fixed noise sources to be acoustically treated, for example with silencers, acoustic louvres and enclosures. - Provide rubber paddings/noise isolators at equipment/machinery used for construction - Provide make shift noise barriers (sand filled bags could be a useful barriers) near high noise generating equipment to minimise horizontal propagation of noise - Loud, sudden noises to be avoided wherever possible. Fixed noise sources to be located away - more than 100m from the nearest sensitive receptor, if any. - Noise prone activities will be restricted during night time (i.e. 2200 to 0600 hours) to reduce the noise impact on sensitive receptors, if any. - Indiscriminate use of power horn in vehicles should be prohibited. - Site workers working near high noise equipment (such as concrete vibrators, crane operations, concrete mixing unit etc) use personal protective devices to minimise their exposure to high noise levels	- Undertake ambient noise level monitoring at one of the construction locations when construction work is ongoing. Conduct the monitoring through the construction phase at a frequency of 2 days in a week and on the days when construction work/ or erection work is scheduled. Monitor the ambient noise levels at the nearest sensitive receptor or 50m whichever is nearer on the downwind side. Compare the results with baseline monitoring results to estimate the noise pollution intensity. Conduct such monitoring annually once at 5% of proposed project locations. - Undertake training on ambient noise level aspects at least once in a year to Projects team and Sub Contractor staff	SIMRAN

Issue	Suggested Mitigation	Monitoring / Training	Management Responsibility
Soil conservation	Before initiating construction activity either at WTG locations, yards or in the substation locations, scrap the top 100mm thick top soil layer and store them within site premises or use them at locations where ground cover vegetation is being attempted. If the chosen site is barren (not even a tinge of grass growth on surface) and rocky, there is no need to implement this measure.	- Monitor the top soil management procedures adopted randomly during the routine inspection process - Undertake training on top soil and general soil conservation aspects at least once in a year to Projects team and Sub Contractor staff	SIMRAN
Soil contamination and pollution	- Prohibit vehicles and equipments straying beyond the acquired site boundaries and access road as they will cause damage to soil environment. - Keep all construction material within the footprint of the area acquired. - All hazardous materials such as fuel oil, lubricants, paints, other chemicals and other such equivalent harmful materials should be stored, used, transported and disposed off in an environmentally safe manner. No leakages and seepages either during storage, use, transport and disposal should be allowed. Use of appropriate impermeable membrane should be deployed to protect the soil environment. - Soil pollution at any of the following locations should be prohibited: at vehicle parking areas due to leakage/seepage of fuel oil and lubricants; temporary mechanical maintenance works at parking areas etc.	- Inspect for leakage, seepage, soil discolouration signs indicating soil contamination and pollution as part of routine inspection process especially at these locations: near fuel oil, lubricants, paints, other chemicals and other such equivalent harmful materials storage/usage/transport areas; vehicle parking bays; maintenance sheds; oiled cloth indiscriminately dumped on ground etc. - Undertake training on soil contamination and pollution aspects at least once in a year to Projects team, Vehicle fleet operators and Sub Contractor staff	SIMRAN

Issue	Suggested Mitigation	Monitoring / Training	Management Responsibility
Soil erosion	- To prevent soil erosion from WTG locations, Access roads and substation locations, adopt the following mitigation measures: - Avoid construction activities during monsoon season - As soon as the construction vehicles and equipments are demobilised from the site, re-spread the stored top soil, if available and attempt developing grass vegetation cover through hydro seeding and mulching techniques. Simple cow dung solution injected with grass seeds can be sprayed on the entire disturbed soil layer to enable faster growth of vegetation cover. - Provide appropriate drainage channels with silt arrestor pits to control soil erosion from the recently demobilised site. Allowing stormwater to stagnate (through sedimentary pits) before discharging at the final outlet point will control soil erosion to large extent. Use of geo-textiles or its equivalent local materials can also be encouraged to control soil erosion. - Storm water runoff from contaminated site locations (fuel storage, paints, chemicals, lubricants) will pollute the downstream water streams. Hence, prohibit soil contamination in the first place as recommended under Soil pollution aspect.	- Inspect soil erosion control measures and their effectiveness periodically. - Undertake training on soil erosion aspects at least once in a year to Projects team and Sub Contractor staff	SIMRAN
Habitat alteration	- Minimise tree felling or trimming to the extent possible at WTG locations, transmission line alignments, substation areas, yards, CMS facility and other ancillary facilities; - Conserve and protect the endangered floral species as identified during planning phase; - Before initiating clearing and grubbing activity, identify, protect, conserve and transplant any endangered floral species. - During compensatory plantation or attempting re-vegetation to improve ground cover, never introduce alien species or invasive species that are incompatible to prevalent local species. Always prefer local floral species for ecological enhancement or compensation.	- Monitor habitat protection measures undertaken by developer during field inspection visits on a weekly basis. - Undertake training on habitat protection and conservation aspects at least once in a year to Projects team and Sub Contractor staff	SIMRAN

Issue	Suggested Mitigation	Monitoring / Training	Management Responsibility
Water resource	- Though water requirement for WTG projects are limited, water sourcing should be compliant to prevalent regulatory framework. - Groundwater is a regulated resource and any new installation of bore wells (across any project sites and ancillary facilities) will need permission from Central Ground Water Board/local designated State Authorities. - Groundwater regulations provides for: protection of ground water resources; prevents sinking of any well within five hundred meters of a public drinking water source; and regulates extraction of water from a well within one kilometre of the public drinking water source in a declared water scarcity area preventing sinking of well in a declared 'over exploited' watershed. The provisions of the Act/ Rules can be better consulted with local Central Ground Water Board/ or Authority officials prior to abstracting water from any source located within or outside Project Districts. - Conserve water at all project locations and ancillary facilities and if possible recycle and reuse water utilising every opportunity. - Any wastewater generated at ancillary facilities of WTG projects should be treated before discharging. Use of soak pits and septic tanks is recommended and at any point of time, do not allow cesspool formation of untreated/ or treated wastewater as it will create serious health hazard.	- Verify that the water sourcing is from a legally compliant source - Inspect the water consumption points and verify the conservation measures adopted. Estimate the water consumption per unit of an appropriate parameter (e.g concrete in cum; per capita per day) to compare/create project benchmarks. - Undertake training on water consumption, conservation and related regulatory provisions at least once in a year to Projects team and Sub Contractor staff	SIMRAN
Water resource - rainwater harvesting, roof water harvesting and ground water recharge	- Since the project area is located in a water scarce area, attempting rainwater harvesting, roof water harvesting and ground water recharge will be a potential enhancement measure that will be welcomed by all concerned stakeholders. - Rainwater harvesting, roof water harvesting and groundwater recharge can be attempted across wind farm project locations such as at WTG locations, intra-site access roads, yards, substations, CMS building, guest houses, local community identified areas and other such wind farm ancillary facilities. - Design, implement and maintain (through project life cycle) appropriate harvesting and recharge structures across as many locations as possible and in common property resources as identified by local community stakeholders.	- Monitor the groundwater level in the region through primary survey of nearby farm wells and record the temporal trend covering pre-monsoon and post-monsoon seasons. - Estimate annually the quantum of water conserved /harvested and recharged per unit of power generated or in acreage terms based on annual rainfall data for sustainability reporting. - Undertake training on water harvesting and groundwater recharging techniques at least once in a year to Projects, OMS team and Sub Contractor staff	SIMRAN

Issue	Suggested Mitigation	Monitoring / Training	Management Responsibility
WTG parts and BOP material transport intra-site	While transporting WTG parts, BOP materials and erection equipments, undertake following mitigation measures: • Accord high priority to local community's health and safety aspects more than anything else. • Control fugitive dust generation by restricting the vehicle speed to 15km/hr or less. • Record incidents and accidents involving project vehicles, equipment transport vehicles etc • Mobilise local teams to support the vehicle fleet movement • Plan traffic movement through: dense semi-urban areas; narrow roads; near sensitive receptors and congested localities during off-peak hours in consultation with local community. • All vehicles including trailers should have light reflective strips pasted all along the edges and corners of the vehicle, brake lights in working condition; protruding WTG parts and equipments should have red flags and red light beacons to highlight the safety hazard. • If these vehicles are parked along road side, ensure that they are parked well away from main carriageway and in night time red reflectors are working with beacon lights switched on. • Along horizontal and vertical curves in the alignment, at least 2-4 ground staff should guide the drivers to negotiate them safely. • Before allowing the vehicle to enter into access roads, check the ropes and chains used for tying the load for their integrity. Any worn out, loosened or slackened ropes/chains should be rectified before moving the vehicles. • Along slopes and curves, overturning of vehicles or loaded parts falling off its place should be assessed before allowing the vehicle to move • When the trailer vehicles enter or exit a major road junction, 2-4 helpers should warn and guide the mainstream traffic about trailer movement.	• Monitor the safe procedures adopted for transporting WTG parts through intra-site access roads. • Undertake training on safe transport procedures and related community H&S aspects at least once in a year to Projects, Vehicle fleet operators and Sub Contractor staff	SIMRAN

Issue	Suggested Mitigation	Monitoring / Training	Management Responsibility
Construction material sourcing, transport and storage	- Construction materials such as stone aggregates, sand, groundwater, brick, borrow pits are material resources whose sources or its processing are regulated by various regulations such as Tamilnadu Mine regulations, Environment (Protection) Act, 1986, Air Act and Water Act etc. - Hence sourcing of all these materials should be from legally compliant source. A copy of currently valid licenses/ permits/ consent issued to construction material supplier should be obtained as part of office records. - During transportation of construction materials to construction site, vehicles engaged shall not create hazardous condition on the network roads enroute to site. No dust generation from loaded trucks; sand or water spilling all along the network roads will be permitted.	- Verify the licenses, permits and consents issued to construction material supplier at least once in 6 months. - Randomly inspect the vehicles used for transporting construction materials to see if they are complying to mitigation measures recommended here.	SIMRAN
Labour sourcing, camps, welfare measures	- Simran/Suzlon will ensure that the labour workforce do not affect adjacent land outside the construction area; - Standing instruction will be issued to all labour contractors and adequate facilities will be provided within the camp area to control the interaction with general community; - Local procurement plan shall be prepared and implemented so as to provide maximum benefits of short term income sources to local people, without compromising the quality; - Sourcing of material shall be done locally to the extent possible and subject to meeting the quality, statutory and safety standards; - Machinery and consumables shall also be purchased locally for onsite construction work; - Fenced labour camps shall be constructed at all construction sites which will have all facilities including water, fuel and sanitation facilities so that minimum interaction with local community takes place; - Land for labour camps will be taken on short term lease basis for which rent shall be paid to the landowner; - Wastewater and other waste discharge outside the construction area /labour camp shall be avoided in all cases; - No worker under 18 years shall be engaged in any hazardous work like a construction site; - No original documents of any workers shall be retained for more than 10 days; - Every worker/subcontractor shall be informed about the working conditions, scope of work, expected deliverables, liabilities etc in a documented and written form.	- Regular inspections of construction sites; - Recording and documentation - Age proof shall be retained for every worker - Labour returns shall be filed in time and all statutory registers shall be maintained - H&S risks assessment and provisioning of adequate PPEs shall be done before undertaking any construction work - Local administration and police will be aware about the details of outside labourers as also a list will be provided to the Panchayat /block office.	SIMRAN and its subcontractors

Issue	Suggested Mitigation	Monitoring / Training	Management Responsibility
Construction waste management	- Construction site should be maintained free of wastes, excavation debris, concrete waste, wood, litter, plastics and metal scraps by periodically collecting, segregating, storing, transporting and disposing them appropriately. - All non-hazardous wastes (such as excavation debris, concrete waste, wood, litter, plastics and metal scraps) should be segregated at source, recycled and reused to the extent possible. - Hazardous wastes (such as used fuel/paint/chemical containers, waste oil, lubricants, oil rags, contaminated soil, used batteries etc) should be segregated at source and stored in secure and leak proof containers before transporting and disposing them through Tamilnadu State Pollution Control Board (TNSPCB) authorised waste management agencies. - Quantum of waste generated across various types and category of wastes should be estimated for reporting purpose.	- Monitor and inspect waste management procedures adopted through the entire waste chain from source to disposal point for both hazardous and non-hazardous waste categories at least once in a week. - Undertake training on waste management procedures and related regulations at least once in a year to Projects and Sub Contractor staff	SIMRAN
Storage and handling of hazardous materials onsite	- Storage of hazardous materials shall be in compliance to manufacturer's specifications. - No hazardous materials will be stored on barren earth surface. - No leakage, seepage of hazardous materials will be permitted during storage, handling, usage and transport. - Hazardous materials/ hazardous waste materials stored either onsite or in yards/scrap yards shall be protected from storm water entering the area. Any contact with them will contaminate and pollute the surface water environment. They shall be stored either under secure roof with bunds to prevent flooding or covered with tarpaulin sheets on a raised impermeable platform.	- Monitor the procedures adopted for storage and handling of hazardous materials onsite. - Inspect the storage, handling, usage and transport points within the site for discolouration of soil or any signs of leakage and seepage of materials. - Undertake training on hazardous material management procedures and related regulations at least once in a year to Projects and Sub Contractor staff	SIMRAN
Occupational Health and Safety – General	- All the required safety measures based on individual job profile to be provided (as per working guidelines, use of personal protective equipments like gloves, helmets, ear muffs, safety belts etc.) for construction worker through the contractors. - Ensure effective work permit system for hot work, electrical work, working at height, working in confined space etc. - Ensure personal protective equipment for all personnel present at site are made available. - Arrangement for fire control measures - Display of phone numbers of the city/local fire services, etc. at site. - Ensure good housekeeping at the construction site to avoid slips and falls. - Dropping/lowering of construction material or tool to be restricted and undertaken only under strict supervision, if required.	- Inspect and monitor the general health and safety procedures adopted by construction staff onsite at least on a weekly basis when work is on. - Undertake daily tool box talk and proper training of the workers regarding health and safety procedures, PPE usage, working at heights, regulatory provisions at least once in 6 months.	SIMRAN

Issue	Suggested Mitigation	Monitoring / Training	Management Responsibility
Occupational H&S – Working at heights	As per IFC guidelines, following mitigation measures have been suggested: • Prior to undertaking work, test structure for integrity; • Implementation of a fall protection program that includes training in climbing techniques and use of fall protection measures; inspection, maintenance, and replacement of fall protection equipment; and rescue of fall-arrested workers; • Establishment of criteria for use of 100 percent fall protection (typically when working over 2 m above the working surface but sometimes extended to 7 m, depending on the activity). The fall-protection system should be appropriate for the tower structure and movements to be undertaken including ascent, descent, and moving from point to point; • Install fixtures on tower components to facilitate the use of fall protection systems; • Provide workers with an adequate work-positioning device system. Connectors on positioning systems must be compatible with the tower components to which they are attached; • Ensure that hoisting equipment is properly rated and maintained and that hoist operators are properly trained; • Safety belts should be of not less than 15.8 mm (5/8 inch) two in one nylon or material of equivalent strength. Rope safety belts should be replaced before signs of aging or fraying of fibres become evident; • When operating power tools at height, workers should use a second (backup) safety strap; • Signs and other obstructions should be removed from poles or structures prior to undertaking work;	• Inspect and monitor the health and safety procedures adopted for working at heights by construction staff onsite on a daily basis when work is on.	SIMRAN
Occupational H&S – Working at heights	As per IFC guidelines, following mitigation measures have been suggested (continued) • An approved tool bag should be used for raising or lowering tools or materials to workers on elevated structures. • Avoid conducting tower installation or maintenance work during poor weather conditions and especially where there is a risk lightning strikes.	-	-

Issue	Suggested Mitigation	Monitoring / Training	Management Responsibility
Community H&S	• Cordon off the construction site (be it WTG location, transmission line, substation, yards, access roads) from free public access such that local community is not exposed to H&S risks. • Follow the mitigation measures suggested for transporting WTG parts and other materials, transmission line construction to prevent community H&S risks. • Do not allow free access to roadside temporary storage areas created as transit points for WTG parts and crane equipments. • Do not leave heavy equipments, vehicles and other such hazardous machinery unattended allowing free access to public. Even roadside parked vehicles carrying WTG parts should be guarded all the time for safety reasons. • Wherever possible, post information boards about public safety hazards in the work area (in the local language) and emergency contact information. • Follow electrical safety regulations before charging the transformer and transmission line. • Record all incidents and accidents involving community stakeholders and take corrective actions. • Standing instruction will be issued to all labour contractors and adequate facilities will be provided within the camp area to restrict the interaction with general community • Local administration and police will be made aware about the details of outside labourers as also a list will be provided to the Panchayat /block office. • To the extent possible, labour will be housed in camps, with good living conditions and access to amenities. Outside labour living in the local community will be discouraged; • Health and safety training of the labour, raising awareness about STDs, and HIV, and maintaining behaviour standards while moving in the community will be a priority; and • Water-logging or collection of water in and around the project site will be prevented to avoid malaria and other diseases.	• Monitor and inspect the community H&S procedures followed by wind farm developer specifically during transporting WTG parts, access road construction, transmission line construction, charging transformer and transmission line, erection and commissioning work at WTG location, demobilising phase etc. • Review the accident and incident records involving community stakeholders at least every month. • Provide training on community health and safety aspects to Projects team and sub-contractor staff.	SIMRAN
Shadow flicker and operational noise mitigation measures	• Implement the mitigation strategies finalised during planning phase at identified WTG locations for shadow flickering and noise impacts. • Involve the concerned stakeholder in planning and execution of mitigation strategies.	• Monitor the implementation status and progress of mitigation strategies. Take concerned stakeholder feedback regularly • Annually once train the Projects team and sub-contractor staff on shadow flicker and cumulative noise impact related issues..	SIMRAN

Issue	Suggested Mitigation	Monitoring / Training	Management Responsibility
Transmission line construction	• Transmission line alignment that causes least impact on farming activities and that enables free movement of loaded vehicles beneath it shall be identified for implementation. • During construction of poles and laying of electrical lines, least damage to standing crops if any shall be attempted. Adequate compensation shall be paid to land owner whose crop is damaged due to construction activity. • No waste materials such as excavated earth, concrete, unused construction materials, litter shall be left over after the work is complete. The site will be cleared of all debris and levelled to original contours. • Developer is responsible for any safety hazards if the erected pole falls down due to weak foundation, soil caving in or poor setting of concrete in the foundation. It is the responsibility of developer to ensure that constructed poles are structurally safe to withstand all natural calamities. • Before charging the transmission line, it shall be clearly communicated to all land owners, who have permitted transmission line to pass through, about the commissioning activity well in advance. They shall be asked to desist from doing any kind of farming or other activities beneath the transmission line till it is tested and certified as safe for operation.	• Monitor and inspect the construction practices adopted for transmission line construction on a weekly basis when the work is on.	SIMRAN
Heavy equipments and vehicles (Parking bays and maintenance workshops)	• Vehicles carrying WTG parts and crane machinery and other off road vehicles used in the project shall be parked in a safe manner averting any community health and safety risks as highlighted above. • Parking/ resting areas should not be used as make-shift maintenance/ workshop areas for undertaking minor repairs and cleaning as it will lead to soil contamination and pollution. • Parked vehicles when entering or exiting the main carriageway should be careful to avoid direct collision with main carriageway traffic. Use of helpers is recommended to guide the driver and main traffic.	• Inspect the vehicle parking areas across various road network in the region and at project locations and check their compliance to mitigation measures	SIMRAN

Issue	Suggested Mitigation	Monitoring / Training	Management Responsibility
Aesthetics and Visual Impact	Follow IFC's EHS guideline recommendations in this regard such as the following: - Minimize presence of ancillary structures on the site by avoiding fencing, minimizing roads, burying intra-project power lines or connecting them serially on overground transmission network, and removing in-operative turbines; - Look beyond conventional transmission line pole designs and colour schemes to improve upon the visual impact; - Avoid steep slopes, implement erosion measures, and promptly re-vegetate cleared land with native species only; - Paint the turbines a uniform colour, typically matching the sky (light gray or pale blue), while observing marine and air navigational marking regulations; - Avoid including lettering, company insignia, advertising, or graphics on the turbines.	- Review and inspect the mitigation measures undertaken for addressing aesthetic and visual impact aspect on environment. - Train the Projects, Land teams and Sub contractor staff, annually once on aesthetic and visual impact aspects.	SIMRAN
Monsoon season	- Construction during monsoon season shall be prohibited. - Movement of heavy vehicles and machineries on unpaved access roads should be prohibited during rainy season.	Monitor monsoon season activity	SIMRAN
Demobilising post-construction phase	- After demobilising all the vehicles, erectioning and lifting equipments, clear the entire site of debris, litter, waste materials, excavated earth mounds and such things. Bring the site back to original contour levels through backfilling and top soil spread. - If any soil contamination or discolouration of surface soil is observed, scrap the entire contaminated soil layer and dispose off it along with hazardous waste materials. - Immediately after demobilising, re-spread the stored top soil, if available and attempt developing grass vegetation cover through hydro seeding and mulching techniques. Simple cow dung solution injected with grass seeds can be sprayed on the entire disturbed soil layer to enable faster growth of vegetation cover. - Clear all drainage channels and clean silt arrestor pits.	Inspect all the demobilised sites for satisfactory compliance to mitigation measures	SIMRAN

Table 8.3 Social and Environment Management Plan for Operation and Maintenance Phase

Issue	Suggested Mitigation	Monitoring / Training	Management Responsibility
Intra-site access road maintenance	- Before monsoon season, at least one month in advance, review the soil erosion control measures in place and maintain them in proper order. Measures implemented such as silt arrestor pits should be cleared of excess silt and vegetated drainage channels should be trimmed to aid free flow of storm water. Do not completely shave off the grass vegetation on drainage channels and rolling slopes. - To control fugitive dust generation, restrict vehicular speed on earthen roads to not more than 15km/hr. Undertake plantation of dense local shrubs and bushes that can grow up to 1-2m height along the access roadside to arrest dust generation within the road carriageway. - Keep road side and cross drainage structures clean of all debris, litter and siltation. Do not shave off grass cover completely. - As soon as the construction phase is complete, safely close all borrow pits in the site especially those along road edge and other sensitive areas. Options of converting borrow pits into proper surface water bodies can be exercised if desired by local community stakeholder. - Along long winding intra-site access roads, install road signs identifying WTG locations, village names, routes and distances etc. Considering visual impacts, do not install metal boards and instead prefer stone pillars.	- Monitor the monsoon preparedness of all roadside structures such as drainage channels and cross drainage structures, silt arrestor pits etc. - Review the effectiveness of mitigation measures implemented by operational staff by random checking - Review and analyse the safety record maintained by the OMS team - Inspect each of the borrow pit locations used during construction phase and verify its safe closure or current use - Undertake once in a year, road safety and safe driving behaviour related training programs to OMS team, sub contractor staff and local community (school kids, women and Panchayat leaders particularly)	SIMRAN
Intra-site access road maintenance	- If the access road is significantly used by local community in the night time for easy access to their habitation, in consultation with community stakeholders, install solar street lighting. - Record and maintain accident and incident records pertaining to access roads. Take corrective action accordingly and aim for zero accident and incident record every year. - OMS project personnel of the wind farm developer and operator should be trained to drive slow, abhor alcoholism, avoid talking on cell phones while driving, wearing helmets and all other road safety manners. The training can be extended to local community members especially school kids as part of CSR activities.	-	-

Issue	Suggested Mitigation	Monitoring / Training	Management Responsibility
Men and material transport	- As fibre optic cable network links all WTGs to CMS, frequent visits to WTGs for supervision and inspection does not arise. Wind farm operators can think of providing alternative sustainable modes of transport for OMS staff. Battery/electrically operated vehicles, CNG/LPG powered vehicles, geared bicycles could be least polluting alternate modes of transport. - Maintain a database of fuel consumption, distance travelled in kms per unit of power production and per unit of WTG locations on a monthly and annual basis. Use this parameter as an inter-site benchmark and continually improve to better performance by conserving fuel and distance travelled.	- Review and monitor the fuel consumed and distance travelled per unit of power produced and per unit of WTG maintained. - Undertake once in a year, awareness programs to OMS team, sub contractor staff and local community (school kids, women and Panchayat leaders particularly) on alternate sustainable modes of transport available and emerging globally.	SIMRAN
Water Resource and Quality	- Maintain and monitor water consumption across wind farm projects locations such as WTG locations; substations, CMS facility, Yards and stores etc. - Conserve water and continually improve upon the efforts to reduce water consumption. - Recycle and reuse treated wastewater if possible - Wastewater should not be discharged without prior treatment. Maintain septic tanks and soak pits periodically. Do not allow treated/ or untreated waste water to form cesspools. - Maintain the roof water harvesting, rain water harvesting and ground water recharging structures and associated infrastructure. Clean them thoroughly at least one month before monsoon season - Near scrap yard location where hazardous wastes, e-wastes and other general wastes are stored, monitor surface water and ground water quality for contamination parameters and values as recommended in Table 1 - Groundwater target values and soil and groundwater intervention values presented in Soil Remediation Circular 2009, Ministry of Housing, Spatial Planning and Environment Directorate-General For Environmental Protection, Government of Netherlands (Refer: http://international.vrom.nl/Docs/internationaal/ENGELSE%20versie%20circulaire%20Bodemsanering%202009.pdf) - Monitor the surface and groundwater quality at least once in 2 years as per ASTM standards E1903. Before initiating monitoring program, develop a baseline values prior to start of scrap yards/project when the site is virgin. - Install a permanent monitoring well around the scrap yard location within 50m radial distance from the yard on the downstream side of groundwater flow direction with regards to scrap storage point.	- Review and monitor water quality data specifically at scrap yard location where hazardous and general wastes are stored, handled and transported. - Inspect wastewater treatment systems periodically. - Inspect water harvesting structures before monsoon season for their operational readiness. - Monitor water consumption data and conservation efforts undertaken in the project site. Report water consumption and conservation in quantum of litres per unit of power produced or other such equivalent units. - Undertake once in a year, training programs to OMS team, sub contractor staff and local community (school kids, women and Panchayat leaders particularly) on water quality, quantity, conservation techniques, harvesting and recharging methods etc.	SIMRAN

Issue	Suggested Mitigation	Monitoring / Training	Management Responsibility
Soil erosion and conservation	- Continue to implement the mitigation measures recommended for: soil conservation; pollution prevention; contamination; and erosion aspects as formulated for construction phase EMP. - Near scrap yard location where hazardous wastes, e-wastes and other general wastes are stored, monitor soil contamination for parameters as recommended in Table 1 - Groundwater target values and soil and groundwater intervention values presented in Soil Remediation Circular 2009, Ministry of Housing, Spatial Planning and Environment Directorate-General For Environmental Protection, Government of Netherlands (Refer: http://international.vrom.nl/Docs/internationaal/ENGELSE%20versie%20circulaire%20Bodemsanering%202009.pdf) - Monitor the soil quality at least once in 2 years. Before initiating soil monitoring program, develop a baseline values prior to start of scrap yards/project when the site is virgin. - Collect as many soil samples as per ASTM standards E 1903 near yard location and close to scrap storage points and other possible soil contamination points such as fuel storage, e-waste storage, waste battery storage, transformer oil storage, DG set, below transformer location at WTG sites, yards, stores and at all places where top soil discolouration is found. - If soil contamination is found at a particular location, then ground water/surface water quality also needs to be checked if not done earlier under water quality monitoring program.	- Review and monitor soil quality data specifically at scrap yard location where hazardous and general wastes are stored, handled and transported. - Inspect mitigation measures recommended for: soil conservation; pollution prevention; contamination; and erosion aspects as formulated for construction phase EMP. - Undertake once in a year, training programs to OMS team, sub contractor staff and local community (school kids, women and Panchayat leaders particularly) on soil pollution aspects.	SIMRAN

Issue	Suggested Mitigation	Monitoring / Training	Management Responsibility
Ecology	• Monitor and maintain compensatory plantation undertaken as part of project mitigation strategy. Manage to maintain survival ratio of planted trees at more than 80%. • Peacocks facing electrocution near transformer yards and transmission lines should be addressed by: increasing the height of wire mesh fencing installed around the yard; reducing the sag in transmission lines; altering local ground topography to increase ground clearance available with electrical utilities; plant thorny shrub and bush specie around the yard etc. • In compliance to IFC guidelines and global best practices, undertake monitoring of bird and bat injury and mortality at all WTG locations in the first two years a high probable area for such incidents to happen. As part of monitoring undertake dead bird searches involving entire carcasses or partial remains and/or feathers which is the most common way to monitor for collisions with wind farms. Undertake stakeholder consultations and feedback as part of monitoring. • Maintain a database of such survey results and extrapolate to assess the overall impact on avian fauna and any specie particularly. Implement corrective actions emerging globally and adopt international best practices in this regard. Use local knowledge and expertise available with community stakeholders. • Financially commit, support and promote 3rd party measures or projects focussed on habitat development, conservation and protection for migratory birds, other avian fauna including bats in the regions (preferably within the state closest to project site) devoid of wind farms to divert and drive faunal population to move away from wind farm regions to non-wind farm regions	• Monitor compensatory plantation's maintenance procedures and their survival rates. • Every 6 months, review the monitoring data and management strategies put in place to mitigate bird-hit aspect. Continually attempt to bring down any such bird-hit incidents/fatalities. • Undertake once in a year, training programs to OMS team, sub contractor staff and local community (school kids, women and Panchayat leaders particularly) on ecological impact aspects due to WTG projects.	SIMRAN

Issue	Suggested Mitigation	Monitoring / Training	Management Responsibility
Ambient Noise level	- Do not use any equipment, instrument or vehicle that contributes to ambient noise levels beyond its design specifications and relevant regulatory standards. Maintain them to optimal levels to reduce noise generation. - Maintain WTG equipments, gearbox machinery, blades etc at WTG locations to reduce mechanical noise over the life of WTGs as per global best practices and manufacturer specifications. - Do not undertake any activity that generates sustained noise levels and adds 10 dB(A) or more to ANLs without adopting noise mitigation measures - Undertake cumulative and comprehensive ambient noise level monitoring and mapping once in 3 years at wind farm site level. - Conduct comprehensive ANL monitoring spread over 2 days in a week and 2 weeks in a month and for one month period (as a minimum) at many locations to form a nearly proper rectangular grid (grid spacing of monitoring sites to be not less than 300-500m) within the wind farm project site. While selecting monitoring locations, select points at: below WTG locations; mid point between 2 WTG locations; sensitive receptors; different land use patterns; local topographical features; and behind natural attenuating features such as coconut orchards etc to get a more accurate monitoring and mapping. - This monitoring results and their inference could be an important input in the future planning process and noise modelling work as recommended under Planning Phase EMP.	- Review noise mitigation strategies implemented by the wind farm operator and its effectiveness at least on a monthly basis. Identify high noise generating points/sources and get the operator agency rectify the same. - Review WTG maintenance schedule to see if they are complying to global best practices and manufacturer specifications. - Review cumulative and comprehensive ambient noise level monitoring results and formulate appropriate mitigation strategies especially for affected stakeholders. - Undertake once in a year, training programs to OMS team, sub contractor staff and local community (school kids, women and Panchayat leaders particularly) on noise impact aspects due to WTG projects.	SIMRAN
Shadow flicker management	- Monitor and implement additional mitigation measures in addition to those recommended in the Planning and Construction phase EMPs to mitigate shadow flicker issue at each individual WTG locations, if necessary. - Regularly consult and obtain affected stakeholder feedback to formulate appropriate corrective action.	Monitor and review shadow flicker management strategies at each WTG locations that are identified and categorised for priority shadow flicker management at least once in 6 months.	SIMRAN

Issue	Suggested Mitigation	Monitoring / Training	Management Responsibility
Useful land utilisation around WTGs	- Undertake water harvesting and ground water recharging measures as recommended earlier. - Form self help groups (SHGs) for below poverty line (BPL) families, women headed households, widows, orphans, tribals and other such underprivileged sections of local community. - Allow such SHGs to undertake commercial agro-farming, animal rearing, bee-hives, mushroom farming, cottage industries, handicrafts, pottery and other such activities on WTG locations (without creating permanent structures on the land) on lease basis. - Give the SHGs adequate training, capacity building, financial support and market linkages to let them earn their livelihood and improve their quality of life.	Monitor the useful utilisation of vacant lands at every WTG locations and report the successful utilisation as part of sustainability reporting.	SIMRAN
Hazardous materials storage at yards	- Material storage, handling, transport, use and disposal should be in compliance to regulatory framework (such as MSIHC Rules, Electricity Act, Factory Act/Rules, Petroleum Rules, Gas Cylinder rules, SMPV Rules etc). - Continue to implement mitigation measured recommended under construction phase - Follow the measures recommended in IFC's general EHS guidelines for hazardous material management (Refer http://www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/gui_EHSGuidelines2007_GeneralEHS_1-5/\$FILE/1-5+Hazardous+Materials+Management.pdf)	- Inspect all hazardous material storage locations across wind farm project site on a monthly basis. - Subject the procedures adopted for managing hazardous materials to external and internal auditing systems. - Undertake once in a year, training programs to OMS team, sub contractor staff on hazardous material storage aspects and relevant regulatory requirements in WTG projects.	SIMRAN
Scrap Yard – Hazardous and general waste management	- Implement location-specific E&S Management Plan and SOPs developed during planning phase at every yard location and subject them for internal and external auditing purposes. - Comply to prevailing waste management regulations such as Hazardous Waste Management Rules, Battery Waste Management Rules, E-waste (draft) regulations, Municipal Solid Waste Rules, Biomedical Waste Management Rules etc. - Continue to implement mitigation measured recommended under construction phase	- Inspect all scrap yard locations across wind farm project site on a monthly basis. - Subject the procedures adopted for managing wastes to external and internal auditing systems. - Undertake once in a year, training programs to OMS team, sub contractor staff on hazardous and general waste management aspects and relevant regulatory requirements in WTG projects.	SIMRAN

Issue	Suggested Mitigation	Monitoring / Training	Management Responsibility
DG sets/Other Plants	• Use DG sets that are certified for conformance under EP Rules for both noise and air emissions. • Comply to stack height regulations of CPCB • Storage, handling, use and disposal of fuel oil, other lubricants shall be as per mitigation measures recommended above for hazardous materials.	• Check if DG sets deployed are having valid certificate of compliance under EP Rules. • Check regulatory emission standards	SIMRAN
Central Monitoring Station (CMS) Facility Management	• Undertake water conservation to continually reduce per capita water consumption. Deploy roof water harvesting, Rainwater harvesting and ground water recharging or harvested water re-use measures. • Undertake energy conservation measures – use of CFL bulbs, alternate standby energy sources such as solar energy instead of DG sets etc. • Treat, reuse and recycle waste water generated onsite. Do not allow cesspool formation and discharge in open. • Recycle and reuse all non-hazardous and dry solid waste. Compost all organic wastes locally and use the manure in gardening. • Pave parking areas to prevent soil contamination due to fuel/oil leakages and seepages from vehicles.	• Monitor sustainable management practices adopted at CMS facility once in 6 months.	SIMRAN

Issue	Suggested Mitigation	Monitoring / Training	Management Responsibility
Occupational H&S	- Follow IFC EHS guidelines for Wind farm projects, IFC's General EHS guidelines and other global best practices on occupational H&S issues. - Continually try and reduce the number of incidents and accidents among O&M staff (whether directly employed or subcontracted) to a rate of zero, especially accidents that could result in lost work time, different levels of disability, or even fatalities. - Maintain a record of occupational H&S incidents, accidents, diseases and dangerous occurrences on a monthly and yearly basis. - Evaluate possible community health risks and ensure that these are addressed and minimised; - Use simple diagrams and pamphlets in local language for this purpose; - Demonstrate that Simran/Suzlon and its contractors are very concerned about health and safety of the community; - Capacity enhancement of contractors etc; - Traffic safety plan should be devised and contractors should be trained on this; - Ensure pollution norms compliant vehicles are used for transportation; - Support the local traffic department's traffic awareness programs, if any; - Place adequate signages and warning signs near and around the facility.	- Monitor and evaluate occupational health and safety performance against internationally published exposure guidelines at least once in 6 months. - Undertake Occupational Health and Safety Monitoring of the working environment. It should be monitored for occupational hazards relevant to project activities. Monitoring should be designed and implemented by accredited professionals as part of an occupational health and safety monitoring program. - Subject Occupational H&S management systems, SOPs, protocols and reporting systems to internal and external auditing systems, - Undertake once in a year, training programs to OMS team, sub contractor staff on occupational health and safety aspects, relevant regulatory requirements, global best practices, case studies of incidents and accidents in WTG projects.	SIMRAN
Local procurement	- Ensure local contracting and vendor opportunities as far as possible; - Avoid using any community infrastructure facilities like water bodies, electricity etc. Seek permission from the community in case this is necessary. - Procurement of good, supplies of consumables and services required for project activities, including labour camps etc. to be done, to the extent possible, from the local markets - In case of impacts, offset it in consultation with the community.	- Local contractors and labour working at construction sites - Local suppliers of vehicles, small machinery, water supply etc - Local youth working as fitters, turners, plumbers, electricians, welders and drivers	SIMRAN
Community H&S	- Follow mitigation measures recommended in IFC EHS guidelines for Wind farm projects and other global best practices on community H&S issues specifically pertaining to: - Aircraft and air defence navigational system safety - Blade throw - Electromagnetic interference and radiation - Public access		

Issue	Suggested Mitigation	Monitoring / Training	Management Responsibility
Community H&S – Blade throw	Mitigation strategies recommended in IFC guidelines for wind farm projects with regards to blade throw is highlighted below: - Establish safety setbacks, and design / site wind farms such that no buildings or populated areas lie within the possible trajectory range of the blade. This safety setback range is unlikely to exceed 300 meters, although the range can vary with the size, shape, weight, and speed of the rotor, and with the height of the turbine; - Equip wind turbines with vibration sensors that can react to any imbalance in the rotor blades and shut down the turbine if necessary; - Regularly maintain the wind turbine; - Use warning signs in local language to alert the public of risk.	Monitor and review safety precautions undertaken for blade throw incidents/accidents.	SIMRAN
Community H&S – Public Access	Mitigation strategies recommended in IFC guidelines for wind farm projects with regards to blade throw is highlighted below: - Use gates on access roads; - Fence the wind farm site, or individual turbines, to prohibit public access close to the turbine and transformer area; - Prevent access to turbine tower ladders; - Post information boards in local language about public safety hazards and emergency contact information.	- Monitor and review safety precautions undertaken for safety aspects arising out of free public access - Undertake training and awareness program covering community H&S aspects annually once to local community stakeholders (specifically covering school kids, teachers, police, Panchayat members, women, elders, farmers, poultry owners, orchard owners etc).	SIMRAN
Aesthetics and Visual Impact	Follow IFC's EHS guideline recommendations in this regard which have been highlighted under construction phase EMP.	-	-

Issue	Suggested Mitigation	Monitoring / Training	Management Responsibility
Decommissioning of WTGs	• If the turbines are to be replaced with another set of advanced technology or higher capacity turbines, all mitigation measures recommended under construction phase shall be applied and followed. • If the WTG location is to be completely decommissioned, prepare a standard operating procedure to be followed based on a E&S screening assessment of proposed decommissioning activities. • Nevertheless, the SOP should follow the relevant mitigation measures suggested for following aspects (both under construction and operational phase EMPs): • Occupational health and safety aspects; • Community health and safety aspects; • Hazardous material and waste management • Aesthetic and visual aspects – do not leave any above ground or underground structures (including concrete foundation, transmission lines, poles & its foundation), ancillary facilities (yards, parking bays, temporary/permanent stores) accessories etc. • Using concrete breaker equipments, break open the concrete foundation and remove the foundation layers till the virgin soil layer is found. Refill the foundation pit using borrow earth and excavated earth. Dress the top surface with top soil scraped from nearby surface such that its final contours match the adjacent land parcels. • Clear the site of all wastes, litter, excavated earth • Depending upon consultations with subsequent land owner, prepare the land area amenable to proposed future land use.	• Monitor and review the implementation of all mitigation measures	SIMRAN

8.1.1 Community Engagement and Grievance Redressal

The community engagement process should be led by Simran in order to enjoy a goodwill in the project area. Since Suzlon is doing the bulk of the activities including its own CSR activities, Simran should also engage with the local community so as to increase its visibility as well as contribute positively to the local development. To the extent possible the CSR activities should be relevant to the needs of the locality and in no case should be detrimental to the E&S sensitivities of the project area. E.g. in case Simran wants to undertake plantation on a wide scale at every WTG, it should first study the ground water regime of the area beforehand and should include measures like rainwater harvesting etc to further mitigate any adverse impacts of its activities.

Managing community grievances (as highlighted in section on impact assessment) is equally important, especially in the present arrangement of land purchase where there is a likelihood of people not being satisfied.

There could be grievances due to the manner in which construction activities are carried out or labour movement in local area etc. Simran needs to mitigate such issues either by getting directly involved or by ensuring that mitigation is done by Suzlon.

8.1.2 SEMP Review and Amendments

The project SEMP is a social and environment management tool which shall be reviewed periodically (at least once in 3 years or earlier) to address changes in the project design, life cycle processes and activities, organisation and regulatory requirements.

8.2 SOCIAL AND ENVIRONMENTAL MONITORING PLAN

In line with SWPPL's corporate SEMS, instituting a robust social and environmental monitoring plan is important for effective supervision of the implementation of SEMP.

Accordingly, against individual mitigation measures, the parameters to be monitored and recommended frequency of monitoring has been formulated and presented in *Tables 8.1 through 8.3* covering the entire life cycle of wind farm project.

8.2.1 Organisation, Roles and Responsibilities

As per Corporate SEMS currently in draft stage, the SEMS management will be managed by a SEMS head at the corporate level. Each project will have SEMS coordinator who will be responsible for the site level operations and reporting. The SEMS coordinator at the project level will be directly responsible to the SEMS head.

Mandate of Head SEMS

As a part of its commitments to SEMS issues, SIMRAN is committed to appoint a corporate level SEMS Head, who will be responsible for ensuring the implementation of the SEMS at the corporate level and at the project level or in any of the interventions that the company plans to engage into either directly or through any other arrangement (sub contractor or operation and maintenance subcontracting).

- SEMS head shall be overall responsible for the ensuring the performance of SIMRAN as per the SEMS policy and ensuring that it is implemented at levels.
- SEMS head shall demonstrate active leadership in promoting and generating awareness among the employees, sub contractors through promoting SEMS implementation at all levels, right from the decision making to implementation and subsequent operation.
- SEMS head shall ensure availability of sufficient resources for the implementation of the SEMS.
- SEMS head shall ensure the regular monitoring of the project activities through quantifiable benchmarks on specific SEMS indicators and make it part of the appraisal system for the projects and staffs involved.
- SEMS head shall ensure compliance with laws, regulations, permits and other related Performance Standards pertaining to across all operations

Responsibilities

The Head SEMS shall have the following responsibilities which have to be implemented across all the operations of the company:

- Develop corporate level protocol, and structure the training and awareness programme to address pertinent SEMS objectives.
- Roll out the SEMS management system at all operating project sites and monitor processes to ensure that the SEMS accountabilities along with rights and responsibilities of staff and subcontractors are identified, defined, documented, maintained, understood, and applied.
- Monitor all internal and external complaints related to EHS and community aspects of SIMRAN's operations are recorded, acknowledged, and investigated as incidents.
- Coordinate effective communication of throughout relevant information on EHS issues and social performance to personnel on a regular basis.
- Decision making at all stages to include monitoring corporate and operational site staff and subcontractors on SEMS issues.
- Periodically review competencies required for all positions
- Review the systems in place to identify, prioritize, plan, document, and monitor training needs and performance for staff and subcontractors.
- Overview that the recruitment process for staff includes an assessment of SEMS awareness and competencies

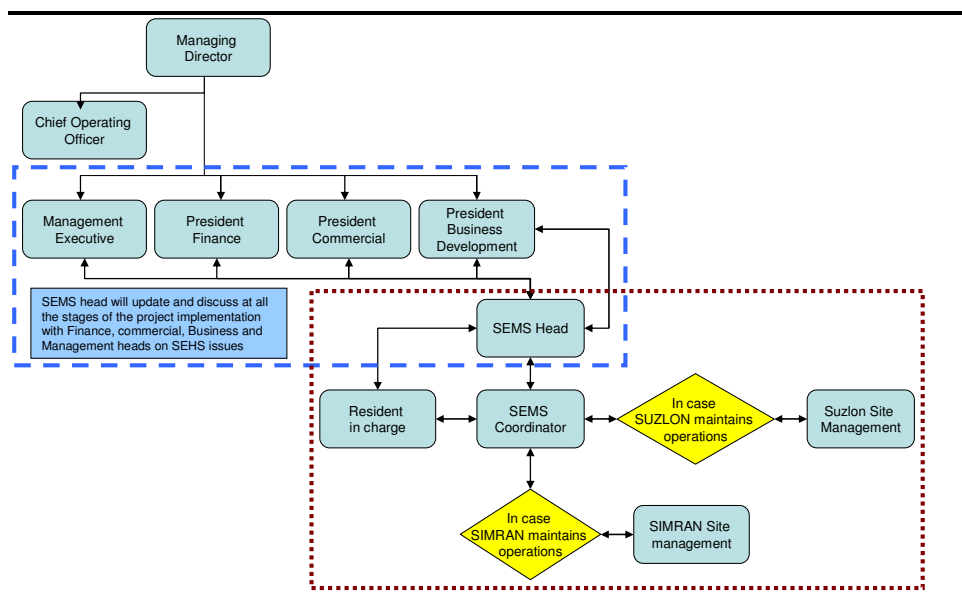
An organisation structure indicating the proposed SEMS head position, SEMS co-ordinator in the company and interaction with Suzlon is provided in **Figure 8.1**. It will be crucial in terms of the assigning of the responsibility from SIMRAN part and on the part of the Suzlon, which is responsible for the operation and maintenance and hence a great responsibility for the SEMS activities falls on Suzlon too. The proposed structure will assign an information flow mechanism and description responsibility at both the levels.

8.2.2 *Inspection, Monitoring & Audit Systems*

In order to operationalize the SEMP, SWPPL's on-site team in consultation with Suzlon's QHSE teams will develop a time-bound and action-oriented Environmental and Social Action Plan delineating the roles and responsibilities of SWPPL and Suzlon towards implementing the mitigation measures. This SEMP will be monitored on a regular basis as specified in the SEMP and audited in accordance with SWPPL's SEMS commitments.

The monitoring process will cover all stakeholders including contractors, labourers, suppliers and the local community impacted by the project activities and associated facilities. Inspection and monitoring of the environmental and social impacts of construction and operation phase activities will increase the effectiveness of suggested mitigations. Through the process of inspection, audit, and monitoring SWPPL will ensure that all the contractors comply with the requirements of conditions for all applicable permits including suggested action plans. The inspections and audits will be done by SWPPL's internal team and external agencies/experts. The entire process of inspections and audits will be documented. The inspection and audit findings will be implemented by the contractors in their respective areas.

Figure 8.1 *Proposed organisational Structure of SIMRAN for coordination with Suzlon on SEMS*



8.2.3 *Reporting and Review*

SWPPL will develop and implement a programme of reporting through all stages of the project construction and commissioning. Contractors will be required to fully comply with the reporting requirements in terms of timely report submission with acceptable level of details. Reporting are to be done in form of environmental, health, safety and social check list, incident record register, environmental, health, safety and social performance reports (weekly, monthly, quarterly, half yearly, yearly etc).

External Reporting and Communication

All complaints and enquiries are to be appropriately dealt with and records be maintained in a Complaint/Enquiry Register by EHS Officers or other delegated staff.

Internal Reporting and Communication

Inspection and audits finding along with their improvement program are to be regularly reported to the senior management for their consideration. The same are also to be communicated within the staff working on the project.

8.2.4 *Documentation and Record Keeping*

Documentation and record keeping system has to be established to ensure updating and recording of requirements specified in SEMP. Responsibilities have to be assigned to relevant personnel for ensuring that the SEMP documentation system is maintained and that document control is ensured

through access by and distribution to, identified personnel in form of the following:

- Master environment management system document;
- Legal Register;
- Operation control procedures;
- Work instructions;
- Incident reports;
- Emergency preparedness and response procedures;
- Training records;
- Monitoring reports;
- Auditing reports; and
- Complaints register and issues attended /closed.

8.3

CAPACITY DEVELOPMENT AND TRAINING

In line with SWPPL's corporate SEMS, instituting a robust social and environmental, health and safety training plan is important for effective implementation of SEMP.

Accordingly, against individual mitigation measures, the aspects/subjects of training and stakeholders to be trained have been identified and presented in *Tables 8.1 through 8.3* covering the entire life cycle of wind farm project.

SWPPL will ensure that the job specific training and EHS induction training needs are identified based on the specific requirements of SEMP and existing capacity of site and project personnel (including the Contractors and Sub-contractors) to undertake the required actions and monitoring activities.

Also, general environmental awareness will be increased among the project's team to encourage the implementation of environmentally sound practices and compliance requirements of the project activities. This will help in minimising adverse environmental impacts, compliance with the applicable regulations and standards, and achieving performance beyond compliance. The same level of awareness and commitment will be imparted to the contractors and sub contractors prior to the commencement of the project.

An environmental and social management training programme will be conducted to ensure effective implementation of the management and control measures during construction and operation of the project. The training programme will ensure that all concerned members of the team understand the following aspects:

- Purpose of action plan for the project activities;
- Requirements of the specific Action Plans;
- Understanding of the sensitive environmental and social features within and surrounding the project areas; and
- Aware of the potential risks from the project activities;

The budget for implementing the SEMP will need to be finalized in conjunction with formulating the action plan by the SWPPL team. The indicative budget for the execution of action plan developed from the SEMP is as provided in the *Table 8.4*.

Table 8.4 *Indicative Budget for Implementing SEMP*

Phase	Activity	Details	Capital Cost (Millions) INR	Recurring Annual Cost (Millions) INR
Planning Phase				
	Planning for Wind Master, Micrositing of WTG locations, Fixing alignment of power evacuation lines, road capacity assessment and access roads	Integrate and include environmental and social sensitivities during planning phase	No separate budget required. Internally manageable	-
	Micrositing	Shadow flickering assessment	No separate budget required.	-
	Micrositing	Cumulative noise impact assessment	No separate budget required	-
	Training activities	Annual training program covering entire planning phase activities (50 participants @ Rs 10,000/person)	INR 0.50 Millions	-
	Stakeholder Consultation	During land take and for ensuring that the ultimate land loser gets the compensation from land developers/agents	No separate budget required but strong due diligence need to be exercised	-
	Stakeholder disclosure	Meetings with Panchayats and general community at the time of selecting land for wind farm	-	0.01 millions per meeting
Construction phase				
	Ambient Air quality	Undertake ambient air quality monitoring as per SEMP (8 stations @Rs 12,000/station)	INR 0.10	-
	Ambient noise levels	Undertake ambient noise level monitoring as per SEMP (8 stations @Rs 5,000/station)	INR 0.04	-

Phase	Activity	Details	Capital Cost (Millions) INR	Recurring Annual Cost (Millions) INR
	Habitat alteration	Compensatory plantation (600 trees @Rs 1000/tree/month	INR 7.0	INR 14.0
	Water resources	Water resource - rainwater harvesting, roof water harvesting and ground water recharge (Lumpsum of Rs 50,000 per site and 80 WTG sites assumed)	INR 5.0	INR 0.8
	Shadow flicker and operational noise mitigation measures	Orchard development and other attenuation measures (Lumpsum of Rs 100,000 per site and 5% WTG numbers)	INR 0.4	INR 0.2
	Training activities	Annual training program covering entire construction phase activities (50 participants @ Rs 10,000/person)	INR 0.50 Millions	-
O&M Phase				
	Access roads	Undertake plantation of dense local shrubs and bushes	No separate budget required.	-
	Men and material transport	Battery/electrically operated vehicles, CNG/LPG powered vehicles, geared bicycles as alternate modes of transport	To be included as part of O&M budget	-
	Water Resources	Monitor surface water and ground water quality for contamination parameters and values (5 samples @INR 15,000/sample)	INR 0.3	INR 0.3
	Soil conservation	Monitor soil contamination ((5 samples @INR 15,000/sample)	INR 0.2	INR 0.2

Phase	Activity	Details	Capital Cost (Millions) INR	Recurring Annual Cost (Millions) INR
	Ecology	Undertake monitoring of bird and bat injury and mortality (100% WTG locations @10,000/location)	INR 0.8	INR 0.8
	Ambient noise levels	Conduct comprehensive ANL monitoring (3 wind farm sites; 80 samples/site; INR 5000/sample)	INR 1.2	INR 1.2 (once in 3yrs)
	Training	Annual training program covering entire O&M phase activities (50 participants @ Rs 10,000/person)	INR 0.5	INR 0.5
	Total		INR 16.54	INR 18.11

8.5 INTEGRATION OF SEMP WITH PROJECT

It is essential that the SEMP developed as part of this study is implemented effectively by integrating it with SWPPLs and Suzlon's Project Management Systems and Procedures. It is recommended that Environmental and Social specialists from SWPPL and Suzlon jointly review the implications of SEMP commitments as the next immediate task. Based on the review, an agreed action plan delineating management responsibilities among themselves concerning each of the SEMP measures can be prepared including the budget estimates as highlighted in *Section 8.4* above.

The delineated and agreed action plan can be integrated into respective Project Management Systems and Procedures of SWPPL and Suzlon.

The SEIA has assessed the Social and Environmental impacts likely to arise as a result of construction and operation of the proposed Wind Farm Projects at two sites across Tamil Nadu in Tirunelveli and Tiruppur districts.

The project is assessed to generate some adverse environmental and social impacts due to construction, operation and establishment of associated facilities.

Mitigation measures for potential impacts on Air, Water, Land, Soil, Noise, Traffic, Ecology, and Socio-economics have been specified through proper:

- follow up of best practice of compensation, public disclosure, and grievance management;
- planning & designing of wind farm sites, WTG location preparation and access route, construction, drainage, traffic movement etc.;
- application of standards for Health and Safety; and
- clearances and permits required for each sub activity.

Social and Environmental Management Plan describe implementation mechanism for recommended mitigation measures together with monitoring and training plan.

This SEIA study together with mitigation measures and follow up of recommendations on management actions will help SWPPL in complying its own SEMS; national/state regulatory framework; and meet the IFC performance standard requirements.

Table 10.1 *Referred Material*

Reference
http://www.dmap.co.uk/ll2tm.htm
http://resource.npl.co.uk/acoustics/techguides/wtnm/
http://tiruppur.tn.nic.in/map_pdf/talukmaps/dharapuram.pdf
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http://www.fsi.nic.in/sfr_2009/tamilnadu.pdf
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