Final Environmental and Social Impact Assessment
60MW Batkurki Wind Power Project

Project Number: 50195-001
March 2017

IND: ReNew Clean Energy Project

Prepared by ERM India Private Limited

Environmental and Social Impact Assessment of 60 MW Batkurki Wind Power Project: *Ramdurg Taluka, Belgaum District, Karnataka, India*

ReNew Wind Energy (Sipla) Private Limited

Final Report

March 2017

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FINAL REPORT

ReNew Wind Energy (Sipla) Private Limited

Environmental and Social Impact Assessment of 60 MW Batkurki Wind Power Project: Ramdurg Taluka, Belgaum District, Karnataka, India

22 March 2017

Reference # I11932P/0365931

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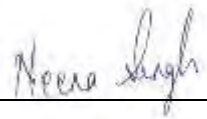
Approved by:	**Neena Singh** *Partner*	

ABBREVIATIONS

Abbreviation	Description
ADB	Asian Development Bank
AENOR	Spanish Standardisation and Certification Association
ALARP	As Low As Reasonably Practicable
ANM	Auxiliary Nurse Midwife
AoI	Area of Influence
ASI	Archaeological Survey of India
ATS	Agreement to Sale
AWEA	American Wind Energy Association
BMTPC	Building Materials and Technology Promotion Council of India
BU	Billion Unit
CBO	Community Based Organisation
CDM	Clean Development Mechanism
CEA	Central Electricity Authority
CGWB	Central Groundwater Board
CH4	Methane
CHC	Community Health Centre
CMS	Convention of Migratory Species
CO2	Carbon dioxide
CPCB	Central Pollution Control Board
CPR	Common Property Resources
CR	Critically Endangered
CSR	Corporate Social Responsibility
CTE	Consent to Establish
DD	Data Deficient
DG	Diesel Generator
DIC	District Industries Commissioner
DISH	Directorate Industrial Safety and Health Department
E	East
E&S	Environment and Social
EHS	Environment, Health and Safety
EHV	Extra-High Voltage
EMF	Electromagnetic Field
EN	Endangered
ENVIS	Environmental Information System
EP	Environmental Protection
EPC	Engineering, Procurement and Construction Contractor
EPFIs	Equator Principles Financing Institutions
ERM	Environmental Resources Management
ESIA	Environmental & Social Impact Assessment
ESMP	Environmental & Social Management Plan
ESMS	Environmental and Social Management System
FCCC	Framework Convention on Climate Change
FGD	Focussed Group Discussion
FPIC	Free, Prior and Informed Consent
GHG	Greenhouse Gas

Abbreviation	Description
GoI	Government of India
GoK	Government of Karnataka
GP	Gram Parishad
H & S	Health and Safety
HDI	Human Development Index
HSE	Health Safety and Environment
HYV	High Yield Variety
IA	Impact Assessment
IAEA	International Atomic Energy Agency
ICAR	Indian Council of Agricultural Research
IEC	International Electrotechnical Commission
IFC	International Finance Corporation
ILO	International Labour Organisation
IMD	Indian Meteorological Department
IPP	Independent Power Producer
IUCN	International Union for the Conservation of Nature
KPTCL	Karnataka Power Transmission Corporation
KREDL	Karnataka Renewable Energy Department Ltd
KSPCB	Karnataka State Pollution Control Board
LC	Least Concern
MNRE	Ministry of New and Renewable Energy
MoEF	Ministry of Environment and Forests
MoEFCC	Ministry of Environment, Forest and Climate Change
MoTA	Ministry of Tribal Affairs
MSW	Municipal Solid Waste
N	North
N2O	Nitrous oxide
NAAQ	National Ambient Air Quality Standards
NARP	National Agricultural Research Project
NASA	National Aeronautics and Space Administration
NE	North-east
NGO	Non-Governmental Organisation
NIWE	National Institute of Wind Energy
NOC	No Objection Certificate
NT	Near Threatened
NW	North-west
O&M	Operation and Maintenance
OH&S	Occupational Health and Safety
OPD	Out Patient Department
PHC	Public Health Centre
PPE	Personal Protective Equipment
PS	Performance Standards
PSS	Pooling Substation
PUC	Pollution Under Control Certificate
R&D	Research and Development
RoW	Right of Way
S	South
SC	Scheduled Castes
SE	South-east

Abbreviation	Description
SEHS	Social, Environment, Health and Safety
SPS	Safety Policy Statement
SRTM	Shuttle Radar Topography Mission
ST	Scheduled Tribes
SW	South-west
TSC	Total Sanitation Campaign
UTM	Universal Transverse Mercator coordinate system
VU	Vulnerable
WB	World Bank
WHO	World Health Organisation
WNA	World Nuclear Association
WPR	Work Participation Ratio
WTG	Wind Turbine Generator

Unit	Description
MW	Mega Watt
kV	Kilo Volt
m	metre
km	Kilo metre
m/s	Metre per second
m2	Metre square
V	Volt
Hz	Hertz
rpm	Rotations per minute
m3/day	Cubic metre per day
L	Litre
m3	Cubic metre
kVA	Kilo volt ampere
km/hr	Kilo metre per hour
kg/day	Kilogram per day
Tonnes/day	Tonnes per day
kg/WTG	Kilo gram per wind turbine generator
Ltr/month	Litre per month
ha	Hectare
MU	Mega Unit
Ceq/kWh	Carbon equivalent per kilo watt hour
CO2e/Gwh	Carbon dioxide equivalent per Giga watt hour
km2	Square kilometre
amsl	Above mean sea level
mm	Millimetre
kmph	Kilo metre per hour
bgl	Below Ground level
dB(A)	Decibel
hrs	Hours

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FIGURES

TABLES

1 INTRODUCTION

ReNew Power Ventures Private Limited (henceforth referred to as 'ReNew' or '*Company*') is an independent power producer (IPP), which was set up in January 2011 for the development of renewable-based power projects. ReNew Power has already commissioned 26 wind power projects located in six different states namely, Rajasthan, Gujarat, Madhya Pradesh, Andhra Pradesh, Maharashtra, Karnataka, with a total installed capacity of over 1000 MW in India (1). The company has constructed a 60 MW wind power project near Village Batkurki, Taluka Ramdurg and District Belgaum in the state of Karnataka, India (henceforth referred to as '*Project*').The Project comprises of 30 Wind Turbine Generators (WTGs) of 2.0 MW capacity each. A Special Purpose Vehicle (SPV) has been formed for the execution of this Project, which is "*ReNew Wind Energy (Sipla) Private Limited*".

The company has signed an agreement with M/s Gamesa Wind Turbines Private Limited (hereinafter referred to as '*Gamesa*' or *'Developer'*) for development of this Project. Gamesa is responsible for land procurement, construction and commissioning of the wind farm. The developer is also responsible for community and land related matters.

1.1 PURPOSE OF THE REPORT

ReNew intends to undertake an Environmental and Social Impact Assessment (ESIA) for the wind power project in order to understand the environmental and social sensitivities associated with the wind farm and to implement mitigation measures in order to avoid adverse impacts during the Project's lifecycle. For this purpose, ERM India Private Limited (ERM) has been entrusted to carry out the ESIA study.

1.2 APPLICABLE REFERENCE FRAMEWORK

ERM has conducted the ESIA study to meet the requirements of the specified framework as follows:

- Applicable local, national and international laws and regulations;
- International Finance Corporation (IFC) Performance Standards on Environmental and Social Sustainability (2012);
- ADB's Safeguard Policy Statement (2009);
- The applicable IFC/World Bank Guidelines:
    - General Environment, Health and Safety (EHS) Guidelines (2007),
    - Guidelines for Wind Energy (2015),

(1) http://renewpower.in/wp-content/uploads/2016/04/Press-Release._ReNew-Power-Achieves-Milestone-of-1GW-Capacity-.pdf. Retrieved on 29th August, 2016.

- Guidelines for Electric Power Transmission and Distribution (2007) [for construction and operation of transmission lines in wind farms]; and
- Relevant ILO conventions covering core labour standards and basic terms and conditions of employment.

Note: Wind energy projects in India at present do not require an Environmental Clearance under the EIA Notification, 2006. The ESIA is thus being undertaken as an internal management tool for ReNew (i.e. ESMS of ReNew Power). ERM is not preparing the ESIA for any regulatory requirements; hence, if any deliverable is used for the same purpose, ERM needs to be notified by the Client.

1.3 RENEW POWER VENTURES PRIVATE LIMITED

ReNew Power, an Independent Power Producer (IPP) company, is committed to leading a change in the country's current energy portfolio by delivering cleaner and smarter energy choices and thereby reducing India's carbon footprint. ReNew Power generates in excess of 1,000 MW of installed and operational clean energy capacity through wind power projects across the states of Maharashtra, Rajasthan, Karnataka, Madhya Pradesh, Andhra Pradesh and Gujarat.

1.3.1 Wind Energy

ReNew has a portfolio of at least 26 operational wind projects located in 6 states that are capable of generating power in excess of 1000 MW. The list of the already commissioned and under development renewable energy projects are given in ***Table 1.1.***

Table 1.1 ReNew Power - Current Wind Power Operational Projects

S.N	State	Project Location	Capacity
1.	Maharashtra	**Vaspet I**, Sangli	45.0 MW
2.		**Vaspet II & III**, Sangli	49.5 MW
3.		**Vaspet IV**, Sangli	49.5 MW
4.		**Jath I**, Sangli	24.65 MW
5.		**Jath II**, Sangli	60 MW
6.		**Jamb**, Satara	28 MW
7.		**Budh**, Sangli	30 MW
8.		**Welturi I**, Beed	50.4 MW
9.		**Welturi II**, Beed	23.1 MW
10.	Rajasthan	**Devgarh**, Prataphgarh	51 MW
11.		**Dangri,** Jaisalmer	30 MW
12.		**Bhakrani**, Jaisalmer	14.4 MW
13.		**Rajgarh**, Jaisalmer	24 MW
14.		**Bhesada I**, Jaisalmer	50.4 MW
15.		**Bhesada II**, Jaisalmer	50.4 MW
16.	Karnataka	**Tadas**, Dharwad	50.4 MW
17.		**Chikodi**, Belgaum	18 MW
18.		**Lingasugur**, Raichur	40 MW
19.	Madhya Pradesh	**Mandsaur**, Rewasdewra Village, Mandsaur	28.8 MW
20.		**Nipaniya**, Mandsaur	18 MW

S.N	State	Project Location	Capacity
21.		**Kod**, Badnawar Taluk, Dhar	60.9 MW
22.		**Limbwas I**, Badnagar Taluk, Ujjain	29.4 MW
23.		**Limbwas II**, Khachrod Taluk, Ujjain	25.2 MW
24.	Andhra Pradesh	**Ellutala I**, Tadipatri Taluka, Anantpur	44.10 MW
25.		**Ellutala II**, Tadipatri Taluka, Anantpur	44.10 MW
26.	Gujarat	**Jasdan**, Rajkot	25.2 MW
Total			**964.75 MW**

Source: http://renewpower.in/wind-energy/our-projects/

Note: The above table only indicates projects that have been listed as operational as per the ReNew Power website. Several additional projects are in the various stages of development and may become operational within a few months and therefore the above list should be considered updated until August, 2016 only.

1.4 OVERVIEW OF THE PROJECT

Details of the 60 MW Project in Batkurki, Karnataka has been provided in ***Table 1.2.***

Table 1.2 Batkurki Wind Power Project - a Snapshot

Detail	Description
Location	30 WTGs are located across the villages of Batkurki, Soppadla, Channapur and Aneguddi in Taluka Ramdurg and District Belgaum in the State of Karnataka, India.
Type of WTGs	30 WTGs with a capacity of 2.0 MW each with a rotor diameter of 97 m and 104 m tower height. Model: G97-2.0 MW
Power Evacuation	• Approximately 10 to 12 km of 33 kV internal transmission line will be constructed for power evacuation from individual WTGs to the pooling substation located in Batkurki Village; and • Approximately 15 to 16 km of 110 kV external transmission line will be constructed for power evacuation from pooling substation to the Salahalli Grid Substation for connection to the power grid.
Land Requirement	• Approximately 3.3 acres of land is required per WTG (inclusive of internal access road and transmission line); • Land parcels for 29 out of the 30 WTG locations have already been procured with negotiations for purchase of land parcel for the 30th WTG underway; • Eight (8) acres of land has been procured for the batching plant and stock yard; and • Five (5) acres of land has been procured for the pooling substation.
Project Status	• Project was in an advanced stage of construction during the ESIA site visit with land procured for 29 out of the 30 WTGs with negotiations for purchase of land parcel for the 30th WTG underway; • Construction phase is anticipated to be completed in a phased manner by the end of March 2017; and • Anticipated commissioning date is March 31, 2017.

Source: Interactions with Project Managers of Batkurki Project from Gamesa and ReNew.

Figure 1.1 highlights the location of the project site, which is further elaborated in **Section 2** of this report.

Figure 1.1 Location of Batkurki Site

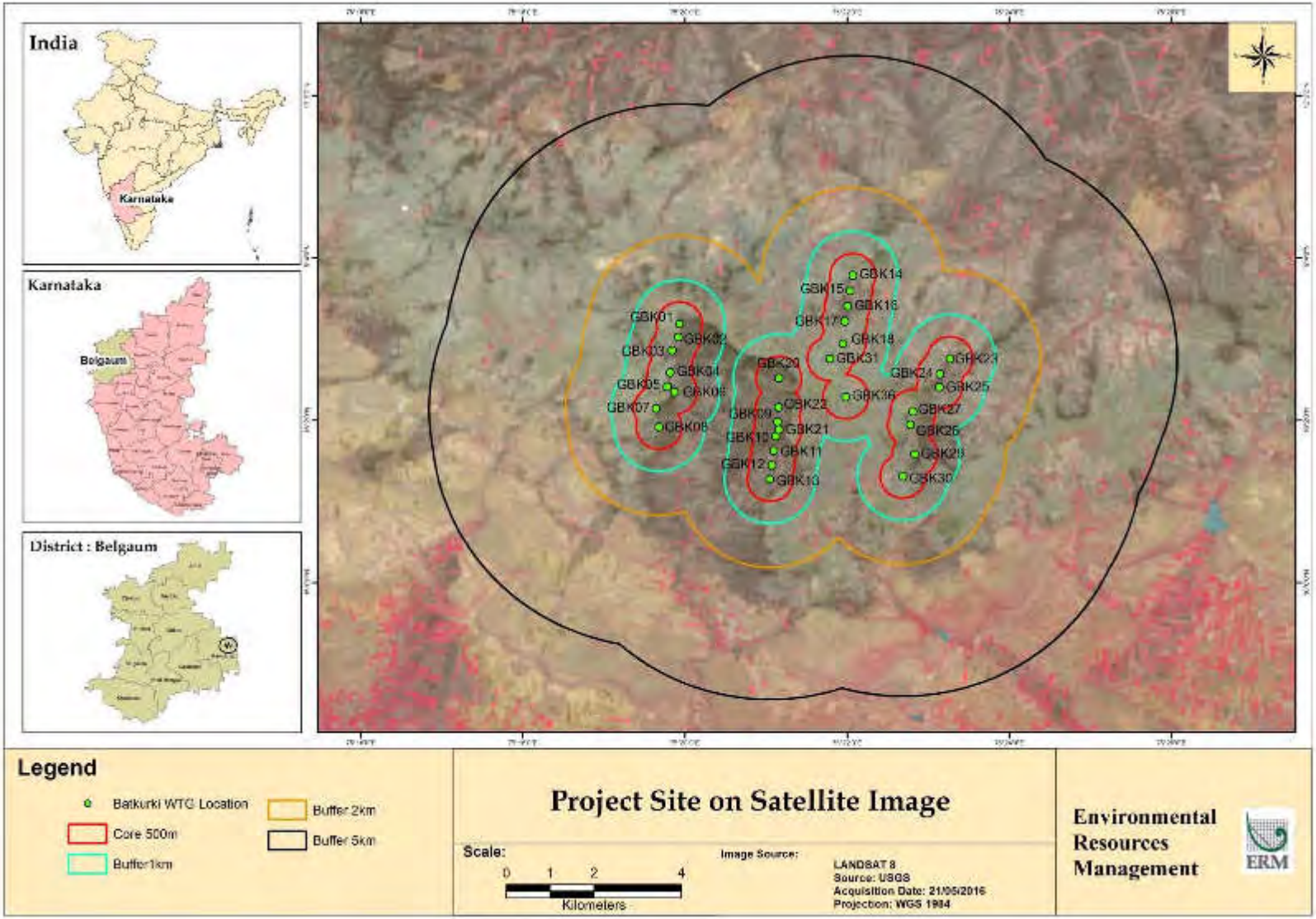
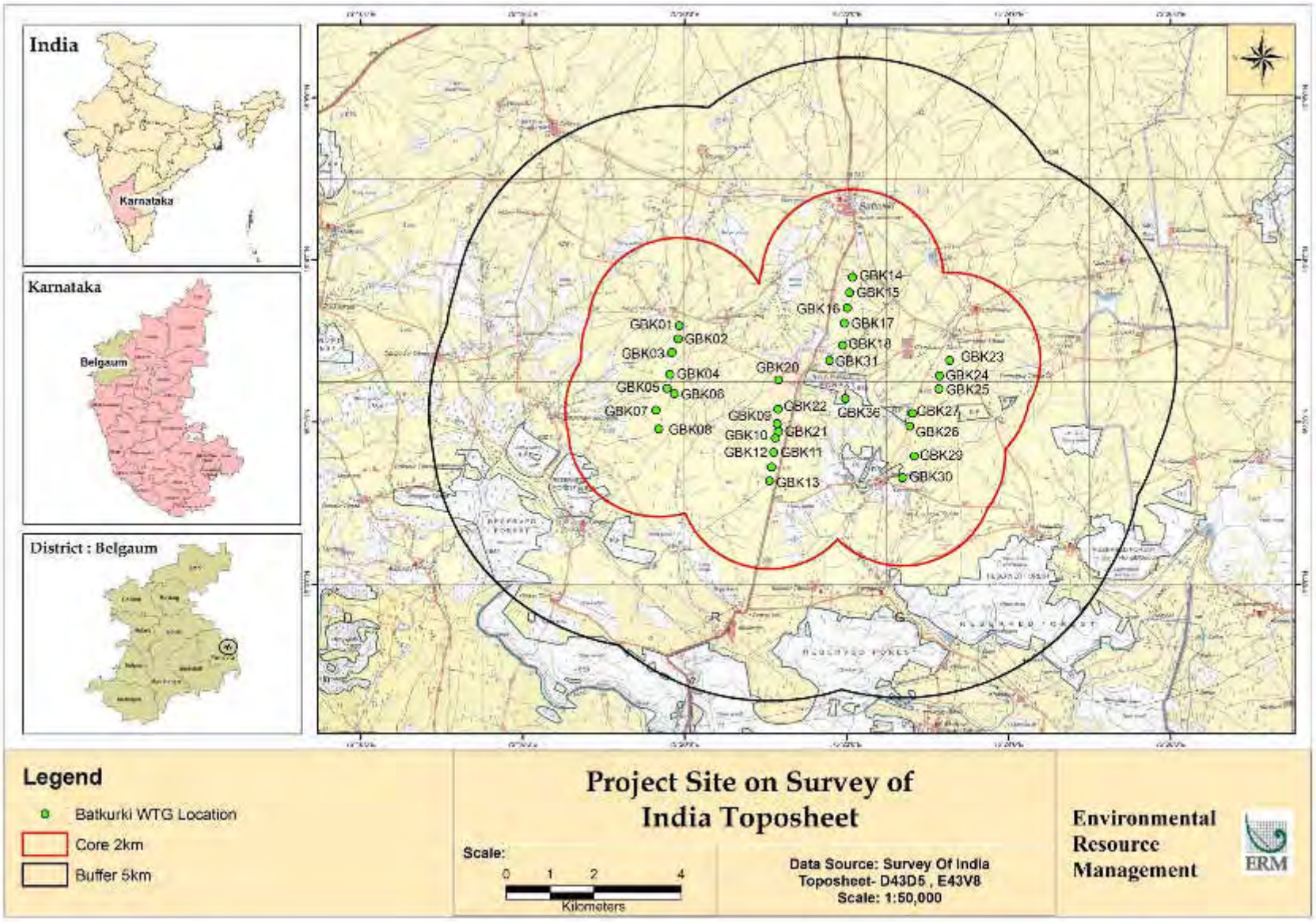


Figure 1.2 Location of Batkurki Site (on Survey of India topographic sheet)



1.5 OBJECTIVE AND SCOPE OF THE ASSESSMENT

1.5.1 Objective

The main objective of the ESIA study is to assess social and environmental impacts and develop social and environmental management strategies to comply with the reference framework (***Section 1.2***) for the 60 MW wind energy project.

The specific objectives are to:

- Develop a baseline environmental and social profile of the Project and its surrounding areas;
- Assess environmental and social impacts from the Project on the established environmental and social baseline;
- Provide mitigation and enhancement measures and prepare an Environmental and Social Management Plan (ESMP); and
- Determine the requirements for additional studies, such as a detailed bird and bat monitoring study.

1.5.2 Scope of Work

In order to meet the objectives mentioned above, the scope of work for the ESIA entails:

- **Regulatory Review:** The study assesses the regulatory framework within which the project will operate by reviewing applicable local, state, national and international environmental and social legislation;
- **Environmental and Social Baseline Generation:** Baseline data collected during the field study with respect to land use, socio-economic profiles and ecology. The baseline supplemented by secondary data obtained through document review with respect to meteorology, soil quality, land-use, geology, geomorphology, hydrology, ecology and socioeconomic profiles in the study area;
- Identification of any **probability of significant shadow flicker** and **noise impact** that would potentially affect human settlements in the vicinity of the project (500m from a WTG) and if identified, to assess the potential shadow flicker/ noise impact and to develop mitigation measures to reduce the impacts;
- Identification, prediction and evaluation of potential aspects and impacts on various environmental and social sensitivities due to the project activities envisaged during land acquisition, construction, operation and decommissioning stages;
- Ascertain whether project footprint or its immediate environment is considered to be ecologically sensitive regarding endangered or protected species, as well as whether the location is a high risk zone for bird and bat activity (migratory routes, foraging and breeding areas);
- Recommendation of appropriate mitigation/enhancement measures for identified environmental, ecological and social impacts;

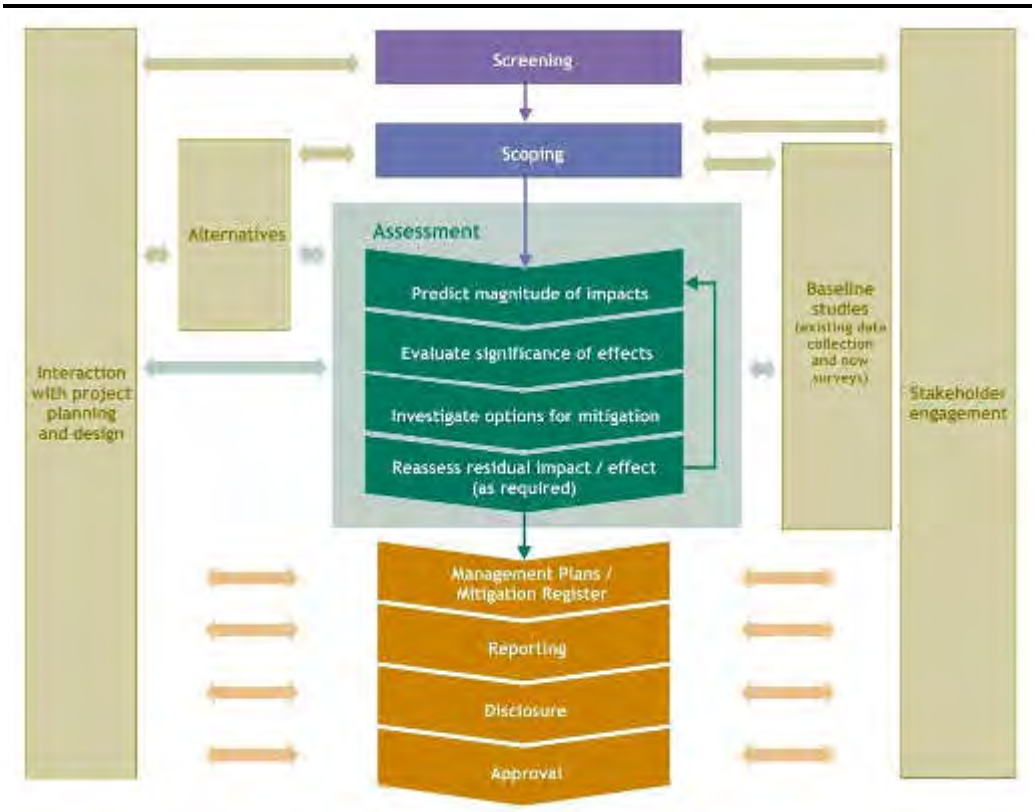
- Comparison and analysis of alternatives considered for the project with respect to location and power generation technology;
- Formulation of an Environmental and Social Management Plan (ESMP) in accordance with IFC's Performance Standards 2 through 8 with management tools and techniques including monitoring and reporting requirements for effective implementation; and
- Review of the land procurement process and assessment of compliance with SPS requirements for negotiated land acquisition.

Note: It is to be noted that an Addendum E & S assessment study of the 33 kV internal and 110 kV external transmission line components of the 60 MW Batkurki wind farm project was undertaken in February 2017.

1.6 ESIA METHODOLOGY

The ESIA methodology follows the overall ESIA approach illustrated in ***Figure 1.3***. The ESIA has been undertaken following a systematic process that predicts and evaluates the impacts the project could have on aspects of the physical, biological, socio-economic and cultural environment, and identifies measures that the project will take to avoid, minimise/reduce, mitigate, offset or compensate for adverse impacts; and to enhance positive impacts where practicable. The stages of the ESIA process are described below

Figure 1.3 The ESIA Process



1.6.1 Screening

Screening is conducted through a desktop study of the site prior to the site visit to gain a high level understanding of the project site and to determine applicable impact assessment requirements. The screening for the project is provided in ***Section 5*** of this ESIA report.

1.6.2 Scoping

The main objective of the scoping is to ascertain the environmental issues associated with the project on which the ESIA study will be focused by reviewing the project information and ascertaining likely environmental issues associated with the project activities. Scoping process determines the terms of reference for ESIA study to be conducted for the project activities. This process helps in ensuring that all the relevant issues are identified and addressed in an appropriate manner in the ESIA study.

For this ESIA study, scoping has been undertaken to identify the potential Area of Influence for the Project (and thus the appropriate Study Areas), to identify potential interactions between the project and resources/receptors in the Area of Influence and the impacts that could result from these interactions, and to prioritize these impacts in terms of their likely significance. This stage is intended to ensure that the impact assessment focuses on issues that are most important decision-making and stakeholder interest.

The details of scoping exercise are also reported in ***Section 5*** of this ESIA report.

1.6.3 Project Description

In order to set out the scope of the project features and activities, with particular reference to the aspects which can impact on the environment, a project description is prepared. This is based on information as provided by the project proponent. The project description has been provided in ***Section 2*** of this ESIA report.

1.6.4 Baseline Conditions

Environmental baseline data has been collected through baseline surveys of the study area of 5 km distance from project area. Secondary information through literature surveys and consultation with stakeholders was also collected for the study area.

The detailed baseline characterisation for the project is provided in ***Section 7*** of this ESIA report.

1.6.5 Stakeholder Analysis and Consultations

An effective ESIA process requires engagement with relevant stakeholders throughout the key stages. This assists in understanding stakeholder views on

the project and in identifying issues that should be taken into account in the prediction and evaluation of impacts.

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

Details of the Stakeholder Engagement activities undertaken for these projects to date are presented in ***Section 8*** of this ESIA report.

1.6.6 Impact Identification/Prediction

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

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

The detailed IA is presented in ***Section 9*** of this ESIA report.

1.6.7 Analysis of Alternatives

A comparative analysis of alternative for the project is provided in terms of site location analysis and feasibility, Power generation technology available including no project scenario etc. in ***Section 6*** of this ESIA report.

1.6.8 Environmental and Social Management Plan (ESMP)

The results of the ESIA study form the basis of the project ESMP. The ESMP will incorporate measures and procedures for the short and long-term environmental and social management of the project during its various stages. The Environmental and Social Management Plan (ESMP) in tabular format with defined roles and responsibilities for implementation and supervision is developed for the Project and is presented in ***Section 10*** of this ESIA report.

1.7 LIMITATIONS

The original ESIA study was conducted in August 2016 and a follow up site visit to assess E & S impacts of the 33 kV internal and 110 kV external transmission lines was undertaken in February 2017. Updated WTG coordinates that have been determined after August 2016 have been visited during the second site visit in February 2017. However, for the new WTG locations, shadow flicker, noise monitoring and WTG profiling assessment

were not carried out as the new locations were either in close proximity of previous locations or far from any sensitive receptors.

1.7.1 Uses of this Report

ERM is not engaged in consulting or reporting for the purpose of advertising, sales promotion, or endorsement of any client interests, including raising investment capital, recommending investment decisions, or other publicity purposes. Client acknowledges this report has been prepared for their and their clients' exclusive use and agrees that ERM reports or correspondence will not be used or reproduced in full or in part for such purposes, and may not be used or relied upon in any prospectus or offering circular. Client also agrees that none of its advertising, sales promotion, or other publicity matter containing information obtained from this assessment and report will mention or imply the name of ERM.

Nothing contained in this report shall be construed as a warranty or affirmation by ERM that the site and property described in the report are suitable collateral for any loan or that acquisition of such property by any lender through foreclosure proceedings or otherwise will not expose the lender to potential environmental or social liability.

1.8 LAYOUT OF THE REPORT

The structure of the report will be as given in ***Table 1.3.***

Table 1.3 Structure of the ESIA Report

Chapter	Title	Description
Section 1	Introduction	(*this section*) Introduction to the Project and ESIA scope
Section 2	Project Description	Technical description of the Project & related infrastructure and activities.
Section 3	Land Requirement and Procurement Process	Land details, procurement and purchase information for the Project.
Section 4	Applicable Legal and Regulatory Framework	Discusses the applicable environmental and social regulatory framework and its relevance for the Project
Section 5	Screening and Scoping	Description of the Scoping outcomes undertaken as part of the ESIA process.
Section 6	Analysis of Alternatives	This section covers a description of the reason for selection of adopted alternative
Section 7	Environmental, Ecology and Social Baseline	Outlines Environmental, Ecology and Social Baseline status in the study area of the project
Section 8	Stakeholder Engagement	Provides an overview of the stakeholder engagement activities undertaken during the ESIA
Section 9	Impact Assessment and Mitigation Measures	This section includes details of identified environmental impacts and associated risks due to project activities, assessment of significance of impacts and presents mitigation measures for minimizing and /or offsetting adverse impacts identified

Chapter	Title	Description
Section 10	Environmental and Social Management Plan	Outline of the Environmental and Social Management Plan (ESMP) taking into account identified impacts and planned mitigation measures and monitoring requirements.
Section 11	Conclusion	Summary of impacts identified for the project
Annex A	Photo-documentation of WTG Profiling	Photo-documentation of land-use in the northern, southern, eastern and western direction of each wind turbine generator (WTG).
Annex B	Approval	Power Evacuation Approval from KPTCL
Annex C	Noise assessment results	Noise assessment results during day and night time and speed/directional analysis
Annex D	Shadow – Project date overview	
Annex E	WTG minimum distances	-
Annex F	Shadow – main results	-
Annex G	Shadow calendar graphical	-

2 PROJECT DESCRIPTION

This section provides a description of the project in terms of location, facilities and associated project infrastructure and activities during the project lifecycle.

2.1 SITE SETTING

The proposed wind farm is located near Village Batkurki, Taluka Ramdurg, District Belgaum in the State of Karnataka in India. The site boundaries for the wind farm site are shown below:

Table 2.1 Boundaries of the Wind Farm

Boundary	WTG Name	Geographical Coordinates
Northern Boundary	GBK14	16° 3′ 47.03″ N
		75° 22′ 4.20″ E
Southern Boundary	GBK13	16° 1′ 16.38″ N
		75° 21′ 2.88″ E
Eastern Boundary	GBK23	16° 2′ 45.62″ N
		75° 23′ 16.11″ E
Western Boundary	GBK08	16° 1′ 59.47″ N
		75° 19′ 43.88″ E

Note: the above boundaries have been determined at the time of the ESIA site visit. Any changes in micro-siting that may have occurred post that is not reflected in the above table.

The Project site is spread over four villages including Batakurki, Soppadla, Channapur and Aneguddi. The topography of the site is flat and ranging from 659 m to 688 m above mean sea level. The land-use around the wind farm site is private agricultural land, however there are several patches of Reserve Forest (1) land located within a 5 km radius of the project components. The closest patch of Reserve Forest to the Project components is a patch located 250m north of GBK 36 and opposite the batching plant. There are also some small Reserve Forest patches near GBK 27 and GBK 30 and larger contiguous patches 3 km south of the wind turbines. The Company has confirmed that no Reserve Forest land will be utilized for construction of Project components, stock yard, access roads or transmission lines.

The closest town to the Project site is Ramadurg, which is located 8.5 km southwest of WTG GBK13. There are no major industries located within a 5 km radius of the Project site with the exception of small stone quarries scattered at distances of 1 to 5 km from the proposed WTG coordinates.

(1) Reserve Forest is an area mass of land duly notified under the provisions of the Indian Forest Act or State Forest Acts having full degree of protection. In Reserved Forests, all activities are prohibited unless permitted by the concerned authority.

2.2 PROJECT COMPONENTS

2.2.1 Wind Farm

The Project comprises of 30 WTGs with an individual capacity of 2.0 MW each, totalling 60 MW. The minimum distance that has been maintained between WTGs is 300 m.

As part of the ESIA study, social and environmental sensitivities were identified for each of the WTG locations. Any structures that fall in a 500 m radius of a proposed WTG were identified as a receptor for shadow flicker assessment and noise impact. The WTG profiling for the wind farm is given in ***Table 2.3***.

Pictorial representation of the land use around WTG locations is provided in **Annex A**.

2.2.2 Wind Turbine Generators

The technical specifications of the WTGs are provided in ***Table 2.2***.

Table 2.2 ***Technical specifications of the wind turbines***

Parameters	Details
General Data	
No. of WTGs	30
WTG Rated Power	2.0 MW
WTG Model	G97-2.0 MW
Wind Class	IIA/IIIA
Cut-in Speed	3 m/s
Cut-out Speed	25 m/s
Rotor	
Diameter	97 m
Swept Area	7,390 m²
Rotational Speed	9.6-17.8 rpm
Control	Variable pitch and speed
Blades	
Length	47.5 m
Material	Fiber glass pre-impregnated with epoxy resin + carbon fiber
Tower	
Height	104 m
Generator	
Type	Doubly-fed generator
Voltage	690 V AC
Frequency	50 Hz/ 60 Hz
Protection Class	IP54
Power Factor	0.95 CAP-0.95 IND throughout the power range

Source: G97-2.0 MW Product Brochure - http://www.gamesacorp.com/recursos/doc/productos-servicios/aerogeneradores/nuevas-fichas/g97-20-mw-eng.pdf

Table 2.3 WTG Profiling of 60 MW Wind Farm (based on an eye view distance of 500 m)

SN	WTG ID	WTG Co-ordinates (in UTM)		WTG Site Elevation (m)	WTG Footprint Area		Nearest house/ structure (within 500 m from WTG Footprint)					Nearest Village		Nearest Cultural/ Religious Site		Approach/ Access Road Condition			Distance from the nearest Paved Road	Land use around WTG Location (Explain) based on visual observation			
		Easting (m)	Northing (m)		Topography	Land-use (Based on Land Records)	Identification (Name/ ID in Map)	Distance (km) and Direction	Type of structure	Use of Structure	Any window in direction of WTG, if yes, type of window	Name	Distance (km) and Direction from WTG	Name/ Identification ID in Map	Distance (km) and Direction from WTG	Is there motor able access to site?	Condition of Road and Type	Name of the nearest approach road		North	East	West	South
1.	GBK01	75°19'55.91"E	16° 3'11.27"N	684	Flat Land	Private Land	A	370m NE	Permanent	Residential	Yes	Naganur Tanda	460m NW	Temple	0.3km NW	No	-	Naganur Village road	310m	Agric-ultural land	Agric-ultural land	Agric-ultural land	Agric-ultural land
							B	460m NW	Permanent	Residential	Yes	-	-	-	-	-	-	-	-	-	-	-	-
							C	500m NW	Permanent	Residential	Yes	-	-	-	-	-	-	-	-	-	-	-	-
							D	485m NW	Permanent	Residential	Yes	-	-	-	-	-	-	-	-	-	-	-	-
							E	480m NW	Permanent	Residential	No	-	-	-	-	-	-	-	-	-	-	-	-
							F	478m NW	Permanent	Residential	Yes	-	-	-	-	-	-	-	-	-	-	-	-
							G	-	-	-	No	-	-	Temple	400m NW	-	-	-	-	-	-	-	-
							H	-	-	-	No	-	-	Shrine	300m N	-	-	-	-	-	-	-	-
2.	GBK02	75°19'54.92"E	16° 3'1.32"N	677	Flat Land	Private Land	-	-	-	-	-	Naganur Tanda	700m NW	-	-	No	-	Naganur-Sopadla Village Road	610m	Agric-ultural land	Agric-ultural land	Agric-ultural land	Agric-ultural land
3.	GBK03	75°19'50.49"E	16° 2'51.53"N	671	Flat Land	Private Land	-	-	-	-	-	Naganur Tanda	940m NNW	-	-	No	-	Naganur-Sopadla Village Road	950m	Agric-ultural land	Agric-ultural land	Agric-ultural land	Agric-ultural land
4.	GBK04	75°19'49.02"E	16° 2'35.22"N	672	Flat Land	Private Land	-	-	-	-	-	Naganur Tanda	1.4 km N	-	-	No	-	Naganur-Sopadla Village Road	1.4 km	Agric-ultural land	Agric-ultural land	Agric-ultural land	Agric-ultural land
5.	GBK05	75°19'46.88"E	16° 2'24.98"N	669	Flat Land	Private Land	-	-	-	-	-	Naganur Tanda	1.7 km N	-	-	No	-	Naganur-Sopadla Village Road	1.7 km	Agric-ultural land	Agric-ultural land	Agric-ultural land	Agric-ultural land
6.	GBK06	75°19'52.16"E	16° 2'21.00"N	669	Flat Land	Private Land	-	-	-	-	-	Soppadla	1.4km SW	-	-	No	-	Naganur-Sopadla Village Road	1.8 km	Agric-ultural land	Agric-ultural land	Agric-ultural land	Agric-ultural land
7.	GBK07	75°19'38.67"E	16° 2'8.62"N	667	Flat Land	Private Land	-	-	-	-	-	Soppadla	900m WSW	-	-	No	-	Naganur-Sopadla Village Road	2.2 km	Agric-ultural land	Agric-ultural land	Agric-ultural land	Agric-ultural land
8.	GBK08	75°19'40.81"E	16° 1'54.98"N	662	Flat Land	Private Land	-	-	-	-	-	Soppadla	870m W	-	-	No	-	Naganur-Sopadla Village Road	2.2 km	Agric-ultural land	Agric-ultural land	Agric-ultural land	Agric-ultural land
9.	GBK09	75°21'8.41"E	16° 1'58.84"N	677	Flat Land	Private Land	-	-	-	-	-	Aneguddi	2.5 km SE	-	-	No	-	Mudenur-Batakurki Village Road	293m	Agric-ultural land	Agric-ultural land	Agric-ultural land	Agric-ultural land
10.	GBK10	75°21'6.98"E	16° 1'48.17"N	680	Flat Land	Private Land	-	-	-	-	-	Aneguddi	2.4 km SE	-	-	No	-	Mudenur-Batakurki Village Road	230m	Agric-ultural land	Agric-ultural land	Agric-ultural land	Agric-ultural land
11.	GBK11	75°21'5.8	16°	676	Flat Land	Private	-	-	-	-	-	Aneguddi	2.3 km	-	-	No	-	Mudenur-	222m	Agric-	Agric-	Agric-	Agric-

SN	WTG ID	WTG Co-ordinates (in UTM)		WTG Site Elevation (m)	WTG Footprint Area		Nearest house/ structure (within 500 m from WTG Footprint)					Nearest Village		Nearest Cultural/ Religious Site		Approach/ Access Road Condition			Distance from the nearest Paved Road	Land use around WTG Location (Explain) based on visual observation			
		Easting (m)	Northing (m)		Topography	Land-use (Based on Land Records)	Identification (Name/ ID in Map)	Distance (km) and Direction	Type of structure	Use of Structure	Any window in direction of WTG, if yes, type of window	Name	Distance (km) and Direction from WTG	Name/ Identification ID in Map	Distance (km) and Direction from WTG	Is there motor able access to site?	Condition of Road and Type	Name of the nearest approach road		North	East	West	South
		5"E	1'37.50"N			Land							ESE					Batakurki Village Road		ultural land	ultural land	ultural land	ultural land
12.	GBK12	75°21'4.32"E	16° 1'26.83"N	669	Flat Land	Private Land	-	-	-	-	-	Aneguddi	2,3 km E	-	-	No	-	Mudenur-Batakurki Village Road	194m	Agric-ultural land	Agric-ultural land	Agric-ultural land	Agric-ultural land
13.	GBK13 -	75°21'2.88"E -	16° 1'16.38"N -	669 -	Flat Land -	Private Land -	I	0.43km S	Temporary	Residential	No	Aneguddi	2.3 km E			No	-	Mudenur-Batakurki Village Road	166m	Agric-ultural land	Agric-ultural land	Agric-ultural land	Agric-ultural land
							J	0.45km S	Semi-Permanent	Commercial (Bus Stop)	No	-	-	-	-	-	-	-	-	-	-	-	-
14.	GBK14	75°22'4.20"E	16° 3'47.03"N	659	Flat Land	Private Land	-	-	-	-	-	Batkurki	1.3km N	-	-	No	-	Mudenur-Batakurki Village Road	358m	Agric-ultural land	Agric-ultural land	Agric-ultural land	Agric-ultural land
15.	GBK15	75°22'2.06"E	16° 3'35.67"N	664	Flat Land	Private Land	-	-	-	-	-	Batkurki	1.7 km N	-	-	No	-	Mudenur-Batakurki Village Road	338m	Agric-ultural land	Agric-ultural land	Agric-ultural land	Agric-ultural land
16.	GBK16	75°22'0.26"E	16° 3'24.41"N	665	Flat Land	Private Land	-	-	-	-	-	Channapur Tanda	1.5 km SE	-	-	No	-	Mudenur-Batakurki Village Road	353m	Agric-ultural land	Agric-ultural land	Agric-ultural land	Agric-ultural land
17.	GBK17	75°21'58.15"E	16° 3'13.22"N	666	Flat Land	Private Land	-	-	-	-	-	Channapur Tanda	1.4 km ESE	-	-	No	-	Mudenur-Batakurki Village Road	344m	Agric-ultural land	Agric-ultural land	Agric-ultural land	Agric-ultural land
18.	GBK18	75°21'56.91"E	16° 2'56.56"N	664	Flat Land	Private Land	-	-	-	-	-	Channapur Tanda	1.3 km E	-	-	No	-	Mudenur-Batakurki Village Road	475m	Agric-ultural land	Agric-ultural land	Agric-ultural land	Agric-ultural land
19.	GBK20	75°21'9.34"E	16° 2'31.06"N	681	Flat Land	Private Land	-	-	-	-	-	Batkurki	1.7 km NW	-	-	Yes	Unpaved	Mudenur-Batakurki Village Road	627m	Agric-ultural land	Agric-ultural land	Agric-ultural land	Agric-ultural land
20.	GBK21	75°21'9.44"E	16° 1'53.15"N	680	Flat Land	Private Land	-	-	-	-	-	Aneguddi	2.4 km ESE	-	-	No	-	State Highway 34	180m	Agric-ultural land	Agric-ultural land	Agric-ultural land	Agric-ultural land
21.	GBK22	75°21'9.14"E	16° 2'9.58"N	674	Flat Land	Private Land	-	-	-	-	-	Batkurki	2.2 km NW	-	-	No	-	Mudenur-Batakurki Village Road	370m	Agric-ultural land	Agric-ultural land	Agric-ultural land	Agric-ultural land
22.	GBK23 - - - - -	75°23'16.11"E - - - - -	16° 2'45.62"N - - - - -	660 - - - - -	Flat Land - - - - -	Private Land - - - - -	K	442 km N	Permanent	Residential	Yes	Channapur Tanda	440 km N	-	-	No	-	Chennapur-Annegudi Village Road	290m	Agric-ultural land	Agric-ultural land	Agric-ultural land	Agric-ultural land
							L	454m N	Permanent	Residential	Yes	-	-	-	-	-	-	-	-	-	-	-	-
							M	460m N	Permanent	Residential	Yes	-	-	-	-	-	-	-	-	-	-	-	-
							N	463m N	Permanent	Residential	Yes	-	-	-	-	-	-	-	-	-	-	-	-
							O	470m N	Permanent	Residential	Yes	-	-	-	-	-	-	-	-	-	-	-	-

SN	WTG ID	WTG Co-ordinates (in UTM)		WTG Site Elevation (m)	WTG Footprint Area		Nearest house/ structure (within 500 m from WTG Footprint)					Nearest Village		Nearest Cultural/ Religious Site		Approach/ Access Road Condition			Distance from the nearest Paved Road	Land use around WTG Location (Explain) based on visual observation			
		Easting (m)	Northing (m)		Topography	Land-use (Based on Land Records)	Identification (Name/ ID in Map)	Distance (km) and Direction	Type of structure	Use of Structure	Any window in direction of WTG, if yes, type of window	Name	Distance (km) and Direction from WTG	Name/ Identification ID in Map	Distance (km) and Direction from WTG	Is there motor able access to site?	Condition of Road and Type	Name of the nearest approach road		North	East	West	South
							P	478m N	Permanent	Residential	Yes	-	-	-	-	-	-	-	-	-	-	-	-
23.	GBK24	75°23'8.89"E	16° 2'34.18"N	668	Flat Land	Private Land	-	-	-	-	-	Channapur Tanda	645m NW	-	-	-	-	Chennapur-Annegudi Village Road	282	Agric-ultural land	Agric-ultural land	Agric-ultural land	Agric-ultural land
24.	GBK25	75°23'8.30"E	16° 2'24.51"N	671	Flat Land	Private Land	-	-	-	-	-	Channapur Tanda	865m NW	-	-	-	-	Chennapur-Annegudi Village Road	405m	Agric-ultural land	Agric-ultural land	Agric-ultural land	Agric-ultural land
25.	GBK26	75°22'48.71"E	16° 2'6.58"N	671	Flat Land	Private Land	-	-	-	-	-	Channapur Tanda	1.2 km N	-	-	-	-	Chennapur-Annegudi Village Road	70m	Agric-ultural land	Agric-ultural land	Agric-ultural land	Agric-ultural land
26.	GBK27	75°22'46.84"E	16° 1'56.82"N	675	Flat Land	Private Land	-	-	-	-	-	Channapur Tanda	1.6 km N	-	-	-	-	Chennapur-Annegudi Village Road	60m	Agric-ultural land	Agric-ultural land	Agric-ultural land	Agric-ultural land
27.	GBK29	75°22'50.03"E	16° 1'34.68"N	666	Flat Land	Private Land	-	-	-	-	-	Aneguddi	675m SW	-	-	-	-	Chennapur-Annegudi Village Road	444m	Agric-ultural land	Agric-ultural land	Agric-ultural land	Agric-ultural land
28 -	GBK30 -	75°22'41.22"E -	16° 1'18.75"N -	661 -	Flat Land -	Private Land -	Q	210m E	Semi-Permanent	Commercial	No	Aneguddi	265m W	-	-	-	-	Chennapur-Annegudi Village Road	578m	Agric-ultural land	Agric-ultural land	Agric-ultural land	Agric-ultural land
							R	265m	Permanent	Residential	Yes	-	-	-	-	-	-	-	-	-	-	-	-
29.	GBK31	75°21'47.36"E	16° 2'45.45"N	680	Flat Land	Private Land	-	-	-	-	-	Channapur Tanda	1.8 km E	-	-	Yes	Unpaved	Mudenur-Batakurki Village Road	333m	Agric-ultural land	Agric-ultural land	Agric-ultural land	Agric-ultural land
30.	GBK36	75°21'58.96"E	16° 2'17.31"N	684	Flat Land	Private Land	-	-	-	-	-	Channapur Tanda	1.6 km NE	-	-	Yes	Unpaved	Mudenur-Batakurki Village Road	1.1 km	Agric-ultural land	Agric-ultural land	Agric-ultural land	Agric-ultural land

Note: The WTGs – GBK 21 and 30 have moved by a distance greater than 500m after completion of the ESIA.

2.2.3 *Power Evacuation*

The Batkurki wind farm site will be connected to a 110/33 kV Pooling Substation (PSS) located in Batkurki Village by a 10 to 12 km internal transmission line. Schematic diagram of 33 kV power collection network of Batkurki Wind Farm is presented in Figure 2.3. This pooling substation will then be connected to the 110 kV Karnataka Power Transmission Corporation (KPTCL) Grid Substation at Salahalli Village through an approximately 12 km EHV line. Power evacuation approval has been obtained from KPTCL as of August 2016 (1).

The Power Evacuation Approval from KPTCL has been provided in ***Annex B***.

2.2.4 *Additional Project Infrastructure*

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

- Batching Plant
- Metering point for measuring production from each WTG;
- Material storage yards and stores; and
- Central monitoring station building and facilities.

The batching plant and storage yard has already been constructed for the Project and consists of an 8 acres land that has been leased in Village Batkurki for a period of 7-8 months.

2.2.5 *Accessibility*

The Batkurki site can be accessed by two cities in Northern Karnataka, namely Bijapur and Belgavi. The site is equidistant from both cities at approximately 85 km. Batkurki is connected to the cities through nearby Lokapur Town, which can be reached using SH 20 from Belgavi or NH 52 from Bijapur.

Wind farm accessibility has been provided in ***Table 2.4*** and ***Figure 2.1***

Table 2.4 Site Accessibility

S.N.	Nearest Access	Detail	Aerial Distance and direction w.r.t nearest WTG
1.	City	Belgavi	84 km West
		Bijapur	88 km Northeast
2.	Town	Lokapur	10 km North
3.	Road	SH 20	10 km North
		NH 52	15 km East
4.	Railway Station	Bagalokote	55 km East
		Badami	40 km Southeast
5.	Airport	Belgavi	80 km West

(1) As per Office Memorandum No. 506/BGM/SEE/Tr. (W&M)/C/EE(O)/AEE-2/16-17/F/2702-03 dated 06/08/16

Access to the wind farm is through 8 m width village roads that have been created by the Department of Public Works. Access to individual WTGs has been created by constructing roads of approximately 8 m width with a turning radius of 45 m for movement of trucks carrying turbine components. Some images of the village roads have been provided in ***Figure 2.1.***

Figure 2.1 Village roads in the Batkurki Site

Figure 2.2 Wind farm site accessibility map

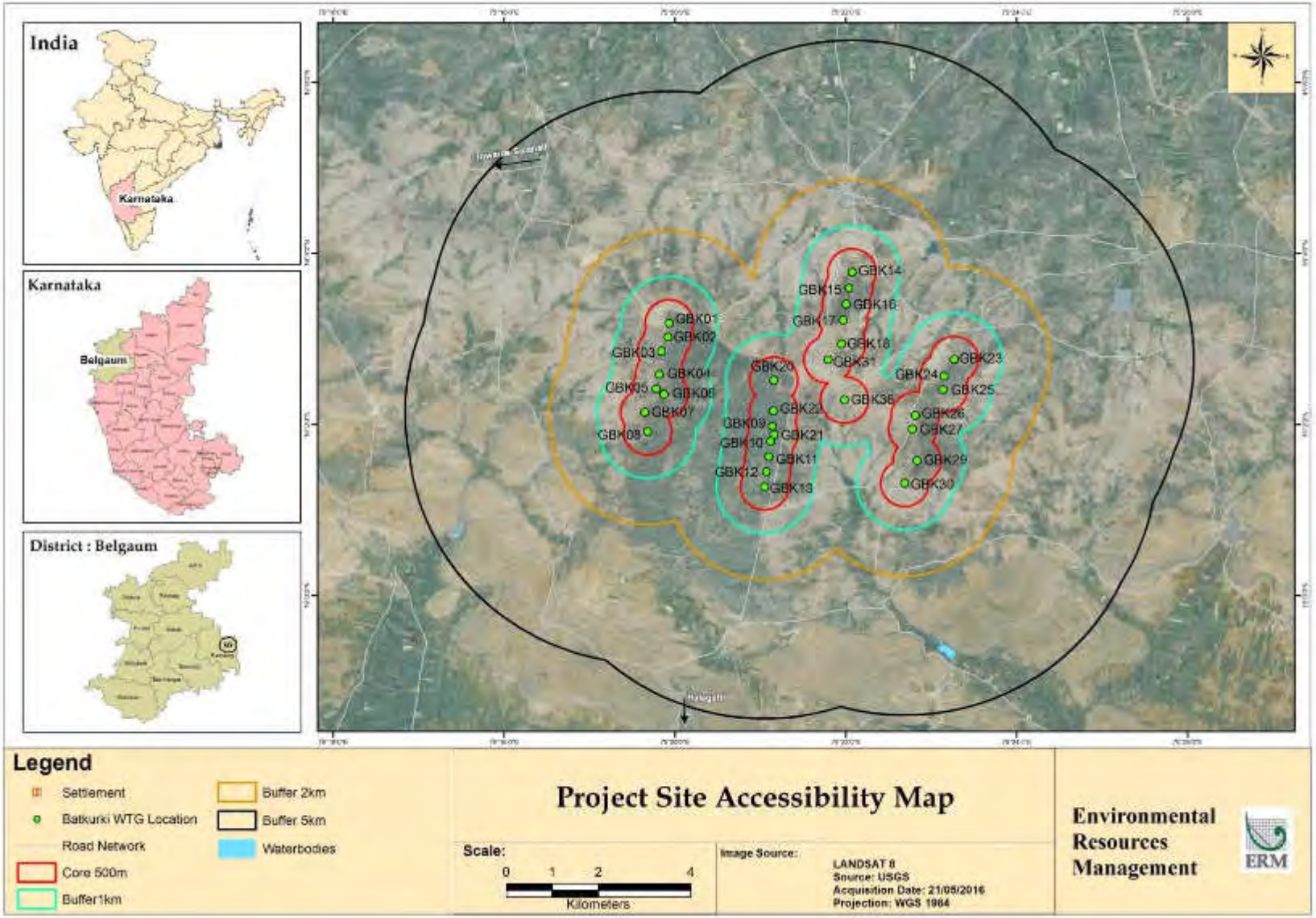
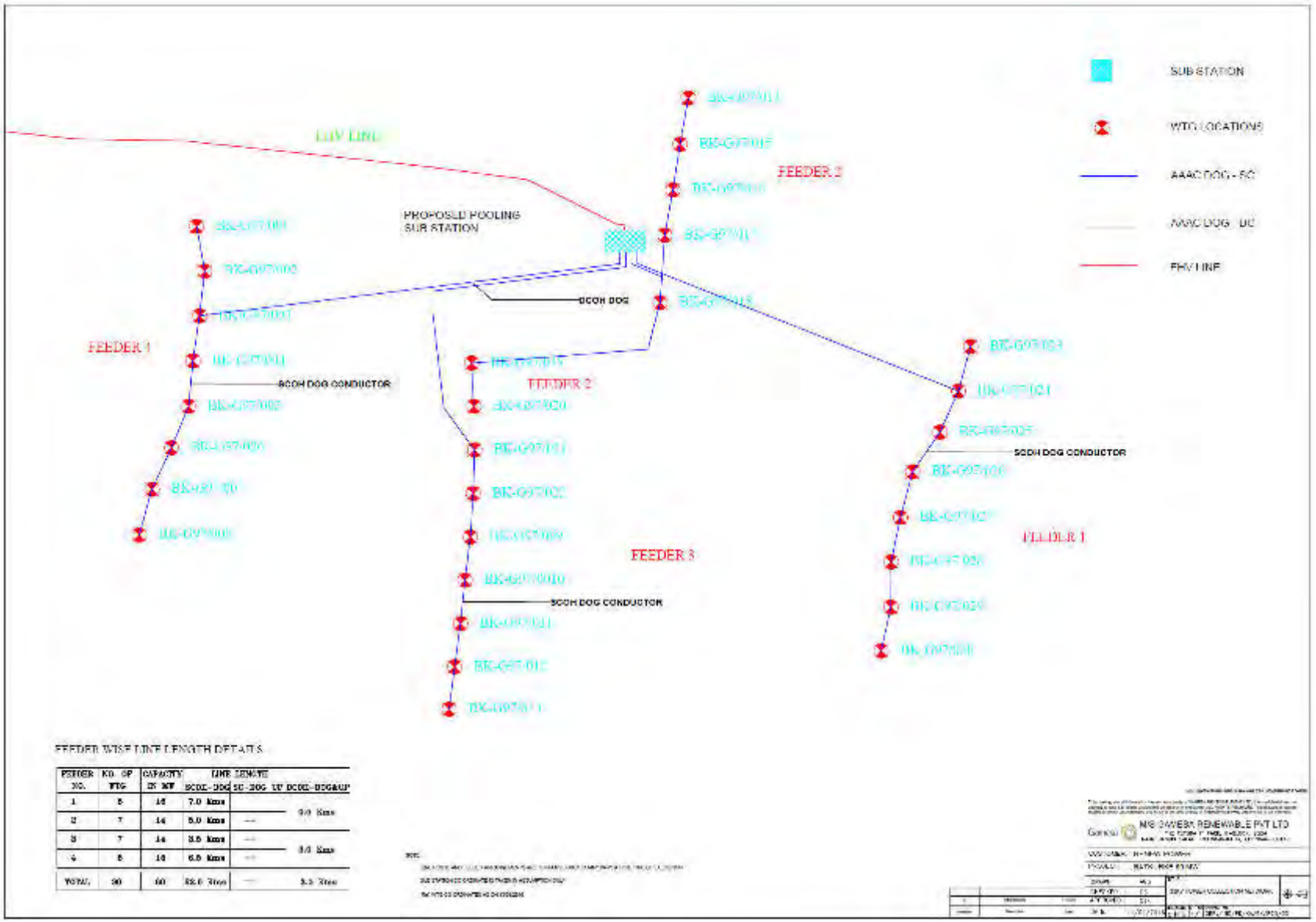


Figure 2.3 33 kV Power Collection Network of Batkurki Wind Farm



2.3 PROJECT PHASES AND ACTIVITIES

The Project life-cycle can be divided into four phases as follows:

- Planning and pre-construction phase;
- Construction phase;
- Operation (including maintenance and repair) phase; and
- Decommissioning.

2.3.1 *Planning Phase*

The planning phase includes the following components:

- Identification of land area and site;
- Site surveys as topographic, geo-technical investigation, micro-siting studies, electrical grid studies, etc.;
- Obtaining all necessary approvals/clearances; and
- Finalization of contractors.

The identification and purchase of land is a key component of the planning and pre-construction phase. The process of purchasing land can be divided into two phases (a) land title verification and (b) purchase of land. This is coordinated by the Land Team of Gamesa in the various villages that come under the Project. At the time of the ESIA visit, Gamesa had finalized three of the thirty locations required for the construction of the wind farm and were in negotiations for several others.

2.3.2 *Construction Phase*

The construction phase includes the following components:

- Deployment of labour and establishment of labour camp;
- Site preparation, including subcontractor mobilization, installation of fencing or suitable barriers, construction of site compounds and lay down areas;
- Establishment of borrow pits (if required);
- Construction, widening and strengthening of access roads;
- Establishment and operation of batching plant;
- Establishment of pooling substation at Batkurki Village;
- Laying of turbine foundations, turbine delivery and installations;
- Internal electrical connections;
- Construction of Extra High Voltage (EHV) line;
- Turbine testing to verify proper operation of the facility; and
- Commissioning of the wind farm.

At the time of the ESIA study, Gamesa had not begun the construction phase of the project. Three of the locations that had been finalized had been connected through internal access roads leading up to the WTG foundation. The towers for the EHV line were set to be installed within the upcoming

weeks and Right of Way (RoW) for 55 of the 66 towers had already been obtained.

2.3.3 Operation and Maintenance Phase

The operation and maintenance phase includes the following activities:

- Regular remote monitoring of WTG operations;
- Normal greasing and cleaning of WTG components;
- Annual shut-down maintenance, which will mostly include cleaning and greasing, change of parts, etc.; and
- Internal road repairs, as and when required.

The design life of the Project is expected to be 20 years from the date of commissioning. Regular maintenance would be required to ensure that the turbines are kept in optimal working order. Most day-to-day facility operations are done remotely through the use of computer networks and a small team. Some limited maintenance and repair activities would need to be undertaken occasionally on site.

2.3.4 Decommissioning Phase

The wind farm site, after having remained in operation for the lifecycle estimated at 20 years, will not lose its value as a wind power generation system. However, it is not yet decided if the Project would approach for upgrading/expansion, once this Project life is completed.

If the site is to be abandoned after completion of the designed plant life, decommissioning should be initiated by dismantling the turbines, supporting towers, O&M building and transporting them out of the Project area. It is expected that this activity will take approximately 3-4 months. The turbine components should be sold as scrap.

The concrete should be broken up and removed to a landfill site. The stored fuel and oil should be transported out of the site for sale/disposal to the authorised seller/disposal facility. The site should be restored as far as possible to its original condition. Infrastructure such as roads and transmission lines should be handed over to the government for use.

2.4 CONTRACTORS

Gamesa is the main EPC contractor and is responsible for planning, construction and maintenance of the projects. Gamesa has appointed and managed several subcontractors for the construction process, land procurement and electrical installations.

A list of subcontractors and their responsibilities has been provided in the table below.

Table 2.5 Subcontractor allocation for site activities

S.N.	Subcontractor	Responsibility
1.	Mahadev Infrastructure and Edison Power	Land Procurement
2.	ABG	Pooling Substation and Extension of bay at KPTCL Salahalli Substation
3.	MR Constructions	110 kV EHV Line (external transmission line)
4.	Annai Constructions	Civil Infrastructure (road and WTG foundation)
5.	DKD + KISWA	33 kV Internal transmission lines
6.	PRV	33 kV USS (DP Yard) and Metering Yard

2.5 RESOURCE REQUIREMENTS

Resource requirements for the 60 MW wind farm are provided in the subsequent sections.

2.5.1 Manpower requirement and facilities

To be provided in detail in ***Section 3*** of this report.

2.5.2 Water requirement

Construction Phase

During construction, water will be required for construction activities, domestic purposes and some drinking water for labourers and Project teams. For construction it is anticipated that 170 L of water would be needed for each m^3 of concrete. As the Project anticipates 180 m^3 concrete for the site, a total of 30,600 L of water per foundation would be required for construction activities. This water is being sources through tankers provided by neighbouring villagers. Reportedly, the original source of the water is groundwater or surface water bodies.

At the peak of construction, approximately 100 people would be anticipated in the site at any given point. Assuming an average of 3L of water per person, a total of 300 L of drinking water would be required per person per day at the maximum. Drinking water would also be sourced from nearby villages.

Table 2.6 Water requirement during construction phase

S.N.	Area	Approximate Quantity	Source
1.	Construction activities	30,600 L per foundation	Tanker Water
2.	Domestic water requirement	10,000 to 12,000 L per day	Tanker Water
3.	Potable water	300 L max./day	Tanker Water

Gamesa is obtaining the water requirement for the Project from nearby villages.

Operation Phase

Approximately 2-3 m^3/day of domestic water will be required during the O&M phase. The water will be sourced from nearby villages through tankers.

2.5.3 Raw Materials

Construction Phase

For the construction of WTGs including foundation and erection of poles for transmission lines, raw materials like steel, sand, stone and cement will be required. Sand and aggregated should be procured from government approved quarries and suppliers. Cement and steel can be supplied by local vendors.

Operation Phase

Raw material utilised during the operation phase will mainly include supplies for site staff and maintenance needs for the WTGs. The maintenance needs for the WTGs, including fuel, oil and spare parts, should be procured from nearby towns and the international market by the Gamesa procurement department.

2.5.4 Fuel Requirement and Storage

Construction Phase

The onsite fuel requirement during construction phase is being procured from nearby petrol pumps.

Operation Phase

Approximately 500 litres of oil per WTG will be required for five years for gearbox maintenance activities. Oil should be stored at designated areas with secondary containment.

2.5.5 Power Requirement

Construction Phase

Power requirement during the construction phase will be met through Diesel Generator (DG) sets. Three DG sets have already been procured for the Project – (i) 85 kVA for operation of batching plant, (ii) 20 kVA for welding activities by subcontractor and (iii) 15 kVA for site office. It was anticipated by the client that grid electricity would soon be made available for the stock yard and site office.

Operation Phase

The power requirement during the operation phase for the site office and WTG monitoring building will be provided by KPTCL. An emergency back-up 15 kVA DG set will be placed near the site office as well.

2.6 POLLUTION CONTROL MEASURES

2.6.1 Air Emissions

Construction Phase

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

- Fugitive emissions from site clearing, digging, filling, material handling, transportation, use of construction machinery, etc.;
- Fugitive dust emissions from unpaved roads;
- Dust emissions from batching plant;
- Vehicular emissions from increased traffic volume from vehicles used for transport of construction material; transportation of WTGs and accessories; and
- Emissions from operation of diesel generators.

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

Operation Phase

Under normal operations there will be no gaseous emissions from the operating areas.

There will be gaseous and fugitive dust emissions owing to plying of maintenance vehicles. It will be ensured that well maintained vehicles with proper PUC are used for maintenance purposes. DG sets deployed as back-up power, will emit a limited amount of gaseous pollutants into the ambient air.

2.6.2 Wastewater Management

Construction Phase

The liquid effluents generated during the construction phase will include domestic sewage from labour camp operation. As part of the site preparation stage, a drainage and sewage system should be constructed for the camp. The sewerage system should consist of soak pits for the collection of waste water from the labour camp kitchen and washing area. Sewage from the toilets should go into septic tanks. Sewage disposal trucks should be used to periodically remove the sludge/sewage from the site.

Operation Phase

The operational phase will have negligible wastewater generation at site office. Septic tank and soak pits will be provided at the site office for disposal of sewage.

2.6.3 *Solid & Hazardous Waste Management*

Construction Phase

The solid waste generated by the Project will consist of labour camp waste, garbage waste, metal scrap and excess construction materials. The main types of waste that will be generated and sources are shown in the table below:

Table 2.7 Waste generated; their sources and disposal method

S. No	Waste Type	Source	Estimated quantity	Method of disposal
Non-hazardous waste				
1.	Domestic solid waste	Labour activities	~5-6 kg/day	Waste will be segregated onsite and will be disposed of at site as approved by local authority.
2.	Construction debris (excavated Earth)	Construction of WTG, access road, storage yard etc.	0.5 – 1.0 tonnes/day	Excavated materials to be used for backfilling and levelling and other debris shall be used for road construction.
3.	Packaging waste containing word, cardboard and other recyclables.	Packaging material for WTGs and accessories.	~ 10 kg/WTG	Return back to the supplier.
4.	Sludge from Septic Tank	Labour Camp	~ 4-5 kg/month	Collected and disposed off through contractors.
5.	All non-recyclables waste	Construction activities and labour camps.	5-10 kg/day	Collected and disposed off by the contractor at designated landfill sites.
Hazardous waste				
1.	Used oil/waste oil	DG set, construction machinery	5-10 ltr/month	Collected and disposed off through approved recyclers in accordance to Hazardous Waste Rules, 2008.
2.	Oil contaminated rags	Cleaning activities	1-2 kg/month	Collected and disposed off through approved vendors in accordance to Hazardous Waste Rules, 2016

Operation Phase

- During operation phase, the waste generated from the Project will include domestic waste at site office, scrap materials like scrap tools, damaged

PPEs etc. and hazardous waste like waste oil, lubricants, oil contaminated rags, damaged batteries and waste oil filter;
- Sewage will be disposed through a combination of septic tanks and soak pits;
- The hazardous wastes will be stored temporarily onsite at separate designated covered area provided with impervious flooring. The storage containers/bins/drum will be clearly marked and identified for their hazards. From site hazards waste materials will be sent to central store for disposal;
- The hazardous wastes will be disposed of in accordance to Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016; and
- Non-recyclable material will be collected, segregated onsite and handed over to local Municipal Corporation for disposal.

2.6.4 Noise Control

Construction Phase

Noise emissions generated from DG sets to be used for emergency power supply will be minimized through provision of acoustic enclosures. Noise generating activities will be restricted to day time only. Workers near noise generating machines will be provided with ear plugs as safeguard against high noise hazards.

Operation Phase

Wind turbines produce noise when operating. The noise is generated primarily from mechanical and aerodynamic sources. Mechanical noise may be generated by machinery in the nacelle of the wind turbines. Aerodynamic noise emanated from the movement of air around the turbine blades, therefore turbine designs which allow lower rotational speeds in higher winds will limit the amount of noise generated.

2.6.5 Fire Safety and Security

Construction Phase

Appropriate firefighting system and equipment shall be provided throughout the construction period. The fire extinguishers will be placed at all strategic locations such as camp site, batching plant, site office, storage yard, heavy construction machinery etc. Besides this, emergency contact numbers will also be displayed onsite.

Operation Phase

Structural Fire Protection

Wind Turbines comprise predominantly non-flammable materials. Most components of the WTGs are predominantly metal. The only inflammable components are rotor blades and the panelling of the machine house, which

are made from fibre glass, electric cables and electrical components, gear box, transformer and hydraulic oils, hoses and other plastic components. It is difficult for a fire to spread from the transformer station to the wind turbine or vice versa.

Fire prevention

The service personnel will take all appropriate measures to prevent fires, Lightening protection system will be based on lightening protection zone concept and in accordance to IEC 61400-24, 62305-1, 3, 4 and DIN EN 50164-1,2. A lightning strike as a cause of fire has been therefore excluded.

Fire extinguishers

One portable dry chemical powder fire extinguisher (Category C) will be maintained at each WTG. These extinguishers are meant for immediate fighting of fire in early stages.

2.7 PROJECT ORGANIZATION STRUCTURE

2.7.1 Project Proponent

The Batkurki Project is overseen by a management team of ReNew at the corporate level at Delhi and an onsite team at the Project site.

2.7.2 Engineering, Procurement and Construction (EPC) Contractor

ReNew has signed an agreement with Gamesa for the responsibility of engineering, procurement, supply, construction, installation and commissioning of the WTGs.

2.7.3 Operation & Maintenance Contractor

Gamesa will be responsible for operation and maintenance activities at the Batkurki Site. Their responsibilities include:

- *Operations:* Provide onsite monitoring and operations of the WTGs;
- *Maintenance:* Onsite maintenance and service for WTGs, supply of spare parts, maintenance of spares, consumables and tools, provision of crane for maintenance, disposal of solid waste.

3 LAND REQUIREMENT AND PROCUREMENT PROCESS

Land for the wind power project is required for the following components;

- Wind Turbine Generators (WTGs);
- RoW for transmission lines – internal and external;
- Pooling Substation (PSS);
- Batching plant;
- Access Roads – internal and external
- Temporary Labour Camps; and
- Material Storage.

Land may also be required for the central monitoring station and other utilities like canteen etc. depending upon the need. The details of land requirement for the various components and the present status of the land procurement and process followed for the same is captured below.

3.1 LAND DETAILS

The available information on total land requirement for each of the project component, type of land, village from which land is procured, and the status of the land procurement is captured in ***Table 3.1.***

The developer – Gamesa has appointed two aggregators – Madhav Infra and Edison Power for procuring land for the project. The land aggregators are responsible for negotiating and procuring the identified land parcels. The land team working on site is reported to be comprised of 10 members (One from Renew and three each from Gamesa, Madhav Infra and Edison Power). The land purchase process for the project started in August 2016 with an original deadline for project commissioning by 31 March, 2017. Purchase of 29 out of the 30 proposed WTG locations has already been completed with negotiations for purchase of land parcel for the 30th WTG underway.

Table 3.1 Summary of the land required for the Project

S. N.	Project Component	Land Area (in acre)	Type of Land	Village	Status of procurement
1.	Wind Turbine Generators (WTGs) (30 WTGs x 2 MW)	99 acres (3.3 acres per WTG)	Private land	4 villages in Ramdurg taluk including; • Batkurki; • Soppadla; • Aneguddi; and • Chennapur	Purchase of 29 out of the 30 proposed WTG locations has already been completed with negotiations for purchase of land parcel for the 30th WTG underway.

S. N.	Project Component	Land Area (in acre)	Type of Land	Village	Status of procurement
2.	Transmission Lines (In kms)	-	Private and Government land	Batkurki, Annegudi, Chennapur, Naganur, Oblapur, Salahalli, Panchegeru, Panchegao, Bidiki, Udapadi and Salapura.	• External transmission line (110 Kv): The total length of the external transmission line is 17 kms. RoW as well as construction (erection and stringing) of all the 66 towers has been completed; and • Internal transmission line (33 Kv): The total length of the internal transmission line is approximately 30 kms. Erection and stringing of more than 80 % of the 530 poles was already complete at the time of ERM site visit.
3.	Temporary Labour Camps	2 acres (3 labour camps)	Private land	-	There are 3 labour camps where migrant manpower engaged in the project-related construction activities reside – (a) one at the batching plant reportedly measuring 0.5 acres operated by Annie Constructions accommodating 15-20 labourers; (b) one measuring approx. 1 acre operated by PRV constructions that accommodates 10-12 labourers; and (c) the third measuring 0.5 acres operated by ABG that accommodates 15-20 labourers.
4.	Material Storage	8 acres	Private land	-	Land procured on lease basis for seven months (August 2016 – February 2017)
5.	Pooling Substation (PSS)	4.8 acres	Private land	-	Land already procured through direct purchase based on willing seller-willing buyer negotiations.
6.	Batching Plant	2 acres	-	-	Land procured on lease basis for a period of seven months (August 2016 – February 2017)
7.	Access Road	-	-	-	Information not available
Total		-	-	-	Information not available

Note: '-' has been used in the above table wherein information is not available.

3.1.1 Project related land procurement and specific issues

On the basis of the information available presently, some of the observations especially with respect to the project related land procurement are mentioned below.

Schedule V Area[1]

The project area does not fall under Schedule V area as defined in the Indian constitution.

Forest land

The WTG locations and PSS are being developed on private agricultural land. As reported, no forest land will be used for the project.

Tribal (Scheduled Tribe) land[2]

The land in the study area predominantly belongs to caste Hindus such as *Brahmins, Lingayats, Marathis* and *Reddys*. Some Scheduled Castes (SC) such as *Holer, Madar, Rajput, Chouhan, Rathore* and *Poddar,* Scheduled Tribes (ST) such as *Chamars, Balais, Malis, Lambani, Nayak* and *Valmiki* etc. and Muslims, mostly Sunni are also reported to inhabit the region.

Landlessness

Consultations with 2 land sellers from whom land for WTGs has been procured, land aggregators (Madhav Infra and Edison Power) engaged for land procurement by Gamesa and the local communities indicated that sale of land to the 60 MW Batkurki windfarm will not result in landlessness of land seller.

Encroachment

No encroachments were observed in any of the 30 land parcels for WTGs, the PSS land and in the RoW corridor for the 33 kV internal and 110 kV external transmission lines. Review of the ATS copies of the land parcels for the WTGs and consultations with the land aggregators confirm that the entire project-related land requirement has been sourced from private land owners.

1. In the Constitution of India, the expression "Scheduled Areas" means such areas as the President may by order declare to be Scheduled Areas. The criteria followed for declaring an area as Scheduled Area are preponderance of tribal population; compactness and reasonable size of the area; under-developed nature of the area; and marked disparity in economic standard of the people. These criteria are not spelt out in the Constitution of India but have become well established. (Source: Official website of the Ministry of Tribal Affairs (MoTA), Government of India (GoI). URL: http://tribal.nic.in/Content/DefinitionofScheduledAreasProfiles.aspx. Accessed on 27.08.2016.
2. Article 366 (25) of the Indian Constitution defines scheduled tribes as "such tribes or tribal communities or parts of or groups within such tribes or tribal communities as are deemed under Article 342 to be Scheduled Tribes for the purposes of this constitution". The criterion followed for specification of a community, as scheduled tribes are indications of primitive traits, distinctive culture, geographical isolation, shyness of contact with the community at large, and backwardness. This criterion is not spelt out in the Constitution but has become well established. Source: Official website of the Ministry of Tribal Affairs (MoTA), Government of India (GoI). URL: http://tribal.nic.in/Content/DefinitionpRrofiles.aspx. Accessed on 27.08.2016.

Common Property Resources (CPR)[1]

No CPRs were reported on any of the 30 land parcels for WTGs, the PSS land and in the RoW corridor for the 33 kV internal and 110 kV external transmission lines.

NOC from Panchayat

The State of Karnataka does not require wind power projects to take a NoC (No Objection Certificate) from the Gram Panchayat of the impacted villages prior to initiation of construction activities. However, the project has obtained a preliminary NOC from the Batkurki Gram Panchayat. It was further reported that the final NOC will only be issued by the concerned panchayat after the entire project land is converted into industrial category. The process is expected to take at least six months post the completion of purchase of all land parcels for the project.

Land use change

As indicated earlier, the project along with all its components is being set up on private land procured on a willing seller-willing buyer basis from individual farmers. All the land parcels are reported to be either under cultivation or are fallow land. Under such circumstances, the setting up of the wind power project will result in permanent land use change of the concerned land parcels from agriculture/ fallow to industrial category.

Mutation

The land is being purchased in the name of the EPC Contractor – Gamesa which will be later transferred to the name of the project proponent – Renew. The ownership of the land will be transferred after procurement of all the land parcels and project-related construction activities are complete. It was also reported that the mutation process of land will be undertaken once procurement of all the identified/ required land parcels is complete.

Karnataka Renewable Energy Policy 2014-2020

The state has a wind energy policy - the Karnataka Renewable Energy Policy 2014-2020 (Wind, Small Hydro, Biomass, Cogeneration and MSW)[2]*. Clauses relevant to the procurement of private land, allotment of government land and diversion of forest land mentioned in the policy are as follows;*

- **Clauses relating to private land:**

1. Common Property Resources (environmental) are natural resources owned and managed collectively by a community or society rather than individuals
2. Draft Karnataka Renewable Energy Policy 2014-2020 (Wind, Small Hydro, Biomass, Cogeneration and MSW). URL: http://kredlinfo.in/Policy/RE%20Policy%202014-20.pdf. Accessed on 27.08.2016.

- Clause 13: Land (b): If the required land is private land, Developer has to acquire the same directly from land owners by any mode of transfer. If it is on lease, the minimum period of lease shall be 30 years; and
- Clause 18: Policy initiatives under consideration of GoK to promote renewable power projects (Land):Necessary amendments to section 79 (1), 79 (b) and 80 of the Karnataka Land Reforms Act are to be made to enable the Renewable Energy project developers to purchase suitable private land directly form the owners of the land.

- **Regarding Government land:**
  - If the required land belongs to Government, the Developer shall approach concerned Department, i.e., Revenue/ Forest or irrigation Department, as the case may be for obtaining the land on lease basis in favour of the company, as per the circular No: **RD 78 LPG 2009 dated 4.1.2011** and subsequent orders of Revenue Department. Revenue Department will directly lease the land to the company for a period of 30 years. At the end of 30 years, the lease shall be extended for 5 years at a time, subject to condition stipulated by Government.

- **Regarding Forest land:**
  - In case, the land belongs to Forest Department, Forest Department should issue facilitation letter as per the standard draft by MoEF, GoI, New Delhi vide letter No: **F.No: 11-113/ 2008 FC dated 30.12.2008** and subsequent orders.

Cultural heritage

During site visit, ERM team came across a Shiva temple in Aneguddi village that is located within 2 kms radius (core zone) of the project. The temple will not be impacted by the project. The temple was reported to be more than 400 years old (***Figure 3.1***). Consultations with local communities revealed that the temple was built by members of the 'Badami Chalukya'. The temple was built as a religious counter measure to appease lord Shiva and in the process bring to an end the natural disasters that had plagued the region. The small temple structure is surrounded by a broken boulder boundary and few stairs that lead to the temple entrance. The temple houses a Shivling, an idol of 'Nandi' – the sanctified bull which according to Hindu mythology serves as the mount or 'Vaahan' of lord Shiva and one sacred stone. The Shivling, idol of 'Nandi' and the sacred stone are only worshipped by a local priest in the Hindu holy month of 'Shravan'. It was also reported that the temple underwent major repair works in the year 1915. Review of information available on the internet indicates that the temple has not been recognized as a 'Cultural Heritage' site by the Archaeological Survey of India (ASI) or the Karnataka State Archaeological Department. The same was confirmed during the site visit as it was not earmarked by any signage of the concerned authorities.

Figure 3.1 Photographs of the Temple taken during ERM Site Visit

Source: ERM Site Visit on 23rd and 25th August, 2016

3.1.2 Land details and existing procurement status for specific components

The land requirement for the various components and the existing procurement status is captured below.

WTGs

Batkurki has 30 WTG locations and an area of approximately 3.3 acres is being procured by the client for each WTG location. Purchase of 29 out of the 30 land parcels has already been made with negotiations for purchase of land parcel for the 30th WTG underway.

Transmission lines

- External transmission line (110 kV): The total length of the external transmission line is 17 kms. RoW and construction (erection and stringing) for all the 66 towers has been completed; and
- Internal transmission line (33 kV): The total length of the internal transmission line is estimated to be approximately 30 kms. Construction of more than 80 % of the 530 poles was reported to have been complete at the time of ERM site visit.

Regarding compensation, it was reported that a mutually agreed one-time compensation amount for RoW was being paid to land owners. It was informed that typically the compensation payment for SPSC pole and SPDC pole ranges from Rs. 6,000 to Rs. 10,000. Similarly, the compensation paid to landowners for erecting a DCTL tower was reported to be in the range of Rs. 40,000 to Rs. 50,000. The compensation amount as indicated earlier is mutually negotiated between the land owner and the representative of the sub-contractor and is dependent on the distance of the land parcel from the nearest access road, no. of poles being installed on a single land parcel etc.

For detailed E & S impact of the 33 kV internal and 110 kV external transmission lines of 60 MW Batkurki wind farm project, kindly refer to the Addendum E & S Assessment Report dated 01 March, 2017.

Temporary Labour Camps

3 temporary labour camps have been set up namely by Annie Construction, ABG and PVR to accommodate approximately 35-40 migrant workers each. The combined land measuring 2 acres for all the three labour camps has been obtained on lease from three local villagers for a period ranging from 7-9 months.

- The camp accommodating nearly 15-20 labourers of Annie Construction has been developed on land measuring approximately 0.5 acres within the batching plant area. The land has been leased from a local villager for a period of seven months (August 2016 – February 2017);
- Similarly, the labour camps of PRV and ABG are built on leased land parcels measuring approximately 1 and 0.5 acres respectively. The land for the two camps has been leased from local farmers for duration of seven and nine months respectively.

Box 3.1 Site assessment of labour camps

- Arrangement of water for drinking and domestic purposes in all the three labour camps was observed to be adequate. It was reported that one water tanker per day was being used to supply water to each labour camp. The supplied water in turn was being stored in storage tanks of varying capacities.
- However, other amenities provided to the migrant workers in the labour camp were not observed to be in complete compliance to the PS 2 of the IFC.
- Observations concerning the good practices as well as the non-conformance as indicated above with respect to PS 2 have been communicated to ReNew.

Source: ERM Site Visit on 23rd and 25th August, 2016

Material storage

Gamesa has procured a land measuring 8 acres on lease basis for material storage for a period of seven months (August 2016 – February 2017). The project office of the developer is also located on the same land parcel.

Pooling Substation (PSS)

Gamesa has procured a land measuring 4.8 acres through direct purchase based on willing seller-willing buyer negotiations. During the site visit, project-related construction activities at the Pooling Substation were observed to be nearing completion.

Access roads

The details of the extent and type (private and government) of land required for access roads could not be obtained. However, it was informed by the site team of Renew that preliminary assessment indicates that 1 acre of land per WTG will be used for developing access roads.

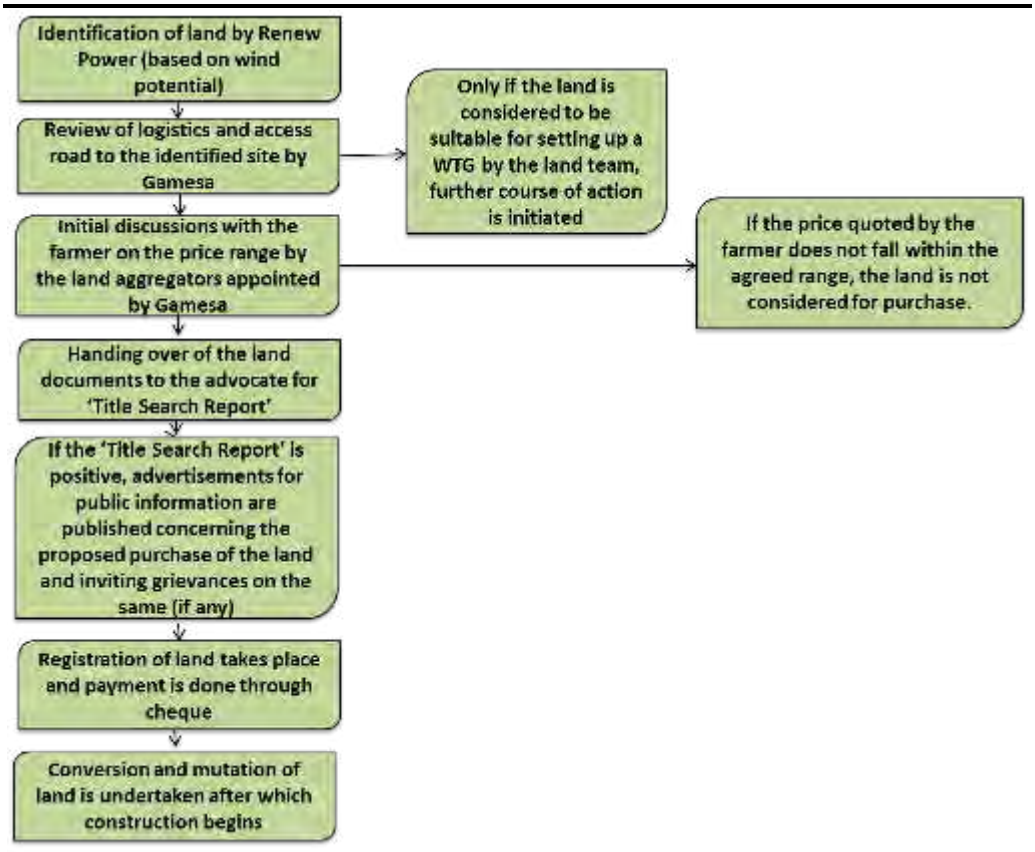
Batching plant

Gamesa has procured a land measuring 2 acres on lease basis for setting up its batching plant from a local farmer for a period of seven months (August 2016 – February 2017).

3.1.3 Land Purchase Process

As indicated earlier, land for the project is reported to be procured by Gamesa through two land aggregators Madhav Infra and Edison Power. The procedure adopted for land procurement was discussed in detail with representatives of Gamesa and Renew. Consultations were held with the land aggregators and two farmers from whom land has been purchased. It was reported by the land aggregators that private land was being purchased through willing seller – willing buyer negotiations. Farmer consultations revealed that adequate and fair compensation against purchase of land parcels was offered by the EPC contractor and that the same was significantly higher than the prevailing circle rate of land in the region. Similarly, replacement cost against loss of trees and compensation for crop loss was also reported to have been paid to the landowners at the time of land purchase. Sample ATS copies have also been shared by Renew for review. Based on the review of the same and an analysis of prevailing circle rate and farmer consultations, it can be concluded that the project has complied with the ADB SPS requirements for negotiated land settlement.

Figure 3.2 Land purchase process



Source: Consultations held with Gamesa and ReNew during ERM Site Visit on 23rd and 25th August, 2016

Market rate

It was reported by Gamesa that farmers are being paid a much higher rate for the land being purchased than the existing circle/ market rate. The same was confirmed through review of sample sale deeds shared by ReNew and through consultations with land sellers undertaken by the ERM team during the site visit. The prevailing government land rates for the region enquired with a retired government employee at the Ramdurg taluk office varied from Rs. 3,000,00 per ha (Rs.1,24,480 per acre) for unirrigated land to Rs. 10,000,00 per ha (Rs. 4,14,937 per acre). No sale deed could be made available for review. Consequently, rates for purchase of land provided by other wind farm developers in the area could not be confirmed.

Grievance redressal process and stakeholder engagement

Gamesa does not have a formal grievance redressal mechanism to address the concerns of the land sellers and local community. However, it was not clear whether they propose to set up a system for the project in the future. Similarly, no systematic process for stakeholder engagement is being followed at site. Stakeholders in the form of landowners, local youth, government officials are being engaged in a need-based manner.

4 APPLICABLE LEGAL AND REGULATORY FRAMEWORK

4.1 INTRODUCTION

This section provides legal and regulatory framework along with Institutional framework for the Project, covering national requirements as well as applicable international treaties and conventions, guidelines and standards. The intent of this section is to lay out the regulatory and non-regulatory performance requirements for all stages of the Project. The section broadly focuses on:

- Institutional Framework for the implementation of the regulations; and
- Applicable national and international Environmental Standards.

Approval from various regulatory agencies authorized by the Central and State Governments, in the form of Licenses, Permits, or Authorizations, are required for the establishment and operation of proposed Project.

4.2 INSTITUTION FRAMEWORK – ENFORCEMENT ACTIVITIES

A brief description of the relevant enforcement agencies with respect to the institutional framework is described in the following ***Table 4.1.***

Table 4.1 ***Enforcement agencies relevant to the Project***

Agency	Functions	Relevance and Applicability to the Project
Central Level		
Ministry of New and Renewable Energy (MNRE)	The Ministry of New and Renewable Energy (MNRE) is the nodal Ministry of the Government of India for all matters relating to renewable energy. The Ministry facilitates research, design, development, manufacture and deployment of new and renewable energy systems/devices for transportation, portable and stationary applications in rural, urban, industrial and commercial sectors.	Project will be developed based on MNRE guidelines

Agency	Functions	Relevance and Applicability to the Project
National Green Tribunal	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 Environmental Protection Act, 1986; • The Public Liability Insurance Act,1991; and • The Biological Diversity Act, 2002. The Act provides 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 of up to 3 years or fine up to Rs. 10 crores or both and an additional fine of Rs. 25,000 per day for any delay which may be further increased to one lac per day.

Agency	Functions	Relevance and Applicability to the Project
Central Electrical Authority (CEA)	The Central Electricity Authority (CEA) is a statutory organisation constituted under Section 3 of the repealed Electricity (Supply) Act, 1948, herein after replaced by the Electricity Act, 2003. Some of the functions performed by CEA include the following: • Advise the Central Government on the matters relating to the national electricity policy, formulate short-term and perspective plans for development of the electricity system and coordinate activities of the planning agencies for the optimal utilization of resources to sub-serve the interests of the national economy and to provide reliable and affordable electricity to all consumers; • Specify the technical and safety standards for construction of electrical plants, electric lines and connectivity to the grid; • Specify the safety requirements for construction, operation and maintenance of electrical plants and lines; • Advise any State Government licenses or the generating companies on such matters which shall enable them to operate and maintain the electricity system under their ownership or control in an improved manner and where necessary, in coordination with any other Government license or the generating company owning or having the control of another electricity system etc.	Project will be developed based on technical standards for CEA for electrical lines and grid connectivity.
State level		

Agency	Functions	Relevance and Applicability to the Project
Karnataka Renewable Energy Department Ltd. (KREDL)	The main objectives of the KREDL is: • Development, propagation and promotion of Renewable Energy sources and technologies; • Development of eco-friendly Projects and harnessing of natural resources to avail green power; • Acceleration of identification, development and implementation of new Renewable Energy Projects; • Encourage the industries, in addition to sugar industry, with cogeneration potential to set up co-gen plants expeditiously; • Provision of 'single window' service for technical consultation, sources of finance and Project clearance; • Decentralized and micro level power generation through renewable energy sources to provide energy supply to agriculture, industry, commercial and household sector; • Creation of suitable environment for private sector participation in Renewable Energy Power Generation; • R & D, Publicity and Popularization of Renewable Energy; • To establish linkages with national and international institutions for active collaboration in development, demonstration and commercialization of new and emerging renewable energy technologies; and • To take concrete steps for Energy Conservation and Energy Efficiency and Clean Development Mechanism (CDM).	Project should be developed based on the "Karnataka Renewable Energy 2009-2014" as amended.
Karnataka Power Transmission Company Limited (KPTCL)	KPTCL is currently responsible for overseeing the transmission infrastructure within the state,	Project needs to obtain necessary permission from KPTCL for grid connectivity.

Agency	Functions	Relevance and Applicability to the Project
Karnataka State Pollution Control Board (KSPCB)	The KSPCB is a statutory authority entrusted to implement environmental laws and regulations within the state of Karnataka, India. The board ensures proper implementation of statuses, judicial and legislative procurements related to environmental protection within Karnataka	The Project would generate used oil from DG sets and WTG maintenance. Authorization needs to be obtained under Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 for the same. As per Central Pollution Control Board's (CPCB) recent notification dated March 7th, 2016 vide No. B-29012/ESS (CPA)/2015-16 for modified directions under Section 18 (1) (b) of the Water (Prevention & Control of Pollution) Act, 1974 and Air (Prevention & Control of Pollution) Act, 1981, regarding harmonization of classification of industrial sectors under red/orange/green/white categories. Industrial sectors having Pollution Index scores inclusive and up to 20, will fall under the White Category projects. Wind projects have been categorized as White Category. It has been mentioned in the notification that there shall be no necessity of obtaining CTO for White Category industries. Intimation to KPCB shall suffice for the Batkurki Project.
Gram Panchayats	The local Panchayats are empowered with management of local resources like forests, groundwater, common land and infrastructure like roads, buildings etc.	Panchayats are empowered to levy and collect local taxes on land, property and provisioning of facilities.
State Labour Department	The Department of Labour is responsible for formulation, implementation and enforcement of the labour laws in the Karnataka state. It also undertakes prevention and settlement of industrial disputes, Industrial safety, and health and promotes welfare of workers in the undertakings within the sphere of the State.	Workmen to be involved during the construction phase and a few in the operation, should be provided with wages and other facilities with state as well as local labour laws and acts.

Agency	Functions	Relevance and Applicability to the Project
Directorate Industrial Safety and Health Department (DISH).	The Directorate of Industrial Safety and Health Department enforces the provisions of Factories Act 1948 and Karnataka Factories rule 1969 and the rules made there under to ensure safety health and welfare of the workers. It also plays a significant role in regularizing working hours, and working conditions and reducing the accident and dangerous occurrences in the factories, redressal of the grievances of the workers in respect of Safety Health and Welfare through a set of policies developed by both the Central and State Govt. Some of the functions of DISH are: •Elimination inequality and discrimination in the work place; •Enhancing occupational health and safety awareness and compliance in the workplace; •Workforce and community participation, to employers, employees, workplaces, communities, businesses and unions; and •Providing policy advice and analysis to government on labour and employment related matters.	Projects needs to comply with different rules under jurisdiction of DISH.
Other institutions		
National institute of wind energy (NIWE)	NIWE 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 provides services such as: • R & D for wind turbine technologies; • Identification of wind resource rich regions in the country; • Testing of complete Wind Turbine Generator Systems (WTGS) according to international standards (IEC) and Type Approval Scheme (TAPS-2000); and • Provisional Type Certification of Wind Turbines as per the Indian Certification Scheme.	Project will be developed based on technical standards of WTGs specified by NIWE.

4.3 *APPLICABLE REGULATORY/POLICY FRAMEWORK*

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

4.4 APPLICABLE ENVIRONMENTAL STANDARDS

4.4.1 National Level Standards

Taking provision of EPA, 1986, the Central Pollution Control Board (CPCB) has stipulated different environmental standards w.r.t ambient air quality, noise quality, water and waste water for the country as a whole. Following standards are applicable for the Projects and need to be complied with during the Project life cycle.

- National Ambient Air Quality Standards (NAAQ Standards), as prescribed by MoEFCC vide, *Gazette Notification dated 16th November, 2009;*
- Drinking water quality – Indian Drinking Water Standard (IS 10500: 2012);
- General standards for discharge as prescribed under the Environment Protection Rules, 1986 and amendments (G.S.R 422 (E) dated 19.05.1993 and G.S.R 801 (E) dated 31.12.1993 issued under the provisions of E (P) Act 1986);
- Noise standards specified by the MoEF vide gazette notification dated 14th February, 2000 (Noise Pollution (Regulation and control) Rules, 2000); and
- Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.

4.4.2 IFC/WB Standards

The General EHS Guidelines (30th April 2007) of IFC/WB have outlined following environmental standards which needs to be compiled for the Project.

- IFC/WB Air Emissions and Ambient Air Quality Standards;
- IFC/WB Guidelines for treated sanitary sewage discharges;
- IFC/WB Noise Standards

Table 4.2 Applicable Environmental and Social Legislative framework for Batkurki Wind Farm

Applicable Indian Legislation/Guidelines	Pre-construction	Construction	Operation	Decommissioning	Agency responsible	Remark/status
Land Purchase						
Karnataka Land Revenue Act, 1964, as amended	√	√	X	X	District Collector and Revenue Department	Land procurement is under process for the Project and it is understood that only private agricultural land will be obtained. Land procurement details have been provided in ***Section 2.5***. The applicability of these regulations has been covered in the process.
Environment Protection						
Environment Protection Act, 1986 as amended	X	√	√	√	KSPCB CPCB MoEFCC	Permissible limits for ambient air quality, water quality, noise limits has been laid down by CPCB under EP Act, 1986 which required to be compiled with.
The Water (Prevention and Control of Pollution) Act, 1974, as amended.	X	√	√	X	KSPCB	Project would be required to obtain Consent to Establish (CTE) and Consent to Operate (CTO) prior to the construction and operation phase respectively. CPCB has introduced a new category of Industries (White Category) in their March 7th, 2016 notification. The list of industries that falls under this category, including wind power projects, no longer requires a CTO. In such a case, intimation to SPCB shall suffice. Karnataka State Pollution Control Board has accepted the new notification as part of their consent management process (1) and do not require CTE and CTO for white category industries. ReNew has however, already applied for a CTE and will apply for a CTO as part of their lender requirements.
The Air (Prevention and Control of Pollution) Act, 1981, as amended.	X	√	√	X	KSPCB	
The Noise (Regulation and Control) Rules, 2000	X	√	√	√	KSPCB	Ambient noise levels are to be maintained as stipulated in the rules for different categories of areas – residential, commercial, industrial and silence zones. ReNew will need to abide by the limits prescribed for residential zones.
Storage of hazardous chemicals						

(1) http://kspcb.gov.in/applyConsent.html

Applicable Indian Legislation/Guidelines	Pre-construction	Construction	Operation	Decommissioning	Agency responsible	Remark/status
Manufacture, storage and import of hazardous chemicals (MSIHC) Rules, 1989 and as amended	X	√	√	X	KSPCB	Rules will be applicable during construction and operation stages if chemicals stored at site satisfy the criteria laid down in the Rules
Handling of Hazardous Waste						
Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016	X	√	√	√	KSPCB	Generation of waste oil and transformer oil at site attracts the provisions of Hazardous and Other Wastes Rules, 2016. The rules provide guidelines for the disposal and treatment of these wastes through approved recyclers.
Labour and Working Conditions						

Applicable Indian Legislation/Guidelines	Pre-construction	Construction	Operation	Decommissioning	Agency responsible	Remark/status
The Factories Act, 1948 and the Karnataka Factories Rule, 1969: • Building and Other Construction Workers (Regulation of Employment and Conditions of Service), Act, 1996; • Inter-state Migrant Workmen (Regulation of Employment and Condition of Service) Act, 1979; • Contract Labour Act, 1970; • Child Labour (Prohibition and Regulation) Act, 1986; • Bonded Labour Systems (Abolition) Act, 1976; • Minimum Wages Act, 1948; • Equal Remuneration Act, 1976; • Workmen's Compensation Act, 1923; and • Maternity Benefit Act, 1961.	X	√	√	√	Deputy Chief Inspector of Factories	Project proponent will need to comply to all requirements of factories rules and participate in periodic inspection during the Operations Phase.

Applicable Indian Legislation/Guidelines	Pre-construction	Construction	Operation	Decommissioning	Agency responsible	Remark/status
Companies Act, 2013.	X	X	√	X	ReNew	According to Schedule 135 sub-section 1, the companies meeting the threshold criteria specified should spend in every financial year, at least 2% of the average net profits of the company made during the three immediately preceding financial years, in pursuance of CSR Policy. The Project will need to comply with the requirements as stated in the law, if it attracts provision under the above mentioned schedule.
Applicable International Conventions						
Conventions on the Conservation of Migratory Species of Wild Animals and Migratory Species.	√	√	√	√	State Forest Department	Migratory birds in the Project area bear protection from killing under Convention of Migratory Species (CMS) to which India is a signatory. Wetlands being utilized by these species are also protected under this convention.
Kyoto Protocol: The 3rd Conference of the Parties to the Framework Convention on Climate Change (FCCC) in Kyoto in December 1997 introduced the Clean Development Mechanism (CDM) as a new concept for voluntary green-house gas emission reduction agreements.	√	√	√	√	NATCOM	The proposed Project being a wind power generation Project becomes the basis for qualifying for the Clean Development Mechanism
IFC/World Bank Guidelines						
IFC Performance Standards	√	√	√	√	IFC, Equator Principles Financing Institutions (EPFIs)	The ESIA report has to be prepared on lines of the IFC Performance Standards (2012).
IFC/WB General EHS Guidelines	X	√	√	√	IFC, EPFIs	During the construction, operation and decommissioning of the site, these guidelines will need to be followed
IFC Guidelines for Power Transmission and Distribution	X	√	√	√		

Applicable Indian Legislation/Guidelines	Pre-construction	Construction	Operation	Decommissioning	Agency responsible	Remark/status
IFC Guidelines for Wind Energy Projects	X	√	√	√		
IFC Guidelines on Worker Accommodation	X	√	√	√		During the construction stage of the Project, these guidelines will need to be followed.

4.5 INTERNATIONAL STANDARDS

4.5.1 IFC Performance Standards

IFC applies the Performance Standards (1) to manage social and environmental risks and impacts and to enhance development opportunities in its private sector financing to its member countries eligible for financing. The Performance Standards may also be applied by other financial institutions choosing to support them in the proposed Project. These performance standards and guidelines ***(Box 4.1***) provide ways and means to identify impacts and affected stakeholders and lay down processes for management and mitigation of adverse impacts.

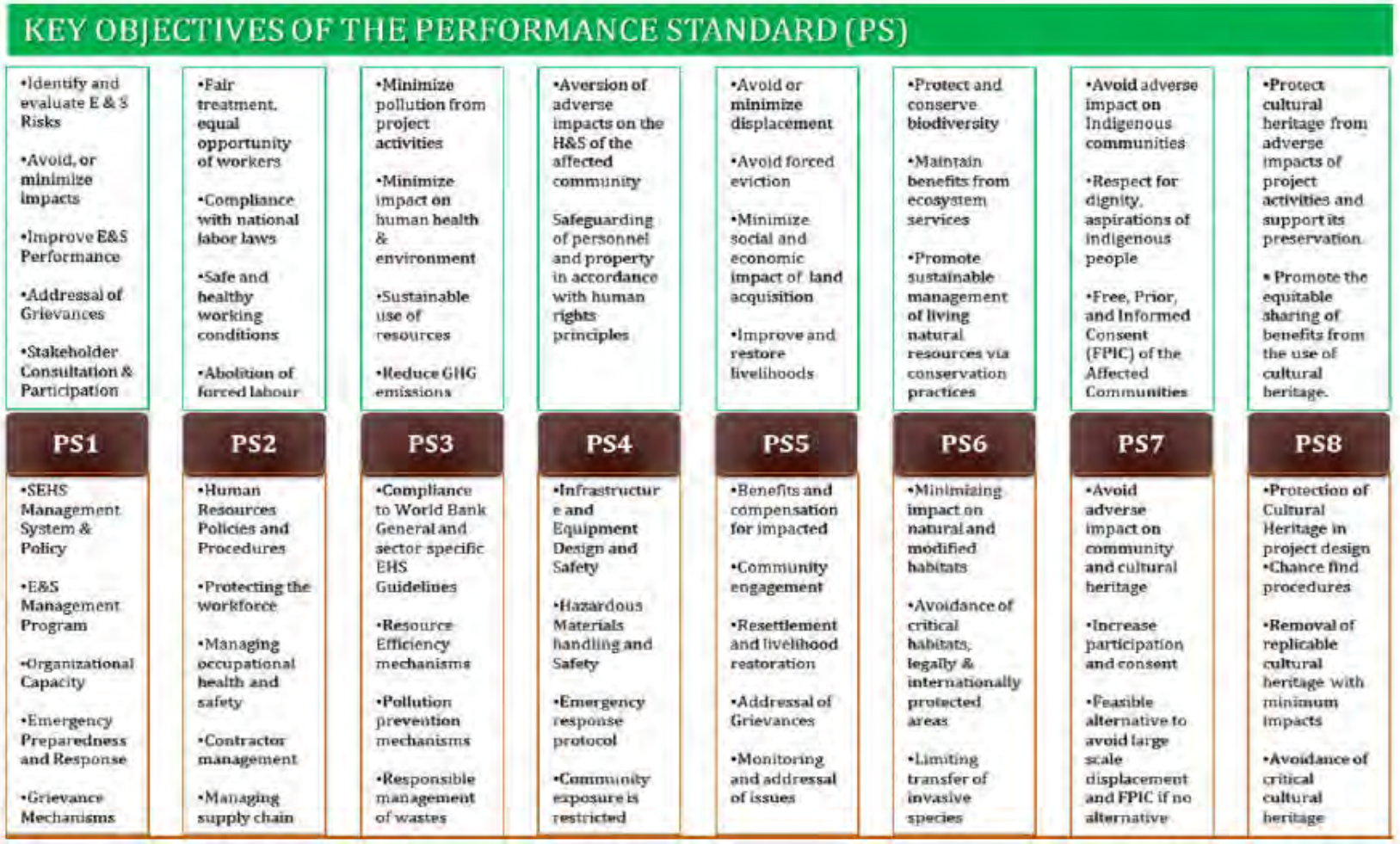
Together, the eight Performance Standards establish standards that the Client is required to meet throughout the life of an investment by IFC or other relevant financial institutions.

- Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts;
- Performance Standard 2: Labour and Working Conditions;
- Performance Standard 3: Resource Efficiency and Pollution Prevention;
- Performance Standard 4: Community Health, Safety and Security;
- Performance Standard 5: Land Acquisition and Involuntary Resettlement;
- Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources;
- Performance Standard 7: Indigenous People; and
- Performance Standard 8: Cultural Heritage.

In addition, during the construction, operation and eventual decommissioning of the site, IFC Environmental, Health and Safety (EHS) Guidelines (2), IFC EHS Guidelines for Wind Energy (3), IFC EHS Guidelines for Power Transmission and Distribution (4) and EHS Guidelines for Toll roads (5) will be applicable to this Project.

(1) http://ifcext.ifc.org/ifcext/sustainability.nsf/Content/PerformanceStandards
(2)
http://www.ifc.org/wps/wcm/connect/554e8d80488658e4b76af76a6515bb18/Final%2B%2BGeneral%2BEHS%2BGuidelines.pdf?MOD=AJPERES
(3)
http://ifcext.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/gui_EHSGuidelines2007_WindEnergy/$FILE/Final+-+Wind+Energy.pdf
(4)
http://www.ifc.org/wps/wcm/connect/66b56e00488657eeb36af36a6515bb18/Final%2B%2BElectric%2BTransmission%2Band%2BDistribution.pdf?MOD=AJPERES&id=1323162154847
(5)
http://www.ifc.org/wps/wcm/connect/7e4c7f80488554d5b45cf66a6515bb18/Final%2B%2BToll%2BRoads.pdf?MOD=AJPERES&id=1323162564158

Box 4.1 Key requirements for performance standards



4.5.2 ADB Safeguard Policy Statement

In July 2009, ADB's Board of Directors approved the new Safety Policy statement (SPS) governing the environmental and social safeguards of ADB's operations [(1)]. The SPS builds upon ADB's previous safeguard policies on the Environment, Involuntary Resettlement, and Indigenous Peoples, and brings them into one consolidated policy framework with enhanced consistency and coherence, and more comprehensively addresses environmental and social impacts and risks. The SPS also provides a platform for participation by affected people and other stakeholders in the Project design and implementation.

ADB adopts a set of specific safeguard requirements that are required to address environmental and social impacts and risks:

- Safeguard Requirements 1: Environment;
- Safeguard Requirements 2: Involuntary Resettlement;
- Safeguard Requirements 3: Indigenous Peoples; and
- Safeguard Requirements 4: Special Requirements for Different Finance Modalities.

(1) http://www.adb.org/sites/default/files/institutional-document/32056/safeguard-policy-statement-june2009.pdf

5 SCREENING & SCOPING

At the initial stage of the ESIA process, preliminary information was provided to aid in the determination of what legal and other requirements apply to the Project. This step was conducted utilising a high level description of the Project and their associated facilities. The screening process involved the following:

- Reviewing of applicable regulatory framework for the Project;
- Reviewing of available Project related activities and their impacts on various components of environment;
- Collection and compilation of available secondary baseline data from different sources;
- Categorisation of Project as per IFC guidelines; and
- Categorization of Project as per ADB Safeguard Policy.

5.1 SCREENING METHODOLOGY

For the screening exercise, ERM undertook discussions with the Project team and a review of the documents available. The following sub sections provide an understanding of the methodology followed.

5.1.1 *Kick-off Meeting*

The ERM team had a brief kick-off meeting with the ReNew team prior to site reconnaissance visit. A discussion was also held with regard to the expectations from this assessment in terms of scope of work, deliverables, timeline and the methodology to be followed for the same.

5.1.2 *Document Review*

Desk based review of the relevant documents of the wind farm site and its surroundings were undertaken to have a clear understanding of the Project and their impacts. Further, review of the secondary information available on the project areas, the administrative block, the district and the state was undertaken to substantiate the primary data.

5.2 PROJECT CATEGORIZATION

5.2.1 Equator Principles and IFC

IFC's Environmental and Social Review Procedure Manual (1) has provided a provisional categorization tool for projects. The tool assigns an E&S category based on risk inherent to the particular sector, as well as on the likelihood of a development taking place and on what can be reasonably ascertained about the environmental and social characterization of the Project's likely geographical setting. The categories are defined as follows:

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

The proposed Project has been categorized as falling under **Category B** as per the guidelines.

5.2.2 ADB Safeguard Policy

ADB uses a classification system to reflect the significance of a project's potential environmental impacts. A project's category is determined by the category of its most environmentally sensitive component, including direct, indirect, cumulative and induced impacts in the project's area of influence. Each proposed project is scrutinized as to its type, location, scale and sensitivity and the magnitude of its potential environmental impacts. Projects are assigned to one of the following four categories:

1. **Category A**: a proposed project is classified as category A if it likely to have significant adverse environmental impacts that are irreversible, diverse or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment is required.
2. **Category B**: A proposed project is classified as category B if its potential adverse environmental impacts are less adverse that those of category A projects. These impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An initial environmental examination is required.
3. **Category C**: a proposed project is classified as category C if it is likely to have minimal or no adverse environmental impacts. No environmental

(1) Environmental and Social Review Procedures Manual: Environment, Social and Governance Department (2012): http://www.ifc.org/wps/wcm/connect/190d25804886582fb47ef66a6515bb18/ESRP%2BManual.pdf?MOD=AJPERES. Accessed on 06.09.2016.

assessment is required although environmental implications need to be reviewed.

4. **Category F1**: A proposed project is classified as category F1 if it involves investment of ADB funds to or through a F1.

The proposed Project has been categorized as falling under **Category B** as per the safeguard policy.

5.2.3 Category Justification

The IFC and ADB categories are similar in nature and therefore the selection of **Category B** is based on similar reasoning:

- **Potentially limited risks/impacts and reversible**: Environmental and social impacts of the Project are anticipated during the construction phase and will encompass changes in land-use, increased noise levels, changes in air quality, use and changes in water quality, impacts on terrestrial ecology, occupational health & safety, etc. Most of these impacts are limited to the wind farm components and their immediate vicinity and can be minimized through application of mitigation measures as proposed in the ESMP.

- **Unprecedented**: Development of wind farms is occurring in large numbers in the last decade and therefore several such projects are located across India. Karnataka Renewable Energy Development Ltd. has identified over 893 wind farms of varying capacities as per their latest wind farm project status report (1). A wind farm project can therefore not be considered an unprecedented activity.

- **Limited adverse impacts on the baseline**: Wind energy development is a non-polluting source of energy and thus is not likely to lead to any adverse impacts on the baseline environment during the operation phase. In terms of social impacts the land required is composed of private agricultural land. The 30 locations proposed for the Project doesn't involve any anticipated settlements and physical displacement. Impacts will be limited to access to land used for grazing and positive impacts on livelihood opportunities.

5.3 SCOPING METHODOLOGY

For this ESIA study, scoping has been undertaken to identify the potential Area of Influence for the project to identify potential interactions between the project and resources/receptors in the Area of Influence and the impacts that could result from these interactions, and to prioritize these impacts in terms of their likely significance. This stage is intended to ensure that the impact

(1) http://kredlinfo.in/wind/commissioned_status.pdf

assessment focuses on issues that are most important decision-making and stakeholder interest.

It is to be noted here that during the period of ESIA study, the project is in the planning phase and therefore, the scoping exercise includes all the phases of the projects, i.e., planning and pre-construction, construction, operation and maintenance and decommissioning into consideration.

The scoping exercise was undertaken on the basis of the information available on the project, the discussions with the project team and the prior understanding of ERM of wind power projects. Potential impacts have been identified through a systematic process whereby the features and activities (both planned and unplanned) associated with the operation and maintenance and decommissioning phases of the project have been considered with respect to their potential to interact with resources/ receptors. Potential impacts have each been classified in one of three categories:

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

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

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

The wind power project will involve key activities during its life cycle which will include planning and pre-construction, construction, operation and maintenance and decommissioning phases as detailed in ***Section 2*** of this report.

5.3.1 Scoping Matrix

All environmental and social impacts and risks described in IFC's Performance Standards, E&S Guidelines and ADB Safeguard Policies have been considered for the interaction matrix. The Potential Interactions Matrix for Project activities and likely impacted resources/ receptors is presented in ***Table 5.1***.

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

Interactions that are likely to lead to significant impacts are presented in ***Table 5.2*** and will be the focus of the impact assessment. Owing to site conditions there are certain possible interactions that will not take place. As a result these interactions have been "scoped out" and are presented in ***Table 5.3***

Table 5.1 Activity-Impact Interaction Matrix for Planning, Construction, Operation & Maintenance and Decommissioning Phases

Environmental and Social Resources/ Receptors / Project Activity	Land use	Topography and Drainage	Soil/Land Environment	Ambient Air Quality	Water Environment	Ambient Noise Quality	Terrestrial Ecology	Aquatic Flora/ Fauna	Occupational Health and Safety	Demography (Influx and Displacement	Local Economy and Employment	Natural /Common Property Resources	Land based Livelihoods	Community Health and Safety	Labour and Human Rights	Social Infrastructure and Services	Culture and heritage
Land procurement																	
Construction/strengthening of access road																	
Site clearance and preparation for WTG, PSS and EHV line																	
Establishment and operation of batching plant																	
Construction material transport and storage																	
Operation of DG set																	
Foundation excavation and construction for WTG, EHV towers																	
Transient storage of WTG components																	
Transportation of WTG component to site																	
Installation of WTGs, erection of EHV tower																	
Stringing of transmission line																	
Construction of pooling substation (PSS) and office building																	
Operation of all WTGs, PSS, Transmission line																	
Inspection/ maintenance work of WTGs, PSS																	
Operation and maintenance of ancillary facilities such as yards, stores, site office																	
Inspection, maintenance and operation of transmission lines																	
Inspection, maintenance and operation of intra-site pathways/access roads																	
Replace WTG parts with new ones																	

Environmental and Social Resources/ Receptors / Project Activity	Land use	Topography and Drainage	Soil/Land Environment	Ambient Air Quality	Water Environment	Ambient Noise Quality	Terrestrial Ecology	Aquatic Flora/ Fauna	Occupational Health and Safety	Demography (Influx and Displacement	Local Economy and Employment	Natural /Common Property Resources	Land based Livelihoods	Community Health and Safety	Labour and Human Rights	Social Infrastructure and Services	Culture and heritage
Demolition of building of ancillary facilities																	
Dismantling of WTG																	

= Represents "no" interactions is reasonably expected
= Represents interactions reasonably possible but none of the outcome will lead to significant impacts
= Represents interactions reasonably possible with one of the outcomes leading to potential significant impact

Table 5.2 Identified interactions that are likely to result in significant impacts

S. No	Interaction (between project activity and Resource/Receptor)	Justification for Expectation of Potentially Significant Impacts
1	Changes in Land Use	Only private agricultural land will be utilized for the Project and therefore there will be a change to non-agricultural purposes during the construction phase. The change will negatively affect the community but the addition of better maintained access roads may be considered a positive for local villages.
2	Alteration of Topography and drainage	Study area of the wind farm site exhibits flat land with undulation at some part of the area. Project activities (e.g., site development, construction of access roads) may lead to alteration of the topography and drainage of this area.
3	Impact on Soil / Land Environment	Vegetation clearance and construction can change the soil properties and negatively affect soil stability in the area. Large vehicle movement can compact or erode soil further. Improper waste disposal can contaminate soil and groundwater layers.
4	Impact on Air Quality	Operation of DG sets, vehicular movement and construction activities can increase air emissions in the area. The loss of tree cover because of site preparation can also contribute to a deterioration of air quality.
5	Impact on Water Environment	Construction and operation of the project will require water from local sources to carry out its activities. Surface and ground water can also be impacted due to improper waste disposal or leaks/spills and runoff.
6	Increased Ambient Noise Levels	Construction, operation of DG sets, vehicular movement, influx of demographics, maintenance activities and establishment of Project components would increase the ambient noise levels. Local communities may be disturbed due to higher than anticipated noise.
7	Impacts on Nearby Establishments (Shadow Flicker)	There are a several settlement areas within 500 m from the WTG locations which might experience shadow flicker. For these receptors the number of hours in a year they are likely to experience shadow flicker has been assessed.
8	Ecology	There are several small Reserve Forests located across the Project study area. The connectivity for these forest patches may be disturbed because of wind farm development and operation. Contamination of water and soil layers as well as vegetation clearance in the construction phase will also have an impact on local ecology. In the operation phase, the movement of the wind turbines could cause a collision risk to flying fauna and transmission lines pose an electrocution risk to perching birds.

S. No	Interaction (between project activity and Resource/Receptor)	Justification for Expectation of Potentially Significant Impacts
9	Occupational Health and Safety	Occupational health and safety hazards can include construction machinery, handling of electricals, noise pollution and dust pollution. In the case of spills/leaks there is a potential for fire hazards and some hazardous substances.
10	Local Economy and Employment	The Project will be providing opportunities to locals during the anticipated construction activities. Migrant labourers, contractors and subcontractors will also be staying in local villages and could provide an influx of money into local businesses. Wind farms tend to higher locals as security guards during the construction and operation phase. ReNew is also using water provided by neighbouring villages to improve the local economy.
11	Land Based Livelihoods	The land is identified for the Project is primarily private agricultural land. Loss of this land will therefore negatively impact persons dependent on agriculture for their livelihood.
12.	Community Health and Safety	Community health and safety hazards include noise pollution, increased traffic, dust pollution and any effects due to structural damage. In the case of spills/leaks, there is a potential for fire hazards and soil/water contamination.
12	Labour and Human Rights	Construction activities are expected to require considerable number of skilled and unskilled labour. The unskilled labour would be sourced from local villages and therefore attention needs to be made to minimum wages, child labour, worker compensation, working conditions, equal remuneration and health and safety policies (including provision of appropriate PPEs). For migrant workers, additionally, regulation of employment and condition of services needs to be monitored as per the pertaining act.

Table 5.3 Scoped-out Interactions

S. No	Impact Title	Reason for Scoping-Out
1	Cultural Heritage	There are no reported archaeological or heritage sites within 500 meters radius of the Project. Based on the site assessment, no local shrines, graveyards, mosques, other places of community worship or cultural attachment could be identified to be getting impacted. The consultations with local people also did not reveal any cultural significance of any natural landscape that would be modified in construction activities of the projects.
2	Demography (Influx and Displacement)	The projects will not result in any physical displacement of the local community. Also, since the labour for the construction phase will primarily be recruited from the local community, the influx of population in the study area due to the project is expected to be restricted to the skilled employees of ReNew and its contractors

S. No	Impact Title	Reason for Scoping-Out
3	Indigenous People	According to the Census records and consultations with the local community, the study areas do not report a significant presence of Scheduled Tribe population within the study area. No direct impacts on indigenous people are identified.

This section provides an analysis of alternatives in relation to both phases of the Project, particularly in regard with the Project conception and planning phase. This includes the following:

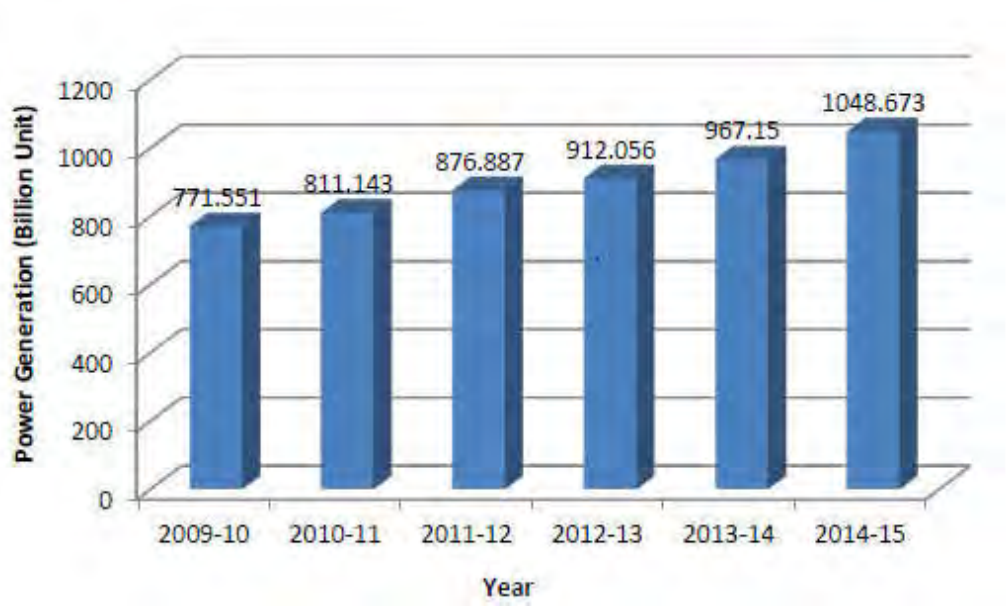
- No Project scenario;
- Alternative Site location during micro-siting of individual WTGs and associated facilities; and
- Alternative methods of power generation.

6.1 NO PROJECT SCENARIO

6.1.1 Power Scenario in India

The overall power generation in the country has been increased from 967.150 BU during 2013-14 to 1048.673 BU during the year 2014-15. Year wise power generation is depicted in ***Figure 6.1.*** The total installed capacity for power sector in India as on 30.04.2015 is provided in ***Table 6.1***.

Figure 6.1 ***Year-wise Power Generation from 2009-10 to 2014-15***



Source: http://powermin.nic.in/power-sector-glance-all-india

Table 6.1 ***Installed capacity***

Fuel	Installed Capacity (MW)	%
Coal	168,208	60.8
Gas	23,333	8.4
Oil	994	0.4
Hydro	41,997	15.2
Nuclear	5,780	2.1

Fuel	Installed Capacity (MW)	%
Renewable Energy Sources (Small Hydro Project, Biomass Gasifier, Biomass Power, Urban & Industrial Waste Power, Wind Energy)	36,471	13.2
Total	276,783	100

Source: *http://powermin.nic.in/power-sector-glance-all-india*

It is evident from the above table that in terms of the installed capacity, renewable energy sector ranks third after coal and hydropower.

6.1.2 *Status of Power in the State of Karnataka*

Electricity generation and distribution in Karnataka has a history of over 100 years with the operation of Asia's first hydroelectric generating station which was set up in Shivanasamudram in 1902. Currently, the main entity in the power sector is the State Owned Karnataka Power Corporation Ltc (KPCL) and the state-owned Karnataka Power Transmission Corporation Ltd (KPTCL) in power transmission.

During the period of 2015-16, Karnataka had an energy requirement of 70,294 MU but the available energy in the region was found to be only 59,065 MU. In terms of peak demand, Karnataka showed a demand of 10,911 MW and an availability of 8,119 MW [(1)] .Karnataka has been observed to experience the maximum energy shortage in the southern region of 5.2%. Karnataka has an anticipated energy 3,240 MW (4.6%) and an anticipated peak energy deficit availability of -1,247 (-11.2%). The detailed month wise power supply position (actual and anticipated) is shown in ***Table 6.2*** and ***Table 6.3*** below.

Table 6.2 Month-wise power supply position for 2015-16

Month	Peak				Energy			
	Demand	Availability	Surplus(+)/ Deficit(-)		Requirement	Availability	Surplus (+)/ Deficit(-)	
	(MW)	(MW)	(MW)	(%)	(MU)	(MU)	(MU)	(%)
Apr '15	10,336	8,119	-2,216	-21.4	6,344	5,448	-896	-14.1
May '15	9,647	8,104	-1,542	-16.0	5,670	5,596	-74	-1.3
Jun '15	9,645	7,390	-2,255	-23.4	5,597	4,893	-704	-12.6
Jul '15	9,227	7,188	-2,038	-22.1	5,629	4,817	-812	-14.4
Aug '15	9,190	7,332	-1,858	-20.2	5,504	4,955	-549	-10.0
Sep '15	9,410	7,129	-2,281	-24.2	5,400	4,681	-719	-13.3
Oct '15	9,169	6,695	-2,473	-27.0	5,423	4,558	-865	-15.9
Nov '15	9,536	6,876	-2,660	-27.9	5,676	4,550	-1,126	-19.8
Dec '15	9,926	6,989	-2,938	-29.6	6,019	4,779	-1,240	-20.6
Jan '16	10,116	7,176	-2,940	-29.1	6,322	5,025	-1,297	-20.5
Feb '16	10,425	7,146	-3,278	-31.4	5,972	4,690	-1,282	-21.5
Mar '16	10,911	7,236	-3,676	-33.7	6,738	5,072	-1,666	-24.7
Annual	**10,911**	**8,119**	**-2,792**	**-25.6**	**70, 294**	**59,065**	**-11,229**	**-16**

Source: *http://www.indiaenvironmentportal.org.in/files/file/lgbr_report.pdf*

(1) http://www.indiaenvironmentportal.org.in/files/file/lgbr_report.pdf

Table 6.3 Anticipated month-wise power supply position for 2016-17

Month	Peak				Energy			
	Demand	Availability	Surplus (+)/ Deficit (-)		Requirement	Availability	Surplus(+)/ Deficit (-)	
	(MW)	(MW)	(MW)	(%)	(MU)	(MU)	(MU)	(%)
Apr '16	10,362	8,363	-1,999	-19.3	6,304	5,436	-868	-13.8
May '16	9,681	8,459	-1,222	-12.6	5,618	5,687	69	1.2
Jun '16	9,619	8,646	-973	-10.1	5,610	5,630	20	0.3
Jul '16	9,342	9,175	-167	-1.8	5,630	6,242	612	10.9
Aug '16	9,218	9,265	48	0.5	5,555	6,274	719	12.9
Sep '16	9,565	8.801	-765	-8.0	5,303	5,751	448	8.4
Oct '16	9.465	8,935	-531	-5.6	5,493	6,060	567	10.3
Nov '16	9.392	8,974	-418	-4.5	5,497	5,898	401	7.3
Dec '16	9,787	9,150	-637	-6.5	5,830	6,226	396	6.8
Jan '17	10,030	9,747	-283	-2.8	6,147	6,800	653	10.6
Feb '17	10, 234	9,905	-330	-3.2	5,949	6,248	299	5
Mar '17	11, 152	9,708	-1,443	-12.9	6,845	6,769	-76	-1.1
Annual	**11,152**	**9,905**	**-1,247**	**-11.2**	**69,781**	**73,021**	**3,240**	**4.6**

Source: http://cea.nic.in/reports/annual/lgbr/lgbr-2016.pdf

6.2 ALTERNATIVE SITE LOCATION

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 for the Project was done by National Institute of Wind Energy (NIWE), based on which, potential areas are notified by NIWE. Hence, the option of choosing an alternative area is not available to the project developer.

6.2.1 *Alternative Locations for WTGs and Associated Facilities*

Within the potential area, there is a possibility as well as flexibility of moving the individual WTG locations (micro-siting) to avoid any potential environmental or social risks like:

- Complete landlessness of a landowner;
- 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.;
- Impacts on nearby residents due to the noise and shadow flickering generated due to the operation of WTGs; and
- Impacts on social sensitive receptors like schools, hospitals, human habitation, individual dwellings, irrigated water lands, government lands, common property resources etc.

The proposed wind power project site has the following location advantages:

- The Project is a pre-approved NIWE site;
- The Project is anticipated to be constructed entirely on private agricultural land;
- The Project does not have any major ecological concerns including eco-sensitive areas and rare, endangered or threatened species;
- The Project does not have any major social sensitivities including SC/ST populations and cultural heritage sites within 1 km of the proposed WTG locations; and
- All villages that could be affected by the movement of the wind turbine blades are located at least 400 m away and there are no stray residential buildings located closer than 500 m to the wind turbines.

6.3 *ALTERNATIVE METHOD OF POWER GENERATION*

Harnessing wind-energy is an eco-friendly process, with an inexhaustible wind resource and minimal environmental footprint. There are minimal fuel and water requirements for operational activities. Wind energy has a short development timeframe (gestation period) compared to most other forms of energy production. Only a brief lead time is required to design, install and start-up a wind plant (up to a maximum of 2 months after micro-siting, approvals and land purchase). ***Table 6.4*** elaborates upon the environmental advantages and disadvantages of various power generation systems.

Table 6.4 Advantage and disadvantages of power generation systems

System	Advantage	Disadvantage
Thermal Power	• Large-scale production potential; • Moderate gestation period; • Wider distribution potential.	• High fossil fuel requirements; • Large quantities of water required for cooling; • High volume emissions from operation; • Accumulation of fly ash (in case of coal powered installations); • Upstream impact from mining and oil exploration; • GHG emissions estimated as 228bCeq/kWh.
Hydropower	• GHG emission estimated as low as 1.1g Ceq/kWh for run of the river projects; • Do not create any waste by-products during conversion process; • Some hydropower facilities can quickly go from zero power to maximum output; • Because hydropower plants can generate power to the grid immediately, they provide essential back-up power during major electricity outages or disruptions.	• Site-specific, dependent on reservoir/river etc; • Long gestation period; • Alteration of river flow regime; • Adverse social; and • Ecological impacts due to inundation and downstream effects.

System	Advantage	Disadvantage
Nuclear Power	• GHG emissions are as low as 2.5gCeq/kWh; • Low fuel cost; • The production of electric energy is continuous. A nuclear power plant generates electricity for almost 90% of annual time. It reduces the price volatility compared to other fuels; • Do not emit smoke particles or gases.	• Availability of fuel source; • Hazards associated with radioactive material; • Disposal of waste is expensive, as wastes are radioactive in nature; • High cost of project; • Long gestation period; • Risk of fallout and meltdown scenarios and its impacts on the local populace and environment;
Solar Power	• Pollution levels are insignificant; • Inexpensive power generation; • Inexhaustible solar resource. GHG emissions are as low as 8.2gCeq/Kwh for the production chain.	• Large land requirement; • Site-specific, dependent on solar insolation; • Expensive installation.
Wind Power	• Pollution levels are insignificant; • Inexpensive power generation; • Inexhaustible wind resource; • GHG emissions as low as 2.5gCeq/kWh for the production chain.	• Large land requirement; • Site-specific, dependent on wind pattern; and • Expensive installation.

Source: International Atomic Energy Agency (IAEA).

6.3.1 *Greenhouse Gas Emissions*

As per the estimations of the International Atomic Energy Agency (IAEA), carbon emission (including CO2,CH4, N2O, etc.) per Gigawatt hour of electricity (CO2e/GWh) for wind energy projects is low and scores favourably when compared with other forms of conventional and non-conventional sources of energy. ***Table 6.5*** provides the greenhouse gas emissions (GHG) associated with each technology

Table 6.5 GHG Emissions from Different Electricity Production Chains

Technology	Mean tonnes (CO_2e/GWh)	Low tonnes (CO_2e/GWh)	High tonnes (CO_2e/GWh)
Lignite	1,054	790	1,372
Coal	888	756	1,310
Oil	733	547	935
Natural Gas	499	362	891
Solar PV	85	13	731
Biomass	45	10	101
Nuclear	29	2	130
Hydroelectric	26	2	237
Wind	26	26	124

Source: World Nuclear Association (WNA)

Considering various factors such as wind resources in potential project areas; favourable environmental and social settings; low GHG emissions across the project life cycle; land use and availability; governmental assistance; 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 in the state of Karnataka.

6.3.2 Water Consumption

Wind power projects use almost insignificant water quantities in comparison to nuclear and coal based power projects. Wind farms require small amounts of water to clean the wind turbine rotor blades in arid climates (where rainfall does not keep the blades clean).

According to the American Wind Energy Association (AWEA), wind power uses less than 1/600 as much water per unit of electricity produced compared to nuclear power, and approximated 1/500 as much as a coal power plant. (1)

6.3.3 Carbon Offsetting

Hydropower, solar and wind energy projects help in offsetting CO_2 emissions from conventional power generation. According to National Renewable Energy Laboratory, 1 MW of wind energy results in 2600 tons of CO_2 offsetting (2) . In the case of ReNew's Batkurki Project, 60MW can offset approximately 1,56,000 tons CO_2.

6.4 CONCLUSION

Based on the discussion above, it can be concluded that the proposed Project:

- Is eco-friendly with minimal GHG emissions; and
- Is the most feasible and preferred choice of power generation in the State.

(1) American Wind Energy Association estimate based on data obtained in personal communication with Brian Roach, Fluidyne Corp., December 13, 1996. Assumes 250 kW turbine operating at 0.25 capacity factor with blades washed four times annually.

(2)http://apps2.eere.energy.gov/wind/windexchange/pdfs/economic_development/2009/ma_wind_benefits_factsheet.pdf

7 ENVIRONMENTAL, ECOLOGY AND SOCIAL BASELINE

7.1 LOCATION AND CONTEXT SETTINGS

The Batkurki Wind Farm Site is located in Village Batkurki, Taluka Ramdurg and District Belgaum in the State of Karnataka, India. Belgaum District is located in northwest Karnataka and borders the states of Maharashtra and Goa along its western border. Belgaum District is bordered by Kolhapur and Sindhudurg districts in Maharashtra to its north and North Goa in the south west direction. Bijapur, Bagalkot, Gadag, Dharwar and Uttar Kannada districts of Karnataka borders Belgaum across its eastern and southern border (refer to ***Figure 1.2***)

The wind farm site is spread across four villages, namely, Batkurki in the north, Aneguddi in the south, Channapur to the east and Soppadla to the west.

7.2 AREA OF INFLUENCE

For the purpose of the baseline establishment and impact assessment, an Area of Influence (AoI) has been determined for the Project site. The subsequent sections provide an understanding of the AoI and reasons for its selection.

7.2.1 Study Area

The study area of the wind farm has been selected based on the location of the wind farm site and its footprint, nature and spatial distribution of potential social and environmental impacts (based on similar type of projects). The study area includes the Project Footprint Area and Area of Influence described below:

Project Footprint Area

The Project Footprint is the area that may reasonably be expected to be physically touched by Project activities, across all phases. Physically, there is no demarcation of fencing for the Project Site boundaries and hence it is contiguous with the rest of the area.

Area of Influence (AoI)

The effects of the Project activities on a particular resource or receptor will have spatial (distance) and temporal (time) dimensions. Some activities would impact a larger radius such as noise which would have more far reaching impacts than other identified impact sources. These activities would also vary across temporal scales with noise having a larger impact during night-time than in daytime. The spatial and temporal dimensions have therefore been taken into account to define a Project's Area of Influence.

Table 7.1 AoI for Environmental and Social Study

S. N.	Project Activity	Determined AoI	Justification
1.	Air Quality	500m	Dust emissions, fugitive dust, etc. is typically observed within 100-200m from the construction/operation area. A minimum of 500m AoI has been taken to capture all sources of these emissions including vehicular movement across access roads.
2.	Ambient Noise	500m	Noise can often be detected up to 400-500m from any operation.
3.	Land Environment	500m	Impacts on soil and land are often restricted to the Project footprint area. An AoI of 500m taken into account indirect effects from erosion and vehicular movement as well as any contamination that may have occurred.
4.	Socio-economic Conditions	5 km	An AoI of 5 km radius is considered for socio-economic consultations to determine perceived impacts due to the Project including employment opportunities, loss of livelihood (grazing and agricultural land) and increased anthropogenic/vehicular activity in remote areas.
5.	Ecology	5 km	An AoI of 5 km radius is considered for the ecological study. The 5 km radius provides an understanding of water body use and use of forested habitat around the wind farm. As several avifaunal and mammal species are known to traverse distances in excess of 5 km in a given day, all species sighted in a 5 km radius are considered likely to be impacted by the wind farm.

Core and Buffer Zones

The AoI defined above has been divided into a core and buffer zone:

- **Core Zone**: the core zone is defined as the radius extending from the Project footprint area which would have majority of the impacts (during mobilization, construction, operation and decommissioning phase); and
- **Buffer Zone**: the buffer zone is the remaining part of the Area of Influence which would have residual or indirect impacts from the Project activities.

Table 7.2 Core and Buffer Zones

Study	Core Zone	Buffer Zone
Environmental Study: air quality, ambient noise and land environment	500 m from WTGs	1 km from WTGs
Socio-economic Study	2 km from WTGs	5 km from WTGs
Ecology Study	500 m from WTGs	5 km from WTGs

7.3 ENVIRONMENTAL BASELINE MONITORING AND SURVEY

ERM undertook a site visit from 23rd to 25th August, 2016 to understand the site setting and environmental sensitivities within the study area. The site visit included a walkover of the site and associated facilities with the ReNew and Gamesa team. As part of the site visit, primary data was collected from sensitive areas and other places inside the study area and concerned government departments. The following subsections provide an understanding of the same.

7.3.1 *Collection of Primary Data*

Site reconnaissance, identification of sensitive receptors, rapid ecological surveys and consultations were conducted to collect information related to the physical environmental conditions, biological resources and socio-economic profile of the study area respectively.

The details of the sampling have been provided in ***Table 7.3.***

Table 7.3 ***Primary Baseline Data Collection***

S.N.	Environmental Attribute	Remarks
1.	Physical Environment	Visual assessment, ground truthing, consultations
1.	Socio-economic Status	Primary consultations were carried out in select villages across the study area.
2.	Flora and Fauna Survey	Ecological survey was undertaken to assess the biodiversity aspects of the study area.

7.3.2 *Collection of Secondary Baseline Data*

Secondary baseline data collection involved identifying and collecting existing published materials and documents. Information on various environment aspects (like geology, hydrology, hydrogeology, drainage pattern, meteorology, ecology, etc.) and socio-economic aspects were collected from different institutions, government offices and literatures, etc. Secondary data was collected for the aspects as given in ***Table 7.4.***

Table 7.4 ***Secondary Baseline Data Collection***

S. N.	Attribute	Source of Data Collection
1.	Meteorological Data	Indian Meteorological Department (IMD)
2.	Geology, geomorphology, hydrogeology and hydrology	Central Ground Water board (CGWB) (1) and District Gazetteer (2)
3.	Land-use data	Through satellite imageries and Survey of India topographical sheets.

(1) Central Groundwater Board (CGWB) Belgaum Profile - http://cgwb.gov.in/district_profile/karnataka/belgaum_brochure.pdf

(2) Karnataka State Gazetteer: Chapter 1 - Belgaum Distirct - http://www.karnataka.gov.in/Gazetteer/Publications/District%20Gazetteers/Belgaum%20District/1987/Belgaum%20Dist%20Gazetteer%201987%20Chp%2001.pdf

S. N.	Attribute	Source of Data Collection
4.	Natural hazards data	Building Materials and Technology Promotion Council of India (BMTPC) (1)
5.	Eco-sensitive areas	Wildlife Institute of India ENVIS Centre on Wildlife and Protected Areas (2) and Birdlife International website (3)
6.	District-level species list	Zoological Survey of India (4) and District Gazetteer.
7.	Socio-economic data	Census of India

7.4 ENVIRONMENTAL BASELINE FINDINGS

7.4.1 Topography

Regional Topography

Belgaum District is located east of the Western Ghats and covers an area of 13,444 km². A rugged terrain marks the western part of Khanapur and Belgaum taluks with deep cutting ravines on the foothills of the Western Ghats. The elevation of these hills varies from 796 to 1025 m amsl. The average elevation of the district is between 450 and 900 amsl.

The northern belt of the district is marked by some plateaus; low rolling bare hills mark the northeast and single peaks dominate the northwest. The west is the most elevated part of the district due to the presence of the Sahyadri Hills. The southern belt is covered with hills and forests but also has more open and levelled land with gentle slopes. The central part of the district is gently undulating plains having sparsely distributed knolls and tors. The elevation in the plains varies from 534m in the northeastern part to 820m in the southwestern part of the district. The south-eastern part of the district has hills with elevations between 686 and 783 amsl. The regional slope of the district is towards northeast and the differential altitude can cause an irregular ground flow patterns on the micro scale.

Local Topography

The Batkurki wind farm site is located in a plateau area with elevations of 659m to 688m amsl and drops gradually approximately 5 km in all directions by 50 to 80 meters. The wind farm plateau is mostly uniform with slight undulations and has its highest elevation near the batching plant and stockyard. The slope is more pronounced in the north-south direction than the east-west direction.

The contour map of the wind farm is shown in ***Figure 7.1*** and the digital elevation map of the wind farm is shown in ***Figure 7.2.***

(1) http://www.bmtpc.org/topics.aspx?mid=56&Mid1=178
(2) http://wiienvis.nic.in/Database/Maps_PAs_1267.aspx
(3) http://www.birdlife.org/datazone/userfiles/file/IBAs/AsiaCntryPDFs/India.pdf
(4) http://faunaofindia.nic.in/php/sfs_books_list.php

Figure 7.1 Contour map of the study area

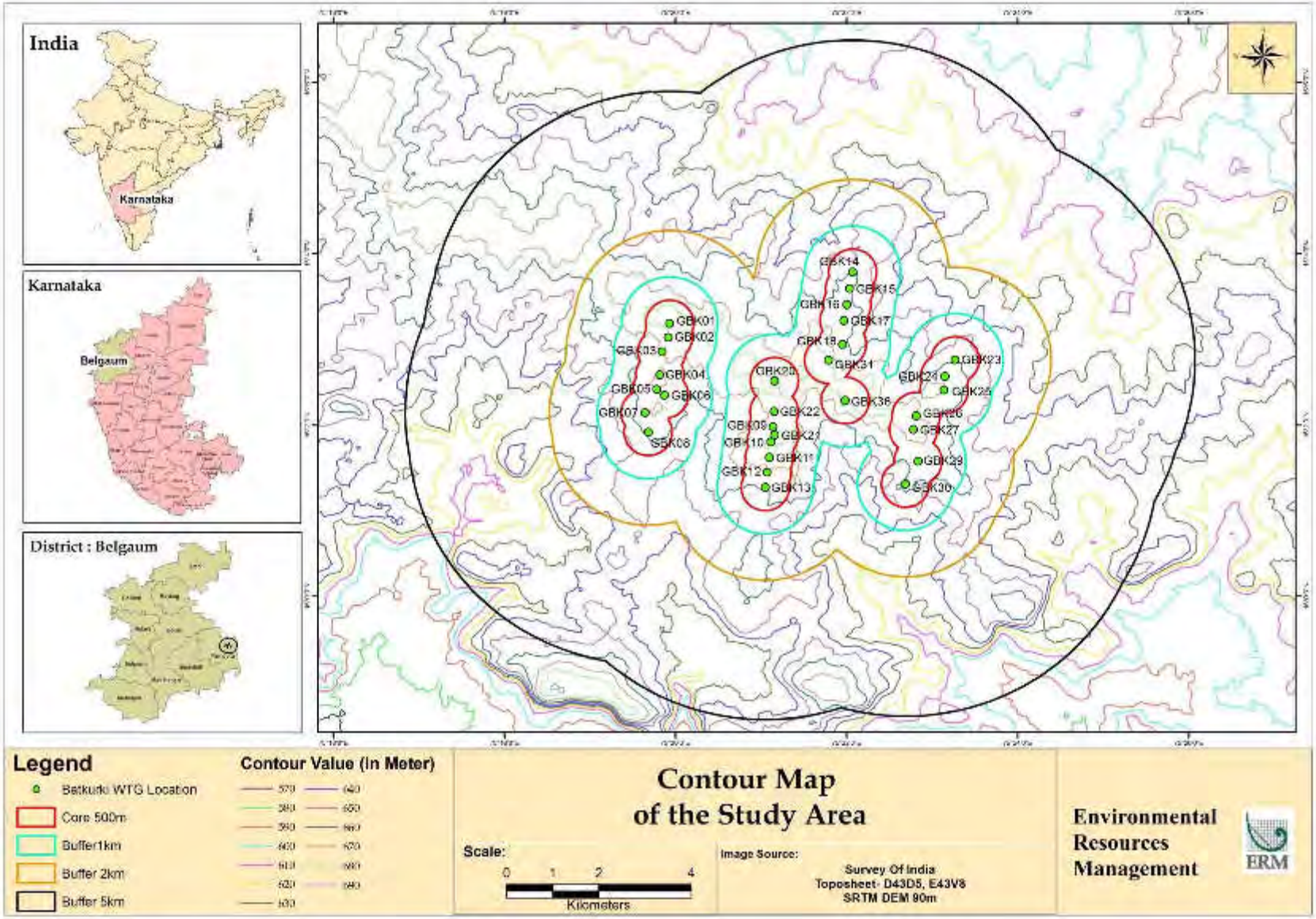
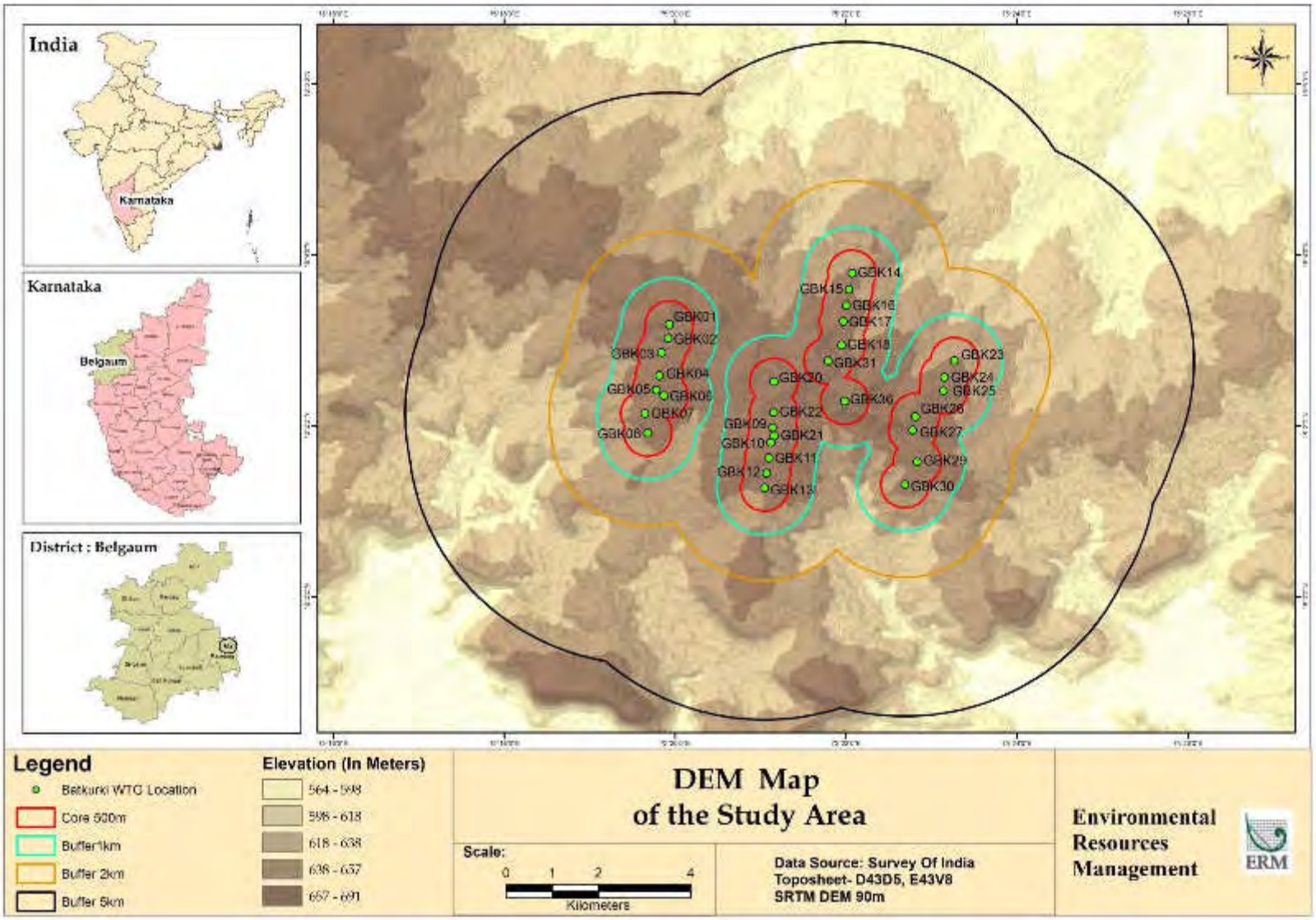


Figure 7.2 Digital elevation map of the study area



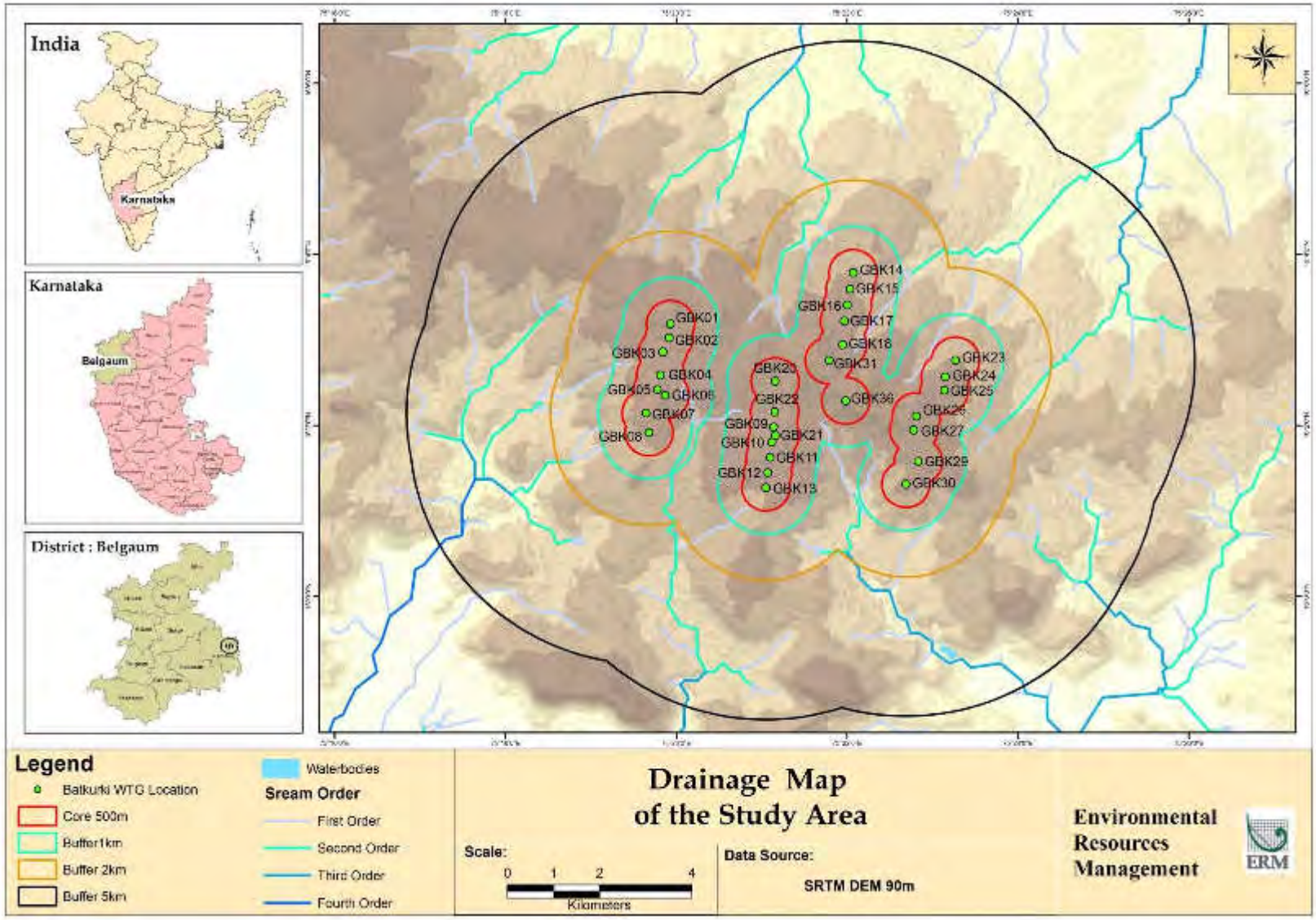
7.4.2 Hydrology and Drainage Pattern

The Belgaum District falls in the Krishna river basin except small catchments of Khanapur, Belgaum and Bailhongal taluks that fall in the catchments of Mahadayi and Kalinadi rivers that flow towards the west. The River Krishna, along with its tributaries Ghataprabha (centre of district) and Malaprabha (south of district) are perennial and effluent in nature and flow in easterly direction. The drainage density varies from 0.80 to 3.4 km/km^2.

The water table follows the topography of the area and is at greater depths in the water divides and topographic highs, but becomes shallower in the valleys and topographic lows. The groundwater therefore moves down and follows the gradient from the higher to lower elevations, that is, from recharge area to discharge area. Local direction of flow from higher elevations is towards the rivers but overall, the general flow direction of ground water in the district is towards the east.

The drainage map of the study area is presented in ***Figure 7.3.***

Figure 7.3 Drainage map of Batkurki Wind Farm



7.4.3 Geology and Soil Classification

Belgaum District is underlain by gneisses, schist, limestone, sandstone, basalts, alluvium, etc. of Archaean to Recent age. Deccan basalts cover an area of 7650 km^2 in the northern part of the district and have a maximum thickness of around 256 m, which gradually thins out in the southern direction. Hard rocks occupy a major part of the district, majority of which are basaltic lava flows.

Ramdurg Taluk comprises of sandstones and quartzites forming low ridges. The quartzites form a line from Daddi to Ramdurg and their dips are almost horizontal. Limestones are also prevalent and dominate the rest of the eastern portion of Belgaum District.

Belgaum District is also rich in mineral resources and necessary investigations have been conducted by Geological Survey of India, Atomic Mineral Division and the Department of Mines and Geology. Iron ore is found along the Dharwad-Belgaum High Road, near Khanapur Railway Station and in shales and brecciated quartzite in Village Kolchi, Taluk Ramdurg or Belgaum District. Manganese is found west of the railway line between Londa and Khanapur. Bauxite is found in several parts of Belgaum and Khanapur taluks. Kankar and Yellow Ochre are largely restricted to Kankar and Gokak taluk respectively. Other minerals include bauxite, limestone, quartzite, native copper and gold.

The soils of Belgaum District can broadly be classified into red soils and black soils. These soils vary in depth and texture, depending on the parent rocky type, physiographic settings and climatic conditions. By and large, black soils predominates the Deccan trap terrain and the red soils are found in the southwestern and south-eastern part of the district in gneissic terrain. These soils in turn can be grouped into seven categories as given below,

1. **Shallow black soils:** These soils occur in the Deccan trap region and to some extent are also developed in schist, shale and limestone terrains. They are greyish to dark greyish-brown in colour with clayey texture. These soils have poor to moderate infiltration characteristics.
2. **Medium black soils:** These soils are predominantly derived from Deccan traps and occupy large parts of the district. They are dark greyish brown to very dark greyish brown with clayey texture. These are derived from the weathered products of basalts and limestone and are darker in valleys than in highlands. Their texture varies from loam to clay, with low to moderate infiltration characteristics.
3. **Deep to very deep black soils:** These sols occupy large tracts in Deccan trap terrain along the Krishna River and also in the gneissic terrain. These soils are dark greyish brown to very dark greyish brown in colour and have clayey texture. These soils occur on plains or lands having gentle slopes. These soils exhibit wide cracks in summers. These are derived from a wide variety of parent rock types, like traps, schists, gneisses and sedimentary rocks. They are generally

transported and therefore occur in valleys and depressions. Accumulation of lime, gypsum and soluble salts at varying depths in the soil profile often pose problems. They have poor infiltration characteristics.

4. **Mixed red and black soils:** These soils occur in the northern parts of the district. They are dark reddish-brown to dark greyish brown in colour with silty-clay to clayey loam textures. These soils are derived from gneisses, schists and sedimentary rocks. Red soils having high infiltration characteristics are confined to uplands, whereas black soils of poor to medium infiltration characteristics occur in valleys and low lands.
5. **Red loamy soils:** these soils occur as small strips in the valleys adjacent to the Western Ghats. They are generally transported and are loamy to silty-loam in texture. They have moderate to good infiltration characteristics.
6. **Lateritic soils:** Lateritic soils are red in colour and occur as pockets. They occur at high levels as in-situ in Deccan Trap terrain and at low levels as transported in Malnad region. They are derived from Deccan traps as well as sedimentary rocks, Dharwarian Schists and peninsular gneisses. These soils have good to moderate infiltration characteristics.
7. **Alluvial Soils:** These soils are developed over the alluvium deposited by the Krishna River and its tributaries. They are very limited in extent and thickness and are local in nature. These soils have good infiltration characteristics and are composed of coarse sand, sandy loam and loams.

7.4.4 Climate and Meteorology

The climate of Belgaum District as a whole can be termed as semi-arid. The variation in the maximum temperature during the year ranges from 27° C to 35.7° C and minimum from 13.9° C to 20.6° C. The district experiences pleasant winters and hot dry summers. The seasons of the district are as follows:

- Summer: March to May;
- Southwest Monsoon: June to September;
- Post-Monsoon: October to December; and
- Pre-Monsoon: January to May.

The average annual rainfall during the period 1971 to 2000 recorded in the district is 769.1mm. The highest mean annual rainfall recorded in the district was 1064 mm in the year 1975 and the lowest rainfall 455 mm in the year 2003.

The long-term meteorological data for Belgaum from 1961 to 1990 is provided in ***Table 7.5.***

Table 7.5 Climatological data for Belgaum (1961-1990)

Parameter	Description
Temperature	The average daily min temperature was 18.6° C and average daily max temperature was 30.6° C. The highest temperature recorded was 39.2° C and lowest temperature recorded was 10.3° C.
Relative Humidity	The average relative humidity in this period was 78%
Rainfall	The average total annual rainfall in the period was 1330.8 mm and the number of rainy days was 78.2.
Wind Speed	The average mean wind speed was 5.2 kmph

Source: Climatological Norms (1961-1990) by Indian Metrological Department Observatory Coordinates - 15° 51' N and 74° 32' E

7.4.5 Natural Hazards

The seismic, flood and cyclone data are shown in ***Table 7.6***. As shown in the table, the Project area is not susceptible to earthquakes or floods and is of low risk for cyclone damage.

Table 7.6 Potential natural hazards that the Project might be exposed to

S.N.	Natural Hazards	Intensity	Source
1.	Seismic Hazard	Zone II: Low Damage Risk Zone (MSK VI or less) (1)	Building Materials and Technology Promotion Council (BMTPC) produced Earthquake Hazard Map in Vulnerability Atlas of India (2nd Edition)
2.	Flood Hazard	The Project area does not fall under a flood prone zone.	Building Materials and Technology Promotion Council (BMTPC) produced Flood Hazard Map in Vulnerability Atlas of India (2nd Edition)
3.	Wind and Cyclone Hazard	Low Damage Risk Zone (V_b = 33 m/s)	Building Materials and Technology Promotion Council (BMTPC) produced Wind and Cyclone Hazard Map in Vulnerability Atlas of India (2nd Edition)

7.4.6 Land Use and Land Cover

The Project area consists largely of private agricultural land with pockets of Reserve Forest land. Major crops grown in the area are jowar, paddy and wheat. The land-use break-up of the Project area is provided in ***Table 7.7***

Table 7.7 Land Use breakup of the Project Study Area

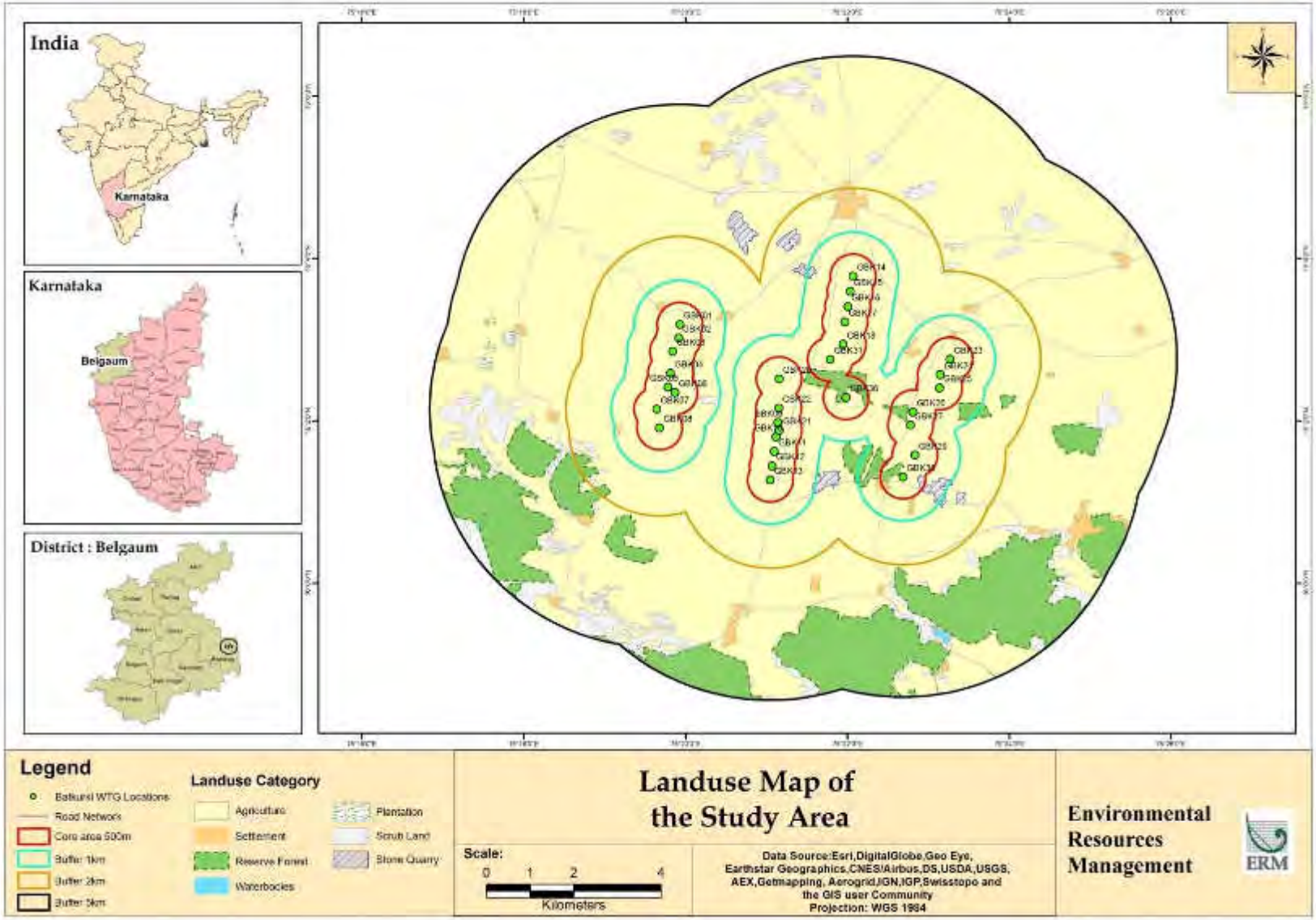
Land-use Category	Area (km²)	Percentage
Agriculture	152.54	82.12%
Plantation	0.21	0.11%
Reserve Forest	21.15	11.39%
Road Network	0.87	0.47%
Scrubland	7.98	4.30%
Settlements	2.06	1.11%

(1) The MSK (Medvedev-Sponheuer-Karnik) intensity broadly associated with the various seismic zones is VI (or less), VII, VIII and IX (and above) for zones 2, 3,4 and 5 respectively, corresponding to Maximum Considered Earthquake (MCE)

Land-use Category	Area (km²)	Percentage
Stone Quarry	0.94	0.51%
Total	185.76	100%

The land use map of the study area is given in ***Figure 7.4.***

Figure 7.4 Land use area map of the Batkurki Wind Farm



7.4.7 *Groundwater Resources*

At the district level, the mean depth to water level ranges between 5 to 20m bgl. No taluk in Belgaum District falls in safe category with the exception of Khanapur and partially safe for Hukkeri. The taluk which has the lowest groundwater availability is Ramdurg Taluk, which is classified as overexploited. The Project site is also located in Ramdurg Taluk and therefore use of groundwater resources should be monitored throughout the lifecycle of the Project. Ramdurg Taluka of Belgaum District in Karnataka is also a notified area by the Central Groundwater Board Authority (1).

It is to be noted that in the "Notified Areas" there is restrictions on construction and installation of any new structure for extraction of ground water resources without prior specific approval of the Authorised Officer (Deputy Commissioner) of the district and is subject to the guidelines/ safeguards envisaged from time to time in this connection by the Central Ground Water Authority (CGWA) for ground water extraction and rain water harvesting/ recharge, etc.[2]

7.5 *ECOLOGICAL BASELINE METHODOLOGY*

An ecological survey was undertaken in the Batkurki Wind Farm from 23rd to 26th August 2016. The purpose of the survey was to establish an ecological baseline of the study area and to understand the impacts of the Project on species and habitats in the surrounding areas.

7.5.1 *Objectives of the Ecological Study*

The ecological surveys were conducted with the following objectives:

Flora

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

(1) http://www.cgwb.gov.in/notified-areas.html
2 http://www.cgwb.gov.in/CGWA/documents/Public%20Notice%20No.2%20of%202011.pdf

Fauna

- Identification of fauna (specifically amphibians, reptiles, birds and mammals) based on direct sightings, calls, pug marks, droppings, nests, etc.;
- Identification and classification of any species recognized as threatened (in accordance with International Union for the Conservation of Nature [IUCN] Red List Online Version 2016-1) and according to the schedules of the Wildlife (Protection) Act, 1972 and its amendments;
- Identification of areas which are important or sensitive for ecological reasons including their breeding, nesting, foraging, resting, over wintering areas including wildlife migratory corridors/avian migratory routes; and
- Identification and assessment of aquatic ecological resources within the study areas.

7.5.2 Habitat Mapping

The study area of the wind farm for ecology is as follows:

- 500m core study area; and
- 5 km buffer study area.

The core study area consists largely of private agricultural land with patches of Reserve Forest, stone areas (and quarries) and scrubland. The buffer study area has more significant Reserve Forest land located to the south, which provides continuous vegetation for resident fauna.

Some of the water bodies identified on the site and visited as part of the study have been presented in ***Table 7.8.*** All of the surveyed water bodies listed in the table had water at the time of the ESIA study due to the recent rains.

Table 7.8 Water bodies surveyed near the wind farm site

S.N.	Water Body	Latitude	Longitude
1.	Batkurki Pond	16° 4′ 42.80″ N	75° 22′ 8.70″ E
2.	Aneguddi Pond	16° 1′ 17.20 " N	75° 22′ 1.50 "E
3.	Kallapur Pond	15° 59′ 17.34″ N	75° 23′ 15.04″ E
4.	Aneguddi Stone Quarry Pond	16° 1′ 13.75″ N	75° 22′ 54.58″ E
5.	Batkurki Stone Quarry Pond	16° 4′ 8.80″ N	75° 21′ 20.70″ E

The water bodies were found to be surrounded by considerable vegetation but had very little aquatic bird activity. Photo-documentation of the habitats found in the study area is presented in ***Figure 7.5.***

Figure 7.5 Photo-documentation of habitats in Batkurki Wind Farm

Agricultural Land

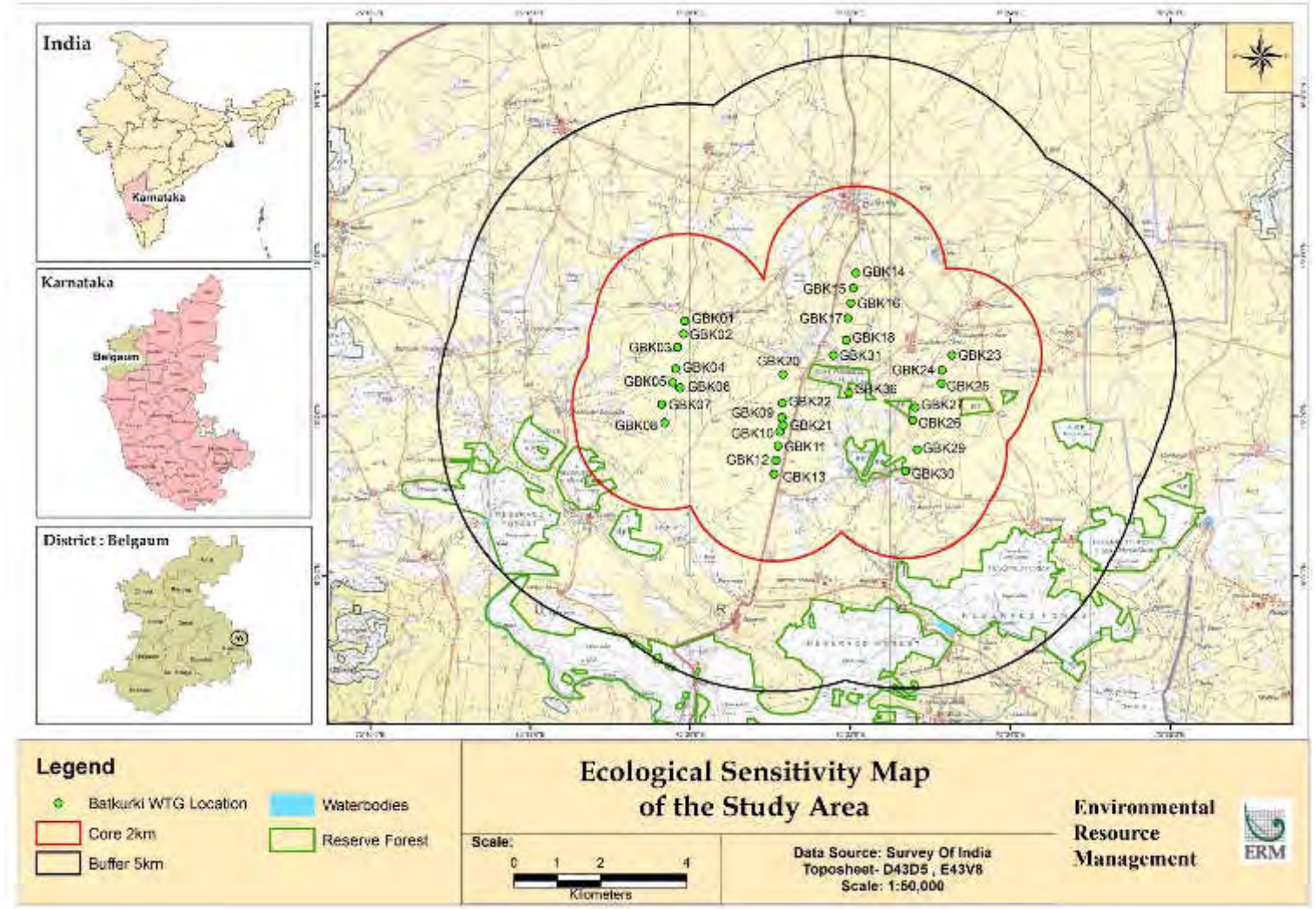
Reserve Forest

Waterbody

Scrubland

The distribution of the habitats found in the study area has been presented in ***Figure 7.6.***

Figure 7.6 Ecological Sensitivity Map of Study Area



7.5.3 *Ecological Baseline Methodology*

Flora

Flora found in the region was determined through a combination of online sources of information and primary identification onsite. The vegetation of the region as per Champion and Seth Vegetation Classification, 1968 (1), is Group 6D Deccan Peninsula: Central Plateau. The vegetation classification of the study area is provided in ***Table 7.9.***

Table 7.9 Vegetation classification of the region

Classification Scheme	Classification
Biogeographical Province of India (2)	Deccan Peninsula: Central Plateau
Agro Ecological Sub Region (ICAR)	Deccan Plateau, Hot Semi-Arid Eco Region (6.4)
Agro-Climatic Region (Planning Commission)	Southern Plateau and Hills Region
Agro Climatic Zone (NARP)	Northern Transitional Zone (KA-8)

The flora found in the region is therefore expected to be dry deciduous forests characteristic of the semi-arid Deccan Plateau. The above was confirmed through primary site visit by identifying commonly found dry deciduous tree species in the Reserve Forest and scrubland regions of the study area.

Fauna

Faunal species from the study area was recorded based on direct sightings and indirect evidences such as dung, droppings, scats, pugmarks, scratch signs, burrows, nests, etc. Consultations with local communities were carried out to provide pictorial representations of species anticipated in the area to confirm whether there have been any recent sightings.

Amphibians

In semi-arid terrain as seen in Belgaum District, amphibians are often restricted to natural and constructed ponds during the hottest parts of the day. Due to constant rains during the survey, these amphibians would however, be found around water bodies as well as flooded parts of the study area. All such water bodies and flooded parts were visited to determine the presence of amphibians.

Reptiles

Reptile presence was determined through the use of Intensive Time Constrained Search Methods (3) (1). The method was adapted for the terrain by

(1) Champion H., and Seth, S.K. 1968. A Revised Survey of the Forest Types of India. Nataraj Publishers, Dehradun, India.

(2) Wildlife Institute of India - ENVIS Centre

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

targeting rocks and logs located around water bodies or recently dried streams hedges and along the trunks of clumped vegetation.

Avifauna

An adapted avifaunal survey method for onshore wind farm assessments was utilized for the purpose of this study (2). The adapted survey method focuses on key habitat features to cover, preferred time of day to ensure maximum bird activity and techniques to determine nocturnal bird activity. Any avifaunal species that was identified by visually sighting or hearing of bird calls was recorded. Birds were identified along motorable roads, around water bodies and in high density vegetation areas during the hottest parts of the day. Binoculars and standard field guides (3) were used for avifaunal identification.

Mammals

Mammal surveys were conducted along motorable roads, near water bodies and in grassy terrain. Mammals in the Project study area were often tracked by local villagers to promote ecotourism opportunities for foreign visitors. Therefore, even mammals that could not be sighted were recorded in the Project study area from secondary sources. Individuals were identified through indirect methods such as pellets, tracks, paw marks and scat. Species were then identified using standard literature (4) (5).

7.5.4 Ecology Baseline Findings

Floral Assessment

The flora in the region largely consisted of dry deciduous trees as indicative of the Deccan Plateau.

A list of flora found in the forest and scrubland areas of the Batkurki Wind Farm has been presented in ***Table 7.10***

Table 7.10 Flora around the Batkurki Wind Farm

Type	Scientific Name
Trees	*Terminalia* spp.
	Anogeissus latifolia

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

(2) Scottish Natural Heritage (SNH). 2014. Recommended bird survey methods to inform impact assessment of onshore wind farms.
(3) Grimmet, R. Inskipp, C. and Inskipp, T. 2013. Birds of the Indian Subcontinent - Second Edition. Published by Christopher Helm, 49-51 Bedford Square, London.
(4) Prater, S.H. 2005. The Book of Indian Animals. Bombay Natural History Society and Oxford University Press - 12th Edition. pp 316
(5) Menon, V. 2003. A field guide to Indian Mammals. Dorling Kindersley (India) Ltd. New Delhi, 201 p

Type	Scientific Name
	Tectona grandis
	Hardwickia binata
	Acacia nilotica
	Albizia odoratissima
	Albizia procera
	Azadirachta indica
	Boswellia serrata
	Buchanania lanzan
	Chloroxylon swietenia
	Diospyros melanoxylon
	Lannea coromandelica
	Pongamia pinnata
	Sterculia urens
	Strychnos potatorum
	Wrightia tinctoria
	Ziziphus mauritiana
	Prosopis juliflora
Climber	*Abrus precatorius*
Shrub	*Calycopteris floribunda*
	Ichnocarpus frutescens
	Decalepis hamiltonii
	Gmelina asiatica
	Canthium parviflorum
	Cassia auriculata
	Ziziphus oenoplia
	Euphorbia spp.
	Sesamum laciniatum
	Plumeria spp.

Among the above species, East Indian Satinwood (*Chloroxylon swietenia*) has been classified as vulnerable as per IUCN Red List (online version 2016-2) (1) because it is a slow-growing species and has become scarce in a large part of its range. A list of agricultural crops has been presented in ***Table 7.11.***

Table 7.11 Agricultural crops in Belgaum District

Crop	Scientific Name
Maize	*Zea mays*
Sugarcane	*Saccharum* sp.
Wheat	*Triticum* spp.
Soybean	*Glycine max*
Groundnut	*Arachis hypogaea*
Sorghum	*Sorghum bicolor*
Cotton	*Gossypium* spp.
Mango	*Mangifera indica*
Banana	*Musa* spp.
Sapoata	*Manilkara zapota*
Grapes	*Vitis* spp.
Guava	*Psidium guajava*
Onion	*Allium cepa*
Green Chilli	*Capsicum* spp.
Potato	*Solamun tuberosum*
Cashew	*Anacardium occidentale*
Coconut	*Cocos nucifera*

(1) http://www.iucnredlist.org/details/33260/0

Crop	Scientific Name
Turmeric	*Curcuma longa*
Blackgram	*Vigna mungo*
Sunflower	*Helianthus* spp.
Chickpea	*Cicer arientinum*
Tobacco	*Nicotiana* sp.

Faunal Assessment

A faunal assessment was carried out based on the aforementioned search techniques (***Section 7.5.3***) for each of the target class of fauna – herpetofauna (amphibians and reptiles), avifauna and mammals. The subsequent sections described the fauna found on the site.

Herpetofauna

A total of eight (8) species of herpetofauna were observed or reported from the wind farm study area. Two of those species – Common Toad (*Duttaphrynus melanostictus*) and Skittering Frog (*Euphlyctis cyanophlyctis*) are amphibians but only the skittering frog was heard during the site visit. The other six species were reptiles out of which only the Indian Monitor Lizard (*Varanus bengalensis*) was seen on site. The list of herpetofauna found on site has been presented in ***Table 7.12***

Table 7.12 Herpetofauna observed/reported in the study area

S.N.	Common Name	Scientific Name	IUCN Red List Categorization (Online Version 2016-2)	Wildlife Protection Act Schedule	Observed/Reported
1.	Oriental Garden Lizard	*Calotes versicolor*	NE	NE	Reported
2.	Common Toad	*Duttaphrynus melanostictus*	LC	IV	Reported
3.	Saw-scaled Viper	*Echis carinata*	NE	IV	Reported
4.	Skittering Frog	*Euphlyctis cyanophlyctis*	LC	IV	Observed
5.	Starred Tortoise	*Geochelone elegans*	VU	IV	Reported
6.	Indian Cobra	*Naja naja*	LC	II	Reported
7.	Rat Snake	*Ptyas mucosus*	NE	IV	Reported
8.	Indian Monitor Lizard	*Varanus bengalensis*	LC	I	Observed

Two herpetofauna have been found to be threatened or protected as per the IUCN Red List and Wildlife Protection Act, 1972 respectively. The Starred Tortoise (*Geochelone elegans*) has been classified as Vulnerable as per IUCN Red List and is found in Gujarat, Rajasthan, Andhra Pradesh, Tamil Nadu, Odisha, eastern Karnataka and the countries of Pakistan and Sri Lanka. The species is extremely rare in the western part of Karnataka, where the Batkurki Wind Farm is located. The Indian Monitor Lizard (Varanus bengalensis) was spotted in a burrow in close proximity to a water body in Batkurki Wind Farm. The species is protected by the Wildlife Protection Act.

Avifauna

A total of 36 avifauna were found or reported during the site visit. Only four of the species were reported by online sources (1) – Pheasant-tailed Jacana (*Hydrophasianus chirurgus*), Bronze-winged Jacana (*Metopidius indicus*), Golden Oriole (*Oriolus oriolus)* and Greater Painted-snipe (*Rostratula benghalensis*). List of avifauna observed and/or reported in the study area is presented in ***Table 7.13*** and photo-documentation of observed species has been presented in ***Figure 7.7.***

Early literature states that the Critically Endangered Red-headed Vulture (*Sarcogyps calvus*) was once found in large number in Belgaum District (2), however, there has not been any sighting recently (3). It is possible that due to the rarity of seeing this species and its preferences for higher elevation, it might still be present in the neighbouring taluks/districts. Due to the rarity in observed sightings of the Red-headed Vulture in the last decade, it has not been listed in ***Table 7.13*** and has not been considered in determination of significance of impacts on ecological receptors.

All the species identified in the wind farm have been categorized as Least Concern as per the latest IUCN Red List categorization. Two species however, are protected by the Wildlife Protection Act, 1972, namely Indian Peafowl (*Pavo cristatus*) and Black-shouldered Kite (*Elanus caeruleus*). All species are also widespread residents of India.

(1) Including Karnataka State Gazetteer, ebird.org and Zoological Survey of India. Only a bird listed in at least two of the above sources has been included in the reported section.

(2) Karnataka State Gazetteer - Chapter 1 - Belgaum District - http://www.karnataka.gov.in/Gazetteer/Publications/District%20Gazetteers/Belgaum%20District/1987/Belgaum%20Dist%20Gazetteer%201987%20Chp%2001.pdf

(3) As per ebird.org and search for recent newspaper/journal articles.

Table 7.13 Avifauna observed/reported in the study area

S.N.	Common Name	Scientific Name	IUCN Red List Categorization (Online Version 2016-2)	Wildlife Protection Act Schedule	Migratory Status	Observed/Reported
1.	Common Myna	*Acridotheres tristis*	LC	IV	Resident	Observed
2.	Indian Spot-billed Duck	*Anas poecilorhyncha*	LC	IV	Resident	Observed
3.	Little Swift	*Apus affinis*	LC	IV	Resident	Observed
4.	Cattle Egret	*Bubulcus ibis*	LC	IV	Resident	Observed
5.	Southern Coucal	*Centropus sinensis*	LC	IV	Resident	Observed
6.	Pied Kingfisher	*Ceryle rudis*	LC	IV	Resident	Observed
7.	Common Pigeon	*Columba livia*	LC	NE	Resident	Observed
8.	Jungle Crow	*Corvus macrorhynchus*	LC	IV	Resident	Observed
9.	House Crow	*Corvus splendens*	LC	V	Resident	Observed
10.	Black Drongo	*Dicrurus macrocercus*	LC	IV	Resident	Observed
11.	Black-shouldered Kite	*Elanus caeruleus*	LC	I	Resident	Observed
12.	Ashy-crowned Sparrow Lark	*Eremopterix griseus*	LC	IV	Resident	Observed
13.	Asian Koel	*Eydynamys scolopaceus*	LC	IV	Resident	Observed
14.	White-throated Kingfisher	*Halcyon smyrnensis*	LC	IV	Resident	Observed
15.	Red-rumped Swallow	*Hirundo daurica*	LC	NE	Resident	Observed
16.	Wire-tailed Swallow	*Hirundo smithii*	LC	NE	Resident	Observed
17.	Pheasant-tailed Jacana	*Hydrophasianus chirurgus*	LC	IV	Resident	Reported
18.	Long-tailed Shrike	*Lanius schach*	LC	NE	Resident	Observed
19.	Little Green Bee-eater	*Merops orientalis*	LC	NE	Resident	Observed
20.	Great White Egret	*Ardea alba*	LC	IV	Resident	Observed
21.	Bronze-winged Jacana	*Metopidius indicus*	LC	IV	Resident	Reported
22.	Little Cormorant	*Microcarbo niger*	LC	IV	Resident	Observed
23.	Purple-rumped Sunbird	*Nectarinia zeylonica*	LC	IV	Resident	Observed
24.	Golden Oriole	*Oriolus oriolus*	LC	IV	Resident	Reported
25.	House Sparrow	*Passer domesticus*	LC	IV	Resident	Observed
26.	Indian Peafowl	*Pavo cristatus*	LC	I	Resident	Observed
27.	Baya Weaver	*Ploceus phillipinus*	LC	IV	Resident	Observed
28.	Rose-ringed Parakeet	*Psittacula kramerii*	LC	IV	Resident	Observed
29.	Red-vented Bulbul	*Pycnonotus cafer*	LC	IV	Resident	Observed
30.	Greater Painted-snipe	*Rostratula benghalensis*	LC	NE	Resident	Reported
31.	Pied Bushchat	*Saxicola caprata*	LC	IV	Resident	Observed

S.N.	Common Name	Scientific Name	IUCN Red List Categorization (Online Version 2016-2)	Wildlife Protection Act Schedule	Migratory Status	Observed/Reported
32.	Laughing Dove	*Spilopelia senegalensis*	LC	IV	Resident	Observed
33.	Eurasian Collared Dove	*Streptopelia decaocto*	LC	IV	Resident	Observed
34.	Brahminy Starling	*Sturnus pagodarum*	LC	IV	Resident	Observed
35.	Large Grey Babbler	*Turdoides caudata*	LC	IV	Resident	Observed
36.	Red-wattled Lapwing	*Vanellus indicus*	LC	IV	Resident	Observed

Figure 7.7 Photo-documentation of avifauna

Indian Spot-billed Duck

Jungle Babbler

Laughing Dove

House Sparrow

Little Green Bee-eater

Red-vented Bulbul

Southern Coucal

Baya Weaver

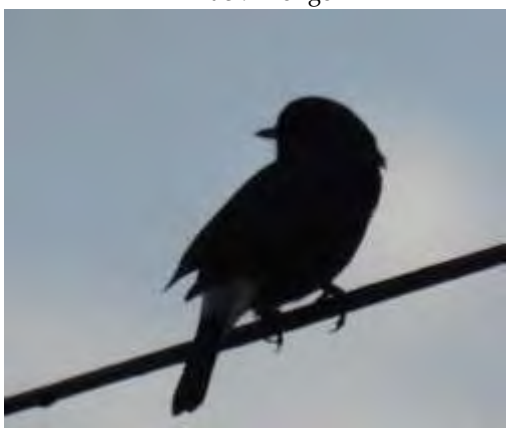
Brahminy Starling

Eurasian Collared Dove

Red-rumped Swallow

Black Drongo

White-throated Kingfisher



Pied Bushchat

Great White Egret

Purple-rumped Sunbird

Common Myna

Pied Kingfisher

Mammals

Thirteen mammals were observed or reported from the study area. Only two of those mammals were observed during the study – Grey Mongoose (*Herpestes edwardsii)* and Southern Plains Gray Langur (*Semnopithecus dussumieri*).

There have been reports of Tigers (*Panthera tigris)* and leopards (*Panthera pardus*) as rare and occasional visitors to the area in the past (1). There has been no recent sighting of either species in the last decade in the wind farm study area and most of the sightings have been from Khanapur Taluka of Belgaum District (2). Due to the small likelihood of either tigers or leopards being found in the study area, they have been omitted from ***Table 7.14*** and the subsequent impact assessment.

Bat activity in the wind farm was determined through consultations with local communities and discussions with the forest guard. Large trees, caves or abandoned buildings in the area were visited to check presence of bat guano and roosting individuals. It was determined that the wind farm area does not have a resident bat population and impacts on bat species has been scoped out of the impact assessment study.

List of mammals observed/ reported in the study area is presented in ***Table 7.14***.

(1) Karnataka State Gazetteer - Belgaum District Chapter

(2) There have been some sightings of tigers in Khanapur Taluka as shown in recent newspaper articles – (i) http://timesofindia.indiatimes.com/city/mangaluru/Youths-sight-tiger-in-Khanapur-fear-spreads-across-taluk/articleshow/45907452.cms and (ii) http://www.navhindtimes.in/border-villagers-put-on-alert-as-khanapur-tiger-turns-man-eater/. Villagers and forest guard consultations within the wind farm area confirmed that there has not been a tiger sighting in the area in more than a decade. The villagers did claim that occasional sightings of leopards occurred several years back.

Table 7.14 Mammals observed/reported in the study area

S.N.	Common Name	Scientific Name	IUCN Red List Categorization (Online Version 2016-2)	Wildlife Protection Act Schedule	Observed/ Reported
1.	Indian Jackal	*Canis aureus*	LC	II	Reported
2.	Jungle Cat	*Felis chaus*	LC	II	Reported
3.	Three-striped Palm Squirrel	*Funambulus palmarum*	LC	IV	Reported
4.	Small Indian Mongoose	*Herpestes auropunctatus*	LC	II	Reported
5.	Indian Grey Mongoose	*Herpestes edwardsii*	LC	II	Observed
6.	Striped Hyaena	*Hyaena hyaena*	NT	III	Reported
7.	Black-naped Hare	*Lepus nigricollis*	LC	IV	Reported
8.	Rhesus Macaque	*Mucaca mulatta*	LC	II	Reported
9.	Bonnet Macaque	*Mucaca radiata*	LC	II	Reported
10.	Asian Palm Civet	*Paradoxurus hermaophroditus*	LC	II	Reported
11.	Southern Plains Gray Langur	*Semnopithecus dussumieri*	LC	II	Observed
12.	Small Indian Civet	*Viverricula indica*	LC	II	Reported
13.	Indian Fox	*Vulpes bengalensis*	LC	II	Reported

None of the mammalian species identified in the study have been classified as threatened or protected as per the IUCN Red List and Wildlife Protection Act respectively. Photo-documentation of mammals observed in the study area has been presented in ***Figure 7.8***

Figure 7.8 Photo-documentation of mammals in the study area

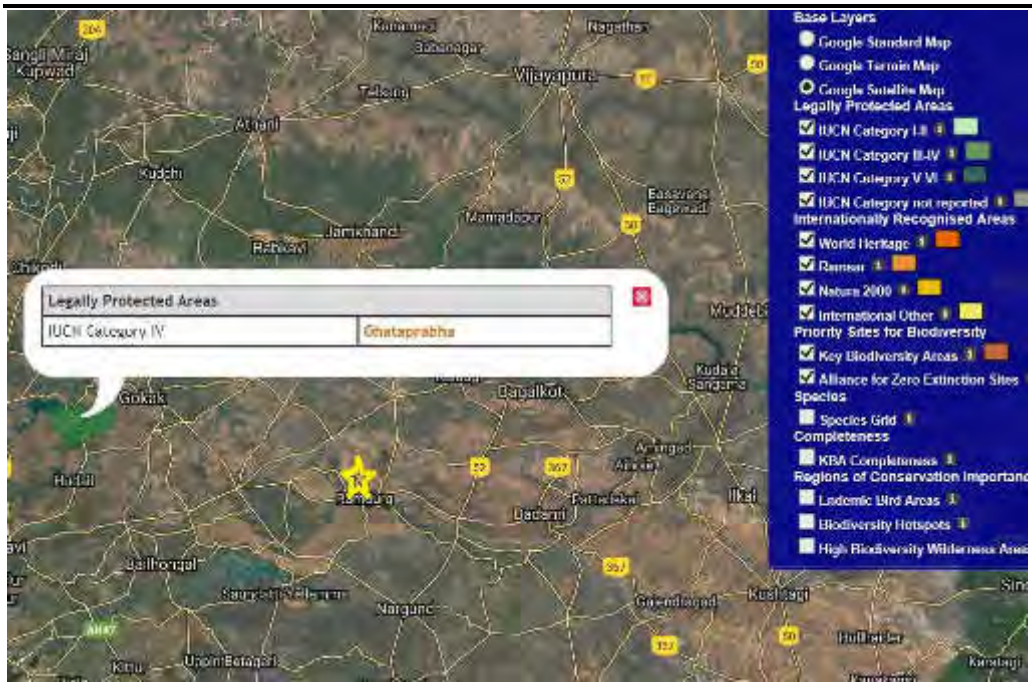
Southern Plains Gray Langur

Protected Areas

There are no wildlife sanctuaries, national parks, community reserves, conservation reserves or important bird areas located in close proximity to the site. (1) The closest protected area is Ghataprabha Wildlife Sanctuary, which is located over 50 km away from the wind farm site. A map of the surrounding protected areas has been given in ***Figure 7.9.***

(1) Close proximity for the purpose of this report has been adjudged to be 50 km in any direciton.

Figure 7.9 Map of surrounding protected areas



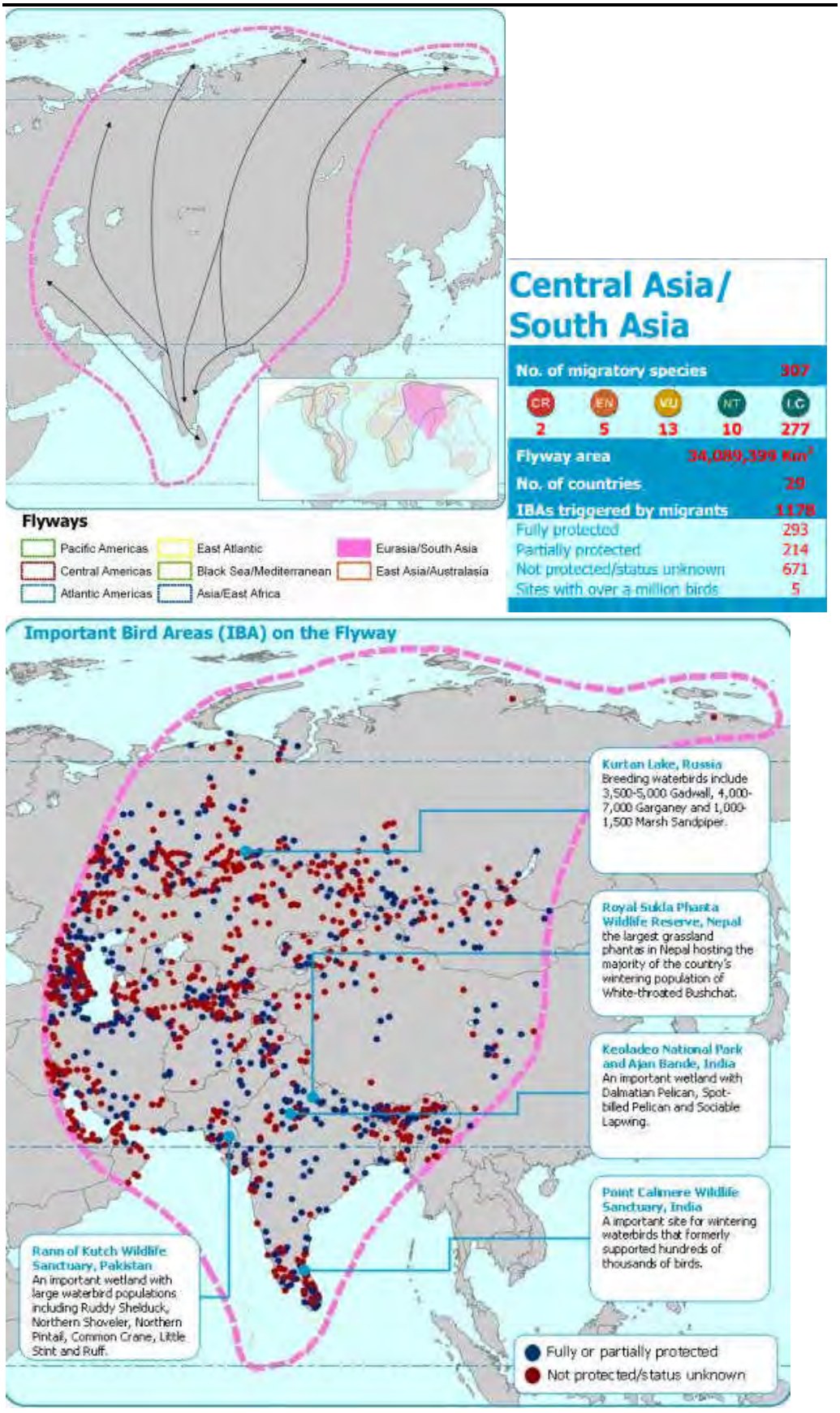
Source: Integrated Biodiversity Assessment Tool (IBAT)
Note: the Project site has been shown by a yellow star.

Migratory Routes

Migratory birds in India fall within the Central Asian Flyway, which is a global migratory pathway that connects the Palearctic (Europe and Northern Asia) to the Indian subcontinent. The Central Asian Flyway and Important Bird Areas for migratory species have been shown in ***Figure 7.10***

The survey was conducted in early August, 2016, which is in the non-migratory season. Migratory activity in the area was therefore ascertained through community consultations, review of Zoological Survey of India (ZSI) articles and confirmation of sightings from recent journals and websites like ebirg.org. It was determined that some common migratory species such as Green Sandpiper (*Tringa ochropus*) and Common Teal (*Anas crecca*) may be found in small numbers in the surrounding larger water bodies. The only water bodies therefore, large enough to have migratory bird activity were in the Reserve Forests that are 3 km south of the wind farm. At a distance of 3 km, the bird activity within the wind farm area or in the direct impact area of the wind farm (within 500m) would be minimal and therefore additional bird and bat studies have not been recommended for this wind farm.

Figure 7.10 Central Asian Flyway



7.6 SOCIO-ECONOMIC BASELINE CONDITIONS

This section presents socio economic baseline of the study area for the 60 MW wind power capacity that Gamesa is installing for Renew in the Belgaum district of Karnataka, India. The project footprint covers at least 5 villages falling under Ramdurg Taluk.

7.6.1 *Approach and Methodology*

The socio-economic baseline for this project has been developed on the basis of a combination of secondary literature review, as well as the inferences drawn from the consultations with different stakeholders including the local community.

Review of secondary information

A review and assessment of the available secondary data and information for the study area was undertaken in order to substantiate and corroborate the understanding gained through stakeholder consultations, understand the performance of the area on socio-economic parameters as well as allow for a comparative assessment of the project area vis-à-vis the block and district level socio economic baseline information. For the purpose of the desk based assessment, following documents and literature have been reviewed:

- Primary Census Abstract data, 2011;
- Belgaum District Census Handbook, 2011;
- Belgaum District Statistical Handbook, 2011;
- Village Directory Data, 2011;
- Agriculture Contingency Plan of Belgaum, 2011;
- Department of Information and Public Relations website of Karnataka (http://karnatakavarthe.org/en/); and
- Published research papers, articles and other information available in public domain on aspects such as irrigation, drinking water supply system, livelihood pattern, land, local governance and decentralisation, civil society and NGOs as well as economic policies and regional development plans the State is pursuing.

Stakeholder mapping and consultation

The stakeholders for this project differ in terms of the degree of impact, interest, and influence over the project. The stakeholder mapping and its analysis was conducted with the objective of identifying each stakeholder group; studying their profile, characteristics and the nature of their stakes; gauging their influence on the project; and understanding the specific issues, concerns as well as expectations of each group from the project.

Key groups of stakeholders who were consulted during the study process were local community, representatives of Gamesa and Renew and school teachers etc. The consultation process was also undertaken with the aim of informing the stakeholders about the project, its proposed activities, while

assessing the awareness levels about the project in the community and simultaneously identifying some of the key issues, concerns and expectations of the community.

Primary data/information collection/site surveys and consultations

Under this phase, consultation of key informants in the study area including local communities was undertaken with the objective of building ground level understanding of the concerned issues and also in parallel gather primary data wherever feasible to support the observations gained through these consultations.

Table 7.15 Consultations undertaken during the site visit

Date	Stakeholder Details
23.08.2016	Consultations with the Project Managers and other representatives of Gamesa and Renew.
23.08.2016	Consultations with local community (Batkurki and Batkurki Tanda) including a retired Government employee of the Ramdurg taluk office.
25.08.2016	FGD in village Chennapur
25.08.2016	Community consultations in village Shirasapur
25.08.2016	Consultations with local community (Naganur Tanda)
25.08.2016	Consultations with teachers from two primary schools (Naganur Tanda)
25.08.2016	FGD in village Aneguddi

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

Details of various stakeholders consulted are provided in the later sections of this report.

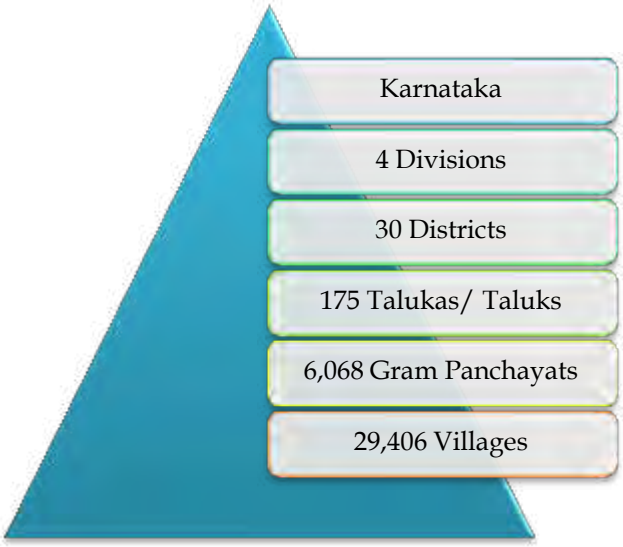
7.6.2 State Profile: Karnataka

Karnataka is located in the south western region of the country and is the seventh largest State in India (in terms of geographical area). The most widely accepted etymology suggests that the name Karnataka has been derived from two Kannada words 'Karu' meaning 'Black' and 'Nadu' meaning region indicating the black cotton soil found in the area. The state shares boundaries with Maharashtra in the north, Goa in the northwest, the Arabian Sea in the west, Kerala and Tamil Nadu in the south and by Andhra Pradesh and Telangana in the east. The state administers an area of 191,791 sq. km. constituting 5.83% of the total geographical coverage of the Country and accounts for 5.05 % of the total population of India, according to the provisional data of Census 2011. The capital of the State is Bengaluru.

The State of Karnataka is divided into 30 districts[1], 4 administrative divisions, 175 talukas/ taluks[1], 6,068 gram panchayats[2], 270 towns and 29,406 villages.

1. A district is an administrative division of an Indian state or territory. They form the tier of local government immediately below that of India's subnational states and territories.

Figure 7.11 Administrative Structure of Karnataka



Source: Department of Information and Public Relations, Karnataka

The State comprises of a population of 61,095,297 individuals, which is predominantly rural, forming 61.32% of the State's total population. The decadal population growth has reduced from 17.51% during 1991-2001 to 15.60% during 2001 to 2011. The sex ratio in the State is 973, which has increased from 965 in the past decade. The sex ratio of Karnataka is significantly higher than that of India which stands at 940 females per 1000 males as per census 2011 data. The population density of India is 382 persons/sq. km. while that of Karnataka is 319 persons/ sq. km., which is considerably lower for a State with the seventh largest geographical area in the country.

The literacy rate of Karnataka is nearly 75.36% (of which the rural literacy stands at 68.73%) which is slightly higher than that of the country, at 74.04%. The male literacy rate is relatively higher, at 82.47% while the female literacy rate is 68.08% which is also higher than the national female literacy rate of 65.46%.

Table 7.16 Demographic profile of Karnataka

Attribute	Number	% of India
Area (sq. km)	3,08,252	5.83
Total population	61,095,297	5.05
Males	30,966,657	4.96
Females	30,128,640	5.12
Sex ratio	940	NA
Percentage of rural Population	61.32	NA

1. Taluk is an administrative division of India denoting a sub-district. Taluks are also referred to as "taluks" or "mandal" in some states. Taluks can consist of multiple villages and a few towns. The Panchayat samitis are usually the administrative governing bodies of the taluks.
2. A Gram Panchayat is the cornerstone of a local self-government organization in India and has a Sarpanch as its elected head. The Panchayat Act specifies the functions, powers and duties of the Gram Panchayats which includes sanitation, drinking water, maintenance, repair, construction and protection of public streets etc.

Attribute	Number	% of India
Percentage of urban population	38.68	NA
Population density	319	NA
Percentage of SC population	17.1	NA
Percentage of ST population	7.00	NA
Total literacy rate	75.36	NA
Male Literacy rate	82.47	NA
Female Literacy Rate	68.08	NA
Rural Literacy	68.7	NA

Source: Census of India, 2011 data

7.6.3 *District Profile: Belgaum*

Belgaum district lies in North-west Karnataka. The district falls under the North Karnataka division. It is renowned for the various tourist destinations that it houses. The district shares boundaries on the southwest with the state of Goa, on the south with the districts of Dharwad and Uttara Kannada, on the east with Bagalkote, on the northeast with Bijapur and on the west and north with the state of Maharashtra. The geographical area of the district is 13,415 sq. kms with a total population of 47,78,439 individuals.

Table 7.17 Administrative set-up of Belgaum District

Sl. No.	Taluk	Total population (2001 Census)	Total number of villages
1	Belgaum	8,15,581	137
2	Chikodi	5,67,601	135
3	Gokak	5,26,092	135
4	Athni	4,61,862	110
5	Raybag	3,47,600	61
6	Hukeri	3,57,193	125
7	Sampgaon	3,56,286	133
8	Parasgad	3,11,693	133
9	Ramdurg	2,27,412	116
10	Khanapur	2,43,185	221

Source: Maps of India

The administrative set-up of the district consists of 10 taluks, 486 gram panchayats and 1306 villages. Out of the 1306 villages in the district, 1158 are inhabited[1] and the remaining 148 are uninhabited. Similarly, there are 13 towns in the district.

Table 7.18 Belgaum District demographic profile vis-a-vis Karnataka

Attribute	Karnataka	Belgaum District
Population	61,095,297	47,78,439
Population Density	319	356
% of SC population	17.1	12.08
% of ST population	7.00	6.99
Sex Ratio	940	969
% total literacy rate	75.36	73.94
% female literacy rate	68.08	64.58

1. Kalkundrikar, A.B. (1990). *Regional Rural Banks and Economic Development.* Daya Books. ISBNs 8170350743 and 9788170350743. pp. 105.

Attribute	Karnataka	Belgaum District
% rural population	61.32	74.65

Source: Census of India, 2011 data

The population growth of Belgaum in the last decade has been 13.41% against the State population growth rate of 15.50% between 2001 and 2011. The population density stands at 356 persons/sq. km as compared to 319 persons /sq. km for the State. The SC people form 12.08 % of the total population of the district while the proportion of ST population is 6.99%. The sex ratio of the district, at 969, is significantly higher than the State and country figure of 940 females per thousand males as per census 2011 data. Even the child sex ratio of Belgaum at 934 girls per 1000 boys in 2011 is higher than the national figure of 919.

The status of literacy in the district reflects a slightly poorer scenario than that of the State. The total literacy rate of the district is 73.94%, while the female literacy rate is 64.58 %, against the State figures of 75.36% and 68.08% respectively. Rural population forms the majority in the district, with 74.65% living in the villages.

7.6.4 Study Area[1]

The area of up to 5 km radius[2] from the project boundary (wind farm area) has been demarcated as study area for the project by considering the extent of project impact in terms of noise, shadow flicker, water resources, human settlement, cultural heritage sites, location of labour sites, location of the access roads, CPRs etc. besides considering the actual land area which is acquired/proposed to be acquired for both the project and its utilities footprints.

The distance up to 2 km radius from project boundary has been considered as project Influence Area (Core zone), while the area from 2 km to 5 km is considered as the buffer zone for the project, based on the observation that magnitude of impact in this influence area is likely to be more visible than the remaining portion of study area, particularly in terms of likely impact caused by land procurement process, impact on livelihood, shadow flicker impact etc.

The study area includes 24 villages – 8 villages in the core zone (villages within 2 Kms) and 16 villages in the buffer zone (villages within 5 kms).

1. The following 2 villages falling in the Core Zone have been excluded from the socio-economic baseline as they do not feature in the Primary Census Abstract, 2011 for Belgaum district; (1) Naganur Tanda and (2) Batkurki Tanda. Similarly, the villages of (1) Jangawad, (2) Bellikindi and (3) Hanapur S.U. falling in the Buffer Zone have also been excluded as it does not feature in the Primary Census Abstract, 2011 for Belgaum district.
2. The study area for a Wind farm is defined by connecting all the WTGs and associated components and connecting them to form a polygon.

Figure 7.12 Community consultations in the project area

Source: ERM Site Visit on 23rd and 25th August, 2016

Table 7.19 Study area - Villages in the core zone and buffer zone

Core Zone (Within 2 Kms)		Buffer Zone (2-5 Kms)	
Sl. No.	Villages	Sl. No.	Villages
1	Chennapur	1	Obalapur
2	Shirasapur	2	Venkanteshwarnagar
3	Aneguddi	3	Shivanakote
4	Naganur Tanda	4	Sadibhavi Salapur
5	Batkurki Tanda	5	Naganur
6	Somapur	6	Batkurki
7	Chetan Nagar	7	Nandihar
8	Soppadla	8	Jangwad
		9	Timmapur S.A.
		10	Bellikindi
		11	Hanapur
		12	Kalamad
		13	Krishnanagar
		14	Mudkavi
		15	Mudenur
		16	Gokulnagar

Source: Study area identification by ERM

7.6.5 Demographic Profile of Study Area

As indicated earlier, Karnataka is the seventh largest State in India in terms of area and the eighth most populous State in India. The population density as shown in the table above is 319 persons per sq.km. Belgaum is one of the most pre-dominantly agrarian districts of the State. However, unlike most agrarian districts, the density of population is relatively higher in this district compared to the State. It also has a higher Human Development Index (HDI), literacy and sex ratio compared to many other districts of the State.

Table 7.20 Demographic profile of Karnataka, Belgaum District and Ramdurg Taluk

Region	Total population	Sex ratio	SC%	ST%	Population density	Literacy rate (%)	Female literacy rate (%)	Rural population (%)
Karnataka	61,095,297	940	17.1	7.00	319	75.36	68.08	61.32
Belgaum district	47,78,439	969	12.08	6.99	356	73.94	64.58	74.65
Ramdurg taluk	2,27,412	970	16.00	3.72	-	54.24	44.21	-

Source: District Census Handbook, Belgaum and Primary Census Abstract, Census of India 2011

All the 24 villages in the study area fall under the Ramdurg taluk. The demographic profile of the villages, except for five (those which could not be located in the Census data 2011 sheet) falling under the study area is captured in the table below.

Table 7.21 Demographic profile of the study area

Name	No. of HH	Total Population	Sex Ratio	SC %	ST %	Literacy Rate	Female Literacy Rate
Core zone							
Somapur	84.00	432.00	886.46	93.75	0.00	30.79	19.70
Chennapur	246.00	1415.00	981.79	50.18	1.63	54.77	40.23
Shirasapur	225.00	1347.00	902.54	100.00	0.00	46.99	32.55
Chetan Nagar	127.00	613.00	891.98	98.53	0.00	31.48	16.61
Soppadla	241.00	1320.00	893.83	17.42	4.32	48.94	39.17
Aneguddi	225.00	1235.00	938.78	4.05	34.01	59.43	48.66
Total	***1148.00***	***6362.00***	***922.64***	***52.59***	***7.86***	***48.95***	***36.46***
Buffer zone							
Shivanakote	140.00	791.00	892.34	96.21	0.00	30.47	14.75
Dadibhavi Salapur	853.00	4413.00	956.12	20.69	0.23	50.65	40.33
Naganur	290.00	1504.00	908.63	5.12	4.52	53.39	41.34
Batkurki	924.00	4603.00	977.23	11.64	3.37	55.94	46.51
Nandihal	325.00	1840.00	976.37	19.84	0.00	53.42	42.24
Timmapur S.A.	62.00	483.00	1020.92	69.98	0.00	54.24	45.90
Krishnanagar	128.00	600.00	935.48	99.83	0.00	39.00	26.55
Kalamad	165.00	977.00	915.69	50.87	3.48	52.20	39.83
Mudenur	616.00	3114.00	942.61	8.57	0.58	55.81	45.14
Mudakavi	518.00	2464.00	966.48	9.54	25.73	58.04	45.83
Venkateshwarnagar	191.00	1439.00	888.45	100.00	0.00	52.68	40.18
Obalapur	364.00	2178.00	913.88	17.40	0.32	46.88	38.56
Gokulnagar	148.00	1014.00	1032.06	99.70	0.00	43.10	32.62
Total	***4724.00***	***25420.00***	***950.13***	***29.18***	***3.64***	***52.03***	***41.31***

Source: Primary Census Abstract, Census of India 2011

The core zone includes 6 villages with a combined population of 6362. Among the villages, Chennapur is the largest in terms of population and Somapur is the smallest with a population of 1415 persons and 432 persons respectively. It could also be observed from the table that the core area has a majority SC population averaging about 52.59%. The population of SCs in the core zone varies from 4.5% in Annegudi to 100% in Shirasapur. Kamalpur possesses the highest proportion of SCs in any of the core villages. The core area is observed to have a negligible presence of 7.86% of ST population and the same was confirmed during the consultations. For the overall study area,

the population of STs varies from nil in several villages such as Somapur, Shirasapur, Chetan Nagar, Shivanakote, Nandihal, Timmapur S.A., Krishnanagar, Venkateshwarnagar and Gokulnagar to 34.01% in Annegudi. Other villages with significant proportion of ST population include; Mudakavi (25.73%).

Box 7.1 Brief narrative on Valmiki - a notified Schedule Tribe inhabiting the study area

Claiming themselves to the descendants of the revered Hindu sage Valmiki, members of the Valmiki Tribe specialize in preparing 'earthen pots' and other clay items. According to popular myth, after the demise of the great sage Valmiki, his descendants continued to inhabit coastal Andhra, especially in the present-day districts of Visakhapatnam and Godavari until the past few centuries. Consultations with elderly members of the Tribe revealed that owing to rising economic insecurity and growing identity crisis, their forefathers had migrated to the Belgaum-Bijapur region of Karnataka during the early 19th century.

As most other Tribal communities, even the Valmikis are an endogamous group where social customs mandate marriage to take place within members of the tribe. However, to further regulate the institution of marriage, the tribe has been divided into various 'Gotrams' or 'Clans' that are regarded to be strictly exogamous. Some of the moset widely practiced ways of acquiring mates among the Valmiki include; marriage by elopment and marriage by mutual consent. Being a largely progressive tribe, widow remmariage and divorce are socially permitted among the Valmikis.

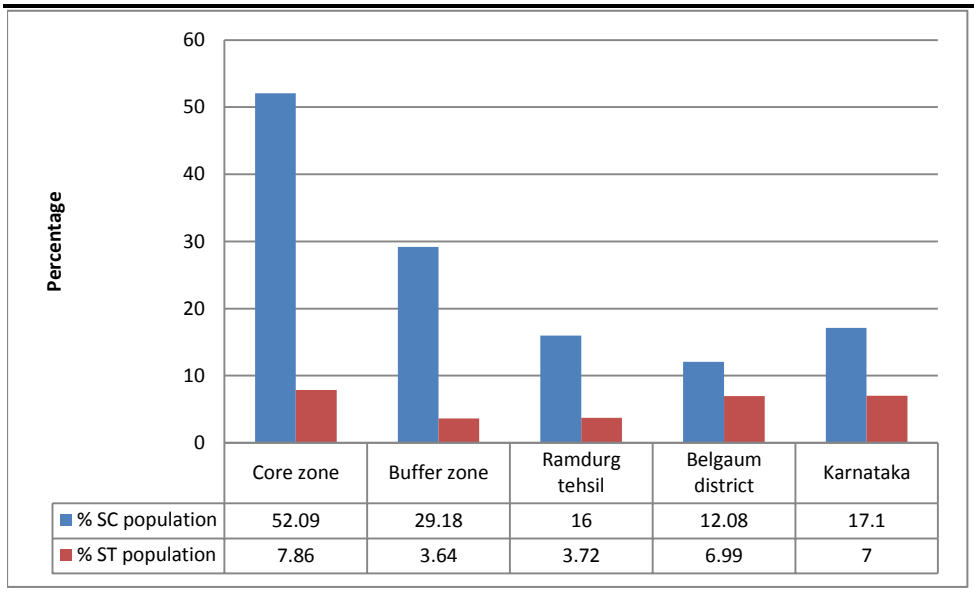
The average sex ratio in the core villages is observed to be 923 which is slightly lower than the district sex ratio of 969. The average literacy rate in the core villages is 48.95% while the average female literacy in the core villages is 36.46%. The literacy rate, especially of the females in the core villages is observed to be considerably lower than the district average.

In the buffer zone, Tonk Khurd is the largest in terms of population and Peerkhedi is the smallest. The buffer zone villages have a considerably lower proportion of SCs at 29.18%. Venkateshwarnagar accounts for the highest proportion of SCs in the area with 100% of its population belonging to the category. Literacy rate of the population is observed to range from 30.47% - 58.04% while female literacy rate is in the range of 14.75% to 46.75%.

Social Stratification

The entire population falls in the rural category as there are no towns in the study area. The study area with special reference to the core zone villages has high proportions of SC population that is significantly higher than that at the State, district and taluk levels. The major sub castes of SC population inhabiting the area are *Holer, Madar, Rajput, Chouhan, Rathore* and *Poddar*. Though no significant deviations in the livelihood pattern from the general community can be observed, the SCs were reported to hold smaller landholdings and to be more dependent on agriculture and wage labour. Engagement of labourers, especially from the landless SC community in illegal stone mining and quarrying activities is a common phenomenon in the region.

Figure 7.13 ***Proportion of SC/ST Population in the villages of Study area vis-a-vis taluka/district***



Source: Primary Census Abstract, Census of India 2011

Karnataka accounts for amongst the lowest proportions of ST population in the Country (7%). Similarly, the presence of ST population is also low in the district (12.08%). Even the study area (Ramdurg taluk – 3.72%) records a significantly lower presence of the community. The ST population presence in the core and buffer zones is recorded to be 7.86% and 3.64% respectively. While Venkateshwara village, lying in the core zone, has the highest SC population in the study area, with a share of 100%, in the buffer zone, Mudakavi village accounts for a maximum of 25.73% STs.

7.6.6 Education Profile of Study Area

Educational Infrastructure

From the table below, it can be observed that only a few villages in the study area have pre-primary schools and all of them have primary schools. Some of them even have middle schools. However, only 7 villages have secondary and none have senior secondary schools. Community consultations on education revealed the poor scenario of infrastructure and an acute dearth of teachers in most schools in the region.

Table 7.22 ***Schools in the study area***

Village Name	No. of Pre-primary Schools	No. of Primary schools	No. of Middle schools	No. of Secondary schools	No. of Senior secondary schools
Core zone					
Somapur	1	1	0	0	0
Chennapur	0	3	2	0	0
Shirasapur	1	1	0	0	0
Chetan Nagar	0	1	0	0	0
Soppadla	1	1	1	0	0
Aneguddi	1	1	1	1	0

Village Name	No. of Pre-primary Schools	No. of Primary schools	No. of Middle schools	No. of Secondary schools	No. of Senior secondary schools
Total	***4***	***8***	***4***	***1***	***0***
Buffer zone					
Shivanakote	1	1	0	0	0
Dadibhavi Salapur	0	4	1	1	0
Naganur	0	2	1	0	0
Batkurki	1	4	2	1	0
Nandihal	0	1	1	1	0
Timmapur S.A.	0	1	0	0	0
Krishnanagar	1	1	0	0	0
Kalamad	0	3	0	0	0
Mudenur	0	2	1	1	0
Mudakavi	0	3	1	1	0
Venkateshwarnagar	0	1	0	0	0
Obalapur	0	3	5	2	0
Gokulnagar	1	1	0	0	0
Total	***4***	***27***	***12***	***7***	***0***

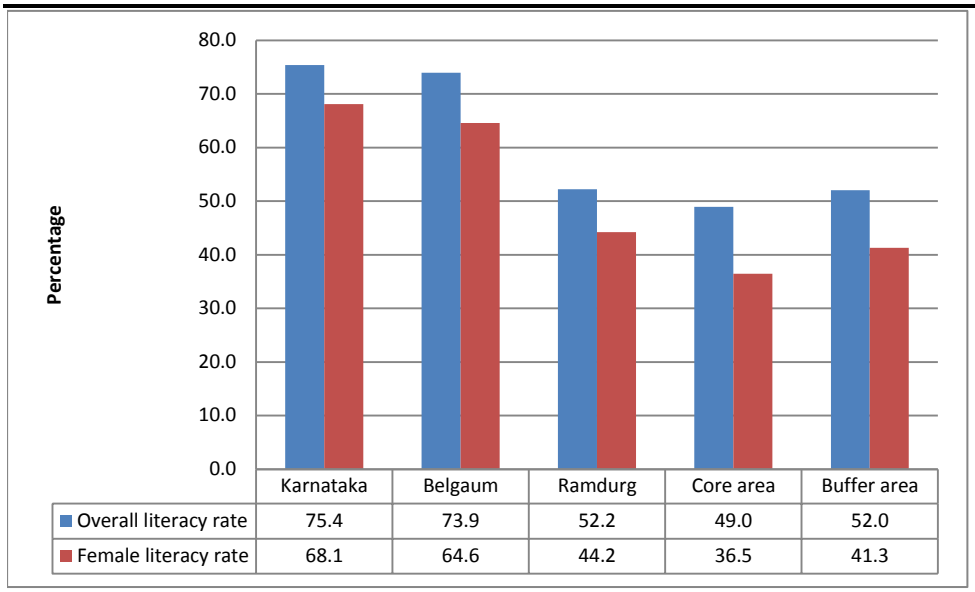
Source: Village Directory, 2011

There are 8 private and government pre-primary schools in the study area – 4 each in the core and buffer villages. Similarly, there are 4 middle schools in the core villages and 12 in the buffer villages. There are 8 secondary schools – all of them except for one are located in the buffer villages. Girla Khedi has the maximum number of schools i.e. 13. Obalapur has the highest number of schools – 10.

Literacy Rate

At 49 %, the overall literacy rate in the core area is the lowest. Similarly, the female literacy rate (36.5 %) in the core area is significantly lower when compared with the State, district, taluks and buffer zone data. Analysis of information furnished in ***Figure 7.14*** suggests that as we move down the administrative layers, the overall literacy rate as well as the female literacy rate declines. In fact, the gap between the overall literacy rate and female literacy rate in the State and the core zone is 7.3 % and 12.5 % respectively.

Figure 7.14 Literacy rates in the state, district, taluk, core and buffer area



Source: Primary Census Abstract, Census of India 2011

7.6.7 Occupation and Livelihood in the Study Area

Agriculture is the mainstay of the local economy of the study area. Cultivators and agricultural labourers constitute significant proportion among the various forms of occupation of the people in the study area. Classification of working population of the study area as per census 2011 data is presented in ***Table 7.23.***

Table 7.23 Occupational pattern in the study area[1]

Name	No. of HH	Total Population	Worker Participation Rate	Main Workers %	Marginal Workers %	Non-Workers %	Casual Labourers %	Agricultural Labourers %	Household Industry %	Other Workers %
Core zone										
Somapur	84.00	432.00	58.33	87.70	12.30	41.67	10.86	87.33	0.00	1.81
Chennapur	246.00	1415.00	50.67	96.09	3.91	49.33	35.12	46.30	2.76	15.82
Shirasapur	225.00	1347.00	45.14	85.53	14.47	54.86	39.62	22.88	0.19	37.31
Chetan Nagar	127.00	613.00	62.97	95.60	4.40	37.03	16.53	82.38	0.00	1.08
Soppadla	241.00	1320.00	55.08	90.37	9.63	44.92	21.61	54.49	8.37	15.53
Aneguddi	225.00	1235.00	58.46	47.09	52.91	41.54	62.94	12.35	0.00	24.71
Total	***1148.00***	***6362.00***	***53.63***	***81.95***	***18.05***	***46.37***	***31.80***	***47.75***	***2.68***	***17.78***
Buffer zone										
Shivanakote	140.00	791.00	52.34	97.83	2.17	47.66	40.25	59.75	0.00	0.00
Dadibhavi Salapur	853.00	4413.00	47.09	67.32	32.68	52.91	61.83	19.44	1.00	17.73
Naganur	290.00	1504.00	52.53	99.62	0.38	47.47	34.31	52.22	0.38	13.09
Batkurki	924.00	4603.00	44.60	94.20	5.80	55.40	33.76	31.90	0.62	33.71

1. According to the Census of India, Workers are classified as Main workers, Marginal workers, Non-workers, Workers engaged in cultivation, Agricultural labourers, Household industry workers and Other workers. url: http://censusindia.gov.in/Census_And_You/economic_activity.aspx. Accessed on 31.08.2016.

Name	No. of HH	Total Population	Worker Participation Rate	Main Workers %	Marginal Workers %	Non-Workers %	Casual Labourers %	Agricultural Labourers %	Household Industry %	Other Workers %
Nandihal	325.00	1840.00	48.53	98.88	1.12	51.47	68.86	17.67	1.02	12.46
Timmapur S.A.	62.00	483.00	50.72	98.78	1.22	49.28	83.88	12.40	0.00	3.72
Krishnanagar	128.00	600.00	50.50	57.10	42.90	49.50	50.87	36.99	0.58	11.56
Kalamad	165.00	977.00	54.86	57.65	42.35	45.14	46.60	27.18	2.27	23.95
Mudenur	616.00	3114.00	44.67	83.68	16.32	55.33	43.13	37.37	3.87	15.64
Mudakavi	518.00	2464.00	41.48	77.30	22.70	58.52	30.00	29.49	5.32	35.19
Venkateshwarnagar	191.00	1439.00	47.74	63.32	36.68	52.26	30.34	18.85	0.00	50.80
Obalapur	364.00	2178.00	45.45	95.66	4.34	54.55	49.52	16.16	0.53	33.79
Gokulnagar	148.00	1014.00	40.93	98.07	1.93	59.07	3.69	60.69	0.00	35.63
Total	***4724.00***	***25420.00***	***46.49***	***83.57***	***16.43***	***53.51***	***44.04***	***30.64***	***1.40***	***23.92***

Source: Primary Census Abstract, Census of India 2011

The average Work Participation Ratio (WPR)[1] in the core zone villages is 53.63 %. Chetan Nagar is observed to have the highest WPR at 62.97 % and Shirasapur (NP) has the lowest at 45.14 %. The average WPR in the buffer zone villages is 46.49 %. Kalamad is observed to have the highest WPR at 54.86 % and Gokulnagar has the lowest at 40.49 %. From the above table it can also be observed that agricultural labours are in a higher proportion than other workers in all villages in the core area except for Aneguddi. The higher presence of agricultural labourers in most villages was also established during consultations. The labourers are mostly engaged in the farmlands of large farmers.

Farm-based livelihood

The table also shows that a considerable proportion of working population in most of the villages in the study area are actually agricultural labours who work on farmlands owned by others at certain mutually negotiated wage rate between the cultivator and the agricultural worker. It was observed that a large majority of the agricultural workers belong to the SC and other backward castes. The observation was also validated through community consultations. The wage rate per day for an agriculture worker in the study area is reported to vary between INR 200 to INR 300.

The primary crops in the region comprise of Maize, Pulses (Tur and Urad), Sugarcane, Grape and Soybean amongst Kharif crops[2] and Wheat, Corn, Gram, Mustard, Onion, Tomatoes and Chillies being the Rabi crops[3].

1. Work Participation ratio (WPR) is defined as percentage of total workers including main and marginal workers out of the total population of the study area
2. Kharif crops or monsoon crops are domesticated plants cultivated and harvested during the rainy (monsoon) season in South Asia, which lasts between April and October depending on the area. Main Kharif crops are millet and rice.
3. Rabi crops are agricultural crops sown in winter and harvested in the spring in South Asia.

There is no systematic irrigation support extended to the region for which dependence on monsoons/ rain fed water for agriculture is extremely high. With the drying up of water bodies, the dependence on rain water further increases in the summer months of May and June. The depth of ground water demonstrates significant variations within the study area. Ground water in some Villages is reported to be found at a depth of 200 feet whereas in most villages, it is in the range of 300 – 700 feet. Water found beyond 500 feet in depth is poor in terms of quality making it unfit for human consumption.

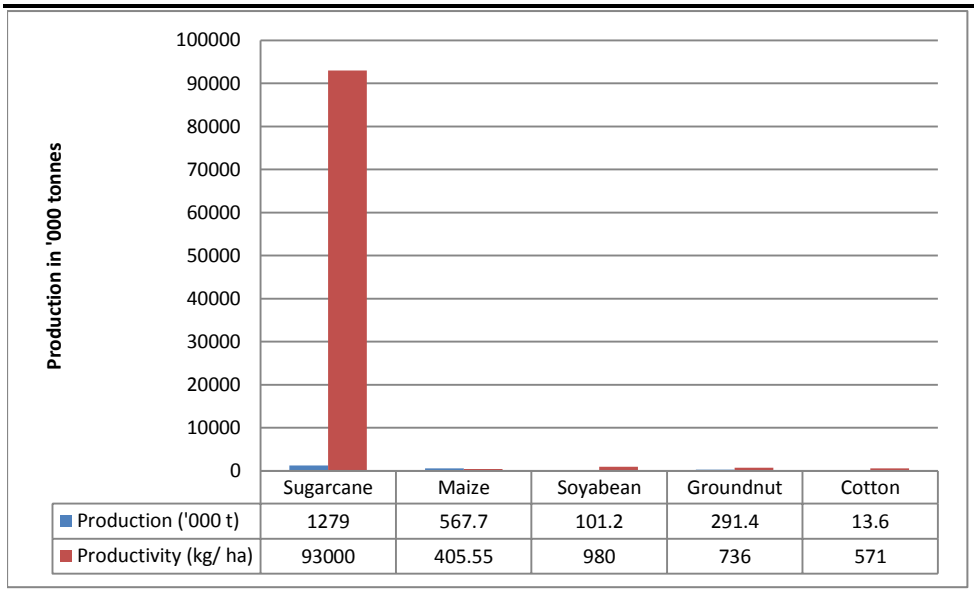
Table 7.24 ***Productivity and related costing of major crops in the study area***

Crop	Agricultural Season	Costing per Bigha	Production	Price per quintal (In Rs.)	Proceeds from 1 Bigha land
Soybean	June-October	Rs. 5,500 – 6,000	2-3 quintals	3,000-3,500	9,000-15,000
Maize	June-October		10 quintals		
Pulses	June-October		3-4 quintals		
Tomatoes	June-September	35,000			1,40,000
Wheat	November-April	Rs.5,000-10,000	9-14 quintals	1,200-1,600	9,000-23,000

Source: Community Consultations undertaken by ERM India, August, 2016

Though not as profitable as sugarcane, social consultations revealed that garlic and grape are the most stable cash crops cultivated in the region. The crops are cultivated on a mass scale by all categories of farmers – small, medium and large. Wheat has the highest relative productivity amongst all major crops grown in the area. Vegetables like onion, tomatoes, chillies, etc., have higher cost of labour and maintenance.

Figure 7.15 ***Average production and productivity of major crops in Belgaum between 2004 and 2008***



Source: Agricultural Contingency Plan, 2011, Belgaum district

Social consultations revealed that efforts through intense community consultations and village-level sensitization campaigns are being made by the

district Agriculture department in order to discourage farmers from taking up cultivation of water-intensive crops such as sugarcane. Farmers in the region are being encouraged to replace sugarcane with cultivation of less water-intensive crops such as pulses and sunflower.

Box 7.2 ***Expanding Vineyards: The case of increasing grape cultivation in the study area***

Consultations in the core villages of Chennapur and Shirasapur pointed towards an increasing inclination of farmers towards grape cultivation. Community elders revealed that though the climatic conditions in the region were conducive for developing grape yards, mass scale cultivation of grapes began only during the 1980s. Setting up of breweries in the neighboring state of Goa and improvement in transportation and communication are attributed as contributing factors towards the growing trend of grape cultivation in the entire district of Belgaum.

Apart from being highly organized with respect to pest treatment and irrigation, the large tracts of vineyards in the region have also provided employment opportunities to the local youth. It was reported that a grape farm measuring 2 acres required the engagement of at least 4 agricultural labourers. Only large vineyards built of land measuring more than 10 acres had set up roofed storage facilities for harvested grapes. The storage facilities were also observed to be used by small grape farmers at a mutually agreed price.


Source: ERM site visit on 23rd and 25th August, 2016

Livestock based livelihood

Unlike most other agrarian societies, livestock rearing is not a vital livelihood pursuit in the study area. However, there are some villages in which livestock holdings play an important part in the livelihoods of the community, in terms of providing extra income in addition to meeting the nutritional intake of the household. The main livestock holdings in the area comprise of cattle, buffaloes, goats and sheep. There were no reported households maintaining livestock holding for solely commercial purposes. However, several households reported rearing of cattle for meeting domestic milk requirements.

Figure 7.16 ***Livestock in the study area***

Source: ERM site visit on 23rd and 25th August, 2016

Community consultations revealed that the practice of livestock holding and cattle rearing was declining in the study area owing to growing food insecurity and growing availability of and inclination towards regular jobs, especially among the youth. There is only one major diary in the study area that is located in the local tehsil headquarters at Ramdurg.

Non-Farm based livelihood

Non-farm based livelihoods act as a supplementary source of income to the families in the area. The non-farm based livelihoods in the area primarily comprise of casual labour involved in the illegal stone mining and quarrying facilities in villages in the Ramdurg tehsil. Stakeholder consultations also suggested migration of people, either alone or with family, to the cities of Mumbai, Bellary and Bengaluru etc., during the agriculturally lean periods.

The setting up of Wind Power plants in the area is expected to provide employment opportunities, mostly to a member of the family whose land will be bought by the company for WTG during the construction stage. Even construction activities (mostly civil construction) in some wind farm projects are expected to be outsourced in the form of work contracts to local contractors. However, job security and regular payment of wages were identified by people as some of the plausible challenges that might be faced by the project proponent. Similarly, reduced engagement avenues for local youths during the operation phase of the project are also a serious area of concern.

7.6.8 Land use pattern in the study area

The study area has a predominantly agrarian economy for which dependence on land resources is considerably high. The table on land utilization reiterates the heavy dependence of people on agriculture (as mentioned in the preceding paragraphs), making it one of the primary sources of livelihood in the region.

The largest village in the core area is Aneguddi with 1383.14 hectares of total land area. It can also be observed that more than three-fourths (82.22%) of the total land in the core zone falls under the 'net sown' category. Forest land constitutes only 1.44% of the core area. Similarly, except for a negligible area of 0.57 acres in village Aneguddi, land under miscellaneous tree crops etc. is not found in any of the other core villages.

Table 7.25 Land use pattern in the study area

Village Name	Total Geographical Area (in Hectares)	Forest Area (in Hectares)	Area under Non-Agricultural Uses (in Hectares)	Barren & Un-cultivable Land Area (in Hectares)	Permanent Pastures and Other Grazing Land Area (in Hectares)	Land Under Miscellaneous Tree Crops etc. Area (in Hectares)	Culturable Waste Land Area (in Hectares)	Fallows Land other than Current Fallows Area (in Hectares)1	Current Fallows Area (in Hectares)2	Net Area Sown (in Hectares)3
Core zone										
Somapur	406.24	0	3.6	0	0	0	25.57	0	0	377.07
Chennapur	831.17	11.8	7.07	32.4	0	0	13.9	0	0	766
Shirasapur	697.9	29.8	3.3	0	0	0	0	2.5	638.6	23.7
Chetan Nagar	575.54	0	4.5	0	0	0	12.64	0	0	558.4
Soppadla	1122.69	0	4	13.59	0	0	0	0	0	1105.1
Aneguddi	1383.14	31	11.47	45.6	0	0.57	0	0	0	1294.5
Total	***5016.68***	***72.6***	***33.94***	***91.59***	***0***	***0.57***	***52.11***	***2.5***	***638.6***	***4124.77***
Buffer zone										
Shivanakote	389.87	0	6.07	0	0	0	5.1	0	0	378.7
Dadibhavi Salapur	2993.31	0	9.61	412.4	0	0.3	37.5	0	0	2533.5
Naganur	1641.81	0	7	71.81	0	0	58.5	0	0	1504.5
Batkurki	3174.38	0	8.98	112.6	0	0.1	111.4	0	0	2941.3
Nandihal	1383.18	0	7.98	20	0	0	16	0	0	1339.2
Timmapur S.A.	290.75	0	2.1	9.25	0	0	2	0	0	277.4
Krishnanagar	402.27	0	0	0	15.3	0.1	18.37	0	0	368.5
Kalamad	359.5	224.1	2.1	32.5	0	0	0	0	0	100.8
Mudenur	1955.02	382.8	2.3	40.4	0	0	20.42	0	0	1509.1
Mudakavi	1495.26	1084.4	3.28	53.18	0	0	0	0	0	354.4
Venkateshwarnagar	382.84	11.1	1	11	0	0	8.34	0	0	351.4
Obalapur	1125.03	465.8	3.3	57.23	0	0	55.7	0	0	543
Gokulnagar	384.73	258.1	8.2	0	0	0	4.73	0	0	113.7
Total	15977.95	2426.3	61.92	820.37	15.3	0.5	338.06	0	0	12315.5

Source: Village Directory, 2011

Among the buffer zone villages, Batkurki has the largest land area and also has the most area under cultivation. With 77.07% of land being categorized as net sown area, the total land under cultivation in the buffer zone is largely

1. Fallow land other than current fallow land are lands, which are taken up for cultivation but are temporarily out of cultivation for a period of not less than one year and not more than five years , i.e., equal or greater than one year but less than or equal to five years. The reasons for keeping such lands fallow may be one or more of the following:

i) Poverty of the cultivator
ii) Inadequate supply of water
iii) Malarial climate
iv) Silting of canals and rivers and
v) Unremunerative nature of farming

2. Current fallow area is the Cropped area which are kept fallow during the current year but was cultivated in the previous year. For example with any seeding area is not cropped in the same year, it may be treated as current fallow.
3. Net sown area is the total area sown with crops and orchards, counting area sown more than once in the same year, only once.

similar to that of the core zone. Presence of forest in the buffer zone villages is relatively higher with 15.18% of the total area being covered by forests.

It can be observed from the above table that only a tiny proportion of the agricultural land for both core and buffer area villages are Culturable waste land. Similarly, for the entire study area, measuring 20,994.63 hectares, the total fallow land (fallow land other than current fallow area + current fallow area) is only 0.007%.

Land Holding Pattern

Similar to the nation-wide problem of land fragmentation and consequent decline in landholding, Belgaum as well as the study area seems to be witnessing a brewing crisis of disintegration of land. In fact, the land holding pattern in Belgaum suggests a smaller than average size of land possession amongst the local communities. As a consequence, the agriculture sector is not faring well with respect to farm output as well as testing of advanced farming machineries and techniques that are generally employed on large tracts of cultivable land. Hence, it would be prudent to state here that the fragmented nature of land holdings have failed to contribute towards improved cultivation in the region.

Land holding pattern of the study area shows that majority famers in these areas are under small and medium categories of farmers. This trend of land holdings was also validated through the stakeholder consultation process including limited community consultations in the project area. It was noticed that the vulnerable section of the villages like people from the SC community are mostly under marginal category. The villages hardly had any landless families. An average family has about 2-3 acres of land.

7.6.9 Drinking water in the Study Area

All villages in the core zone have access to hand pumps and tube wells/ bore wells except for one - Chennapur. While, only one village - Shirasapur has access to covered wells and springs, only 3 villages – Somapur, Shirasapur and Aneguddi have access to treated tap water supply. 2 out of the 6 core villages for which information on drinking water could be sourced have access to tanks, ponds or lakes.

In the buffer zone, the scenario of drinking water is similar with all villages having access to hand pumps and tube wells/ bore wells. However, only 3 out of the 13 buffer villages have access to tap water, covered wells and springs. None of the villages in the study area have access to waterfall.

Box 7.3 Quenching thirst through water: The case of water scarcity in the study area

The study area suffers from an acute lack of clean and potable drinking water. With less than a quarter of the villages in the core and buffer zones having access to tap water and covered wells, water scarcity over the past few years has deteriorated further. Increasingly long spells of summer and a corresponding decline in rainfall are reported to have severely affected the water table in the region.

Besides lack of adequate availability of water, especially for drinking purposes, its continuing wastage in the form of discharge into waste water bodies and overflow from tanks has also contributed towards decaying of the overall water scenario in the region. Community consultations revealed that illegal stone quarrying and consequent dumping of the excavated material has impeded the percolation of rainwater into the soil that in turn has also contributed its share in the depletion of the water table in the region.

Source: ERM site visit on 23rd and 25th August, 2016

Table 7.26 Drinking water facilities in the study area

Village Name	Tap Water-Treated (Status A(1)/NA(2))	Tap Water Untreated (Status A(1)/NA(2))	Covered Well (Status A(1)/NA(2))	Uncovered Well (Status A(1)/NA(2))	Hand Pump (Status A(1)/NA(2))	Tube Wells/Borehole (Status A(1)/NA(2))	Tanks/Lakes Area (in Hectares)	Waterfall Area (in Hectares)
Core zone								
Somapur	1	1	2	1	1	1	20.4	0
Chennapur	2	2	2	2	1	2	0	0
Shirasapur	1	1	1	2	1	1	3.4	0
Chetan Nagar	2	2	2	1	1	1	0	0
Soppadla	2	2	2	1	1	1	0	0
Aneguddi	1	1	2	1	1	1	0	0
Buffer zone								
Shivanakote	1	2	1	1	1	1	50.5	0
Dadibhavi Salapur	2	2	2	1	1	1	0	0
Naganur	2	2	2	1	1	1	129.5	0
Batkurki	2	2	2	1	1	1	0	0
Nandihal	2	1	2	2	1	1	0	0
Timmapur S.A.	2	2	2	2	1	1	0	0
Krishnanagar	2	2	1	2	1	1	14.5	0
Kalamad	2	1	2	1	1	1	0	0
Mudenur	2	2	2	1	1	1	0	0
Mudakavi	2	1	2	1	1	1	0	0
Venkateshwarnagar	2	2	2	1	1	1	0	0
Obalapur	2	2	2	1	1	1	0	0
Gokulnagar	1	1	2	1	1	1	0	0

Source: Village Directory, 2011

7.6.10 *Sanitation in the Study Area*

Only 1 village in the buffer zone has been covered under the Total Sanitation Campaign (TSC). While all villages in the core area have access to some form of drainage – closed, open, open pucca covered with tile slabs, open pucca drainage uncovered or open kuccha drainage, only 2 villages – Shirasapur and Gokulnagar are covered by closed drainage. However, there are no dedicated Community Toilet Complexes, Community Biogas Plants or system for garbage collection in the core and buffer villages.

Table 7.27 Sanitation coverage in the study area

Village Name	Closed Drainage (Status A(1)/NA(2))	Open Drainage (Status A(1)/NA(2))	No Drainage (Status A(1)/NA(2))	Open Pucca Drainage Covered with Tiles Slabs (Status A(1)/NA(2))	Open Pucca Drainage Uncovered (Status A(1)/NA(2))	Open Kuccha Drainage (Status A(1)/NA(2))	Whether Drain water is discharged directly into water bodies or to sewar plant (For Water Bodies-1/Sewar Plants-2)	Is the Area Covered under Total Sanitation Campaign (TSC)? (Status A(1)/NA(2))	Community Toilet Complex (including Bath) for General Public (Status A(1)/NA(2))	Community waste disposal system after house to house collection (Status A(1)/NA(2))	Community Bio-gas or recycle of waste for production use (Status A(1)/NA(2))	No System (Garbage on road/street) (Status A(1)/NA(2))
Core area												
Somapur	2	1	2	2	1	1	1	2	2	2	2	1
Chennapur	2	1	2	1	2	1	1	2	2	2	2	1
Shirasapur	1	1	2	2	1	1	1	2	2	2	2	1
Chetan Nagar	2	1	2	1	2	1	1	2	2	2	2	1
Soppadla	2	1	2	2	2	1	1	2	2	2	2	1
Aneguddi	2	2	1	2	2	2	2	2	2	2	2	1
Buffer area												
Shivanakote	2	1	2	2	1	2	1	2	2	2	2	1
Dadibhavi Salapur	2	2	1	2	2	2	2	2	2	2	2	1
Naganur	2	2	1	2	2	2	2	2	2	2	2	1
Batkurki	2	2	1	2	2	2	2	2	2	2	2	1
Nandihal	2	1	2	2	1	2	1	2	2	2	2	1
Timmapur S.A.	2	2	1	2	2	2	2	2	2	2	2	1
Krishnanagar	2	1	2	2	1	2	1	2	2	2	2	1
Kalamad	2	1	2	1	2	2	1	2	2	2	2	1
Mudenur	2	2	1	2	2	2	2	2	2	2	2	1
Mudakavi	2	2	1	2	2	2	2	2	2	2	2	1
Venkateshwarnagar	2	1	2	2	2	1	1	1	2	2	2	1
Obalapur	2	1	2	2	2	1	1	2	2	2	2	1
Gokulnagar	1	2	2	2	2	2	1	2	2	2	2	1

Source: Village Directory, 2011

Less than 10 % (5.26%) of the villages in the buffer area are covered under the TSC. While all villages in the buffer area have access to some form of drainage – closed, open, open pucca covered with tile slabs, open pucca drainage uncovered or open kuccha drainage, only one village is covered by closed

drainage. Similarly, there are no dedicated Community Toilet Complexes for the general public or Community Biogas Plants in any of the buffer villages.

7.6.11 Irrigation in the Study Area

In the core zone, 95.18% of the total area under cultivation is unirrigated. While Shirasapur is the most irrigated village with 100% irrigation coverage, Chennapur is the least irrigated village with less than 10% (2.48%) irrigated farm lands. 88.09% of the irrigation water in the core villages is sourced from well/ tube wells. Canals and Waterfalls do not serve as sources for irrigation water in any of the core villages.

In the buffer zone, 15.12% of the total area under cultivation is irrigated. While Naganur is the most irrigated village with 42.71% irrigation coverage, Gokulnagar is the least irrigated village with 0% of its farmlands having access to irrigation. Only one village – Mudakavi has access to canal as a source of irrigation. None of the villages in the buffer zone use water from waterfalls for irrigation purpose.

The various sources of irrigation and the area irrigated in the study area comprising of the core and buffer villages have been indicated in the table below.

Table 7.28 Irrigation facilities in the study area

Village Name	Net Area Sown (in Hectares)	Total Unirrigated Land Area (in Hectares)	Area Irrigated by Source (in Hectares)	Canals Area (in Hectares)	Wells/Tube Wells Area (in Hectares)	Tanks/Lakes Area (in Hectares)	Waterfall Area (in Hectares)	Other Source (specify) Area (in Hectares)
Core area								
Somapur	377.07	315.27	61.8	0	41.4	20.4	0	0
Chennapur	766	747	19	0	19	0	0	0
Shirasapur	23.7	0	23.7	0	20.3	3.4	0	0
Chetan Nagar	558.4	533.9	24.5	0	24.5	0	0	0
Soppadla	1105.1	1066.6	38.5	0	38.5	0	0	0
Aneguddi	1294.5	1262.1	32.4	0	32.4	0	0	0
Total	***4124.77***	***3924.87***	***199.9***	***0***	***176.1***	***23.8***	***0***	
Buffer area								
Shivanakote	378.7	305.8	72.9	0	11.3	50.5	0	11.1
Dadibhavi Salapur	2533.5	2080.2	453.3	0	453.3	0	0	0
Naganur	1504.5	861.9	642.6	0	513.1	129.5	0	0
Batkurki	2941.3	2712.4	228.9	0	228.9	0	0	0
Nandihal	1339.2	1206	133.2	0	133.2	0	0	0
Timmapur S.A.	277.4	264.3	13.1	0	13.1	0	0	0
Krishnanagar	368.5	303.5	65	0	50.5	14.5	0	0
Kalamad	100.8	78.5	22.3	0	22.3	0	0	0
Mudenur	1509.1	1439.8	69.3	0	69.3	0	0	0
Mudakavi	354.4	260.2	94.2	90.1	4.1	0	0	0
Venkateshwarnagar	351.4	346.4	5	0	5	0	0	0
Obalapur	543	480.4	62.6	0	62.6	0	0	0
Gokulnagar	113.7	113.7	0	0	0	0	0	0
Total	***12315.5***	***10453.1***	***1862.4***	***90.1***	***1566.7***	***194.5***	***0***	***11.1***

Source: Village Directory, 2011

Community consultations in several villages pointed towards a rise in problems associated with irrigation and ensuing cultivation of water intensive crops. In fact in the core zone, several farmers in the Villages of Aneguddi and Naganur Tanda have already switched to either cultivation of crops that are less water intensive or have adopted a non-farm based livelihood. An increasingly erratic monsoon can also be held responsible for the phenomenon.

7.6.12 Social and Physical Infrastructure

Health facilities and health seeking behaviour

The health facilities in the study area are characterised by a three tier health infrastructure. The health facilities available at the village level comprise of Primary Health Sub Centres and Public Health Centres (PHC). While the sub centres cater to a population of 5,000 individuals, the PHCs are for a population of 10,000-30,000 individuals. While the PHCs are mostly for OPD (Out Patient Department) and basic IPD (Indoor Patient Department) cases, sub centres usually have a delivery room and 2 resident nurses (one male and one female). Each PHC has 5-6 sub centres under them. In turn, a cluster of 6-10 PHCs come under a CHC (Community Health Centre), which caters to a population exceeding 1 lakh, and also provides emergency services. The CHCs in turn report to the public hospitals at the district level.

While there is no Community Health Center (CHC) in the study area, there is only one Primary Health Center (PHC) at village Batkurki. The nearest CHC is located in Hosakoti. There are no maternity and child welfare centers. There are no Allopathic Hospitals, TB Clinics, dispensaries or Mobile Health Clinics operating in the study area.

The Auxiliary Nurse Midwife (ANM) guides the women of the villages regularly and there is a high adoption of institutional deliveries in the area, with the provision of Ambulance in the village to facilitate commutation of women to Government hospital at the time of delivery.

Roads and post offices

While none of the villages in the study area have access to National Highways, only 5 villages – Shirasapur in the core zone and Shivanakote, Batkurki, Obalapur and Gokulnagar in the buffer zone have access to State Highway Roads.

None of the villages have Post Offices. One village in the core – Shirasapur and three in the buffer zone – Shivanakote, Timmapur S.A. and Gokulnagar have sub-post offices. Similarly, post and telegraph services have been extended to only 3 villages in the buffer zone (Shivanakote, Obalapur and Gokulnagar). However, most villages fall within the mobile phone coverage area.

8 STAKEHOLDER ENGAGEMENT

8.1 INTRODUCTION

Stakeholder mapping refers to the process of identifying individuals or groups having influence over a project and assessing the effects of their actions on the project. Stakeholder mapping helps in identifying the different stakeholders as primary or secondary based on the degree of influence on a project and by analysing the stakes or interest each of them has in the project and the manner in which both the stakeholder group as well as the project can benefit from each other.

Box 8.1 Who is a Stakeholder?

"A stakeholder is defined as a party that has an interest in an enterprise or project. The primary stakeholders in a typical corporation are its investors, employees, customers and suppliers. However, modern theory goes beyond this conventional notion to embrace additional stakeholders such as the community, government and trade associations"[1]

Stakeholder identification and their inclusion in the decision making process is critical in prioritizing, analysing and addressing issues; and developing management systems and mechanisms to address their respective concerns as well as apprehensions. This also helps in instilling trust within stakeholders regarding the project.

For the purpose of the project, stakeholder mapping has been carried out with the following objectives;

- Identify relevant stakeholder groups;
- Study the profile and characteristics and the nature of stakes each stakeholder group has;
- Assess their respective influence levels on the project; and
- Appreciate the precise issues and concerns as well as the expectations from the project that each group possesses.

8.2 STAKEHOLDER CONSULTATION AND DISCLOSURE REQUIREMENT FOR THE PROJECT

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

1. url: http://www.investopedia.com/terms/s/stakeholder.asp. Accessed on 28.09.2015.

Table 8.1 Overview of Disclosure and Stakeholder Consultation Requirement

Institution/ Regulatory Body	Reference Regulation/ Standard	Requirements
IFC	PS-1 (Assessment and Management of Environmental and Social Risks and Impacts)	• Community engagement is to be undertaken with the affected communities and must be free of external manipulation, interference, or coercion, and intimidation. • Furthermore, in situations where an affected community may be subject to risks or adverse impacts from a project, the proponent must undertake a process of consultation so as to provide the affected communities with an opportunity to express their views on the project risks, impacts, and mitigation measures, as well as allow the proponents to consider and respond to them. • *Informed participation:* For projects with significant adverse impacts on affected communities, the consultation process must ensure that free, prior and informed consultation with affected communities occurs and that processes exist to facilitate participation by those affected. • Apart from such a consultation process, the project proponents are also to establish a Grievance Redressal Mechanism, which will allow the affected communities' concerns and grievances about the project proponent's environmental and social performance to be received and allow for steps to be taken to resolve the same • *Broader stakeholder engagement:* The proponent must identify and engage with stakeholders that are not directly affected by the project but those that have established relationships with local communities and/or interest in the project – local government, civil society organizations, etc. – and establish a dialogue.

8.3 STAKEHOLDER CATEGORIZATION

A stakeholder is "any identifiable group or individual who can affect the achievement of an organization's objectives or who is affected by the achievement of an organization's objectives"[1]. Stakeholders thus vary in terms of degree of interest, influence and control they have over the project. While those stakeholders who have a direct impact on or are directly impacted by the project are known as **Primary Stakeholders,** those who have an indirect impact or are indirectly impacted are known as **Secondary Stakeholders**. Keeping in mind the nature of the project and its setting, the stakeholders have been identified and listed in the table given below.

1.Freeman, R. and Reed, D. (1983). Stockholders and Stakeholders: A new perspective on Corporate Governance. *California Management Review.* pp. 88 – 106.

Table 8.2 Stakeholder Group Categorization

Stakeholder Groups	Primary Stakeholders	Secondary Stakeholders
Community	• Land Sellers • Developers and EPC Contractors • Local Labourers	• Local community • Vulnerable Communities • Agricultural Labourers
Institutional Stakeholders	• Gram Panchayats	• Civil Society/ Local NGOs
Government Bodies	• Regulatory Authorities; • District Administration	
Other Groups	• Migrant Workforce	

8.4 APPROACH AND METHODOLOGY FOR STAKEHOLDER ANALYSIS

The significance of a stakeholder group is categorized considering the magnitude of impact (type, extent, duration, scale and frequency) or degree of influence (power and proximity) of a stakeholder group and urgency/likelihood of the impact/influence associated with the particular stakeholder group in the project context. The magnitude of stakeholder impact/influence is assessed taking the power/responsibility and proximity of the stakeholder group and the group is consequently categorized as negligible, small, medium or large. The urgency or likelihood of the impact on/influence by the stakeholder is assessed in a scale of low, medium and high. The overall significance of the stakeholder group is assessed as per the matrix provided below (***Table 8.3***):

Table 8.3 Stakeholder Significance and Engagement Requirement

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

8.5 STAKEHOLDER ANALYSIS

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

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

- ***Low Influence:*** This implies a low degree of influence of the stakeholder on the project in terms of participation and decision making or low priority to engage that stakeholder.

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

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

Table 8.4 Stakeholder Analysis

Stakeholder Category	Relevant Stakeholders	Profile/Status	Impact/Influence of the project on this Stakeholder Group	Impact/Influence of the Stakeholder Group on the project	Expectations, Opinions Key Concerns of Stakeholders	Overall Rating of Stakeholder Influence
Primary Stakeholder	Land sellers	• The project involves procurement of only private land; • It was reported that land already purchased as well as proposed to be procured for the project were/ are being used for agriculture purpose; • Though the sale of land will not result in physical dislocation, whether any of the land sellers will be rendered landless or not could not be ascertained; • The agricultural census of India defines farmers on the basis of the following; o Marginal – Farmers having less than one hectare of land; o Small – Farmers having between one and two hectares of land; o Semi-medium – Farmers having between two and four hectares of land; o Medium – Farmers having between four and ten hectares of land; and o Large – Farmers	• Constituting the most critical stakeholder group, landowners who will sell land for the project have previously seen the process of land purchase as several windfarm projects have been set up in the area for over 15 – 20 years; • It was reported that the client is following the willing seller – willing buyer process under the ambit of law; • The level of impact of loss of land could not be ascertained as the proportion of the total landholdings of the land owners proposed to be purchased is not known; and • The land losers will also be benefitted by means of the local employment opportunities that	• Though the stakeholder category could not be consulted with, general community consultations in the core villages pointed towards the demand of the land sellers which included allocation of construction work relating to the project and employment during the construction as well as operation phases.	• The major concern of the stakeholder group is that of accessing employment opportunities that the project will generate.	High

Stakeholder Category	Relevant Stakeholders	Profile/Status	Impact/Influence of the project on this Stakeholder Group	Impact/Influence of the Stakeholder Group on the project	Expectations, Opinions Key Concerns of Stakeholders	Overall Rating of Stakeholder Influence
		having more than 10 hectares of land • However, in the project area, the common perception regarding farmer categorization is as follows; o Landowners with less than 4 acres are small farmers; o With 4-6 acres are medium farmers; and o Above 6 acres are large landowners; and • Farming is the primary source of living for most families in the study area but, the actual area of cultivation is considerably lower owing to the lack of adequate water and any irrigation facilities. Highly unpredictable pattern of rain coupled with frequent droughts often leads to poor farm yield/ productivity.	will be generated for which they will be provided preference.			
	Developers and EPC Contractors	Gamesa is the developer for the project and will be responsible for construction, operation and maintenance of the project. Madhav Infra and Edison Power, the two land aggregators appointed by Gamesa are directly responsible for community	• Hassle-free procurement of the identified plots of land for the project; and • Smooth operation of the construction activity and to complete the work	• Non-compliance to the legal requirements; • Not meeting the community expectations; and • Leaving behind a legacy of	The contractors and sub-contractors play an important role during the project construction phase for timely commissioning of the project with quality construction	Medium

Stakeholder Category	Relevant Stakeholders	Profile/Status	Impact/Influence of the project on this Stakeholder Group	Impact/Influence of the Stakeholder Group on the project	Expectations, Opinions Key Concerns of Stakeholders	Overall Rating of Stakeholder Influence
		liasoning and for land purchase/land lease process.	within the scheduled time and cost.	conflict ridden relationship with local communities.	and within the stipulated budgetary provisions.	
	Local Labourers	• A considerable section of the working population of the local area are agriculture labourers; • Due to the lack of industries in the region, the availability of employment in the unskilled category is limited; and • However, during the harvesting season, availability of unskilled labour is a concern.	The local wage earners have developed high expectations for employment in the project.	• Any labour unrest and protests will cause delays in construction schedule and create a non-congenial social atmosphere; and • The project delay will have financial implications on the project.	The major concerns of this stakeholder group includes; • Regular payment of wages for the work rendered; • Continued employment even beyond the completion of construction work; • Health and Safety issues at work; and • Holidays and leaves as per labour laws applicable etc.	Medium
	Gram Panchayats (GPs)	• Constituting the lowest strata of Decentralized Local Governance in the Country, a typical Panchayat consists of one or more revenue villages. This body of local governance was created through the 73rdAmendment to the Constitution of India; and • Sarpanch and other	The project will create collective benefit for the local community.	GPs play an important role in overall mobilization and shaping the perception and opinions of the people in the project area. They also serve as the official forum for consent and approval required for the project.	The expectations/ concerns of the GPs include; • Employment Opportunities for the Local Youth; • CSR activities for development of local area; and • Nature of	Medium

Stakeholder Category	Relevant Stakeholders	Profile/Status	Impact/Influence of the project on this Stakeholder Group	Impact/Influence of the Stakeholder Group on the project	Expectations, Opinions Key Concerns of Stakeholders	Overall Rating of Stakeholder Influence
		members of the Gram Panchayat need to be actively involved in various activities relating to the economic development and social justice of their Panchayat. The smooth and hassle-free functioning of the project is also the onus of the Panchayats.			impact that the project would have on the livelihoods of communities.	
	Regulatory Authorities	• The office of District Industries Commissioner (DIC) regulates Industrialization at the District Level; and • Karnataka Transmission Corporation Limited for power evacuation/grid connectivity etc.	The project has complied with the applicable regulatory framework comprising of the guidelines and policies of the State Government such as the Karnataka Renewable Energy Policy 2014-2020. Permission and coordination with the District Industries Centre, Belgaum is mandatory for creation of local infrastructure and smooth operation of the industry.	-	The sole expectation of the Regulatory Authorities from the project Proponents is abidance to all applicable guidelines, policies and laws;	Low
	District/Tehsil Administration	• The project area is administered at three levels by different Government Bodies: at the district level, at the block/tehsil level and at the Panchayat level in each village/or cluster of villages; • In this context, local	The process of land registration has been completed for 29 out of the 30 WTGs proposed for the project with negotiations for purchase of land parcel for the 30th WTG underway. The status of registration of land for other	There are several permissions and regulatory approvals that are required prior to as well as after the construction of the project from the District Administration. Delay in issuance of	The key concerns of the District Administration authorities might include; • Matters concerning local employment; • Preference to local youths in	Low

Stakeholder Category	Relevant Stakeholders	Profile/Status	Impact/Influence of the project on this Stakeholder Group	Impact/Influence of the Stakeholder Group on the project	Expectations, Opinions Key Concerns of Stakeholders	Overall Rating of Stakeholder Influence
		administration refers to the district level and block level administration comprising of the offices of the Tehsildaar, District Magistrate Collectors, and Revenue officer etc.; and • The sub-registrar of the revenue department is responsible for registration of sale of land, land mutation, updating of records of transfer of land.	components of the project is not known at this stage. The District Administration is expected to play a significant role in the matter.	the relevant permits can adversely impact the timely execution of the project. Similarly, unresolved matters relating to land such as litigation, non-payment of compensation and encroachment might create complications, drag the firm into legal disputes thereby delaying project execution.	matters of vehicle hire and issuance of contract job etc.; and • Local area development through CSR interventions.	
	Migrant Workforce	• Project-related construction activities have been started by three contractors – ABG, Annie and PRV constructions. The present migrant workforce engagement on site is estimated to be 35-40. However, no projections regarding the scale of engagement of migrant workforce in the future were shared.	• Migrant workers may see this as a better economic and livelihood opportunity for them; and • The fluctuation of the supply of local labour in harvest and other agricultural peak seasons can be met by deployment of migrant workers.	Retaining the migrant workforce, especially during the construction phase of the project is extremely critical. This is because there are similar experiences of the lack of availability of manpower in the local area.	The major concerns of this stakeholder group may include; • Regular payment of wages for the work rendered; • Continued employment even beyond the completion of construction work; • Health and Safety issues at work; • Holidays and leaves as per labour laws applicable etc.;	Low

Stakeholder Category	Relevant Stakeholders	Profile/Status	Impact/Influence of the project on this Stakeholder Group	Impact/Influence of the Stakeholder Group on the project	Expectations, Opinions Key Concerns of Stakeholders	Overall Rating of Stakeholder Influence
					and • Issues relating to conflicts with the local labour and host community.	
Secondary Stakeholders	Local Community	• The stakeholder group comprising of local communities around a radius of 2 kms (Core Villages) inhabit the Villages of Chennapur, Shirasapur, Aneguddi, Naganur Tanda, Batkurki Tanda, Somapur, Chetan Nagar and Soppadla; • The study area comprises of; o General Castes: Brahmins, Lingayats, Marathis and Reddys; o SC: Holer, Madar, Rajput, Chouhan, Rathore and Poddar; o ST: Chamars, Balais, Malis, Lambani, Nayak and Valmiki etc.; and o Minorities: Muslims, mostly Sunni • 52.59 % and 29.18 % of the population in the Core and Buffer Villages respectively are SCs with corresponding presence of only 7.86 % and 3.64 %	• There are several community members who might be indirectly dependent on the land proposed to be sold to the project, and hence have to be compensated through adequate entitlements. • In addition, the CSR activities focused on education and health, among others should also target at the neighbouring villages and the immediate local community which will lead to improvement in livelihood.	The broad support of the local community will create a hindrance or risk free business process.	• Expectations of getting employment benefits from the project; and • Growing community demands for implementing welfare interventions in the region by the project Proponent.	Low

Stakeholder Category	Relevant Stakeholders	Profile/Status	Impact/Influence of the project on this Stakeholder Group	Impact/Influence of the Stakeholder Group on the project	Expectations, Opinions Key Concerns of Stakeholders	Overall Rating of Stakeholder Influence
		STs; and • The community in the study area is primarily dependent on agriculture followed by wage labour and other activities etc. such as stone mining and quarrying. Livestock rearing is not a major source of living.				
	Vulnerable Communities	This stakeholder group comprises of SC and ST Communities in the study area. As indicated earlier, while SCs account for 52.59 % and 29.18 % of the total population in the core and buffer villages; the corresponding presence of STs is reported to be 7.86 % and 3.64 %.	In view of the poor social and economic conditions of the Vulnerable Communities, the project Proponent may have to provide engagement avenues to its members.	The stakeholder group will have a negligible impact on the project.	Key concerns of this stakeholder group will primarily revolve around targeted support being extended for availing the benefits of community interventions by the project Proponent.	Low
	Agricultural Labourers	There are only a few large farmers in the study area. Most of the farmers are small to marginal farmers who cultivate their land and work as agricultural labourers in neighboring farms also.	Land for the project is located on private land of the locals that are largely rain fed.			Low
	Civil Society/Local NGOs	• The local NGOs, mostly based out of the Cities of Belgaum, Bijapur and in the bordering regions of Maharashtra are acting as a social watchdog in matters relating to	With respect to contributing towards the cause of local development, the project proponent can either participate in the ongoing developmental	• The NGOs and Civil Society Groups often play a critical role in bringing to the limelight the issues of	The opinion of the NGOs and Civil Society Groups towards a project is determined largely by whether the impacts of setting up	Low

Stakeholder Category	Relevant Stakeholders	Profile/Status	Impact/Influence of the project on this Stakeholder Group	Impact/Influence of the Stakeholder Group on the project	Expectations, Opinions Key Concerns of Stakeholders	Overall Rating of Stakeholder Influence
		securing the livelihoods of rural communities along with their related socio-cultural facets; and • However, the number of such NGOs active in the study area is highly limited.	activities of the Government or might take up interventions on its own or through partnerships with NGOs and CBOs after obtaining prior approval from competent authorities.	vulnerable communities in the society; and • They can also play a major role in community mobilization, building trust and even participate in implementing CSR initiatives.	of the development venture is being viewed/ perceived in positive light by the local population with special reference to the vulnerable communities or not. The key concerns of this stakeholder group centres around justice and equal opportunities in matters of economic and social development being provided to the Vulnerable Communities.	

Note: It is significant to note that the stakeholder analysis is based on the current situation. The stakeholder influence on the project is dynamic and may change during the project life. Consequently, the stakeholder analysis needs periodical reassessment and updating.

Summary of overall stakeholder influence is presented in the ***Table 8.5.***

Table 8.5 Summary of overall stakeholder influence

Stakeholder Category	Relevant Stakeholders	Magnitude of Influence/Impact	Urgency/ Likelihood of Influence	Overall Rating of Stakeholder Influence
Primary stakeholder	Land Sellers	High	High	High
	Developers and EPC Contractors	Medium	Medium	Medium
	Local Labourers	Negligible	Medium	Medium
	Gram Panchayats	Medium	Negligible	Medium
	Regulatory Authorities	Negligible	Negligible	Low
	District/Tehsil Administration	Negligible	Negligible	Low
	Migrant Workforce	Negligible	Negligible	Low
Secondary Stakeholders	Local Community	Negligible	Negligible	Low
	Vulnerable Communities	Negligible	Negligible	Low
	Agricultural Labourers	Negligible	Negligible	Low
	Civil Society/Local NGOs	Negligible	Negligible	Low

9 IMPACT ASSESSMENT AND MITIGATION MEASURES

9.1 INTRODUCTION

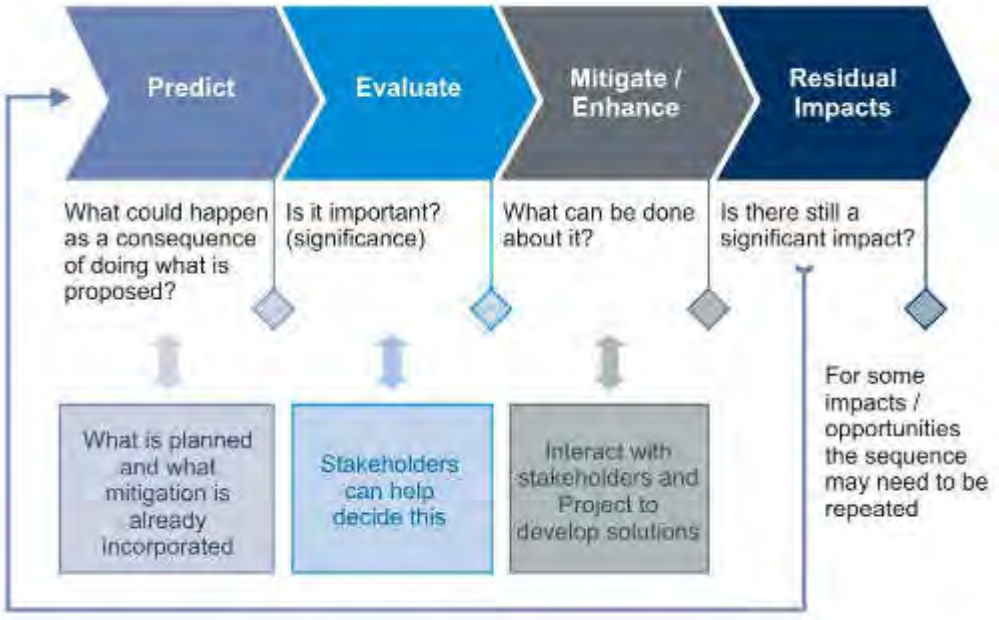
This section assesses the manner in which the Project will interact with elements of the physical, ecological or social environment to produce impacts to resources/ receptors. It has been organized as per the various phases of the Project life cycle to understand the risks and impacts associated with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

9.2 ASSESSMENT METHODOLOGY

Impact identification and assessment starts with scoping and continues through the remainder of the IA Process. The principal IA steps are summarized in ***Figure 9.1*** and comprises of

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

Figure 9.1 Impact Assessment Process



Prediction of Impacts

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

Evaluation of Impacts

Each impact was described in terms of its various relevant characteristics (e.g., type, scale, duration, frequency, extent). The terminology used to describe impact characteristics is shown in ***Table 9.1.***

Table 9.1 Impact Characteristic Terminology

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

The definitions for the type designations are given in ***Table 9.2***. Definitions for the other designations are resource/receptor-specific.

Table 9.2 Impact Type Definitions

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

The above characteristics and definitions apply to planned and unplanned events. An additional characteristic that pertains only to unplanned events is likelihood. The likelihood of an unplanned event occurring was designated using a qualitative scale, as described in ***Table 9.3.***

Table 9.3 Definitions of Likelihood Designations

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

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

- Extent
- Duration
- Scale
- Frequency

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

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

- Positive
- Negligible
- Small
- Medium
- Large

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

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

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

- Low
- Medium
- High

Once magnitude of impact and sensitivity/ vulnerability/ importance of resource/ receptor have been characterised, the significance was assigned for each impact. Impact significance is designated using the matrix shown in ***Figure 9.2***

Figure 9.2 ***Impact Significance***

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

The matrix applies universally to all resources/receptors, and all impacts to these resources/receptors, as the resource/receptor-specific considerations are factored into the assignment of magnitude and sensitivity/ vulnerability/ importance designations that enter into the matrix. ***Box 9.1*** provides a context of what the various impact significance ratings imply.

Box 9.1 Context of Impact Significance

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

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

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

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

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

An activity – impact interaction matrix for construction and operation phases of the Project is presented in ***Table 5.1***, which has been further used to assess the impact significance at activity levels on environmental, ecological and social resources.

Identification of Mitigation and Enhancement Measures

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

- Avoid at Source, Reduce at Source: avoiding or reducing at source through the design of the Project.
- Abate on Site: add something to the design to abate the impact.
- Abate at Receptor: if an impact cannot be abated on-site then control measures can be implemented off-site.
- Repair or Remedy: some impacts involve unavoidable damage to a resource (e.g. agricultural land and forestry due to creating access, work camps or materials storage areas) and these impacts can be addressed through repair, restoration or reinstatement measures.

- Compensate in Kind, Compensate Through Other Means: where other mitigation approaches are not possible or fully effective, then compensation for loss, damage and disturbance might be appropriate (e.g., planting to replace damaged vegetation, financial compensation for damaged crops or providing community facilities for loss of fisheries, access, recreation and amenity space).

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

Management and Monitoring

The final stage in the IA Process was the definition of the basic management and monitoring measures that are needed to identify whether: a) impacts or their associated Project components remain in conformance with applicable standards/ guidelines; and b) mitigation measures are effectively addressing impacts and compensatory measures and offsets are reducing effects to the extent predicted. This is covered in ***Section 10*** under environmental and social management plan (ESMP).

9.3 KEY ENVIRONMENTAL RISKS

Interactions that are likely to lead to significant impacts as identified during the scoping exercise (refer to ***Section 5.3.1***) and baseline conditions (***Section 7.4***) are presented ***Table 9.4***.

Table 9.4 Environmental Interactions identified that are likely to result in significant impacts

Resource/Receptor	Potentially Significant Impacts
Land Use	• Temporary changes in land use due to construction of temporary structures such as stockyard and batching plant; • Permanent changes in land use due to construction of access, site office, erection of WTGs and EHV towers;
Soil / Land Environment	• Decrease of soil quality due to loss of vegetation cover; • Erosion of loose soil during monsoon season and windy periods; • Removal of top soil at WTGs, ancillary facilities and transmission tower sites; • Sedimentation of nearby water bodies due to excessive soil erosion and run-off; • Storage and handling of hazardous materials (e.g., fuel and lubricant) and waste generated from operation of construction equipment and machinery and their maintenance may lead to soil contamination due to leaks/ spillage; • Impact on soil and land environment due to improper

Resource/Receptor	Potentially Significant Impacts
	management of domestic solid waste generated; • Generation of construction and demolition debris;
Ambient Air Quality	• Fugitive dust emissions due to movement of machinery and vehicles; • Dust emissions due to operation of batching plant, excavation and back-filling activities etc.; and • Air emissions due to operations of DG sets
Water Environment	• Usage of ground water for construction activities • Surface water contamination due to improper disposal of sewage at site
Ambient Noise Quality	• Noise generation due to movement of vehicles, heavy earth moving vehicles and machineries • Noise generation due to operation of batching plant, DG set • Noise generation due to operation of WTGs
Impacts on Nearby Establishments (Shadow Flicker)	• There are a several settlement areas within 500 m from the WTG locations which might experience shadow flicker. • For these receptors the number of hours in a year they are likely to experience shadow flicker has been assessed.
Occupational Health and Safety	• Occupational health hazards due to dust and noise pollution; • Safety risk due to wrong handling of construction machinery, working at heights and falling objects; and • Exposure of workers to electromagnetic field (EMF) while working in proximity to charged electric power lines during operation and maintenance.

9.3.1 Change in Land Use

For the purpose of assessment of impacts on land use of the area, following project activities leading to an alteration in land use of the area during construction phase were considered:

- Construction/ strengthening of access roads;
- Site clearance and preparation for WTG, PSS and EHV line;
- Establishment and operation of batching plant; and
- Transient storage of WTG components.

Criteria

For the assessment of land use, the sensitivity and magnitude criteria outline in ***Table 9.5*** and ***Table 9.6*** have been used respectively.

Table 9.5 Sensitivity Assessment Criteria for Land Use

Land Use Sensitivity	Criteria
Low	• Land use not of relevant use by Community • Negligible visual change.
Medium	• Land use of local use by communities e.g. grazing, agriculture, but no major dependence • Visual Change but common feature
High	• Land use of regional importance. Change would impact Land use classification of the area. • Land use of major dependence of local people for agriculture, livestock grazing, settlement etc. • Visual Change aesthetically affecting locals.

Table 9.6 Criteria for Impact Magnitude for Assessment of Impact to Land Use

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

Context and Receptor Sensitivity

The study area consists largely of private agricultural land with patches of Reserve Forest, scrubland and stone quarries. All WTG locations are on agricultural land which is currently being used by locals and therefore the change in land use has been categorized as **medium** as per ***Table 9.5.***

Embedded/In-built Controls

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

Impact Magnitude

The Project area has a good infrastructure and therefore only changes in land use will be on land where WTGs have been erected, access road from the main village road to the individual WTGs, batching plant site, site office and stockyard site, pooling substation and any erected EHV line towers. The total acreage for the land used for the above is approximately 142 acres. As a majority of the above changes are reversible and will occur for only the life cycle of the wind farm (~ 20 years), the impact magnitude has been assessed to be **small**.

Significance of Impact

The overall impact significance will therefore be **minor.**

Additional Enhancement Measures

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

Residual Impact Significance

The residual impact significance will remain **minor** as the change in land-use will be evident for only the 6-7 month period when construction activities are ongoing. Long-term changes in land-use including erected WTGs, access roads and transmission towers would not create a significantly noticeable change in land use character and can be restored to pre-project levels after the decommissioning phase of the project.

Impact	Changes in Land use during construction and operation				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to WTG footprint, construction areas and associated facilities				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource /Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **minor.**				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **minor.**				

9.3.2 *Impact on Topography and Drainage*

For the purpose of assessment of impacts on topography and drainage of the area, sensitivity and magnitude criteria have been outlined in ***Table 9.7*** and ***Table 9.8*** respectively.

Table 9.7 Sensitivity Assessment Criteria for Topography

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

Table 9.8 Criteria for Impact Magnitude for Assessment of Impacts on Topography and Drainage

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

Receptor Sensitivity

The project area exhibits flat topography with undulation in some parts. There is no water bodies located in a 1 km radius of the proposed WTGs. The receptor sensitivity has been assessed to be **low** because of the gentle slope and lack of water bodies in the immediate vicinity.

Impact Magnitude

The closest water bodies to the Project site is part of existing stone quarries, which have already considerably changed topography and drainage channels in the area. Topography may be changed slightly due the construction of approach roads, excavation work for proposed WTGs and ancillary facilities. The changes would be small and restricted to the immediate vicinity of the project components. The impact magnitude has therefore been assessed as **small** because it can be best described as a subtle change affecting a wider area and can eventually be reversed completely.

Embedded/In-built Control

The EPC contractor will be instructed to avoid any unnecessary changes in the topography. Water bodies and hilly terrain should be particularly avoided when constructing access roads or planning the transmission line pathway. Appropriate number of cross drainage channels should be provided during access road construction to maintain flow in existing natural channels.

Significance of Impacts

Topographic changes will be limited to the Project footprint and impact on drainage channels should be **negligible** because of the distance from proposed WTG locations. Any significant changes in topography can be avoided during access road construction and transmission line laying by avoiding hilly areas and water bodies.

Additional Enhancement Measures

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

Impact	Change in topography and drainage				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to project site (specifically WTG locations, internal roads, laydown areas and batching plant)				
Frequency	Several times during construction phase				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **negligible**				

9.3.3 *Impact on Soil Environment*

Project Phases and Associated Activities

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

Construction Phase

- Construction/strengthening of access roads;

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

Operational Phase

- Storage of oil and lubricants onsite; and
- Storage of waste materials onsite.

Decommissioning Phase

- Removal of WTGs; and
- Removal of infrastructure.

For the assessment of soil quality, the sensitivity and magnitude criteria is outlined in ***Table 9.9*** and ***Table 9.10*** respectively.

Table 9.9 Sensitivity Assessment Criteria for Soil Quality (compaction, erosion and contamination)

Sensitivity Criteria	Contributing Criteria	
	Environment	*Social*
Soil Quality related criteria as compaction, erosion and contamination and Landuse change	The extent to which the soil and its quality plays an ecosystem role in terms of supporting biodiversity. This includes its role as in supporting a lifecycle stage	The extent to which the soil and its quality provides a use (agricultural use) to the local communities and businesses, or is important in terms of national resource protection objectives, targets and legislation
Low	• The soil quality does not support diverse habitat or populations and/or supports habitat or population of low quality	• The soil quality has little or no role in provisioning of services as agricultural uses for the local community.
Medium	• The soil quality supports diverse habitat or population of flora and fauna and supports habitats commonly available in the study area	• The soil has local importance in terms of provisioning services as agricultural services but there is ample capacity and / or adequate opportunity for alternative sources of comparable quality i.e. ready availability across the study area.
High	• The soil quality supports economically important or biologically unique species or provides essential habitat for such species.	• The soil is wholly relied upon locally, with no suitable technically or economically feasible alternatives, or is important at a regional level for provisioning services.

Table 9.10 Criteria for Impact Magnitude for Assessment of Impact to Soil

Magnitude Criteria	Negligible	Small	medium	Large
Soil compaction	• Qualitative-	• Perceptible	• Clearly evident	• Major (e.g.

Magnitude Criteria	Negligible	Small	medium	Large
and erosion	No perceptible or readily measurable change from baseline conditions • Scale- Localized area as Particular activity areas • Time-Short duration (few days) or one time as temporary	change from baseline conditions but likely to easily revert back to earlier stage with mitigation • Scale- -Project site, activity areas and immediate vicinity not impacting any sensitive receptor • Short term- Only during particular activities or phase of the project lifecycle as civil works or construction phase (few months)	(e.g. perceptible and readily measurable) change from baseline conditions and/or likely take time to revert back to earlier stage with mitigation • Scale- Project site, activity areas and immediate vicinity impacting sensitive receptor/s • Long term- Spread across several phases of the project lifecycle (few years)	order of magnitude) change in comparison to baseline conditions and/or likely difficult or may not to revert back to earlier stage with mitigation • Scale- Regional or international; • Permanent change
Soil contamination	Well within Dutch standard[1]	Well within Dutch standard[2]	Exceeds Target Value but well within Interventional Value	Exceeds Interventional Value and needs intervention.

Receptor Sensitivity

The receptor sensitivity has been assessed as **medium** because of the preponderance of agriculture as a source of livelihood in the area but ample availability of land for alternate patches of agricultural land. Furthermore, the wind farm is small in comparison to other industries and requires a small amount of land for its construction.

Even though the receptor sensitivity has been assessed as only medium, it should be noted that there are Reserve Forest patches are located as close as

1 Dutch Target and Intervention Values (Soil remediation Circular 2009-2012 Revision), https://zoek.officielebekendmakingen.nl/stcrt-2012-6563.pdf.
The assessment of potential impacts to soil and sediment has been considered as per the Dutch Standard as Bangladesh does not have any local standards for soil or sediment quality.

2 Dutch Target and Intervention Values (Soil remediation Circular 2009-2012 Revision), https://zoek.officielebekendmakingen.nl/stcrt-2012-6563.pdf.
The assessment of potential impacts to soil and sediment has been considered as per the Dutch Standard as Bangladesh does not have any local standards for soil or sediment quality.

200 m from the batching plant site. There is also large continuous Reserve Forests located 4-5 km south of the wind farm with a gentle downward slope towards these forested areas.

Soil Compaction and Erosion

Soil compaction and erosion has been considered for the construction and decommissioning phases only. In the operation phase, soil compaction and erosion may occur due to heavy vehicle movement, which only happens during the occasional maintenance activities. Soil compaction for the operation phase has therefore been considered to be infrequent and negligible.

Impact Magnitude

The site clearance, excavation and access road construction will largely affect the top layers of the soil. Loss of top soil quality would have an impact on the agricultural productivity of the land but the effects can be reversed over time. Site clearance for the site is anticipated to be minimal because ReNew is going to leave all Reserve Forest intact and scrubland will be minimally affected. The soil and land environment has also already been affected due to the presence of several stone quarries in the area.

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

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

Embedded/In-built Controls

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

Significance of Impact

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

Additional Mitigation Measures

- Top soil that has been stripped should be stored for landscaping of the site;
- The stock piles of soil should be kept moist to avoid wind erosion of the soil;
- Soil should be ploughed in compacted areas after completion of construction work;
- Revegetation of the construction boundaries using fast-growing local vegetation can be utilized to strengthen soil that is located on slopes; and
- Site should be restored at the end of the Project life cycle to pre-Project levels.

Significance of Residual Impacts

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

Impact	Soil Erosion and Compaction (Construction and Decommissioning)				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to Project areas				
Frequency	Construction and Decommissioning Phases				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **Minor.**				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **Negligible.**				

Waste Generation and Soil Contamination

Waste is generated in all phases of the Project:

Construction:

- Construction waste including concrete, pallets, steel cuttings, wood, metals, etc.;
- Packaging waste; and
- Municipal solid waste produced by the labour camp(s) including food, plastic, glass, aluminium cans and waste paper.

Operation:

- Hazardous waste including used oil, hydraulic fluids, waste fuel, grease, oil containing rags, etc.;
- Solid waste generated by the O&M team including disposal of food, plastic, aluminium cans, glass, etc.; and
- Construction and Demolition waste from changing of WTG parts, access road maintenance and transmission line maintenance.

Decommissioning:

- Demolition waste generated from removal of site components;
- Hazardous waste including unused oil, fluids, lubricants and grease; and
- Municipal solid waste generated by any labour camp(s).

Context

Waste is generated in all phases of the project and due to the proximity of the construction site(s) to Reserve Forest area; it can have an impact on sensitive receptors. Stored resources including oil, lubricants and diesel can have a significant impact on the soil layers as a result of leaks, accidents or spillages.

Impact Magnitude

The Project does not anticipate any major labour camp(s) with the exception of some settlements being erected by the subcontractors who are at site for an extended period of time. ReNew and Gamesa (the EPC contractor) has managed several wind farm projects in the past and have effective management systems for waste and hazardous substances being generated or utilized during the Project life cycle. Any accidents can be contained locally because of the gentle sloping topography and the lack of water bodies in the immediate area. The impact magnitude has therefore been assessed as **small**.

Significance of Impact – Construction and Decommissioning Phases

The impact significance for waste generation and soil contamination has been assessed as **minor** because of effective management, small scale of the wind farm and decreased anthropogenic presence on site (no major labour camps).

Additional Mitigation Measures

- EPC Contractor should ensure that no unauthorized dumping of used oil and other hazardous waste is undertaken at the site;
- Proper receptacles or designated areas should be provided for Solid Municipal Waste and daily collection and period disposal should be ensured;
- Construction and Demolition Waste should be stored separately and be periodically collected by an authorized treatment and storage facility;

- Hazardous waste should be properly labelled, stored onsite at a location provided with impervious surface and in a secondary containment system; and
- All waste should be stored in a shed that is protected from the elements (wind, rain, storms, etc.) and away from natural drainage channels.

Significance of Residual Impacts

The significance of impacts due to waste generation in the construction and decommissioning phases after implementation of mitigation measures has been considered as **negligible.**

Impact	Impact on soil environment due to waste generation (hazardous and non- hazardous)				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to project area				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **minor.**				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Major
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **negligible.**				

Significance of Impacts – Operation Phase

The impact significance for waste generation and soil contamination has been assessed as **minor** in the operation phase because of effective management and the small scale of the wind farm.

Additional Mitigation Measures

- Proper receptacles or designated areas should be provided for Solid Municipal Waste and daily collection and period disposal should be ensured;
- Hazardous waste should be properly labelled, stored onsite at a location provided with impervious surface and in a secondary containment system;
- All waste should be stored in a shed that is protected from the elements (wind, rain, storms, etc.) and away from natural drainage channels;

- Transport vehicles and equipment should undergo regular maintenance to avoid any oil leakages; and
- Unloading and loading protocols should be prepared for diesel, oil and used oil respectively and workers should be trained to prevent/contain spills and leaks.

Significance of Residual Impacts

The significance of impacts due to waste generation from the operation phase after implementation of mitigation measures has been reduced to **negligible**. The significance has been reduced for the operation phase because of the removal of the batching plant site and reduced inventory of hazardous substances that would be needed during the operation phase.

Impact	Impact on soil environment due to waste generation (hazardous and non- hazardous)				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to project area				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **minor.**				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Major
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **negligible.**				

9.3.4 *Impact on Water Environment*

The impacts of project on the water environment are assessed due to consumption of water during project activities. For the assessment of water quality, the sensitivity and magnitude criteria are outlined in ***Table 9.11*** and ***Table 9.12*** respectively have been used.

Table 9.11 Sensitivity Assessment Criteria for Water Resources (Surface water and Ground water)

Sensitivity Criteria	Contributing Criteria	
	Environment	***Social***
Water Resources -Surface water and ground water (quality/quantity related criteria)	The extent to which the water resource plays an ecosystem or amenity role in terms of supporting biodiversity either directly or indirectly, particularly with respect to dependent ecosystems.	The extent to which the water resource provides or could provide a use (drinking water, agricultural uses, washing and other domestic or industrial, use as waterways) to the local communities and businesses, or

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

Table 9.12 ***Criteria for Impact Magnitude for Assessment of Impact to Surface and Groundwater Resources***

Magnitude Criteria	Negligible	Small	Medium	Large
General Criteria	No perceptible or readily measurable change from baseline conditions.	Perceptible change from baseline conditions but likely to be within applicable norms and standards for mode of use.	Clearly evident (e.g. perceptible and readily measurable) change from baseline conditions and / or likely to approach and even occasionally exceed applicable norms and standards for mode of use.	Major changes in comparison to baseline conditions and / or likely to regularly or continually exceed applicable norms and standards for mode of use.
Water	There is likely to be negligible or no consumption of surface water by the Project at any time	The Project will consume surface water, but the amounts abstracted are likely to be relatively small in comparison to the resource available at the time of use (i.e. taking into account seasonal fluctuation)	The Project will consume surface water, and the amounts abstracted are likely to be significant in comparison to the resource available at the time of use (i.e. taking into account seasonal fluctuation)	The Project will consume surface water, and the amounts abstracted are likely to be very significant in comparison to the resource available at the time of use (i.e. taking into account seasonal fluctuation)
	There is likely to be negligible or no abstraction, use of or discharge to the groundwater by the Project at any time.	The Project will consume groundwater or deliver discharge to groundwater, but the amounts abstracted / discharged are likely to be relatively small in comparison to the resource available at the time of use (i.e. taking into account seasonal fluctuation).	The Project will consume groundwater or discharge to groundwater, and the amounts abstracted / discharged are likely to be significant in comparison to the resource available at the time of use (i.e. taking into account seasonal fluctuation).	The Project will consume groundwater or discharge to groundwater, and the amounts abstracted / discharged are likely to be very significant in comparison to the resource available at the time of use (i.e. taking into account seasonal fluctuation).

Receptor Sensitivity

The receptor sensitivity has been assessed as low for environmental criteria but high for social criteria as per ***Table 9.11.*** The local aquatic diversity of the area is small with no identified rare, endangered or threatened species. The local water bodies therefore do not support a significant diversity of aquatic flora and fauna. The groundwater development stage of Ramdurg Taluka

however, has been classified as over-exploited and makes the receptor sensitivity high for water resources and it is also a "Notified Area"for regulation of ground water abstraction/ development. The overall receptor sensitivity has therefore been classified as **high**.

Embedded/In-built control

The source of water used for the Project should be tracked to the source and any groundwater usage should be preceded by an abstraction permit from the groundwater board/ Deputy Commissioner (CGWB Notified Area).

Impact Magnitude

The Project sources their water for construction activities, drinking and domestic usage from nearby villages. The original source of water is not known to ReNew, however, considering the Project location in a remote area, the likely source of water would be ground water. Due to the shortage of ground water in the area, the likely source of water is surface water bodies in the area. However, the water demand during construction phase will be limited to 6 – 7 months and only 30 WTG foundations will be there. Considering that the water requirement of over 31 KL per foundation and maximum 12 KL per day for domestic usage and other activities, the impact magnitude has therefore been assessed as **small**.

Significance of Impact – Construction Phase

The impact significance in the construction phase has been assessed as **moderate** as the abstraction of ground water will have strain on already diminished water resources in the region.

Additional Mitigation Measures

- Construction labour deputed onsite should be sensitised about water conservation and encouraged for optimal use of water;
- Optimum use of water during sprinkling on roads for dust settlement, washing of vehicles, concrete mixing for WTG foundation, etc.; and
- Regular inspection for identification of water leakages and preventing wastage of water from water supply tankers.

Significance of Residual Impact

ReNew should find an alternate source for their water requirement. The recommended mitigation measures can be implemented on another source of water and then the residual impact for the project can be reduced to minor. Until an alternate source is found, the residual impact significance has to be retained as **moderate**.

Impact	Water resource availability		
Impact Nature	Negative	Positive	Neutral
Impact Type	Direct	Indirect	Induced

Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to project areas				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **moderate.**				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Major
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **moderate** but can be reduced to minor if an alternate source for water requirement is found.				

Significance of Impact – Operation Phase

The water requirement for the operation phase will be considerably less and will only be for domestic use and drinking water. The amount of water anticipated is at the most 2-3 KL per day. Taking the long-term requirement into account (~20 years), the impact magnitude has been assessed as **moderate.**

Additional Mitigation Measures

- Regular inspection for identification of water leakages and preventing waste of water from water supply tankers.
- ReNew should supply the O&M team with packaged drinking water from nearby towns and villages instead of relying on reverse osmosis of local water resources.

Significance of Residual Impact

The above mitigation measures can then be implemented to minimize the water usage. The residual impact will remain **moderate** until the source of drinking and domestic water has been confirmed to be not from local sources. If an alternate source of water is obtained, the impact magnitude can be decreased to minor.

Impact	Water resource availability				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to project areas				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	

	Significance of impact is considered **moderate.**				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Major
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **negligible** if an alternate source for water requirement is found.				

9.3.5 *Impact on Air Quality*

The assessment with respect to air quality of the study area has been done for the following Project activities:

- Construction activities including site preparation, excavation of WTG foundation, access road widening and construction of ancillary facilities;
- Transportation of WTG components, construction materials, machinery and personnel;
- Operation of batching plant;
- Operation of DG sets;
- Strengthening and maintenance of access roads; and
- Demolition activities during decommissioning phase.

The sensitivity criteria and impact magnitude criteria has been provided in ***Table 9.13*** and ***Table 9.14*** respectively.

Table 9.13 Sensitivity criteria for air quality

Sensitivity Criteria	Contributing Criteria	
	Human Receptors	*Ecological Receptors*
Low	Locations where human exposure is transient.[11]	No
Medium	Few Receptors (settlements) within 500 m WTGs, batching plant and pooling substation	Nationally designated sites.
High	Densely populated receptors(settlements) within 500 m of WTGs, batching plant and pooling substation	Internationally designated sites.

Table 9.14 Criteria for Impact Magnitude for Assessment of Impact to Air Quality

Magnitude Criteria	Negligible	Small	Medium	Large
Air Quality	Soil type with large grain size (eg sand); and/or No emissions/dust generation due to	Soil type with large grain size (eg sand); and/or Limited emissions/dust	Moderately dusty soil type (eg silt); and/or Dust generation and emissions	Potentially dusty soil type (eg clay, which will be prone to suspension when dry due to small

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

Magnitude Criteria	Negligible	Small	Medium	Large
	Project across all phases	generations for short duration	from Projects for long duration	particle size); and Significant process emissions from Project for the entire Project cycle.

Receptor Sensitivity

The receptor sensitivity has been assessed as medium for human receptors and medium for ecological receptors. The receptor sensitivity is therefore **medium** based on the criteria provided in ***Table 9.13.*** The proposed WTG locations are located within 500 m of Naganur and Channapur Tanda villages and the access roads to these locations are through pre-existing village roads. The batching plant and stock yard is also located within 200 m of a Reserve Forest and is therefore in close proximity to a nationally designated site.

Construction Phase

Air quality impacts in the construction phase will be largely due to the following sources:

- Fugitive dust emissions from site clearance, excavation work, cutting and levelling work, stacking of soils, handling of construction materials, transportation of materials, emission due to movement of vehicles on unpaved roads, plying of heavy construction machinery, etc.
- Vehicular emissions due to increased traffic movement on site and on the approach roads;
- Particulate emission from operation of batching plant;
- Exhaust emissions from construction machinery and other heavy equipment such as bulldozers, excavators and compactors; and
- Emissions from diesel generators required to be run for construction power purposes.

Impact Magnitude

The biggest source of emissions in the construction phase is the fugitive dust emissions from construction activities. As the proposed wind farm site is small and requires very limited road construction, the fugitive dust emissions should be minimized. The construction activities are also going to occur for a small period of time (~ 7 months). The impact magnitude has been categorized as **small** because the soil type is largely coarse sand and the dust emissions will only occur for a limited period of time.

Embedded/In-built Controls

- Diesel generator use should be restricted to emergencies and power back-up only to minimize air emissions; and
- Vehicle engines need to be properly maintained and should have a valid Pollution Under Control (PUC) to ensure minimization in vehicular emissions.

Significance of Impact

The impact significance for air quality in the construction phase is assessed as **minor**. There will be some impacts due to plying of vehicles on remote village roads and due to the proximity of the proposed WTG locations to villages. The impacts however, are not anticipated to be significant.

Mitigation Measures

- Speed of vehicles on site should be limited to 10-15 km/hr;
- DG sets should be placed within enclosures and have an adequate stack height;
- Minimize stockpiling by coordinating excavations, spreading, regrading and compaction activities; and
- Prevent idling of vehicles and equipment.

Significance of Residual Impact

The significance of residual impact will be **negligible** after implementing mitigation measures.

Impact	Ambient Air quality – Construction phase				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Project area and vicinity				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **minor.**				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Major
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **negligible.**				

Decommissioning Phase

Air quality impacts in the decommissioning phase will be largely due to the following sources:

- Fugitive dust emissions from demolition, handling of demolition materials and transportation of materials;
- Vehicular emissions due to increased traffic movement on site and on the approach roads;
- Exhaust emissions from demolition machinery and other heavy equipment such as bulldozers, excavators and compactors; and
- Emissions from diesel generators required to be run for demolition purposes.

Impact Magnitude

The biggest source of emissions in the decommissioning phase is the fugitive dust emissions from demolition activities. The demolition activities are likely to occur for a very small period of time (~3-4 months) and therefore the impact magnitude has been assessed as **small** as per ***Table 9.14.***

Embedded/In-built Controls

- Diesel generator use should be restricted to emergencies and power back-up only to minimize air emissions; and
- Vehicle engines need to be properly maintained and should have a valid Pollution Under Control (PUC) to ensure minimization in vehicular emissions.

Significance of Impact

The impact significance for air quality in the decommissioning phase is assessed as **minor**. There will be some impacts due to plying of vehicles on remote village roads and due to the proximity of the proposed WTG locations to villages. The impacts however, are not anticipated to be significant.

Mitigation Measures

- Speed of vehicles on site should be limited to 10-15 km/hr;
- DG sets should be placed within enclosures and have an adequate stack height; and
- Prevent idling of vehicles and equipment.

Significance of Residual Impacts

The significance of residual impact will be **negligible** after implementing mitigation measures because of the fugitive dust emissions anticipated during demolition activities.

Impact	Ambient Air quality – Decommissioning Phase			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term	Permanent

Impact Extent	Local	Regional	International		
Impact Scale	Project area and vicinity				
Frequency	Regular during decommissioning				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **minor.**				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Major
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **negligible.**				

9.3.6 *Impact on Noise Levels*

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

- Construction activities including site preparation, excavation of WTG foundation, access road widening, construction of ancillary facilities and erection of transmission towers;
- Transportation of WTG components, construction materials, machinery and personnel;
- Operation of batching plant;
- Operation of DG sets;
- Operation and maintenance of WTG components and access roads; and
- Demolition activities during decommissioning phase.

Criteria

The ambient noise levels have been assessed with respect to Noise Pollution (Regulation and Control) Rules, 2000 and WHO Guidelines as shown in ***Table 9.15*** and ***Table 9.16*** respectively.

Table 9.15 Ambient noise quality standards [(1)]

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

Note:

1. *Day time shall mean from 6.00 a.m. and 10.00 p.m.*
2. *Night time shall mean from 10.00 p.m. and 6.00 a.m.*

[(1)]*Source: Schedule of The Noise Pollution (Regulation and Control) Rules, 2000 vide S. O. 123(E), dated 14.2.2000 and subsequently amended vide S.O. 1046(E), dated 22.11.2000, S.O. 1088(E), dated 11.10.2002, S.O. 1569 (E), dated 19.09.2006 and S.O. 50 (E) dated 11.01.2010 under the Environment (Protection) Act, 1986*

3. *Silence zone is an area comprising not less than 100 metres around hospitals, educational institutions, courts, religious places or any other area which is declared as such by the competent authority.*
4. *Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.*

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

Table 9.16 Noise emission criteria

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

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

The above standards have been utilized to create a sensitivity criteria for ambient noise (***Table 9.17***) and criteria for impact magnitude for assessment of impact to ambient noise (***Table 9.18***).

Table 9.17 Sensitivity criteria for ambient noise

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

Table 9.18 Criteria for impact magnitude for assessment of impact to ambient noise

Magnitude Criteria	Negligible	Small	Medium	Large
Noise Quality	Predicted noise levels are at or less than 3 dB (A) above the relevant limits / thresholds. Short term exposure (Few hours in a day and not continuous)	Predicted noise levels are 3 to less than 5 dB (A) above the relevant limits / thresholds.	Predicted noise levels are between 5 and 10 dB (A) above the relevant limits / thresholds. Medium Term Exposure (1 to 6 months)	Predicted noise levels are more than 10 dB (A) above the relevant limits / thresholds. Long term exposure (> 6 months)

The receptor sensitivity has been assessed as **medium** as per the criteria set in ***Table 9.17*** as all of the proposed WTG locations and ancillary facilities are in residential areas.

Construction Phase

The sources of noise in the construction phase include construction activities, operation of batching plant, operation of DG sets and movement of vehicles. There will also be increased noise levels because of increased anthropogenic movement in the area.

Context

The construction activities are expected to last for 6-7 months and construction activities will be limited to daytime only. Construction of ancillary facilities, operation of batching plant and operation of DG set is currently planned at a distance of at least 1 km from any settlements. The largest sources of ambient noise impact would therefore be construction of access roads to connect the WTG with the main village road and movement of vehicles across the study area.

Receptor Sensitivity

Three villages – Naganur, Aneduggi and Channapur Village are the most likely to be affected by increasing noise levels because of proximity to the proposed WTG locations. Aneguddi Village may be affected by combined noise levels due to proximity to a proposed WTG location (~210 m) and presence of an active stone quarry (~600 m). The receptor sensitivity is therefore considered as **medium.**

Impact Magnitude

The receptors including the three aforementioned villages are located at least 400m away with the exception of the GBK 30, which is located 210m from Aneguddi Village. The batching plant, material storage yard and PSS are also located at least 1 km away from any receptor. The impact magnitude would therefore be **small** on the receptors in the area.

Significance of Impact

The impact significance has therefore been assessed as **minor.**

Mitigation Measures

- Normal working hours of the contractor to be defined (preferable 8 am to 6pm). If work needs to be undertaken outside these hours, it should be limited to activities which do not generate noise;
- Only well-maintained equipment should be operated on-site;

- If it is noticed that any particular equipment is generating too much noise then lubricating moving parts, tightening loose parts and replacing worn out components should be carried out to bring down the noise and placing such machinery far away from the households as possible;
- Machinery and construction equipment that may be in intermittent use should be shut down or throttled down during non-work periods; and
- Minimal use of vehicle horns and heavy engine breaking in the area needs to be encouraged.

Significance of Residual Impacts

The residual impact significance has been reduce to negligible because there will still be very minimal impact on nearby receptors from vehicular traffic and GBK 30 that is located within 500m of a receptor/village. Moreover, this impact will be limited to the construction period (~ 7 months).

Impact	Ambient Noise Levels – Construction Phase				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Project area and vicinity				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered to be **minor.**				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Major
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **negligible.**				

Operation Phase

Sources of Wind Turbine Sound

The emanation of noise form the operation of WTGs is of the following two types: (a) mechanical noise, from interaction of turbine components; and (b) aerodynamic noise, produced by the flow of air over blades. Mechanical sounds originate from the relative motion of mechanical components and the dynamic response among them. Sources of such sounds include:

- Gearbox
- Generator
- Yaw drives
- Cooling fans
- Auxiliary equipment (e.g. hydraulics)

Aerodynamic sound is typically the largest component of wind turbine acoustic emissions. It originates from the flow of air around the blades. Aerodynamic sound generally increases with rotor speed.

The Project will have 30 WTGs of GAMESA G97 2000 with a rated capacity of 2.0 MW each with 97 m rotor diameter. The hub height will be 104 m. The noise generation from the turbines have been taken into consideration during strong wind conditions (with wind velocity ≥ 8 m/s at 10 m height, which is equivalent to about 11.5 m/s at hub height) for the noise assessment to consider worst case scenario. Based on the available information from the turbine manufacturer, following are the noise generation due to the wind turbines (***Table 9.19***):

Table 9.19 Noise Generation from WTGs

Wind Velocity at 10 m height (m/s)	Noise Generation [dB(A)] at Hub Height	Wind Velocity at Hub height (m/s)	Noise Generation [dB(A)] at Hub Height
3.0	94.0	5.0	94.4
4.0	94.9	6.0	95.7
5.0	99.0	7.0	98.5
6.0	102.4	8.0	101.1
7.0	104.5	9.0	103.1
8.0	***104.5***	10.0	104.5
9.0	104.5	***11.0***	***104.5***
10.0	104.5	12.0	104.5
11.0	104.5	13.0	104.5
12.0	104.5	14.0	104.5

Source: Windpro database (based on manufacturer document GD161807-en, Rev.0.)

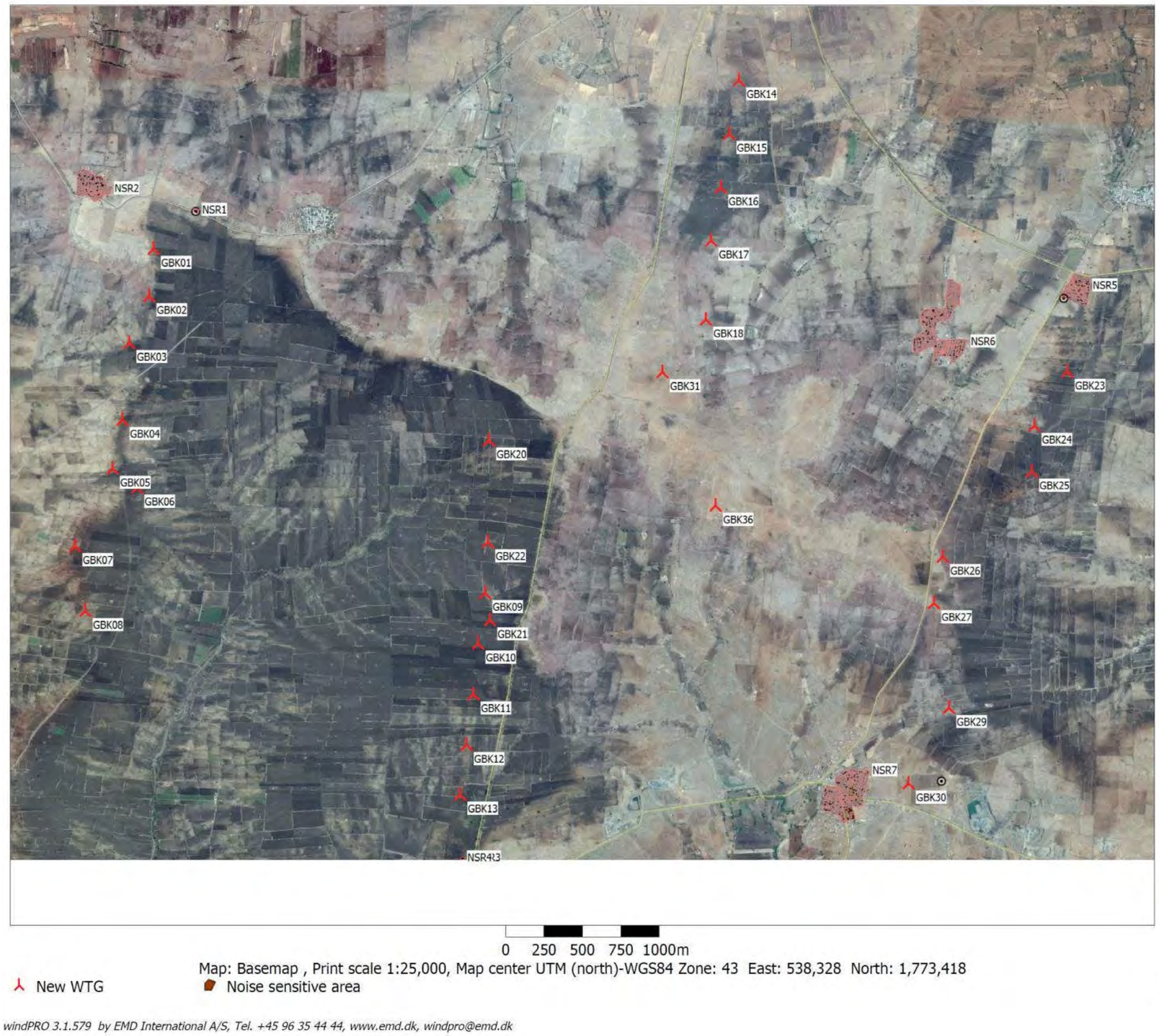
Receptors

Three villages – Naganur and Channapur Village are the most likely to be affected by increasing noise levels because of proximity to the proposed WTG locations. Aneguddi Village may be affected by combined noise levels due to proximity to a proposed WTG location (~210 m) and presence of an active stone quarry (~600 m). The noise sensitive receptors (NSRs) considered in this study are as follows:

Table 9.20 Noise Sensitive Receptors

Receptor	Name	Nearest WTG	Distance from Nearest WTG	Direction from Nearest WTG
NSR1	House (Permanent)	GBK01	365 m	NE
NSR2	Naganur Tanda	GBK01	470 m	NW
NSR3	House (Permanent)	GBK13	400	S
NSR4	House (Permanent)	GBK13	410	S
NSR5	Settlement	GBK23	450	N
NSR6	Settlement	GBK23	690	W - NW
NSR7	Aneguddi	GBK30	310	W - SW

Figure 9.3 Map showing WTGs and Noise Sensitive Receptors



Project:
ReNew_Batkurki

Description:
60 MW Wind Power Project, Batkurki, District - Belgaum, Karnataka

BASIS -
Map
Calculation:
Basis - Project Data Overview

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Building 10, 4th Floor, Tower A, DLF Cyber City
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10/18/2016 11:08 AM/3.1.579

windPRO 3.1.579 by EMD International A/S, Tel. +45 96 35 44 44, www.emd.dk, windpro@emd.dk

10/18/2016 2:50 PM / 1 windPRO

Embedded/in-built control

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

Prediction of Impacts

Methodology: The environmental noise prediction module (NORD 2000) of WindPro 3.1 was used for modelling noise emissions from the WTGs. In order to consider worst case scenario (with strong wind conditions), it has been assumed that the WTGs are operational at standardised wind speed of ≥ 8 m/s at 10 m height (i.e. about 11.5 m/s at hub height)[1]. Operating of WTGs with 100% usage scenario was modelled to cover the operation phase of the Project. In addition, to represent a worst-case scenario for the assessment, all WTGs were assumed to be operating simultaneously and for 24 hours. Noise generation had been considered at the hub height of 104 m above ground. Local terrain has been considered for putting noise sources as well as receptors in the model. It has been assumed that the noise sensitive receptors are always in downwind direction to consider the worst case scenario. The geo-profile of the area has been considered to define the area types and relative roughness and surface hardness in order to consider the surface absorption and reflection.

Predicted Noise Levels at Receptors: The predicted noise levels within the study domain at 7 receptors during day and night-time with cloudy conditions (which provide a stable atmospheric condition and is suitable for worst case consideration) and with strong wind conditions (refer to ***Table 9.19***) are presented in Table 9.21. The noise contour map of showing predicted noise levels within the study domain has been presented in Figure 9.4. Detailed noise assessment results during day and night time and speed/directional analysis are presented in ***Annex C***.

Table 9.21 Predicted Noise Levels at Noise Sensitive Receptors during Operation Phase with Strong Wind Conditions and Most Downwind Conditions

Receptor Code	Receptor Type	Nearest WTG	Distance from Nearest WTG (m)	Predicted Noise Level at Receptors, L_{eq} (dBA)		Applicable Standard as per Landuse (dBA)(3), (4)	
				Leq day(1)	Leq night (2)	Leq day	Leq night
NSR1	House (Permanent)	GBK01	365	42.5	43.0	55	45
NSR2	Settlement	GBK01	470	39.9	40.6	55	45
NSR3	House (Permanent)	GBK13	400	41.8	42.4	55	45
NSR4	House (Permanent)	GBK13	410	41.9	42.4	55	45

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

Receptor Code	Receptor Type	Nearest WTG	Distance from Nearest WTG (m)	Predicted Noise Level at Receptors, L_{eq} (dBA)		Applicable Standard as per Landuse (dBA)[3], [4]	
				Leq day[1]	Leq night [2]	Leq day	Leq night
NSR5	Settlement	GBK23	450	39.6	40.2	55	45
NSR6	Settlement	GBK23	690	38.9	39.8	55	45
NSR7	Settlement	GBK30	310	41.5	42.0	55	45

[1] Leq day has been predicted with average temperature of 25°C and clouded sky.
[2] Leq night has been predicted with average temperature of 15°C and clouded sky.
[3] IFC/WB EHS Guidelines: Noise Management dated April 30, 2007 gives, Noise level guidelines for Residential; institutional and educational receptors in daytime (07:22:00) and night time (22:00-7:00) as 55 and 45 one hour Leq dB(A) respectively. For industrial and commercial receptors it is 70 one hour Leq dB(A) for both night and day time.
[4] Noise standards notified by the MoEF vide gazette notification dated 14 February 2000 as amended in January 2010 based on the *A* weighted equivalent noise level (L_{eq}) for residential areas

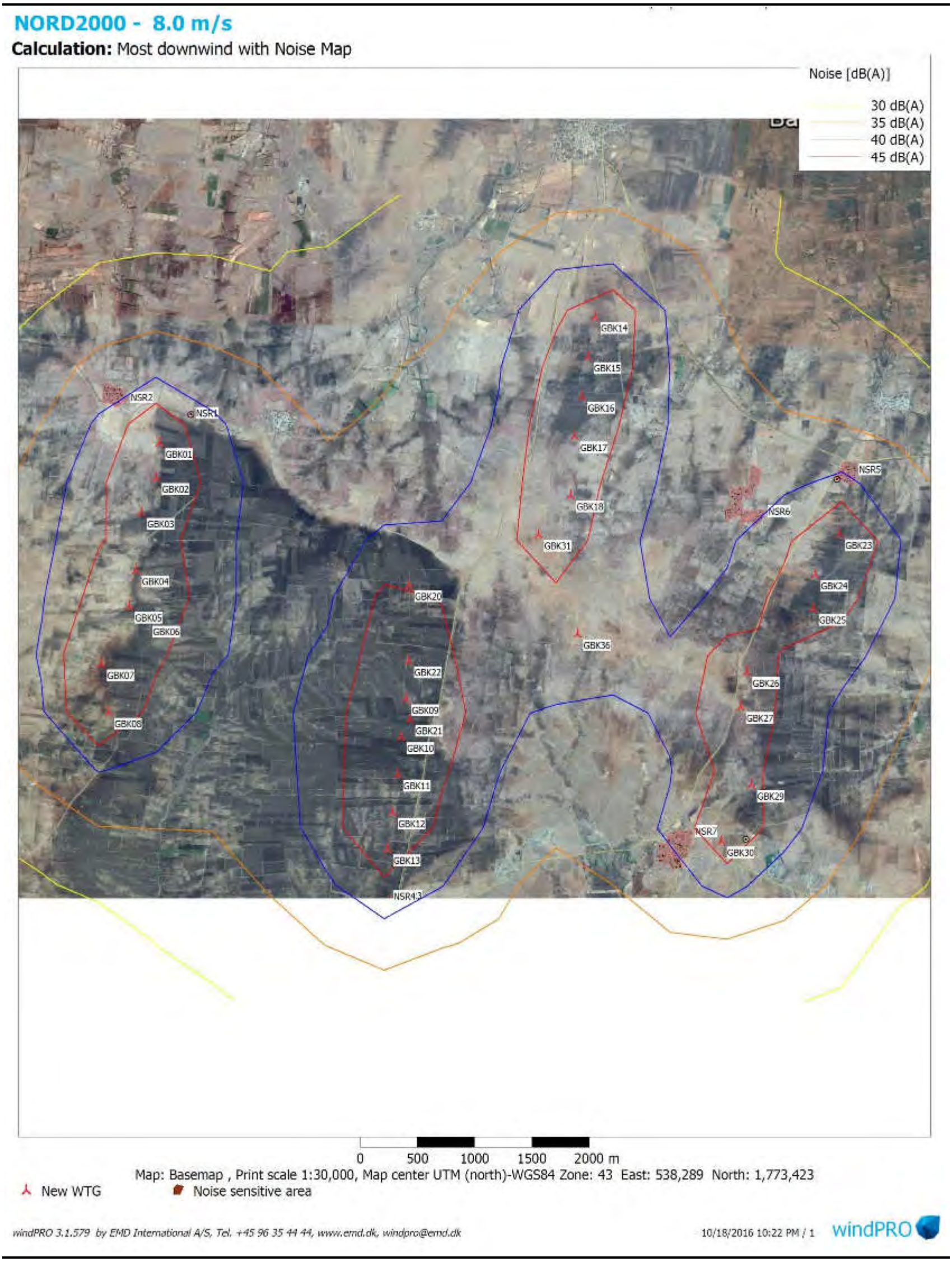
Impact Significance

It is evident from Table 9.21 that both day and night time noise levels at identified noise sensitive receptors are well within the applicable standards. Therefore, the impact of noise on identified receptors due to operation of WTGs during **day** and **night time** will be **negligible**.

Impact	Noise generation from operation of the WTGs – Day time				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to within 150 m of WTGs.				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered as **negligible for all the receptors.**				

Impact	Noise generation from operation of the WTGs – Night time (moderate wind condition)				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to within 250m of WTGs.				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered as **negligible for all the receptors.**				

Figure 9.4 Noise Contour Map



Enhancement Measures

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

- Regular maintenance of WTGs;
- Periodic monitoring of noise near to the sources of generation to ensure compliance with design specification; and
- Half yearly monitoring of ambient noise levels (during day and night time) at identified residential receptors for determination of actual impact due to operation of WTGs.

Decommissioning Phase

Similar impacts as during the construction Phase will be observed for ambient noise in the decommissioning phase.

9.3.7 Impacts on Nearby Establishments (Shadow Flicker Assessment)

Overview

Shadow flicker is a term used to describe the pattern of alternating light intensity observed when the rotating blades of a wind turbine cast a shadow on a receptor under certain wind and light conditions. Shadow flicker occurs under a limited range of conditions when the sun passes behind the hub of a wind turbine and casts an intermittent shadow over neighbouring properties.

Indian energy planning and environmental policies and legislation contains no specific shadow flicker requirements and recommendations. At present, only Germany has detailed guidelines on limits and conditions for calculating shadow impact.[1]

Box 9.2 International Guidelines for Shadow Flicker Assessment

According to the German guidelines, the limit of the shadow is set by two factors:
• The angle of the sun over the horizon must be at least 3 degrees;
• The blade of the WTG must cover at least 20% of the sun.
The maximum shadow impact for a neighbour to a wind farm according to the German guidelines is:
• Maximum 30 hours per year of astronomical maximum shadow (worst case);
• Maximum 30 minutes worst day of astronomical maximum shadow (worst case); and
• If automatic regulation is used, the real shadow impact must be limited to 8 hours per year.

In Sweden and Denmark there are no official guidelines as yet on shadow flickering, but for practical purposes, 10 hours (Denmark) and 8 hours (Sweden) real case (weather-dependent) shadow impact is used as the limit. In the UK, no official limits are in force, however an assessment must be made at all dwellings within ten rotor diameters of the turbine locations (PPS22 (2004) for England), TAN8 for Wales). In Ireland, a worst-case 30 hours per year, 30 minutes per day limit has been set.

(1) 1 These are found in "Hinweise zur Ermittlung und Beurteilung der optischen Immissionen von Windenergianlagen" (WEA-Shattenwurf-Hinweise).

Shadow flicker is most pronounced at sunrise and sunset when shadows are the longest, and at high wind speeds (faster rotating blades leading to faster flicker). A UK government report recommends that for inhabitants near wind turbines, shadow flicker should be limited to 30 hours in a year and 30 minutes in a day[1]. There is anecdotal evidence internationally that shadow flicker could lead to stress and headaches. There is also a fear that shadow flicker, especially in the range of 2.5-50 Hertz (2.5-50 cycles per second) could lead to seizures in epileptics and may also scare away livestock.

An analysis of those conditions that may lead to shadow flicker and the location of potential sensitive receptors (residential and community properties) is provided in this section. The timing and duration of this effect can be theoretically calculated from the geometry of the wind turbines, their orientation relative to nearby houses and the latitude of the potential site, using specialised software such as WindPro 3.1.

The results provide the total number of hours in a year when a theoretical shadow flicker will occur. This is most pronounced during sunrise and sunset when the sun's angle is lower and the resulting shadows are longer. However the actual shadow flicker could be substantially lower compared to theoretical values because shadow flicker does not occur where there is vegetation or other obstructions between the turbines and the shadow receptors; if windows facing a turbine are fitted with blinds or shutters; or if the sun is not shining brightly enough to cause shadows.

The theoretical calculations done by WindPro does take into account the reduction in shadow flicker due to topographic features, however it does not take into account the reduction in shadow flicker due to these onsite factors i.e. vegetation. Simple geometry relating to the position of the sun and the angle of the turbine blades can also eliminate or significantly reduce the effects of shadow flicker. In addition, shadow flicker will only occur inside buildings where the flicker is occurring through a narrow window opening.

In India, at present there is no standard in case of non-forest land diversion for wind power projects. However, as per Ministry of Environment, Forests and Climate Change (MoEFCC) guidelines, a minimum distance of 300 m is recommended between windmill and highways or village habitation.

Weather conditions at the site, such as bright sunshine, will greatly enhance the occurrence and intensity of shadow flicker, whereas cloud density, haze or fog will cause a reduction. Receptors further away from the turbines which may have experienced a shadow flicker effect under bright sunshine conditions will, as a result of these weather conditions, experience either no effect or one which is greatly reduced in intensity.

The distance between receptors and turbines has a large effect on the intensity of shadow flicker. Shadow flicker intensity can be defined as the difference in

(2) (1) Draft EIA Guidelines Wind Power Sector, prepared by Centre for Science and Environment, New Delhi

brightness between the presence and absence of a shadow at any given location. This study does not examine variations in intensity but rather the occurrence in number of hours shadow flicker may occur, whether or not this is clearly distinct or barely noticeable. The assessment assumes a conservative worst case of bright sunshine conditions in all periods when flicker may occur.

Considering all of the above points, the likelihood of shadow flicker occurring is greatest when the circumstances listed below exist simultaneously.

- The receptor is at a position which is between 130° clockwise (1) and anticlockwise from north and located within 10 turbine rotor diameters of the wind turbine (~1000 m).
- The sun is shining and visible in the sky in line with the monthly mean sun-shine hours at nearby location.
- The wind speeds are between 3 m/s and 22 m/s and the turbine is therefore in operation.
- The turbine blades are perpendicular to the line between the sun and the observer or receptor most of time as per reported wind mast data.

Due to lack of data regarding epilepsy rates in India and operation levels below of 1 Hz for modern turbines, seizures caused by shadow flicker are considered to be extremely unlikely. The turbines (proposed to be used in this Project) being considered operate at a frequency outside the range where negative health effects may result (2). Potential effects on people are likely to be limited to nuisance.

Potential Significant Impacts

In India at present, there is no agreed level of shadow flicker identified as causing a significant effect. However, the Danish Wind Industry Association note on their website that in Germany, the rule of thumb is that 30 hours shadow flicker a year received at a property is acceptable (3). The 'Wind Energy Development Guidelines, 2006' published by the Irish Government Department of the Environment, Heritage and Local Government recommend that shadow flicker at neighbouring offices and dwellings within 500 m should not exceed 30 hours per year. A threshold of 30 hours per year has therefore been considered and applied for this assessment.

Assessment Methodology and Modelling

Shadow flicker calculations have been made using WindPro software. The model used in this analysis is very conservative and assumes the following conditions:

(1) It is acknowledged by this assessment however that India is at lower latitude than the European countries and therefore angles of shadow flicker may be narrower.
(2) See Health and Safety Executive/Local Authority Enforcement Liaison Committee (HELA) circular, entitled 'Disco Lights and Flicker Sensitive Epilepsy' (available at http://www.hse.gov.uk/lau/lacs/51-1.htm). It provides medical details on flicker frequencies likely to give rise to epileptic effects. It states: 'In 1971 the Greater London Council banned the use of flicker rates greater than 8 fps but to be effective the above figures show that any advice on restriction of flicker rate has to limit the frequency to below 5 fps.'
(3) www.windpower.org

- the mean monthly sunshine hours have been taken from the India Meteorological Department (IMD) station at Panjim, Goa covering the data period (1969 – 1999)[1];
- the wind turbines have been considered operational with wind speed more than 3 m/s and for the same wind mast data has been considered, which indicates that about 87% time of the year, the wind turbines will be operational;
- the blades of the wind turbines are perpendicular with northwest - southeast orientation have been considered based on the predominant wind direction available from the wind mast data at site, which could result in maximum possible size circular/ elliptical;
- there are no trees, buildings or vegetation on the surface which may obscure the line of sight between shadow receptor and turbine;
- the sun can be represented as a single point;
- Flicker is ignored if sun is less than 3° above horizon (due to atmospheric diffusion/ low radiation/ sheltering);
- structures identified within within settlements are considered as shadow receptors.

The following data inputs were used in this study:

- a digital elevation model of the site (National Aeronautic and Space Administration (NASA) Shuttle Radar Topography Mission (SRTM) Data at 30 m resolution);
- latitude and longitude at centre of the site used to calculate the position of the sun (calculated in GIS using UTM co-ordinates);
- mean monthly sun-shine hours recorded over a period of 30 years at a nearby IMD solar radiation station (Panjim, Goa);
- turbine locations – coordinates (identified in GIS);
- project consists of 30 WTGs of GAMESA G97 2000 make;
- turbine rotor diameter for G97 make turbine is 97 m and hub height is 104 m;
- tilt angle of the 'window' (always assumed vertical);
- shadow receptors contain on openings measuring 0.9 m by 1.2 m facing towards the closest wind turbines; and height above ground level of the 'window' 0.9 m.

Receptors

The maximum horizontal distance between a receptor affected by shadow flicker and turbine location for example has been identified as being equal to the diameter of the turbine multiplied by ten. In this instance, turbine rotor diameter is 97 m; and therefore an area envelope of 1000 m from the nearest turbine is used in shadow flicker analyses. However, the shadow receptors have been taken into consideration falling within 500 m from each of the WTG as the impact of shadow flicker reduces with distance.

(1) 1 Available in WindPro database of climatological data

Project data overview has been presented in ***Annex D*** which provides the details of WTGs in the study area as well as location details of the shadow receptors considered in this study. ***Annex E*** provides the minimum distances between the WTGs. ***Figure 9.5*** shows the study area of the assessment (within 500 m) of each of the proposed wind turbine location and the surrounding nearby settlements. A total of 20 shadow receptors (including 15 permanent houses, 1 temporary house and 4 other structures) have been identified as being within the study area of the wind farm falling under different villages. All the shadow receptors considered in this study are located within 500 m from any of the WTG location.

The Model – WindPro Shadow

SHADOW is the WindPRO calculation module that calculates how often and in which intervals a specific neighbour or area will be affected by shadows generated by one or more WTGs. These calculations are worst-case scenarios (astronomical maximum shadow, i.e. calculations which are solely based on the positions of the sun relative to the WTG). Shadow impact may occur when the blades of a WTG pass through the sun's rays seen from a specific spot (e.g. a window in an adjacent settlement). If the weather is overcast or calm, or if the wind direction forces the rotor plane of the WTG to stand parallel with the line between the sun and the neighbour, the WTG will not produce shadow impacts, but the impact will still appear in the calculations. In other words, the calculation is a worst-case scenario, which represents the maximum potential risk of shadow impact. A calendar can be printed for any specific point of observation, which indicates the exact days, and time periods where shadow impact may occur.

Apart from calculating the potential shadow impact at a given neighbour, a map rendering the iso-lines of the shadow impact can also be printed. This printout will render the amount of shadow impact for any spot within the project area.

The calculation of the potential shadow impact at a given shadow receptor is carried out simulating the situation. The position of the sun relative to the WTG rotor disk and the resulting shadow is calculated in steps of 1 minute throughout a complete year. If the shadow of the rotor disk (which in the calculation is assumed solid) at any time casts a shadow reflection on the window, which has been defined as a shadow receptor object, then this step will be registered as 1 minute of potential shadow impact. The following information is required:

- The position of the WTGs (x, y, z coordinates)
- The hub height and rotor diameter of the WTGs
- The position of the shadow receptor object (x, y, z coordinates)
- The size of the window and its orientation, both directional (relative to south) and tilt (angle of window plane to the horizontal).
- The geographic position (latitude and longitude) together with time zone and daylight saving time information.

- A simulation model, which holds information about the earth's orbit and rotation relative to the sun.

Prediction of Shadow Flicker

The output of the shadow flicker assessment at each shadow receptor has been presented in ***Annex F*** and the results of the shadow flicker assessment are shown in Table 9.22. The supporting graphs of Shadow Calendar are provided in ***Annex G***. The graphs shown in ***Annexure G*** illustrate the times of the year at each of the 20 receptors in the analysis where theoretical shadow flicker was predicted to occur. Figure 9.6 presents the shadow flicker map around the project WTGs upto 1000 m from each WTG.

Impact Assessment

Given the guidelines of 30 hours or less per year is considered to be acceptable, the operation of the wind farm theoretically results in shadow flicker impacts that could be considered as significant for the purposes of this study. The results show that theoretical shadow flickers in real case scenario occur at 3 shadow receptors out of total 20 receptors considered in this study. The maximum shadow flicker will occur at residential receptor 'S', which is located close to WTG '*GBK30*' with maximum shadow flickering in a year of 41:36 hr/year.

It is relevant to emphasise that predicted hours of shadow flicker effects are real case scenarios with certain assumptions. Assumptions made during the analysis include optimal meteorological, natural light and geometrical conditions for the generation of shadow flicker. The assessment does not account for trees or other obstructions that intervene between receptor and turbine during times when effects may occur. The assessment calculation is therefore an over estimation in the probability of effects. It should also be noted that for shadow effects to occur, properties need to be occupied, with blinds or curtains open and views to the wind turbine unobstructed. However, for the purposes of assessment, it has been assumed that all worst-case circumstances apply.

Mitigation Measures

There needs to be close monitoring through engagement with residents during the operational phase where there are predicted impacts from shadow flicker. The likelihood of direct line of sight to the location of proposed turbine locations can be assessed visually and the potential for using screening like higher fencing and planting trees can be explored at problem locations. The use of curtains can also be explored. If these prove effective and the impacts mitigated, the shutting down of turbines during certain environmental conditions, which meet the physical requirements for theoretical shadow flicker to occur, will not be required.

Should the impact of shadow flicker be identified, and the mitigation measures proposed above prove ineffective, further analysis can be carried out to identify the exact timings and conditions under which shadow flicker

occurs, and a technical solution sought. This is likely to involve pre-programming the turbine with dates and times when shadow flicker would cause a nuisance for nearby receptors. A photosensitive cell can be used to monitor sunlight, and the turbine could potentially then be shut down, when the strength of the sun, wind speed and the angle and position of the sun combines to cause a flicker nuisance.

Assessment of Residual Impacts

The results of the WindPro shadow flicker assessment show a real case estimate with certain assumptions and the mitigation measures above will be implemented for the identified properties that experiences shadow flicker.

Impact	Shadow Flickering during the Operation Phase				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Within 500 m from the WTGs on the receptors located in the SE-NE and SW-NW orientation from the WTG/s.				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Vulnerability of Receptors	Low	Medium	High		
	Out of total 20 receptors considered in the study 3 receptors (out of which 1 is non-residential structures) are impacted with (> 30 hrs/ year). The 2 residential structures are having low impact (between 30 to 100 hr/ year). Remaining shadow receptors indicate negligible impact (i.e. < 30 hrs/ year).				
Impact Significance	Negligible	Minor	Moderate	Major	
	Considering the overall impact magnitude and vulnerability of receptors, the impact significance is assessed as **minor for 2 receptors, and negligible for rest of the receptors.**				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **negligible**				

Residual impacts following the application of required mitigation measures, as discussed above, is likely to result in **negligible** impacts.

Table 9.22 Shadow Flicker Analysis at Each Receptor

S. No.	Label	Structure	Structure Type	UTM Coordinates**		Elevation [m]	Nearest WTG	Approximate Distance from the Nearest WTG (m)	Direction from the WTG (degree)	Shadow Hours per Year [hr/year]
				Easting [m]	Northing [m]					
1	A	House	Residential	535,807	1,775,088	678.5	GBK01	380	48	0:00
2	B	House	Residential	535,240	1,775,217	675	GBK01	480	320	0:00
3	C	House	Residential	535,204	1,775,187	680.6	GBK01	490	315	0:00
4	D	House	Residential	535,185	1,775,178	682.2	GBK01	500	312	0:00
5	E	House	Residential	535,157	1,775,160	683	GBK01	490	310	0:00
6	F	House	Residential	535,154	1,775,152	683	GBK01	490	308	0:00
7	G	Temple	Non-Residential	535,313	1,775,181	679.1	GBK01	410	328	0:00
8	H	Shrine	Non-Residential	535,482	1,775,134	684.2	GBK01	300	350	0:00
9	I	House	Temporary	537,547	1,770,879	660.2	GBK13	430	177	0:00
10	J	Bus Stop	Non-Residential	537,614	1,770,882	658.2	GBK13	440	170	0:00
11	K	House	Residential	541,581	1,774,496	652.7	GBK23	450	13	0:30
12	L	House	Residential	541,535	1,774,513	651.5	GBK23	460	7	0:22
13	M	House	Residential	541,518	1,774,520	650.5	GBK23	470	4	0:26
14	N	House	Residential	541,508	1,774,526	650	GBK23	480	0	0:26
15	O	House	Residential	541,477	1,774,534	648	GBK23	470	358	0:15
16	P	House	Residential	541,458	1,774,538	648	GBK23	480	357	0:16
17	Q	Cabin	Stone Quarry	540,665	1,771,411	660.6	GBK30	215	86	**61:59**
18	R	House	Residential	540,175	1,771,429	651.9	GBK30	285	280	**40:16**
19	S	House	Residential	540,162	1,771,348	654.3	GBK30	300	260	**41:36**
20	T	House	Residential	540,108	1,771,266	654.4	GBK30	360	250	23:35

*Figures highlighted and bold represent greater than 30 hours per year of shadow flicker
** WGS84 Zone: 43

Figure 9.5 Map showing WTGs and Shadow Receptors

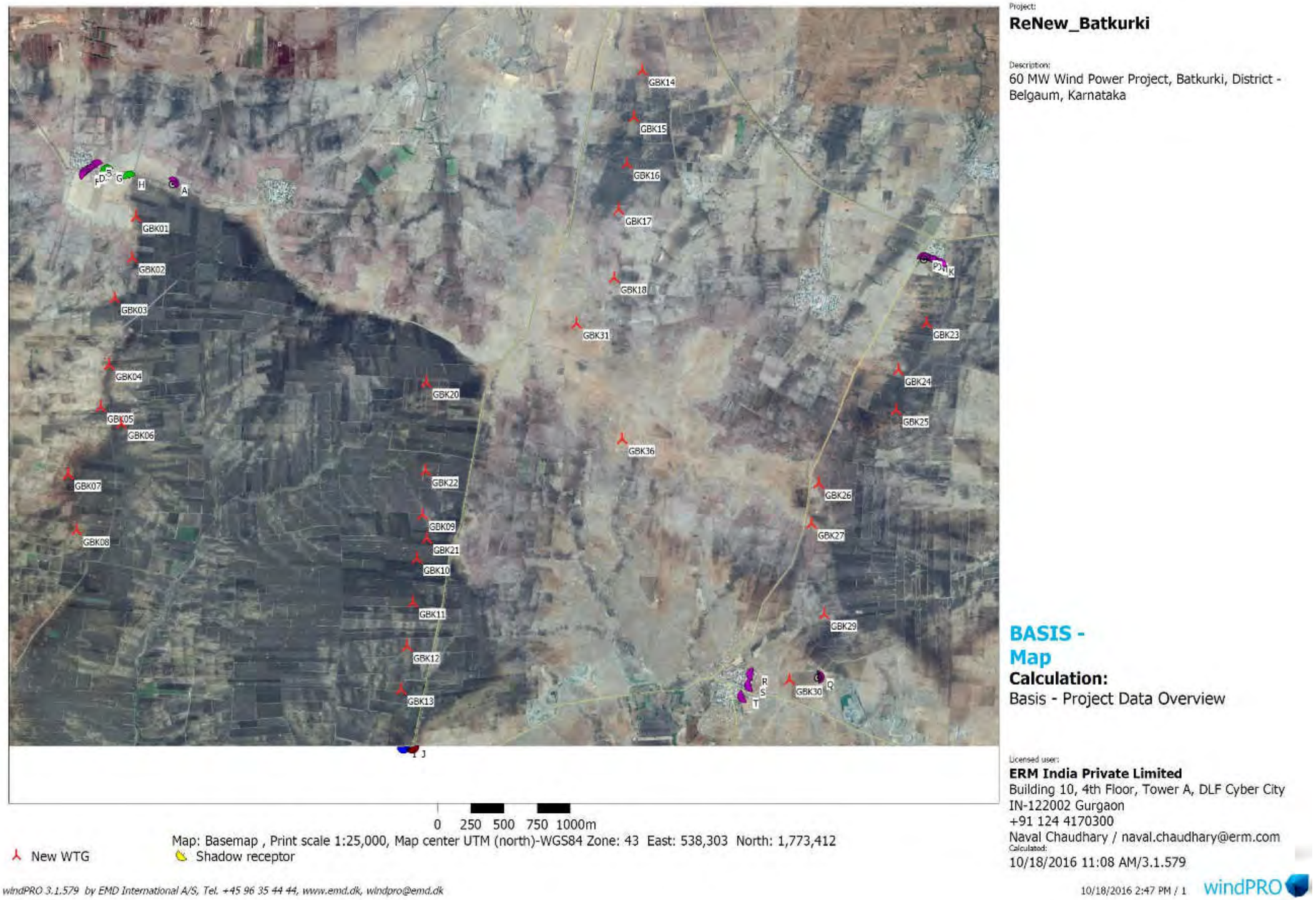
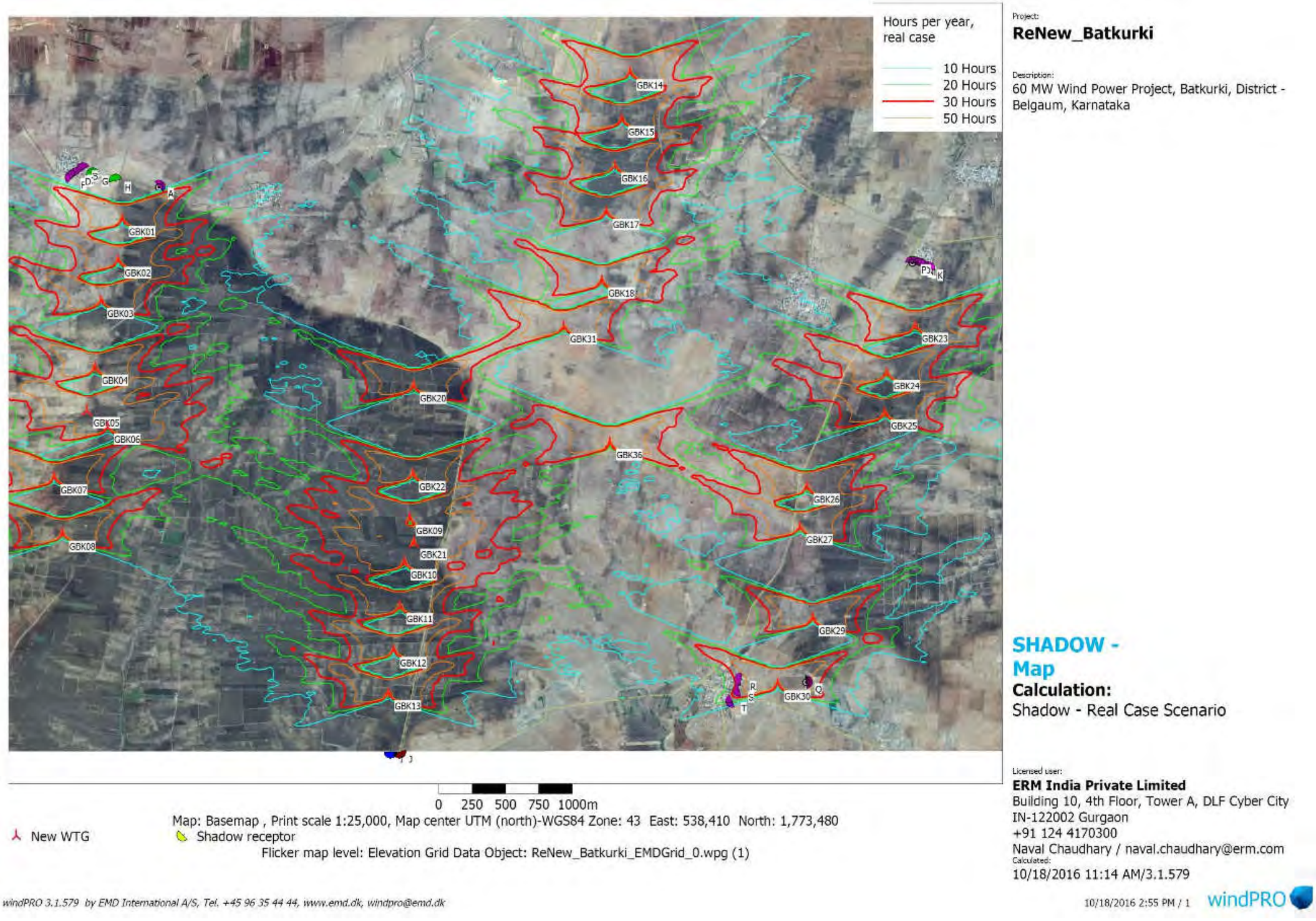


Figure 9.6 *Shadow Flicker Map - Real Case Scenario*



9.3.8 Occupational Health and Safety

Occupational health and safety needs to be monitored for several activities anticipated for the Project:

- Working at height during erection of WTGs, transmission towers and establishment of transmission lines;
- Working in confined spaces within the WTGs and pooling substation;
- Working with rotating machinery including the batching plant, rollers and layers; and
- Working with live electrical components – transmission towers, lines and WTG internal electrical parts.

The Project site also needs to implement proper measures for fire safety, public accessibility, falling objects, structural safety and any emergency situations.

The occupational health and safety concerns mentioned above would be consistent across the Project life cycle and therefore the impacts would be similar in nature.

Embedded/In-built Controls

- All construction activities should be carried out during daytime hours and vigilance should be maintained for any potential accidents;
- Personal Protective Equipment (PPEs) including safety shoes, helmet, goggles, ear muffs and face masks;
- Structural integrity should be checked before undertaking any work; and
- Electrical and maintenance work should not be carried out during poor weather and during lightning strikes.

Significance of Impact

The Project site is located in an area with flat topography and no major risks for environmental calamities (earthquakes, heavy winds, floods, etc.). Gamesa and ReNew are both companies that have a large portfolio of constructed and operated wind farms respectively and should already have a Health and Safety procedures in-place. The impact significance on occupational health and safety is therefore assessed as **minor.**

Mitigation Measures

- All workers (regular and contracted) should be provided with training on Health and Safety policies in place with appropriate refresher courses throughout the life cycle of the Project;
- Permitting system should be implemented to ensure that cranes and lifting equipment is operated by trained and authorized persons only;
- Appropriate safety harnesses and lowering/raising tools should be used for working at heights;

- Safe drinking water supply should be provided for the workers;
- Excavated areas should be temporarily fenced to avoid access to outsiders and wildlife;
- Security should be deputed at potential accident sites to restrict entry and prevent near miss or fatal incidents;
- An up-to-date first aid box should be provided at all construction sites and a trained person should be appointed to manage it;
- All equipment should be turned off and checked when not in use; and
- A safety or emergency management plan should be in place to account for natural disasters, accidents and any emergency situations. The nearest hospital, ambulance, fire station and police station should be identified in the implemented emergency management plan.

Impact	Occupational health and safety in windfarm construction, operation, maintenance and decommissioning.			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term	Permanent
Impact Extent	Local	Regional	International	
Impact Scale	The project will employ local workers primarily on a contractual basis, including semi-skilled and unskilled workers. Skilled workers may be migratory workers as and when is needed by Gamesa and its subcontractors			
Frequency	Throughout the project life cycle			
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Vulnerability of Receptors	Low	Medium	High	
	The erection of WTGs will be done through experienced and trained workers. However, construction of other components will involve local workers who may not have earlier experience. Hence, there will be greater vulnerability for accidents.			
Impact Significance	Negligible	Minor	Moderate	Major
	Considering the overall impact magnitude and vulnerability of social receptors, the impact significance is assessed as **minor**.			

9.4 *KEY ECOLOGICAL RISKS*

Interactions that are likely to lead to significant impacts on ecology within the study area are presented in ***Table 9.23.***

Table 9.23 Identified interactions that are likely to lead to significant impacts

S.N.	Potential Impacts	Causes of Impacts
1.	Permanent and/or temporary loss of habitat (terrestrial or aquatic) including connectivity boosting habitat such as plantations in agricultural land, green corridors and nesting grounds.	• Clearance of mature trees across the agricultural found in the study area; • Excavation and construction that will affect burrowing species through loss of habitat and noise/vibration impacts on sensitive species; and • Sedimentation and erosion effects on local water bodies because of construction

		activities and loosening of soil layers.
2.	Disturbance and displacement of species due to noise, light, anthropogenic movement, traffic, etc.	• Increased movement of vehicles and people can increase the stress levels of fauna that causes them to spend an increased amount of time in alert mode instead of foraging, socializing, mating or nesting; • Noise, light and uncovered wastes can attract or repel faunal species to or from the wind farm.
3.	Mortality as a result of vehicular and machine operation	• Road kills especially for smaller mammals, reptiles and amphibians that utilize habitats adjacent to current or proposed access roads.
4.	Mortality as a result of worker influx and increased hunting, trapping and poaching of wildlife	• Improper education and regulation of demographic influx that can impact wildlife numbers.
5.	Collision risk from movement of wind turbine blades	• Operation of the wind farm can act as a hazard to flying fauna because of collision risks and small changes in pressure created by the blade movement; and • Multiple wind farms in a single region can exponentially increase the impact levels on avifaunal species due to increased collision risk and increased expenditure of energy to find alternate resources to those lost within the Project footprint area.
6.	Hazards associated with roosting and nesting of avifauna on transmission lines and towers.	• Transmission lines create an electrical hazard to the large number of birds that utilize the height as a roosting point for foraging and keeping a watch out for prey/predators.

9.4.1 Assessment Criteria

ERM Impact Assessment standard defines sensitivity of ecological receptors by determining the resource sensitivity for species and habitat separately. The impact assessment criteria is given in ***Table 9.24*** and ***Table 9.25.***

Table 9.24 Habitat Impact Assessment Criteria

Habitat Sensitivity/ Value		Magnitude of Effect on Baseline Habitats			
		Negligible	Small	Medium	Large
		Effect is within the normal range of variation	Affects only a small area of habitat, such that there is no loss of viability/ function of the habitat	Affects part of the habitat but does not threaten the long-term viability/ function of the habitat	Affects the entire habitat, or a significant portion of it, and the long-term viability/ function of the habitat is threatened.
Negligible	Habitats with negligible interest for biodiversity.	**Not significant**	**Not significant**	**Not significant**	**Not significant**
Low	Habitats with no, or only a local designation / recognition, habitats of significance for species listed as of Least Concern (LC) on IUCN Red List of Threatened Species, habitats which are common and widespread within the region, or with low conservation interest based on expert opinion.	**Not significant**	**Not significant**	**Minor**	**Moderate**
Medium	Habitats within nationally designated or recognised areas, habitats of significant importance to globally Vulnerable (VU) Near Threatened (NT), or Data Deficient (DD) species, habitats of significant importance for nationally restricted range species, habitats supporting nationally significant concentrations of migratory species and / or congregatory species, and low value habitats used by species of medium value.	**Not significant**	**Minor**	**Moderate**	**Major**
High	Habitats within internationally designated or recognised areas; habitats of significant importance to globally Critically Endangered (CR) or Endangered (EN) species, habitats of significant importance to endemic and/or globally restricted-range species, habitats supporting globally significant concentrations of migratory species and / or congregatory species, highly threatened and/or unique ecosystems, areas associated with key evolutionary species, and low or medium value habitats used by high value species.	**Not significant**	**Moderate**	**Major**	**Critical**

Table 9.25 Species Impact Assessment Criteria

Baseline Species Sensitivity/ Value		Magnitude of Effect on Baseline Species			
		Negligible	Small	Medium	Large
		Effect is within the normal range of variation for the population of the species	Effect does not cause a substantial change in the population of the species or other species dependent on it	Effect causes a substantial change in abundance and/or reduction in distribution of a population over one, or more generations, but does not threatened the long term viability/ function of that population dependent on it.	Affects entire population, or a significant part of it causing a substantial decline in abundance and/or change in and recovery of the population (or another dependent on it) is not possible either at all, or within several generations due to natural recruitment (reproduction, immigration from unaffected areas).
Negligible	Species with no specific value or importance attached to them.	**Not significant**	**Not significant**	**Not significant**	**Not significant**
Low	Species and sub-species of LC on the IUCN Red List, or not meeting criteria for medium or high value.	**Not significant**	**Not significant**	**Minor**	**Moderate**
Medium	Species on IUCN Red List as VU, NT, or DD, species protected under national legislation, nationally restricted range species, nationally important numbers of migratory, or congregatory species, species not meeting criteria for high value, and species vital to the survival of a medium value species.	**Not significant**	**Minor**	**Moderate**	**Major**
High	Species on IUCN Red List as CR, or EN. Species having a globally restricted range (i.e. plants endemic to a site, or found globally at fewer than 10 sites, fauna having a distribution range (or globally breeding range for bird species) less than 50,000 km^2), internationally important numbers of migratory, or congregatory species, key evolutionary species, and species vital to the survival of a high value species.	**Not significant**	**Moderate**	**Major**	**Critical**

The habitat sensitivity for the Project site has been assessed as **low** because of the presence of only least concern species. For similar reasons, the species sensitivity has also been assessed as **low** for the Project site.

There are three Schedule I species, namely Black-shouldered Kite (*Elanus caeruleus*), Indian Peafowl (*Pavo cristatus*) and Indian Monitor Lizard (*Varanus benghalensis*) in the Project study area. All three Schedule I species are widespread in India and extremely adaptable to a wide variety of habitats. The limited loss of vegetation anticipated in the Project would therefore not have a significant impact on these species.

The East Indian Satinwood (*Chloroxylon swietenia*) and Starred Tortoise (*Geochelone elegans*) are classified as vulnerable by IUCN Red List (Online Version 2016-2) but are rarely found in the Project study area. The Satinwood is located at the outskirts of the Project study area in the Reserve Forests in the south (***Figure 7.6***) and is unlikely to be impacted by construction activities. The tortoise is an occasional visitor to Belgaum District and is more likely to be found in the continuous vegetation in the Reserve Forest. The site has also been identified as Striped Hyaeana (*Hyaena hyaena*) habitat but the lack of continuous open scrub or thorny busy that is preferred by the species indicates that it might only be an occasional visitor to the area.

9.4.2 Construction Phase

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

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

Impacts due to Vegetation Clearance

Context and Receptor

Vegetation clearance occurs for the establishment of labour camps, storage yards, access/internal roads, excavation for the erection of WTGs and construction of ancillary facilities. Loss of vegetation will directly affect the floral diversity in the area and indirectly affect fauna through loss of habitat,

loss of connectivity and decrease in soil/water quality. Additionally, loss of vegetation can reduce options for nesting habitat, shelter from predators, foraging resources, shade, perching habitat and breeding sites.

The impact magnitude for habitats has been assessed as **small** because limited vegetation clearance is anticipated and only a small amount of species will be affected. There should be a negligible impact due to construction of WTGs and ancillary facilities but the laying of approach roads and transmission lines may result in some clearance of vegetation in the area.

The impact magnitude for species has been assessed as **negligible.** All the species found on the site are widespread or very occasional visitors to the region and should be able to adjust to the limited anticipated clearance of vegetation.

Embedded/In-built Controls

- As stated by Gamesa, Reserve Forests will remain unaffected by construction, approach road widening and transmission line laying. These activities should also avoid areas immediately adjacent to Reserve Forests so as to not affect the fauna in the area;
- Construction activity should be conducted in a phased manner to prevent excessive noise, anthropogenic movement and vehicular movement throughout the entire wind farm area at any given time; and
- Clearance of mature trees or continuous scrub should be avoided to the extent possible when planning the wind farm components.

Significance of Impacts

Vegetation clearance will occur for construction activities. The construction is largely anticipated on agricultural land with some impacts extending to scrubland. The trees found in the region are fairly common species and restricted to the Reserve Forest patches located at the southern part of the study area. There is a spattering of mature trees around the agricultural land that may be affected by the construction activities.

The habitat found in the area including agricultural crops, trees, shrubs and plants are fairly common and widespread across Belgaum District and the State of Karnataka. The loss of a small percent of the habitat would therefore not have a significant effect on the species in the area. Due to the limited amount of scrubland being affected, the faunal class that would be most impacted by the Project would be herpetofauna and granivorous avifauna. Species that would be affected by loss of agricultural land include Baya Weaver (*Ploceus phillipinus*), House Sparrow (*Passer domesticus*), Rose-ringed Parakeet (*Psittacula krameri*), Laughing Dove (*Stigmatopelia senegalensis*) and snake species (rat snake, saw-scaled viper and cobra). All of the above species are fairly common and widespread across India and therefore the receptor sensitivity has been assessed as **low**.

The impact significance for vegetation clearance has therefore been assessed as **negligible**.

Mitigation Measures

The following mitigation measures will further reduce the impact on habitat and species:

- Vegetation clearance should be restricted to the Project activity area(s);
- Mature vegetation should be avoided when planning any site clearance activities;
- Top soil should be stored separately for restoration of habitat after construction;
- Unnecessary disturbance of vegetation due to off-roading, fuel wood procurement, unchecked expansion of labour camp(s) and destruction of floral resources should be prohibited; and
- Local grass species can be seeded in disturbed areas during monsoon season.

Impact	Clearance of vegetation- construction phase				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to construction area and immediate surroundings				
Frequency	Construction phase				
Likelihood	Likely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity (Open Scrubland & agricultural lands)	Low	Medium	High		
Resource Sensitivity (Species)	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **not significant/negligible.**				

Impacts from Construction Activities

Context and Receptor

Impacts from construction activities on the environment have been discussed in the previous sections. Other activities in the construction phase will also have an impact on the local ecology as follows:

- WTG excavation, laying of transmission lines and access road construction/widening will result in disturbance of soil layers for burrowing and ground roosting species;
- Increased chances of erosion of soil layers and sedimentation of water bodies;

- Increased noise from construction and vehicular movement will result in an increased time spent in alert mode for faunal species;
- Increased vehicular movement can lead to an increased risk in road kills; and
- Increased demographic influx has a potential for more human-wildlife conflict including hunting, poaching and trapping of wildlife.

The species found in the study area were common, widespread and easily adaptable. If precautions are taken to ensure that the construction activities are restricted to the Project footprint area and there are no wildlife-human conflicts that are purposely initiated by the labour force, the impact magnitude can be assessed as **small**.

Embedded/In-built Controls

- Labourers should be provided training for dealing with wildlife as well as *dos* and *don'ts* when dealing with them;
- Strict no hunting, poaching or trapping of wildlife policy should be communicated and enforced by the EPC contractor; and
- Project components should be planned such that they are sufficiently away (preferably 500m) from water bodies, Reserve Forests and any heavily vegetated area to reduce the impact on local wildlife.

Significance of Impact

The construction activities will have a small impact on the soil properties in the area. The species most likely to be affected by changes in soil properties are Saw-scaled Viper (*Echis carinatus*), Rat Snake (*Ptyas mucosus*), Monitor Lizard (*Varanus benghalensis*), Black-naped Hare (*Lepus nigricollis*) and all floral species. As pre-existing roads and agricultural land is being utilized for majority of the anticipated Project construction, the impacts should be negligible.

The increased noise and vehicular movement will have an impact on all faunal species. Herpetofauna would be at the greatest risk for road kills, avifauna may be displaced from the wind farm boundaries and mammals will be affected by increased noise levels. The vehicular movement and noise will occur for a short period of time and if planned to avoid peak activity periods, can have a low impact on local fauna. The presence of Schedule I species in the area including Starred Tortoise (*Geochelone elegans*), Monitor Lizard, Black-shouldered Kite (*Elanus caeruleus*) and Indian Peafowl (*Pavo cristatus*) that could be directly affected by construction activities, the receptor sensitivity for species has been assessed as **medium**. The total impact significance has therefore been assessed as **minor** for habitats and species in the area.

Mitigation Measures

- Construction and transportation activities should be avoided at night (6:00 pm to 6:00 am) and should particularly avoid high faunal activity areas such as heavy vegetation and water bodies during dawn (6:00 am to 8:00 am) and dusk (5:00 pm to 7:00 pm);

- High biodiversity value areas such as water bodies, forest patches and areas adjacent to them should be avoided when conducting construction activities.
- Temporary barriers should be installed around excavation areas;
- Waste materials should be covered and cleared periodically so as to not attract fauna to the construction site;
- If access roads are created in key crossing paths for herpetofauna or smaller mammals then culverts or alternate paths should be provided to prevent road kills;
- Labour movement should be restricted to between construction camps and sites; and
- General awareness regarding the presence of protected species (Black-shouldered Kite, Indian Peafowl and Indian Monitor Lizard) as well as occasional sighting of Indian Starred Tortoise should be raised among the staff and labourers through interactive sessions, charts, posters or trainings.

Impact	Construction activities				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Largely restricted to construction area and immediate surroundings.				
Frequency	Construction phase				
Likelihood	Likely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity (Habitat)	Low	Medium	High		
Resource Sensitivity (Species)	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **negligible**				

Impact	Construction activities				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Largely restricted to construction area and immediate surroundings.				
Frequency	Construction phase				
Likelihood	Likely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity (Habitat)	Low	Medium	High		
Resource Sensitivity (Species)	Low	Medium	High		

Impact Significance	Negligible	Minor	Moderate	Major
	Significance of impact is considered **negligible**			

9.4.3 Operational Phase

Impacts from operational activities include the following:

- Movement of wind turbine blades:
  - Collision risk for flying fauna,
  - Behavioural avoidance by flying species and increased energy expenditure,
  - Barrier effects that lead to connectivity issues and access to resources; and
- Electrical hazards including roosting or nesting on transmission lines and towers.

Hazards associated with turbine blade movement

Context

An operational wind farm has several wind turbine generators located 300 m to 1 km apart that rotate at speeds relative to the wind. The rotating blades and the varying speeds of their movement is a collision hazard to flying birds and bats. The hazard is especially pronounced for aerial hunters that have a flight height that matches the blade height of the WTGs. A bird/bat that avoids collision with the blades can still be impacted by the visual movement of the blades. Bats were not found during the ESIA assessment and have therefore not been considered for collision risk.

Birds adjust to the presence of the wind farm by changing their behaviour. Flight deviation, alternate resource utilization, dispersion from the wind farm area and changing flight heights are types of behavioural changes that the birds can utilize to adjust to the wind farm. The avoidance behaviour can still result in night collisions and collisions due to sudden change in wind speeds. The energy expenditure to avoid the wind farm can be a strain on birds and decrease energy reserves for foraging, hunting, socializing and breeding. The avoidance and dispersion can also lead to loss of foraging resources, habitats and migration pathways.

All avifauna found on the site are Least Concern or Schedule IV species with the exception of the Black-shouldered Kite (*Elanus caeruleus*). The Black-shouldered Kite is a Schedule I species but very widespread in its distribution in India and was seen on only one occasion during the three-day site visit. Village consultations confirmed that raptor species are not commonly seen in the area and therefore the Black-shouldered Kite would only occasionally be a concern for collision with wind turbine blades. The receptor sensitivity has therefore been assessed as **low**. The impact magnitude has been assessed as **small.**

Embedded/In-built Controls

- Inter-turbine distance should be large enough that birds can avoid turbine blades and utilize minimal energy while doing so;
- Avoid siting of WTGs near important habitat features such as water bodies, rocky terrain and thick vegetation; and
- WTGs should be sited in areas that are visible from a manoeuvrable distance for flying species and shouldn't be located near sudden changes of elevation, large trees or be blocked by any manmade/natural structure.

Significance of Impacts

The birds most susceptible to wind farm collisions are aerial hunters such as Black-shouldered Kite (*Elanus caeruleus*) and White-throated Kingfisher (*Halcyon smyrnensis*). Both species were not found in close proximity to the proposed WTG locations with the Kite appearing on transmission lines along the national highway used to access the wind farm and the Kingfisher was found closer to water bodies. All other species are common and widespread in the wind farm. Most of these species are also granivores and therefore have access to similar agricultural habitat in surrounding areas.

The Black-shouldered Kite is a Schedule I species but is found on very rare occasions in the wind farm as per the primary survey and village consultations. The impact significance has therefore been assessed as **negligible.**

Mitigation Measures

- Flash lamps on the WTGs will prevent bird collisions at night;
- Waste materials should not be left uncovered as it will attract birds and other fauna to the wind farm boundary;
- Overhead cables should be marked using diffractors; and
- Restoring herb layers in the vicinity of the wind turbines will provide shelter for prey animals (e.g. lizards, snakes and rodents) and prevent raptors such as the Black-shouldered Kite from flying into the wind farm.

Significance of Residual Impacts

The significance of residual impacts after implementation of the above mitigation measures will remain **negligible**. The implementation of flash lamps and restoration of herb layers will prevent the biggest causes of concern for collision, namely night collisions and raptor presence in the wind farm. Providing sufficient distance between wind turbines will prevent the wind farm from acting as a barrier to faunal species.

Impact	Bird & Bat Collision Risk			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term	Permanent
Impact Extent	Local	Regional	International	

Impact Scale	Limited to core zone of the wind farm as well as a displacement radius of 1 km for birds that are showing avoidance behaviour				
Frequency	Operation phase				
Likelihood	Likely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity (Species)	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **minor** for flying fauna				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **negligible.**				

Electrical Hazards for Avifaunal Species

Context

Several species of birds are found roosting on wire and poles of existing transmission lines in the wind farm study area. The addition of more transmission lines and poles can create a greater risk for electrocution for these perching bird species. Some birds also utilize these poles for nesting by placing the nests across wires or using holes in the tower itself.

Embedded/In-built Controls

There are no embedded/in-built controls to prevent nesting/roosting birds in transmission towers.

Significance of Impacts

Many of the avifaunal species found in the wind farm were found roosting across transmission lines. These species include Common Myna (*Acridotheres tristis*), Pied Kingfisher (*Ceryle rudis*), Common Pigeon (*Columba livia*), Jungle Crow (*Corvus macrorhynchus*), House Crow (*Corvus splendens*), Black Drongo (*Dicrurus macrocercus*), Black-shouldered Kite (*Elanus caeruleus*), White-throated Kingfisher (*Halcyon smyrnensis*), Red-rumped Swallow (*Hirundo daurica*), Wire-tailed Swallow (*Hirundo smithii*), Long-tailed Shrike (*Lanius schach*), Little Green Bee-eater (*Merops orientalis*), House Sparrow (*Passer domesticus*), Red-vented Bulbul (*Pycnonotus cafer*), Pied Bushchat (*Saxicola caprata*), Eurasian Collared Dove (*Streptopelia decaocto*) and Brahimny Starling (*Sturnus pagodarum*). None of the above species with the exception of Black-shouldered Kite is classified as protected or threatened. The Schedule I Indian Peafowl (*Pavo cristatus*) is also present in the wind farm and their low flight height combined with poor manoeuvrability in the air make them prone to electrocution on transmission lines. The receptor sensitivity has therefore been raised to **medium** for electrocution hazards.

The impact magnitude has been assessed as **low** as the two most significant species – Black-shouldered Kite and Indian Peafowl are widespread across India and therefore the electrocution hazard will not have a huge impact on

the local population of the species and its viability. The impact significance has therefore been assessed as **minor.**

Mitigation Measures

- Transmission poles should be raised with suspended insulators in order to reduce the electrocution of bird species;
- Bird-safe strain poles with insulation chains at least 60 cm in length should be adopted; and
- Regular checking of the vacuums or holes in the towers for nesting bird species should be practiced.

Other insulation practices to prevent electrocution of birds due to transmission lines have been provided in (1).

As industry good practice, ReNew should maintain a bird mortality register for the wind farm during the operation and maintenance phase. A bird mortality register will record all bird carcasses within 500m of a project component (including transmission lines and pooling substation). The register should include the following:

- GPS coordinates of identified carcass;
- Distance from nearest wind turbine along with the name of the wind turbine; and
- Description or picture of the carcass to identify the species and the cause of death as electrocution or collision with wind turbines.

Residual Impact Significance

The species found in the wind farm are widespread and common and therefore the residual impact significance has been reduced to **negligible** after implementation of mitigation measures. Black-shouldered Kite has been found rarely in the wind farm and implementation of proper insulation should avoid majority of the electrocution risk associated with Indian Peafowl.

Impact	Electrocution hazards				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to electrical components of the wind farm including wind turbine generators, transmission lines (internal and external) and transmission poles.				
Frequency	Operation phase				
Likelihood	Likely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large

(1) Haas, D., Nipkow, M., Fielder, G., Schneider, R., Haas, W. and Schurenberg, B. 2005. Protecting birds from power lines. Convention on the conservation of European Wildlife and Habitats. Nature and Environment, No.140.

Resource Sensitivity (Species)	Low		Medium		High
Impact Significance	Negligible	Minor	Moderate		Major
	Significance of impact is **minor** for species.				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Moderate		Major
	Significance of impact is considered **negligible.**				

9.5 *KEY SOCIAL RISKS*

9.5.1 *Assessment Criteria*

For the assessment of social impacts, the sensitivity and magnitude criteria outlined in ***Table 9.26***and ***Table 9.27*** respectively have been used. The social impacts associated with the pre-construction, construction, operations and decommissioning stages have been assessed qualitatively and in some cases quantitatively (subject to availability of data), using professional judgment based on past experience from similar projects.

Table 9.26 ***Receptor Sensitivity for Local Communities***

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

Table 9.27 ***Impact Magnitude for Local Communities***

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

9.5.2 *Community Health and Safety*

Context and receptor

The construction phase activities such as the erection of the WTGs, construction of transmission lines and substations and movement of material and personnel may result in impacts on the health and safety of the community. These activities will involve the use of heavy machinery and live

transmission power lines. Furthermore, the movement of material and personnel via the access roads may result in damage to human life or livestock due to accidents. At the time of the site visit, construction activities for foundation erection were already complete in 28 out of the 30 WTG locations..

The major community health and safety risks include structural safety of project infrastructure, life and fire safety, public accessibility and management of emergency situations. The receptors for impacts on community health and safety include the local community within the study area who may be present in the vicinity of the project activities, for grazing purposes or while commuting.

Embedded/ In Built Control

Occupational Health and Safety (OH &S) at Gamesa (the developer for the project) is governed by the 'Gamesa Excellence Policy'. Besides OH & S, the policy, all the manufacturing centres of Gamesa have been certified for OH & S by the Spanish Standardisation and Certification Association (AENOR). Even the project proponent - Renew has developed and implemented a Healthy and Safety Policy on site.

Impact Significance

Based on the above analysis, the impact is assessed to be **minor**.

Mitigation/ Management Measures

The following risk mitigation measures are suggested to minimize the risks/ hazards of construction activities onsite;

- Developing an onsite ESMS and HSE Policy by the developer;
- Ensuring that the sub-contractor agreements that the developer enters into require all contractors to possess an EHS plan with provisions for monitoring of the EHS performance of contractors and their workers;
- Ensuring that the excavated areas are properly fenced for safety and sign boards in local languages are put up;
- Ensuring that drivers carrying construction machinery and materials are instructed to drive within speed limits with careful consideration for village traffic;
- Regulating movement of heavy equipment and construction materials during peak hours; and
- As part of the stakeholder engagement and information disclosure process, providing an understanding to the community concerning the activities proposed to be undertaken and the precautions being adopted for safety.

Residual Impact Significance

After the implementation of the above mitigation measures, the residual impact significance is anticipated to remain **negligible**.

Impact	Community health and safety				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to project footprint				
Frequency	Project lifecycle				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **Minor**				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **negligible.**				

9.5.3 *Reduction of Land-holding and loss of agricultural income*

Context and receptor

The project involves 30 WTGs, all of which are located/ proposed to be located on private agricultural land. The private land is proposed to be purchased from willing landowners in accordance with the Karnataka Renewable Energy Policy, 2014-2020.

Families selling land to the project and communities engaged in share cropping of the land are receptors of this type of impact.

The land requirement per WTG is reported to be only a fraction of the total landholdings of the landowners. Consultations in villages Aneguddi, Chennapur and Shirasapur suggested that the average landholding was between 2 – 3 acres (***Section 7.6.8***). This is slightly less than the parcel of land to be used for a single WTG. 29 out of the 30 land parcels required for WTGs was reported to have been procured with negotiations for purchase of land parcel for the 30th WTG underway. The project does not involve any physical displacement. However, it could not be ascertained whether any of the sellers would be rendered landless post the sale of to the Project as none of the prospective land sellers could be consulted. The purchase process is in progress and compensation payment is being made.

Presently, majority of the households apart from agricultural labour are also involved in wage labour, especially in local stone mining and quarrying activities or self-employment. The sale of land therefore is not expected to have significant impact on the agricultural income of the family. It was reported that the entire project land along with the internal and external trans,mission line corridors do not contain CPRs.

Embedded/ In Built Control

- The developer is trying to ensure that it will not make the land sellers landless; and
- 1 Security personnel for 2 WTGs in three shifts of 8 hours each will be deployed during the construction phase. However, during the operation phase, deployment of security personnel at WTG and other components of the project will be limited to the nightshift i.e. between 09:00 AM to 05:00 AM. Additional employment opportunities may also be created for the local youth by the Wind Farm developer.

Significance of Impact

Based on the above analysis, after implementing the embedded controls, the impact is assessed to be **minor.**

Additional Mitigation/ Management Measures

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

- Providing skills-based training interventions, especially for self-employment to the young and unemployed in the families who will be selling land to project. This will enhance their employability and create potential for income generation through self-employment;
- Providing preference to members of the families who will be selling land to the project for livelihood opportunities in Construction phase;
- Providing training and agricultural inputs in the form of subsidized HYV seeds, equipments etc. to help in improving the farm yield in the project area;
- Providing potable drinking water to households that lack access to supply of piped water or even tube wells. Preference may be provided to the land sellers;
- Persuading the sellers of land to purchase land elsewhere using the money earned through the sale so as to ensure that the total landholding of such families does not decline; and
- Procuring resources from the local sources so as to induce more employment in the supply chain.

Residual Impact Significance

After the implementation of the above mitigation measures, the residual impact significance is anticipated to remain **negligible**.

Impact	Economic loss due to selling of land			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term	Permanent

Impact Extent	Local		Regional		International
Impact Scale	Limited to project footprint				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
	The impact magnitude will be medium as the average land of 3.33 acres required for the WTG component of the project is higher than the average land holding in the study area. Consequently, the probability of a farmer becoming landless or remaining in possession of an extremely small piece of land is more. There will also be loss of the income and yield associated with the land parcel.				
Resource Sensitivity	Low		Medium		High
	The land sellers are reported to receive compensation amount higher than the existing market rate. Generation of opportunities for employment will be created for the land sellers. With the remaining landholdings of the landowners being categorized between small and medium, the resource sensitivity is assessed to be low.				
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **Minor**				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Residual impact significance is considered **negligible.**				

9.5.4 *Impact on local employment*

Context and receptor

It is evident from the social baseline conditions of the study area that major working population of the entire study area villages are cultivators and agriculture labourers, those working on other's field for a sum negotiated with the cultivator/owner of the field.

Community consultations and observations made during the site visit suggest that the existing scenario of the agriculture in the study area is not capable enough to meet requirements of the people who are solely dependent upon it; especially with the growing population and fragmentation of the limited land holdings. Though employment of unskilled and semi-skilled labour in the unregulated stone mining and quarrying sector has increased over the past couple of years, the scale of engagement being offered by the sector is limited to a few thousand local youth of the district. In absence of any major industrial activity in the study area, people in several villages have already resorted to cultivating cash crops (which is capital intensive and not affordable for the majority), entering into petty trades or have started migrating to other places in search of work.

Enhancement Measures

As gathered from community consultations, a significant segment of labour requirement during the construction phase will be sourced locally. During construction phase of the project, employment opportunities will be significant for local people whereas during the operation phase, it could be

restricted to the requirement of few security personnel and few housekeeping staff at site office. The following additional measures may be recommended to minimize this impact;

- The sourcing of local labour wherever possible should be made obligatory for the sub-contractors and in all major procurement activities. The project proponent will establish a mechanism to audit subcontractors and suppliers with respect to compliance of utilizing local labour and resources;
- Information on local employment should be communicated to the GPs and information on availability of employment opportunities should be displayed at GP office premises in consultation with the Sarpanch; and
- Skills training programmes for promoting agri-allied activities so as to create self-employment opportunities should be promoted.

Impact Significance

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

Impact	Impact on local employment opportunities during the project life cycle				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Locals will mostly have short term employment opportunities during construction phase of the project. However, people in limited numbers, from the neighbouring districts of Bijapur and from the bordering regions of Maharashtra are likely to be engaged in the project, especially in the highly skilled category of manpower.				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
	The impact magnitude will be positive as people from the locality will definitely be employed, especially during the construction phase of the project. However, the exact figures of local people benefitting from the employment opportunities cannot be estimated.				

9.5.5 Accidental Impacts – Blade Throw and Natural Disasters

Context and receptor

The failure in the rotor blade can result in the 'throwing' of a rotor blade which may affect public safety. Further, there are chances of malfunction or destructions due to natural disasters such as storms, cyclones, earthquakes and lightening.

Any communities lying in close proximity to the WTG are receptors of this type of impact. Blade throw risk for public safety is treated as extremely low as in the event of failure, the blade can reach between 15-100 meters from the wind turbine. Hence, the micro-siting guidelines keep this in mind while prescribing a safety setback distance.

The project area is not prone to storms and cyclones and does not fall in an active earthquake prone zone. The project area falls in Zone II according to the Seismic Hazard Map of India. Zone II is defined as a low damage risk zone and vulnerable to earthquakes of intensity MSK VII[1].

Embedded/ In Built Controls

The WTG design and micro-planning guidelines so as to reduce incidences of blade throw and other natural disasters are not known. Similarly, no embedded/ in built controls to mitigate the risk were reported.

Significance of Impact

Based on the above analysis, the impact is assessed to be **negligible**.

Mitigation/ Management Measures

The following risk mitigation measures are suggested to be included in the ESMP to minimize the risks/ hazards of accidents and natural disasters:

- Communicating the local community about the accidental risks and safety features of the WTGs within the wind farm;
- Communicating the local community on the 'dos' and 'don'ts' during emergency scenarios;
- Involving the district disaster management cell and the nearest fire service station while preparing for emergency situations; and
- Renew should get adequate third party insurance cover to meet the financial loss to any third party due to such emergencies.

Impact	Accidents and natural disasters				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	All communities and livestock inhabiting with a radius of 100 meters from the WTG sites are likely to be impacted				
Likelihood	Unlikely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low	Medium	High		
	The nearest settlement is about 200 m from any of the project WTG.				
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **negligible.**				

1.url: http://www.hpsdma.nic.in/ResourceList/Maps/EqIndia.pdf. Accessed on 06.09.2016.

9.5.6 Impact of Labour Influx/Migrant Workforce

Context

It was reported that the estimated labour requirement during the construction phase of the project range from 130 – 150 workers. Nearly one-third of the total labour requirement i.e. approximately 40-50 workers are expected to be sourced from outside the study area. Nearly 40 migrant workers are already engaged at site under three contractors. Please refer to the sub-section titled Temporary Labour Camps for more details on the contractors and the corresponding migrant workers engaged by them. The workers, especially belonging to the Skilled and Highly Skilled categories engaged in project activities such as; (a) Installation of Substation and transformer, (b) Erection of tower, (c) Civil foundation works, (d) Electrical works, (e) Mechanical works etc. have been sourced predominantly from the neighbouring states of Maharashtra, Goa and from the southern state of Tamil Nadu.

Due to lack of the required skills among the local youth, especially in undertaking the steel work for WTG foundation, the migrant labourers were reported to have been engaged for the purpose during the construction phase. The labour requirements in the unskilled category are being met locally. Consultations suggest that locals prefer other employment and vendor opportunities for increasing their income.

Embedded/ In Built Control

At the time of the ERM site visit, construction work was already complete in 28 out of the 30 WTGs. However, visit to the labour camps housing the migrant workers indicated that no systematic embedded/ in built control measures for addressing the risks associated with influx of migrant workforce have been put in place by the developer.

Significance of Impact

Based on the above analysis, the impact after implementing the embedded controls is assessed to be **moderate**.

Mitigation/Management Measures

The recommended mitigation/management measures to address the impacts related to Labour In-migration should include:

- Provisioning adequate ventilation, lighting, bathing facilities and bedding suitable to the extreme climatic condition in the labour camps;
- Ensuring health check-ups of all labourers employed at the project site to screen pre-existing communicable diseases;
- Extending provisions for hygiene in Labour Camps as well as Work Site;
- Providing recreational and entertainment facilities to labourers in holidays or on their off-days; and
- Access to healthcare services and medical care in case of sickness.

Residual Impact significance

After the implementation of these mitigation measures, the residual impact significance is expected to be **minor**.

Impact	Labour in-migration issues				
Impact Nature	Negative		Neutral		
Impact Type	Direct		Indirect		Induced
Impact Duration	Temporary	Short-term		Long-term	Permanent
Impact Extent	Local		Regional		International
Impact Scale	The required skill-set being not available at the local level, migrant workers, especially in the skilled and highly skilled categories are being employed during the construction phase of the project over a period of 4 to 6 months. Presently, only a fraction of the total construction activities have started. It is expected that during the peak construction phase, the number of migrant workers will increase.				
Frequency	Construction phase				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low		Medium		High
	The receptor vulnerability can be identified as medium. This is because, the local community is mostly engaged in agriculture and allied activities and only a fraction of the local youth is engaged in in stone quarrying and mining. Consequently, most of the local youth do not possess the requisite skills for participating in construction activities. However, abrupt influx of outside population to take advantage of employment opportunities cropping up in their region might create resentment among the local communities.				
Impact Significance	Negligible	Minor		Moderate	Major
	Significance of impact is considered to be **Moderate**				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor		Moderate	Major
	Significance of residual impact is considered M**inor.**				

10 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

This section presents the Environmental and Social Management Plan (ESMP) for the wind farm. The purpose of this ESMP is to specify the standards and controls required to manage and monitor environmental and social impacts during construction and operation phase. To achieve this, the ESMP identifies potential adverse impacts from the planned activities and outlines mitigation measures required to reduce the likely negative effects on the physical, natural and social environment.

10.1 RENEW'S ORGANIZATIONAL STRUCTURE

To ensure the efficacy of Environmental and social management plan, certain institutional mechanism with well-defined roles and responsibilities is essential for effective implementation of identified mitigation measures both during construction and operation phases.

10.1.1 ReNew Management

ReNew will have ultimate responsibility for implementing the provisions of the ESMP. This role will include the on-going management of environmental and social impacts, monitoring of contractor performance as well as development of mechanisms for dealing with environmental and social problems.

Renew will also ensure that the activities of its contractors are conducted in accordance with good practice measures, implementation of which will be required through contractual documentation.

10.1.2 EPC Contractor – Gamesa

ReNew has appointed Gamesa as EPC contractor for the project for construction phase.

10.1.3 Roles and Responsibilities of EHS Department

ReNew will majorly play a role of supervisor to oversee the project performance pertaining to environment, health, safety and social issues.

The EPC contractor, i.e. Gamesa will have a dedicated HSE department for these Projects. The HSE department take the overall responsibility for co-ordination of the actions required for environment and social management and mitigation and for monitoring the progress of the proposed ESMP for the project. However, ultimate responsibility for implementing the provisions of the ESMP will lie with ReNew.

Environment, Health and Safety Department (HSE) of Gamesa

In general, the HSE department shall perform the following activities:

- Preparation of required documents on environmental and social management;
- Ensuring availability of resources and appropriate institutional arrangements for implementation of ESMP;
- Implementation of the health and safety measures;
- Collection of the statistics of health of workers;
- Providing support during routine medical check-ups of workers;
- Awareness and implementing safety programmes;
- Providing job specific induction training;
- Compliance of regulatory requirements;
- Carrying out environmental audits;
- Identify unsafe acts & conditions and suggest remedies;
- Develop safety culture and comply with company's HSE policy & standards requirements;
- Encourage and enforce the use of PPE's;
- Educate all employees for the use of PPE's & safe practices;
- Direct, coordinate and orient the safety activities;
- Promulgate the spread of policy, objectives, rules and/or regulations;
- Perform a thorough investigation of all accidents and review the recommendations to avoid any repetition;
- Monitoring the progress of implementation of ESMP; and
- Reviewing and updating the ESMP as and when required for its effective implementation.

10.2 INSPECTION, MONITORING AND AUDIT

Inspection and monitoring of the environmental impacts of the Project activities will increase the effectiveness of ESMP. Through the process of inspection and auditing, ReNew will ensure that the conditions stipulated in various permits are complied. The inspection and audits will be done by the project identified HSE staff in coordination with O & M contractors and any other external agencies identified. The entire process of inspections and audits should being documented. The inspection and audit findings are to be implemented by the site In-charge in their respective areas.

10.3 REPORTING AND DOCUMENTATION

ReNew will develop and implement a programme of reporting through all stages of the project cycle. Delegated personnel shall require to fully complying with the reporting programme in terms of both timely submissions of reports as per acceptable level of detail. Reporting will be done in form of environmental check list, incident record register, environmental and social performance reports (weekly, monthly, quarterly, half yearly, yearly etc.).

10.3.1 Documentation

Documentation is an important step in implementing ESMP. ReNew will establish a documentation and record keeping system to ensure recording and updating of documents per the requirements specified in ESMP. The documents should be kept as hardcopies as well as in electronic format. Responsibilities have to be assigned to relevant personnel for ensuring that the ESMP documentation system is maintained and that document control is ensured through access by and distribution to, identified personnel in form of the following:

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

10.3.2 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. To maintain an open communication between the staff and management on HSE and social issues the followings are being used:

- Team Briefings,
- On-site work group meetings;
- Work Specific Instructions; and
- Meeting with stakeholders.

10.3.3 External Reporting and Communication

HSE head is the responsible person for ensuring that communication with regulatory agencies and stakeholders are maintained as per the requirement. All complaints and enquiries are to be appropriately dealt with and records be maintained in a Complaint/Enquiry Register by the delegated staff of HSE. All communications made to regulatory agencies should also be reported to ReNew's corporate HSE Head.

10.3.4 ESMP Review and Amendments

The ESMP act as an environment and social management tool which needs to be reviewed periodically to address changes in the organisation, process or regulatory requirements.

Following a review, HSE Head will be responsible for making the amendments in the ESMP and seeking approval from the senior management. The amended ESMP will be communicated to all the staff.

10.4 TRAINING PROGRAMME AND CAPACITY BUILDING

Training is needed for effective implementation of ESMP. HSE Officer of Gamesa as well as ReNew Corporate HSE Head will ensure that Environmental health and safety induction training and job specific trainings are identified and given to the concerned personnel for construction activities and during operations of the wind farm.

Also general environmental awareness will be increased among the projects' teams 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 projects

10.5 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

This section outlines the potential adverse impacts, mitigation measures, monitoring and management responsibilities during construction and operation phases of the Projects.

The purpose of ESMP is to:

- Provide an institutional mechanism with well-defined roles and responsibilities for ensuring that measures identified in ESIA designed to mitigate potentially adverse impacts, are implemented;
- List all suggested mitigation measures and control technologies, safeguards identified through the ESIA process;
- Provide Project monitoring program for effective implementation of the mitigation measures and ascertain efficacy of the environmental management and risk control systems in place; and
- Assist in ensuring compliance with all relevant legislations at local, state and national level for the Projects.

In order to minimize adverse impacts during different phases of project lifecycles, mitigation measures, monitoring plan and responsibilities for its implementation are given in ***Table 10.1***

The responsibility for implementation of ESMP will primarily lies with Gamesa HSE Department and ReNew will majorly plays a role of supervisor

to oversee the project performance pertaining to environment, health, safety and social issues.

Table 10.1 Environmental and Social Management and Monitoring Plan

Project Activities	Impact/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
Land use									
• Construction and strengthening of access road; • Site clearance and preparation for WTGs, PSS and HEV line • Establishment and operation of batching plant; and • Transient storage of WTG components	Permanent and temporary changes in land use	Construction	On completion of construction activities, land used for temporary facilities such as stockyard, batching plant and labour camps should be restored to the extent possible.	Gamesa EPC team	Site inspection	Upon completion of task	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			The land use in and around permanent project facilities should not be disturbed.	Gamesa EPC team	Site inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
Topography and Drainage									
• Construction and strengthening of access roads; • Site clearance and preparation for WTGs, PSS and EHV line; and • Establishment and operation of batching plant	Changes in Topography and Drainage	Construction	Levelling and grading operations will be undertaken with minimal disturbance to the existing contour thereby maintaining the general slope of site; and	Gamesa EPC team	Site inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Disruption/alteration of micro-watershed drainage pattern will be minimized to the extent possible.	Gamesa EPC team	Site inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
Soil									
• Construction/ strengthening of access roads; • Vehicular movement; and • Stripping and stockpiling of soil layers.	Soil compaction	Construction and Decommissioning	Vehicles should utilize existing roads to access the site to the extent possible. Existing roads should be widened to have the width and turning radius to accommodate the necessary vehicles for the Project	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Soil should be ploughed in compacted areas after completion of construction work	Gamesa EPC team	Site inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesato HSE department of ReNew
• Construction/ strengthening of access roads; • Selective clearing of vegetation in areas designated for WTG erection, PSS and electrical poles; • Stripping and stockpiling of soil layers;	Soil Erosion	Construction and Decommissioning	Stripping of top soil should be conducted only when required and top soil should be retained for landscaping.	Gamesa EPC team	Site inspection and Record Keeping	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Stripping of top soil, excavation and access road construction should not be carried out during the monsoon season or during heavy winds to minimize erosion and run-off.	Gamesa EPC team	Site inspection and Record Keeping	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew

Project Activities	Impact/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
• Excavation for WTG foundations and electrical poles; • Removal of WTGs; and • Removal of infrastructure.			Topography should be restored to the extent possible and re-vegetated to prevent soil erosion.	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			The stock piles of top soil should be kept moist to avoid wind erosion of the soil	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Revegetation of the construction boundaries using fast-growing local vegetation can be utilized to strengthen soil that is located on slopes	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Site should be restored at the end of the Project lifecycle to pre-Project levels	Gamesa EPC team	Site inspection	One time monitoring (repeat if goal is not achieved)	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
• Storage and transport of construction materials; • Storage of oil and lubricants onsite; and • Storage of waste materials onsite.	Soil contamination	Construction Operation Decommissioning	No unauthorized dumping of used oil and other hazardous waste should be undertaken at site.	Gamesa EPC team	Site inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Transport vehicles and equipment should undergo regular maintenance to avoid any oil leakages	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Unloading and loading protocol should be prepared for diesel, oil and used oil respectively and workers should be trained to prevent/contain spills and leaks	Gamesa EPC team	Site Inspection and Record Keeping	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
• Storage of waste materials onsite;	Waste Generation	Construction Operation Decommissioning	Proper receptacles or designated areas should be provided for Solid Municipal Waste and daily collection and periodic disposal should be ensured	Gamesa EPC team	Site Inspection and Record Keeping	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Construction and demolition waste should be stored separately and be periodically collected by an authorized treatment and storage facility	Gamesa EPC team	Site Inspection and Record Keeping	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Hazardous waste should be properly labelled, stored onsite at a location provided with impervious surfaces and in a secondary containment system	Gamesa EPC team	Site Inspection and Record Keeping	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			All waste should be stored in a shed that is protected from the elements (wind, rain, storms, etc.) and away from natural drainage channels	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
Air Quality									

Project Activities	Impact/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
• Site preparation and excavation of WTG foundation; • Access road widening, strengthening and maintenance; • Construction of ancillary facilities; • Operation of batching plant; • Operation of DG sets; and • Demolition activities.	Particulate, fugitive and vehicular exhaust emission	Construction Operation Decommissioning	Diesel generators should be restricted to emergencies and power back up only to minimize air emissions.	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Vehicle engines need to be properly maintained and should have a valid Pollution Under Control (PUC).	Gamesa EPC team	Site Inspection and Record Keeping	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Speed of vehicles should be limited to 10-15 km/hr	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			DG sets should be placed within enclosures and have an adequate stack height	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Minimize stockpiling by coordinating excavations, spreading, regrading and compaction activities.	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Prevent idling of vehicles and equipment.	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
Water Environment									
• Construction of WTGs; • Domestic water for labour camp and contractor (s); and • Reverse Osmosis of drinking water for O&M team.	Depletion of water resource	Construction Operation	The original source of water used for the Project should be tracked to determine if any groundwater or surface water is being obtained from CGWB overexploited/notified areas	Gamesa EPC team	Record Keeping (Proof of contract to be made available)	Upon completion of task	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Regular inspection for identification of water leakages and preventing water wastage	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Optimum use of water during sprinkling on roads for dust settlement, washing of vehicles, concrete mixing, etc.	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Construction labour deputed onsite should be sensitized about water conservation and encouraged for optimal use of water	Gamesa EPC team	Site Inspection and Record Keeping	Upon completion of task(s)	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew

Project Activities	Impact/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
• Operation of labour camp; • Storage of hazardous substances and waste onsite; • Operation of batching plant; and • Construction and demolition activities that causes dust and erosion.	Water Contamination	Construction Operation Decommissioning	Provision of septic tanks and soak pits (as per specification given in IS 2470 1995 Part I and II) onsite for treatment and disposal of sewage thereby minimizing the impacts of wastewater discharge.	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Planning of toilets, soak pits and septic tanks and waste collection areas should be away from natural drainage channels	Gamesa EPC team	Site Inspection and Record Keeping	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Use of licensed contractors for management and disposal of waste and sludge	Gamesa EPC team	Site Inspection and Record Keeping	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Spills/leakage clearance plans to be adopted for immediate cleaning of spills and leaks.	Gamesa EPC team	Site Inspection and Record Keeping	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Proper cover and stacking of loose construction material at batching plant and WTGs site to prevent surface runoff.	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Labourers should be given training towards proactive use of designated areas/bins for waste disposal and use of toilets. Open defecation and random disposal of waste should be strictly prohibited	Gamesa EPC team	Site Inspection and Record Keeping	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Garland drain should be provided at batching plant.	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
Noise quality									
• Construction activities; • Operation of batching plant; • Operation of DG sets; and • Vehicular movement	Increase in noise level	Construction Operation Decommissioning	Normal working hours of the contractor to be defined (preferable 8 am to 6pm). If work needs to be undertaken outside these hours, it should be limited to activities which do not generate noise;	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Only well-maintained equipment should be operated on-site.	Gamesa EPC team	Site Inspection and Record Keeping	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew

Project Activities	Impact/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
			If it is noticed that any particular equipment is generating too much noise then lubricating moving parts, tightening loose parts and replacing worn out components should be carried out to bring down the noise and placing such machinery far away from the households as possible.	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Machinery and construction equipment that may be in intermittent use should be shut down or throttled down during non-work periods.	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Minimal use of vehicle horns and heavy engine breaking in the area needs to be encouraged.	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Regular maintenance of WTGs	Gamesa and ReNew O&M Team	Site Inspection	Quarterly	Site HSE Officer of ReNew	HSE department of ReNew	Report from HSE officer of ReNew to HSE department of ReNew
			Periodic (half-yearly) monitoring of noise near the sources of generation to ensure compliance with design specifications	Gamesa and ReNew O&M Team	Record Keeping	Quarterly	Site HSE Officer of ReNew	HSE department of ReNew	Report from HSE officer of ReNew to HSE department of ReNew
Shadow Flicker									
Shadow flicker	Shadow flicker impacts on nearby residents	Operation	Wind turbines identified as sensitive in the shadow flicker assessment should be visited regularly. Consultations with nearby receptors should be undertaken to monitor the impact of shadow flicker on the residents.	ReNew O&M Team	Site Inspection	Monthly monitoring	Site HSE Officer of ReNew	HSE department of ReNew	Report from HSE officer of ReNew to HSE department of ReNew
			Direct line of sight to the wind turbine can be prevented through obstructions including tree plantations, walls and fencing. The provision of curtains to cover these windows can also be utilized to reduce the impact.	ReNew O&M Team	Site Inspection	Monthly monitoring	Site HSE Officer of ReNew	HSE department of ReNew	Report from HSE officer of ReNew to HSE department of ReNew
Operational Health and Safety									
• Working at heights; • Working in confined spaces; • Working with rotating machinery; and • Working with live electrical components	Injury, near-misses and fatalities for labour contracted on site.	Construction Operation Decommissioning	All construction activities should be carried out during daytime hours and vigilance should be maintained for any potential accidents	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Personal Protective Equipment (PPEs) including safety shoes, helmets, goggles, ear muffs and face masks should be provided as necessary	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Structural integrity should be checked before undertaking any work	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew

Project Activities	Impact/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
			Electrical and maintenance work should not be carried out during poor weather and during lightning strikes	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			All workers (regular and contracted) should be provided with training on Health and Safety policies in place with appropriate refresher courses throughout the life cycle of the Project	Gamesa EPC team	Site Inspection and Record Keeping	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Permitting system should be implemented to ensure that cranes and other lifting equipment is operated by trained and authorized persons only	Gamesa EPC team	Site Inspection and Record Keeping	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Appropriate safety harnesses and lowering/raising tools should be used for working at heights	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Safe drinking water supply should be provided for the workers	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Excavated areas should be temporarily fenced to avoid access to outsiders and wildlife	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Security should be deputed at potential accident sites to restrict entry and prevent near misses, injuries and fatalities	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			An up-to-date first aid box should be provided at all construction sites and a trained person should be appointed to manage it.	Gamesa EPC team	Site Inspection and Record Keeping	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			All equipment should be turned off and checked when not in use	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			A safety or emergency management plan should be in place to account for natural disasters, accidents and any emergency situations. The nearest hospital, ambulance, fire station and police station should be identified in the implemented emergency management plan.	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
Ecology									
Vegetation	Vegetation Clearance	Construction	Reserve Forests and areas immediately adjacent to the forest should remain unaffected by construction, approach road widening and transmission line laying	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Clearance of mature trees or continuous scrub should be avoided to the extent possible when planning the wind farm components.	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew

Project Activities	Impact/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
			Vegetation clearance should be restricted to the Project activity area(s)	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Unnecessary disturbance to vegetation due to off-roading, fuel wood procurement, unchecked expansion of labour camps and destruction of floral resources should be prohibited	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Local grass species can be seeded in disturbed areas during monsoon season.	Gamesa EPC team	Site Inspection	End of construction phase	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
Construction Activities	Loss of habitat, sedimentation, contamination, noise, vehicular movement and human-wildlife conflicts	Construction	Construction activities should be conducted in a phased manner to prevent excessive noise, anthropogenic movement and vehicular movement throughout the entire wind farm area at any given time	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Labourers should be trained for dealing with wildlife as well as *dos* and *don'ts* when dealing with them.	Gamesa EPC team	Site Inspection and Record Keeping	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Strict no hunting, poaching or trapping of wildlife policy should be communicated and enforce by the EPC contractor	Gamesa EPC team	Site Inspection and Record Keeping	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Project components should be planned such that they are sufficiently away from water bodies, Reserve Forests and any heavily vegetated areas to reduce the impact on local wildlife.	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Construction and transportation activities should be avoided at night (6:00 pm to 6:00 am) and should particularly avoid high faunal activity areas such as heavy vegetation and water bodies during dawn (6:00 am to 8:00 am) and dusk (5:00 pm to 7:00 pm)	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Temporary barriers should be installed around excavation areas	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Waste materials should be covered and cleared periodically so as to not attract fauna to the construction site	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			If access roads are created in key crossing paths for herpetofauna or smaller mammals then culverts of alternate paths should be provided to prevent road kills.	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
			Labour movement should be restricted to between construction camps and sites	Gamesa EPC team	Site Inspection	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew

Project Activities	Impact/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
			General awareness regarding the presence of protected species (Black-shouldered Kite, Indian Peafowl and Monitor Lizard) as well as occasional sightings of the Indian Starred Tortoise should be raised among the staff and labourers through interactive sessions, charts, posters and trainings.	Gamesa EPC team	Site Inspection and Record Keeping	Monthly monitoring	Site HSE Officer of Gamesa	HSE department of ReNew	Report from HSE officer of Gamesa to HSE department of ReNew
Hazards associated with turbine blade movement	Bird collisions, increased energy expenditure and barrier effects	Operation	Inter-turbine distance should be large enough that birds can avoid turbine blades and utilize minimal energy while doing so	Gamesa and ReNew O&M Team	Site Inspection	One-time monitoring of site prior to construction	Site HSE Officer of ReNew	HSE department of ReNew	Report from HSE officer of ReNew to HSE department of ReNew
			Avoid siting of WTGs near important habitat features such as water bodies, rocky terrain and thick vegetation	Gamesa and ReNew O&M Team	Site Inspection	One-time monitoring of site prior to construction	Site HSE Officer of ReNew	HSE department of ReNew	Report from HSE officer of ReNew to HSE department of ReNew
			WTGs should be sited in areas that are visible from a manoeuvrable distance for flying species and shouldn't be located near sudden changes of elevation, large trees or be blocked by any manmade/natural structures.	Gamesa and ReNew O&M Team	Site Inspection	One-time monitoring of site prior to construction	Site HSE Officer of ReNew	HSE department of ReNew	Report from HSE officer of ReNew to HSE department of ReNew
			Flash lamps on the WTGs will prevent bird collisions at night	Gamesa and ReNew O&M Team	Site Inspection	One-time monitoring of WTGs prior to operation	Site HSE Officer of ReNew	HSE department of ReNew	Report from HSE officer of ReNew to HSE department of ReNew
			Waste materials should not be left uncovered as it will attract birds and other fauna to the wind farm boundary	Gamesa and ReNew O&M Team	Site Inspection	Quarterly monitoring	Site HSE Officer of ReNew	HSE department of ReNew	Report from HSE officer of ReNew to HSE department of ReNew
			Overhead cables should be marked using diffractors	Gamesa and ReNew O&M Team	Site Inspection	One-time monitoring of transmission lines prior to operation	Site HSE Officer of ReNew	HSE department of ReNew	Report from HSE officer of ReNew to HSE department of ReNew
			Restoring herb layers in the vicinity of the wind turbines will provide shelter for prey animals (E.g. lizards, snakes and rodents) and prevent raptors such as Black-shouldered Kite from flying into the wind farm.	Gamesa and ReNew O&M Team	Site Inspection	Upon completion of task	Site HSE Officer of ReNew	HSE department of ReNew	Report from HSE officer of ReNew to HSE department of ReNew
Electrical Hazards	Electrocution from live electrical components	Operation	Transmission poles should be raised with suspended insulators in order to reduce the electrocution of bird species	Gamesa and ReNew O&M Team	Site Inspection	One-time monitoring of transmission lines prior to operation	Site HSE Officer of ReNew	HSE department of ReNew	Report from HSE officer of ReNew to HSE department of ReNew
			Bird-safe strain poles with insulation chains at least 60 cm in length should be adopted	Gamesa and ReNew O&M Team	Site Inspection	One-tie monitoring of transmission lines prior to operation	Site HSE Officer of ReNew	HSE department of ReNew	Report from HSE officer of ReNew to HSE department of ReNew
			Regular checking of the vacuums or holes in the towers for nesting bird species should be practiced.	Gamesa and ReNew O&M Team	Site Inspection	Quarterly monitoring	Site HSE Officer of ReNew	HSE department of ReNew	Report from HSE officer of ReNew to HSE department of ReNew

Project Activities	Impact/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
Community Health and Safety									
Community health and safety hazards associated with the project	Structural safety of project infrastructure, life and fire safety, public accessibility and management of emergency situations.	Construction and Operation	• Developing an onsite ESMS and EHS policy for the developer as well as contractors; • Proper fencing and use of signages in excavated areas; • Training of drivers carrying construction machinery regarding speed limits with careful consideration for village traffic; and • Sensitization of local community on H & S issues.	Gamesa and Renew Land team	• Review of ESMS and EHS Policies; and • Site verification	Quarterly monitoring	Gamesa, Renew Land team and site HSE officer	HSE and Land departments of Renew	Report from HSE officer of ReNew to HSE department of ReNew
Social									
Reduction of land holding and loss of agricultural income	Sale of land by land owners will lead to loss of agricultural landholding that will lead to overall loss in agricultural income.	Construction and Operation	The following mitigation measures is proposed for family members of the land sellers; • Skill based training; • Providing preferences in allocating work in the project-related construction activities; • Providing training and agricultural inputs; • Persuading to purchase land using the compensation amount received in lieu of land sale from the developer; and • Maximum possible procurement of resources from the local source.	Gamesa and Renew Land team	• Records of skills training; • Records of land purchased by land sellers post sale of land to the project; and • Site verification	Quarterly monitoring	Gamesa and Renew Land team	Land department of Renew	Report from site land team of Renew to the corporate land team
Accidental Impacts – Blade throws and natural disasters	The accidental throwing of a rotor blade as well as natural disasters might result in accidents impacting the local communities as well as other receptors such as the livestock in the project area.	Construction and Operation	• Communicating the local community regarding the accident risks and safety features of WTGs; • Communicating the 'dos' and 'don'ts' to local community during emergency scenario; • Involving local disaster management agencies during emergency situations; and • Obtaining adequate third party insurance cover to meet financial loss owing to emergency situations.	Game and Renew land and HSE teams	• Community consultations; and • Site verification	Quarterly monitoring	Gamesa and Renew Land and HSE teams	Land department of Renew	Report from site land team of Renew to the corporate land team
Impact of labour influx/ migrant workforce	Sudden and unplanned influx of a large migrant workforce might put pressure on local resources – water, health care services, daily consumables, food and grocery etc.	Construction	• Provisioning adequate arrangements of drinking water, lighting, ventilation, bedding, bathing and other basic facilities in the labour camps; • Ensuring proper health-check-ups of all labourers employed at the project site; • Providing separate toilet facilities for men and women at the accommodation as well as site; and • Facilitating healthcare services and medical care in case of sickness.	Gamesa and Renew O&M team	• Labour consultations; and • Site verification	Monthly during the construction phase	Gamesa and Renew O&M team	Jointly by Gamesa and Renew O&M team	Monthly Report on labour management and associated issues by Renew site team to the corporate office.

11 CONCLUSION AND RECOMMENDATIONS

11.1 INTRODUCTION

This Environmental and Social Impact Assessment has been conducted to evaluate the impacts associated with the wind farm project of 60 MW capacity near Village Batkurki and District Belgaum in the State of Karnataka. The impact assessment has been conducted in compliance with administrative framework, identified herein, including relevant national legislative requirement, international conventions and ReNew's corporate requirement.

11.2 IMPACTS REQUIRING DETAILED ASSESSMENT

Following a scoping exercise, this ESIA was focused on interactions between the Project activities and various resources/receptors that could result in significant impacts. The table below presents the outcomes of the comprehensive assessment of identified impacts as a result of the various phases of the Project.

Table 11.1 Impact Assessment Summary

Impact Description	Impact nature	Significance of Impact	
		Before Mitigation	With Mitigation
Construction Phase			
Change in land use	Negative	Minor	Minor
Change in Topography and Drainage	Negative	Negligible	Negligible
Soil erosion and compaction	Negative	Minor	Negligible
Soil contamination from waste generation and spills/leaks	Negative	Minor	Negligible
Depletion of water resource	Negative	Moderate	Moderate
Impact on ambient air quality	Negative	Minor	Negligible
Impact on noise quality	Negative	Minor	Negligible
Occupational Health and Safety	Negative	Minor	Negligible
Community Health and Safety	Negative	Minor	Negligible
Impacts due to Vegetation Clearance	Negative	Negligible	Negligible
Impacts due to Construction Activities	Negative	Negligible	Negligible
Reduction of land-holding and loss of agricultural income	Negative	Minor	Negligible
Impact on Local Employment	Positive		
Impact of labour influx/migrant workforce	Negative	Moderate	Minor
Operation Phase			
Soil contamination due to waste generation, spillage and leakage	Negative	Minor	Negligible
Depletion of water resources	Negative	Moderate	Negligible
Impact on noise quality	Negative	Negligible	Negligible
Shadow Flicker	Negative	Minor	Negligible
Occupational Health and Safety	Negative	Minor	Negligible
Bird and Bat Collision	Negative	Minor	Negligible
Electrocution Hazards	Negative	Minor	Negligible

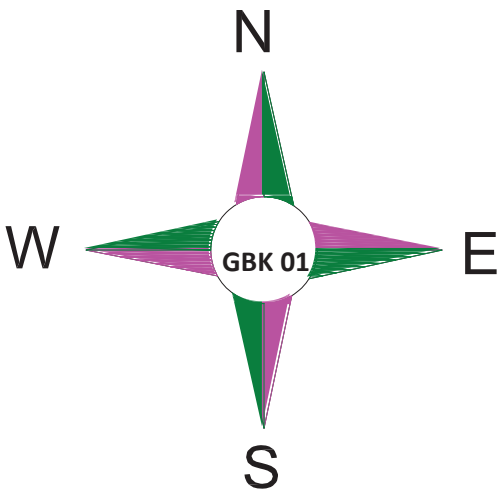
Impact Description	Impact nature	Significance of Impact	
		Before Mitigation	With Mitigation
Impact on Local Employment	Positive		
Accidental Impacts: Blade Throw and Natural Disaster	Negative	Negligible	Negligible
Decommissioning Phase			
Impact on soil environment	Negative	Minor	Minor
Impact on ambient air quality	Negative	Minor	Negligible
Occupational Health and Safety	Negative	Minor	Negligible

The Environmental and Social Management Plan (ESMP) describes mitigation measures for impacts specific to the Project activities and also discusses implementation mechanisms.

To conclude, implementation of ESMP will help ReNew comply with national/state regulatory framework as well as to meet IFC/ADB reference framework requirements.

Annex A

Photo-Documentation of WTG Profiling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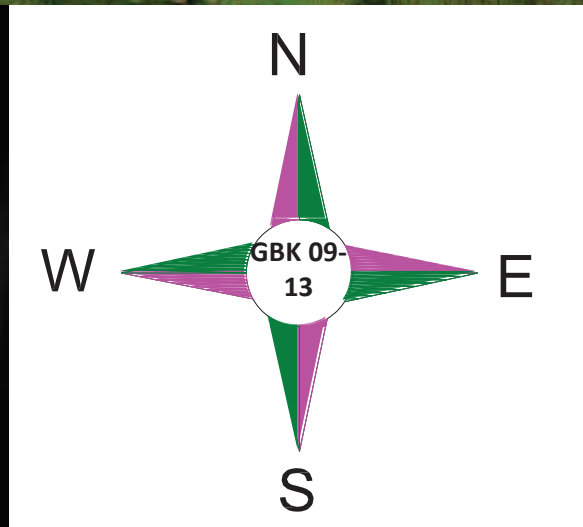
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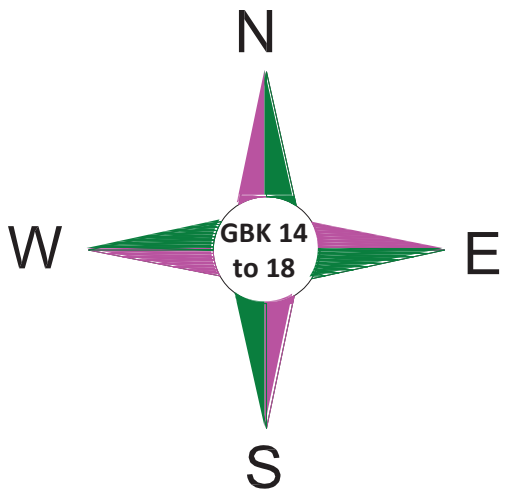
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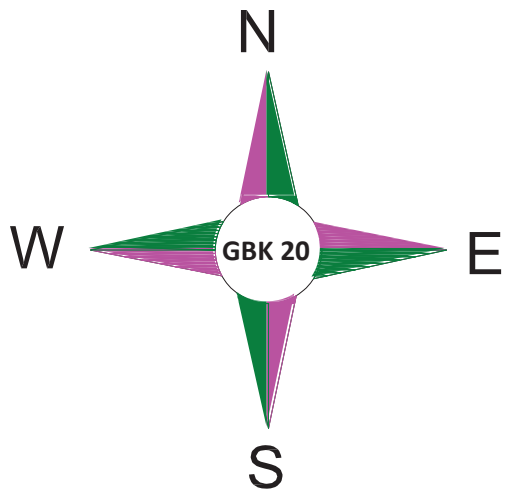
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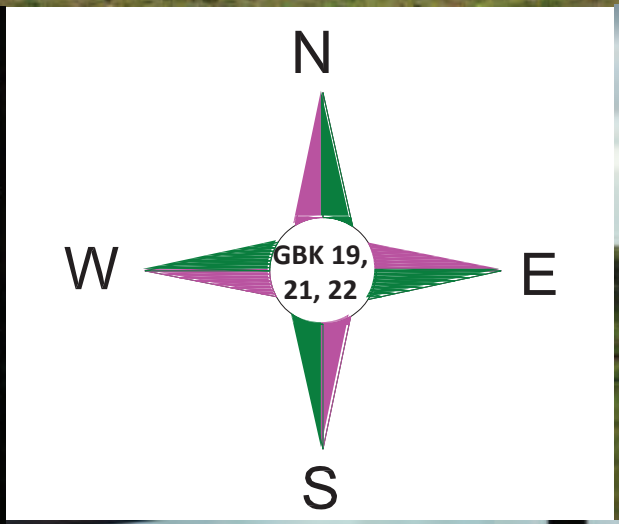
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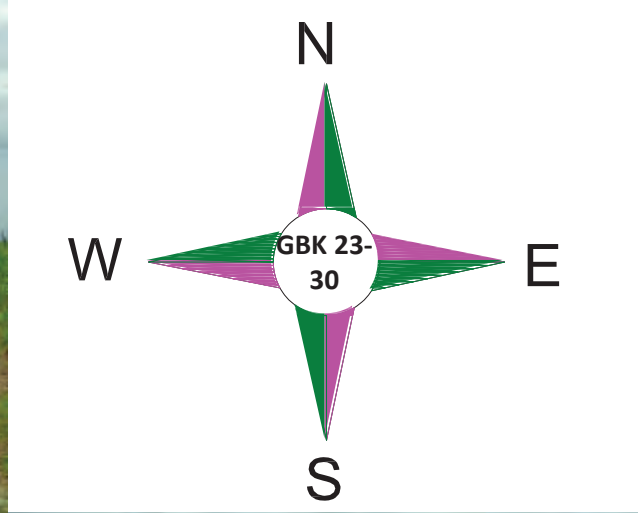
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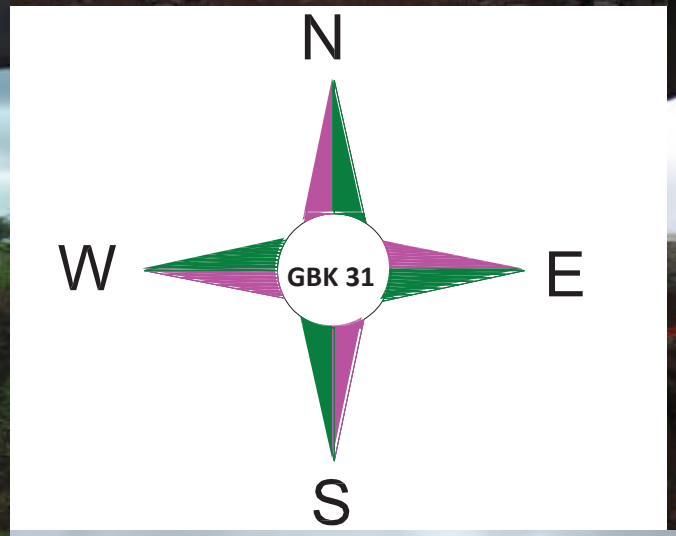
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Annex B

Power Evacuation Approval from KPTCL

KARNATAKA POWER TRANSMISSION CORPORATION LIMITED

Std: 0831-2437101
0831-2437099
Fax: 0831-2437101
E-mail:semwcbmkptcl@gmail.com

Office of the
Superintending Engineer Ele,
Transmission (Works & Maintenance),
Circle, KPTCL,
Nehru Nagar, Belagavi- 590010

Encl:

Sub: Approval to detailed survey for "Proposed 110KV DC line on DC towers from existing 110/33/11KV Sub Station to the proposed 33/110KV Pooling station of M/s G M Navarra Wind Energy Pvt Ltd, at Batakurki in Ramadurg Taluk, Belagavi Dist.".

Preamble:

1. The Chief Engineer Electy, Planning & Co-ordination, KPTCL, Bangalore has communicated approval for regular evacuation scheme for 60MW wind power in favour of M/s G M Navarra Wind Energy Pvt Ltd, Bangalore vide Letter No: Power evacuation approval Letter No: CEE(P&C)/SEE(plg)/ EE(PSS)/KCO-96 /34261/F-795/14143-58 Dated: 29.03.2016.
2. As per the evacuation approval firm has to construct 110KV DC line on DC towers from existing 110Kv sub station Salahalli to the proposed 33/110KV Pooling station of M/s G M Navarra Wind Energy Pvt Ltd at Batakurki in Ramadurg Taluk, Belagavi Dist under self execution and at risk and cost of the firm.
3. The firm M/s G M Navarra Wind Energy Pvt Ltd, Bangalore has conducted the detailed survey through M/s R S Constructions and Surveyors, Bangalore under self execution Scheme and submitted the reports for approval.
4. The Executive Engineer Ele, Major Works Division, KPTCL, Belagavi has submitted the detailed survey report and profile vide Letter No: 606/BGM/EEE/MWD/AEE(O)/1598-600 Dated: 04.08.2016.
5. The firm M/s G M Navarra Wind Energy Pvt Ltd, Bangalore has requested for approval of detailed survey report for obtaining approval from Electrical Inspectorate and PTCC approval.
6. The estimate for the detailed survey prepared by the Executive Engineer Ele, Major Works Division, KPTCL, Belagavi has been finalized provisionally for Rs 387500.00, accordingly the firm has paid the necessary supervision charges of Rs 38750.00 + 5813.00 (Service Tax @ 15% on Supervision Charges).
7. Hence this order.

OFFICIAL MEMORANDUM

No: 506/BGM/SEE/Tr.(W&M)/C/EE(O)/AEE-2/16-17/F- /2708-03 Date: 06/08/16

Approval is hereby accorded for "Conducting detailed survey for Proposed 110KV DC line on DC towers from existing 110/33/11KV sub station Salahalli to the proposed 33/110KV Pooling station of M/s G M Navarra Wind Energy Pvt Ltd at Batakurki in Ramadurg Taluk in Belagavi Dist."

The Length of the line is **16.222Kms**. 60 Nos 110KV DC Towers, 04 Nos 110KV MC Towers and 02 Nos 220KV Narrow Based Towers (Hoody – HAL Design) **Total 66 Nos Towers**.

AEE(O)/AEE-2
180 6/8

Please note that, the approval given is subject to the following terms and Conditions.

1. Approval is given on request of the firm M/s G M Navarra Wind Energy Pvt Ltd only for obtaining approval from Electrical Inspectorate and PTCC approval.
2. Any deviations required during construction and ROW of the line are the sole responsibility of the firm.
3. The work should be carried out as per KPTCL specifications and terms.
4. Firm has to observe all the terms and conditions stipulated in the evacuation approval communicated by the Chief Engineer Electy, Planning & Co-ordination, KPTCL, Bangalore.
5. The Supervision Charges and Service Tax paid by firm are non refundable and are provisional and subjected for revision.
6. Any other terms and conditions deemed fit from time to time is binding on firm.

Superintending Engineer Ele,
Transmission (W&M) Circle, K P T C L, Belagavi.

1. Copy to the Executive Engineer (Ele), Major Works Division, KPTCL, Belagavi for information.
2. Copy to M/s G M Navarra Wind Energy Pvt Ltd, # Unit 1/7, The Presidency, #1 (New No 82), St Marks Road,Bangalore-01 for information.

GPS CO-ORDINATES

Name of Work : Proposed 110KV DC line from existing 110/33/11KV Salahalli Sub-station to proposed 33/110KV Pooling Sub-station Of M/S G.M.Navarra Wind Energy Pvt.Ltd. at Batakurki by using ACSR LYNX

Clients: M/S G.M.Navarra Wind Energy Pvt.Ltd.

SURVEYOR CONSULTANTS : R.S.CONSTRUCTIONS & SURVEYORS, BANGALORE

Sl. No.	AP Nos	UTM Format WGS - 84		Angle of deviation	REMARKS/AP Nos.
		UPS	UTM		
1	BAY	524681	1777733	-	Existing 110/11KV Salahalli Sub-station
2	AP-1	524714	1777732	38°43'L	
3	AP-2	524971	1777940	3°10'R	
4	AP-3	525733	1778499	11°6'L	
5	AP-4	526479	1779330	39°14'R	
6	AP-5	527192	1779441	34°47'R	
7	AP-6	527338	1779370	20°59'L	
8	AP-7	528860	1779238	47°48'R	
9	AP-8	528927	1779150	21°54'L	
10	AP-9	531174	1777808	7°20'L	
11	AP-10	531914	1777486	15°13'R	
12	AP-11	532111	1777328	12°26'R	
13	AP-12	532466	1776887	8°20'L	
14	AP-13	533698	1775745	36°35'L	
15	AP-14	534686	1775637	5°17'L	
16	AP-15	535520	1775623	5°4'R	
17	AP-16	537348	1775430	1°27'R	
18	AP-17	538125	1775328	19°3'R	
19	AP-18	538794	1774994	19°6'L	
20	AP-19	538863	1774985	89°52'R	
21	BAY	538858	1774946	-	Proposed 33/110KV Pooling Sub-station at

For R.S. Constructions & Surveyors,
Bangalore.

TOWER SCHEDULE

Name of Work : Proposed 110KV DC line from existing 110/33/11KV Salahalli Sub-station to proposed 33/110KV Pooling Sub-station Of M/S G.M.Navarra Wind Energy Pvt.Ltd. at Batakurki by using ACSR LYNX Conductor.

Clients: M/S G.M.Navarra Wind Energy Pvt.Ltd.

Surveyors : M/s R.S. CONSTRUCTIONS & SURVEYORS, BANGALORE

Sl No	AP Nos	Type of tower	Angle of Deviation	Span in Mts	Cum. Chainage	Weight Span In Mts			Crossing Details	Type of soil	Village Limits
						L	R	T			
	-	BAY	-		0	-	-	-	Survey commenced from existing 110/33/11KV S/S at Salahalli	B.C SOIL	Salahalli
				40					Fencing, 11KV line line to be lowered/Shifted		
1	AP-1	DD+0 9 Cross arm	38°43'L		40	-	-109	-109		"	"
				55							
2		MD+3	0°0'0"		95	164	121	285	110KV Multi Circuit tower start	"	"
				285					33KV line		
3	AP-2	MD+3	3°10'R		380	164	143	307		"	"
				290					Bund, Bore well at right side		
4		MA+3	-		670	147	117	264		"	"
				270					Mud road, Bund		
5		MD+3	0°0'0"		940	153	-16	137	110KV Multi Circuit tower end	"	"
				80					-		
6		DD+3	0°0'0"		1020	96	133	229		"	"
				300					Bund, Bore well at right side		
7	AP-3	DD+3	11°6'L		1320	167	110	277		"	"
				280					Halla, 2 Nos.11KV line, Small bridge		
8		DA+3	-		1600	170	104	274		"	"
				280					11KV line		
9		DA+3	-		1880	176	102	278		"	"
				280					-		
10		DA+6	-		2160	178	171	349		"	"
				280					2Nos. 11KV line, Tar road from Hoskote to Salahalli towards to SH		
11	AP-4	DD+3	39°14'R		2440	109	144	253		"	Panchagaon
				240					Cart track		
12		DA+3	-		2680	96	135	231		"	"
				230					Cart track		

Sl No	AP Nos	Type of tower	Angle of Deviation	Span in Mts	Cum. Chainage	Weight Span In Mts			Crossing Details	Type of soil	Village Limits
						L	R	T			
13		DA+3	-		2910	95	92	187		"	"
				255					-		
14	AP-5	DD+6	34°47'R		3165	163	91	254		"	Bidki
				162					Water stored area, **SH Tar road from Lokapura to Belgaum**, 2Nos. 11KV line		
15	AP-6	DD+6	20°59'L		3327	71	164	235		"	"
				270					11KV line, Mud road from Panchegeru to towards SH		
16		DA+3	-		3597	106	140	246		"	"
				260					Mud road from Bidike to towards SH		
17		DA+0	-		3857	120	140	260		"	"
				250					-		
18		DA+3	-		4107	110	155	265		"	"
				255					Cart track, LT line		
19		DA+0	-		4362	100	104	204		"	"
				240					-		
20		DD+0	0°0'0"		4602	136	2	138		"	"
				255					-		
21	AP-7	DD+9 220KV D/C NB Tower Hoody - HAL Design	47°48'R		4857	253	44	297		"	"
				110					**Existing 110KV S/C line on D/C towers from Lokapura to Salahalli in between T.No. 44'A' & 45'AP'**		
22	AP-8	DD+9 220KV D/C NB Tower Hoody - HAL Design	21°54'L		4967	66	205	271		"	"
				275					Cart track		
23		DD+0	0°0'0"		5242	70	130	200		"	"
				260					Bund, Tar road from Yakatapura to Udapadi		

Sl No	AP Nos	Type of tower	Angle of Deviation	Span in Mts	Cum. Chainage	Weight Span in Mts			Crossing Details	Type of soil	Village Limits
						L	R	T			
24		DA+6	-		5502	130	172	302		"	Udapadi
				280					LT line		
25		DA+3	-		5782	108	158	266		"	"
				255							
26		DA+0	-		6037	97	163	260		"	"
				240					-		
27		DC+0	0°0'0"		6277	77	164	241		"	"
				260					-		
28		DA+3	-		6537	96	156	252		"	"
				260					-		
29		DA+3	-		6797	104	101	205		"	"
				260					Tar road from Salapura to Salahalli		
30		DA+0	-		7057	159	99	258		Red & stone mixed Soil	"
				260					-		
31		DA+0	-		7317	161	131	292		"	"
				270					Bund		
32	AP-9	DD+0	7°20'L		7587	139	78	217		BC Soil	Salapura
				230					Cart track		
33		DC+6	0°0'0"		7817	152	92	244		"	"
				290					Halla, 11KV line, Bund		
34		DA+6	-		8107	198	142	340		"	"
				290					11KV line		
35	AP-10	DD+3	15°13'R		8397	148	161	309		"	"
				255					Bund		
36	AP-11	DC+3	12°26'R		8652	94	117	211		"	"
				285					LT line, 11KV line, Bore well at left side		
37		DA+6	-		8937	168	175	343		"	Salapura
				285					2Nos. 11KV line		
38	AP-12	DD+3	8°20'L		9222	110	106	216		"	"
				230					11KV line, Tar road from Salapura Tanda to Ramadurga, Bund		
39		DA+3	-		9452	124	105	229		"	"

Sl No	AP Nos	Type of tower	Angle of Deviation	Span in Mts	Cum. Chainage	Weight Span In Mts			Crossing Details	Type of soil	Village Limits
						L	R	T			
				225					2Nos. 11KV line		
40		DA+3	-		9677	120	156	276		"	"
				245					-		
41		DA+0	-		9922	89	94	183		"	"
				240					LT Pole at right side, Bund		
42		DA+0	-		10162	146	197	343		"	"
				240					3Nos. Bund		
43		DC+0	0°0'0"		10402	43	153	196		"	Naganur Tanda
				255					-		
44		DA+0	-		10657	102	152	254		"	"
				245					Cart track, Bund		
45	AP-13	DD+0	36°35'L		10902	93	98	191		"	"
				265					2Nos. LT line, Transformer &11KV line at right side		
46		DC+0	0°0'0"		11167	167	45	212		"	"
				245					-		
47		DA+3	-		11412	200	97	297		"	"
				250					Bund		
48		DA+0	-		11662	153	121	274		"	"
				240					-		
49	AP-14	DD+0	5°17'L		11902	119	126	245		"	"
				280					Tar road from Salapura Tanda to Nagnur Tanda, Bund		
50		DA+6	-		12182	154	173	327		"	"
				280					LT line, Bund		
51		DA+6	-		12462	107	142	249		"	"
				275					Bund		
52	AP-15	DD+3	5°4'R		12737	133	137	270		"	"
				260					Metal road from Nagnur to Batakurki, 11KV line, LT line		
53		DD+3	0°0'0"		12997	123	162	285		"	Naganur Tanda
				260					-		
54		DA+3	-		13257	98	124	222		"	"

Sl No	AP Nos	Type of tower	Angle of Deviation	Span in Mts	Cum. Chainage	Weight Span In Mts			Crossing Details	Type of soil	Village Limits
						L	R	T			
				260					-		
55		DA+3	-		13517	136	110	246		"	"
				260					Cart track		Batakurki Tanda
56		DC+3	0°0'0"		13777	150	148	298		"	"
				260					LT line, Transformer at left side		
57		DA+3	-		14037	112	151	263		"	"
				280					-		
58		DA+3			14317	129	158	287		"	"
				260					2Nos. 11KV line, Tar road, LT line at right side		
59	AP-16	DD+3	1°27'R		14577	102	206	308		"	"
				275					-		
60		DD+3	0°0'0"		14852	69	98	167		Red Soil	"
				240					3Nos. LT line, Open well at right side, nala		
61		DC+6	0°0'0"		15092	142	75	217		BC Soil	Batakurki
				270					Cart track, 11KV line		
62	AP-17	DD+6	19°3'R		15362	195	131	326		"	"
				260					-		
63		DA+0	-		15622	129	125	254		"	"
				235					-		
64		DD+0	0°0'0"		15857	110	110	220		"	"
				255					-		
65	AP-18	DD+3	19°6'L		16112	145	118	263		"	"
				70					Tar road from Batakurki to ramdurg		
66	AP-19	DD+0 9 Cross arm	89°52'R		16182	-48	-	-48		"	"
				40					-		
		BAY	-		16222	-	-	-	**Joining to proposed bay at proposed 33/110KV Pooling S/S, Batakurki.**	"	"

ABSTRACT OF TOWERS

Name of Work : Proposed 110KV DC line from existing 110/33/11KV Salahalli Sub-station to proposed 33/110KV Pooling Sub-station Of M/S G.M.Navarra Wind Energy Pvt.Ltd. at Batakurki by using ACSR LYNX Conductor.

Sl.No.	TYPE OF TOWERS	NORMAL	+3	+6	+9	TOTAL
Proposed 110KV D/C Towers						
1	'DA'	32	16	6	-	32
2	'DC'	7	2	2	-	7
3	'DD'	19	10	3	-	19
4	'DD' 9 Cross arm	2	-	-	-	2
					Total =	60Nos.
Proposed 110KV Multi Circuit towers						
1	'MA'	1	1	-	-	1
2	'MD'	3	3	-	-	3
					Total =	4Nos.
Proposed 220KV D/C Narrow Based Towers (Hoody - HAL Design)						
1	'DD'	2	-	-	2	2
					Total =	2Nos.
					Grand Total =	66Nos.

NOTE : 1) Minor deviation if any due to way leave problem that may arise during the execution of the work will be incorporated accordingly.

For R.S. CONSTRUCTIONS & SURVEYORS
Bangalore

Assistant Engineer Ele
Major Works Sub-Division,
KPTCL, Belagavi

Assistant Executive Engineer Ele
Major Works Sub-Division,
KPTCL, Belagavi

Executive Engineer Ele
Major Works Division,
KPTCL, Belagavi

Approved

Superintending Engineer Ele
Transmission (W&M) Circle,
KPTCL, Belagavi

Annex C

Noise Assessment Results

Licensed user:
ERM India Private Limited
Building 10, 4th Floor, Tower A, DLF Cyber City
IN-122002 Gurgaon
+91 124 4170300
Naval Chaudhary / naval.chaudhary@erm.com
Calculated:
10/18/2016 3:46 PM/3.1.579

NORD2000 - Main Result

Calculation: Most downwind

Assumptions

Weather stability	
Relative humidity	50.0 %
Air temperature	25.0 °C
Height for air temperature	2.0 m
Stability parameters	Night;Clouded
Inverse Monin Obukhov lenght	0.0000
Temperature scale T*	0.0000

Terrain
Elevation based on object
Elevation Grid Data Object: ReNew_Batkurki_EMDGrid_0.wpg (1)
Roughness based on area object
Area object (Roughness): REGIONS_ReNew_Batkurki_1.w2r (1)
Terrain type based on area object
Area object (Roughness): REGIONS_ReNew_Batkurki_1.w2r (1)

Month for calculation	January

Wind speed criteria
Uniform wind speed at 10 m agl.

Height above ground level for receiver	1.5 m

Wind speed has been extrapolated to calculation height using
IEC profile shear (z0 = 0.05m)
No stability correction

Version	3.1.0.0

All coordinates are in
UTM (north)-WGS84 Zone: 43

WTGs

					WTG type						Noise data	
	Easting	Northing	Z	Row data/Description	Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Creator	Name
			[m]					[kW]	[m]	[m]		
GBK01	535,533	1,774,841	684.5	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
GBK02	535,504	1,774,535	677.0	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
GBK03	535,373	1,774,234	670.8	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
GBK04	535,330	1,773,733	673.8	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
GBK05	535,267	1,773,418	667.0	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
GBK06	535,424	1,773,296	669.0	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
GBK07	535,024	1,772,915	666.1	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
GBK08	535,088	1,772,496	661.6	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
GBK09	537,691	1,772,619	675.6	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
GBK10	537,649	1,772,291	681.0	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
GBK11	537,616	1,771,963	677.4	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
GBK12	537,571	1,771,635	666.8	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
GBK13	537,529	1,771,314	659.4	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
GBK14	539,343	1,775,946	661.0	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
GBK15	539,280	1,775,597	660.4	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
GBK16	539,227	1,775,251	663.5	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
GBK17	539,165	1,774,907	668.7	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
GBK18	539,129	1,774,395	664.1	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
GBK20	537,717	1,773,609	678.6	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
GBK21	537,722	1,772,444	680.2	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
GBK22	537,712	1,772,949	671.1	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
GBK23	541,483	1,774,063	657.5	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
GBK24	541,269	1,773,711	667.0	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
GBK25	541,252	1,773,414	670.3	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
GBK26	540,671	1,772,862	670.1	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
GBK27	540,616	1,772,562	674.0	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
GBK29	540,712	1,771,882	665.3	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
GBK30	540,451	1,771,392	661.3	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
GBK31	538,846	1,774,053	679.0	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
GBK36	539,192	1,773,189	684.9	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012

Calculation Results

Licensed user:
ERM India Private Limited
Building 10, 4th Floor, Tower A, DLF Cyber City
IN-122002 Gurgaon
+91 124 4170300
Naval Chaudhary / naval.chaudhary@erm.com
Calculated:
10/18/2016 3:46 PM/3.1.579

NORD2000 - Main Result

Calculation: Most downwind

Sound level

Noise sensitive area							Demands	Sound level	Demands fulfilled?
No.	Name	Easting	Northing	Z [m]	Imission height [m]	Wind speed [m/s]	Noise [dB(A)]	From WTGs [dB(A)]	Noise [dB(A)]
NSR1	Noise sensitive area: (1)	535,806	1,775,091	678.5	1.5	8.0	45.0	42.5	Yes
NSR2	Noise sensitive area: (2)	535,149	1,775,235	678.9	1.5	8.0	45.0	39.9	Yes
NSR3	Noise sensitive area: (3)	537,604	1,770,903	658.0	1.5	8.0	45.0	41.8	Yes
NSR4	Noise sensitive area: (4)	537,546	1,770,900	661.0	1.5	8.0	45.0	41.9	Yes
NSR5	Noise sensitive area: (5)	541,553	1,774,591	650.1	1.5	8.0	45.0	39.6	Yes
NSR6	Noise sensitive area: (6)	540,661	1,774,326	657.3	1.5	8.0	45.0	38.9	Yes
NSR7	Noise sensitive area: (7)	540,048	1,771,331	650.9	1.5	8.0	45.0	41.5	Yes

Sound level

Noise sensitive area								Demands	Sound level	Demands fulfilled?
No.	Name	Easting	Northing	Z [m]	Imission height [m]	Wind speed [m/s]	Dir [°]	Noise [dB(A)]	From WTGs [dB(A)]	Noise [dB(A)]
NSR1	Noise sensitive area: (1)	535,806	1,775,091	678.5	1.5	8.0	0.0	45.0	41.9	Yes
NSR1						8.0	30.0	45.0	41.9	Yes
NSR1						8.0	60.0	45.0	42.0	Yes
NSR1						8.0	90.0	45.0	42.1	Yes
NSR1						8.0	120.0	45.0	42.2	Yes
NSR1						8.0	150.0	45.0	42.5	Yes
NSR1						8.0	180.0	45.0	42.5	Yes
NSR1						8.0	210.0	45.0	42.5	Yes
NSR1						8.0	240.0	45.0	42.4	Yes
NSR1						8.0	270.0	45.0	42.3	Yes
NSR1						8.0	300.0	45.0	42.1	Yes
NSR1						8.0	330.0	45.0	42.0	Yes
NSR2	Noise sensitive area: (2)	535,149	1,775,235	678.9	1.5	8.0	0.0	45.0	38.5	Yes
NSR2						8.0	30.0	45.0	38.7	Yes
NSR2						8.0	60.0	45.0	39.3	Yes
NSR2						8.0	90.0	45.0	39.6	Yes
NSR2						8.0	120.0	45.0	39.8	Yes
NSR2						8.0	150.0	45.0	39.9	Yes
NSR2						8.0	180.0	45.0	39.8	Yes
NSR2						8.0	210.0	45.0	39.7	Yes
NSR2						8.0	240.0	45.0	39.4	Yes
NSR2						8.0	270.0	45.0	39.1	Yes
NSR2						8.0	300.0	45.0	38.6	Yes
NSR2						8.0	330.0	45.0	38.4	Yes
NSR3	Noise sensitive area: (3)	537,604	1,770,903	658.0	1.5	8.0	0.0	45.0	41.8	Yes
NSR3						8.0	30.0	45.0	41.8	Yes
NSR3						8.0	60.0	45.0	41.7	Yes
NSR3						8.0	90.0	45.0	41.6	Yes
NSR3						8.0	120.0	45.0	41.2	Yes
NSR3						8.0	150.0	45.0	41.1	Yes
NSR3						8.0	180.0	45.0	41.0	Yes
NSR3						8.0	210.0	45.0	41.1	Yes
NSR3						8.0	240.0	45.0	41.2	Yes
NSR3						8.0	270.0	45.0	41.5	Yes
NSR3						8.0	300.0	45.0	41.7	Yes
NSR3						8.0	330.0	45.0	41.8	Yes
NSR4	Noise sensitive area: (4)	537,546	1,770,900	661.0	1.5	8.0	0.0	45.0	41.8	Yes
NSR4						8.0	30.0	45.0	41.8	Yes
NSR4						8.0	60.0	45.0	41.8	Yes
NSR4						8.0	90.0	45.0	41.9	Yes
NSR4						8.0	120.0	45.0	41.7	Yes
NSR4						8.0	150.0	45.0	41.6	Yes
NSR4						8.0	180.0	45.0	41.6	Yes
NSR4						8.0	210.0	45.0	41.6	Yes
NSR4						8.0	240.0	45.0	41.7	Yes
NSR4						8.0	270.0	45.0	41.9	Yes
NSR4						8.0	300.0	45.0	41.9	Yes
NSR4						8.0	330.0	45.0	41.8	Yes
NSR5	Noise sensitive area: (5)	541,553	1,774,591	650.1	1.5	8.0	0.0	45.0	39.0	Yes
NSR5						8.0	30.0	45.0	38.7	Yes
NSR5						8.0	60.0	45.0	38.7	Yes
NSR5						8.0	90.0	45.0	39.0	Yes

To be continued on next page...

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Calculated:
10/18/2016 3:46 PM/3.1.579

NORD2000 - Main Result

Calculation: Most downwind

...continued from previous page

Noise sensitive area								Demands	Sound level	Demands fulfilled?
No.	Name	Easting	Northing	Z [m]	Imission height [m]	Wind speed [m/s]	Dir [°]	Noise [dB(A)]	From WTGs [dB(A)]	Noise [dB(A)]
NSR5						8.0	120.0	45.0	39.2	Yes
NSR5						8.0	150.0	45.0	39.2	Yes
NSR5						8.0	180.0	45.0	39.5	Yes
NSR5						8.0	210.0	45.0	39.6	Yes
NSR5						8.0	240.0	45.0	39.5	Yes
NSR5						8.0	270.0	45.0	39.5	Yes
NSR5						8.0	300.0	45.0	39.4	Yes
NSR5						8.0	330.0	45.0	39.2	Yes
NSR6	Noise sensitive area: (6)	540,661	1,774,326	657.3	1.5	8.0	0.0	45.0	38.0	Yes
NSR6						8.0	30.0	45.0	37.6	Yes
NSR6						8.0	60.0	45.0	37.1	Yes
NSR6						8.0	90.0	45.0	37.1	Yes
NSR6						8.0	120.0	45.0	37.2	Yes
NSR6						8.0	150.0	45.0	37.5	Yes
NSR6						8.0	180.0	45.0	38.0	Yes
NSR6						8.0	210.0	45.0	38.4	Yes
NSR6						8.0	240.0	45.0	38.8	Yes
NSR6						8.0	270.0	45.0	38.9	Yes
NSR6						8.0	300.0	45.0	38.4	Yes
NSR6						8.0	330.0	45.0	38.0	Yes
NSR7	Noise sensitive area: (7)	540,048	1,771,331	650.9	1.5	8.0	0.0	45.0	41.5	Yes
NSR7						8.0	30.0	45.0	41.4	Yes
NSR7						8.0	60.0	45.0	41.3	Yes
NSR7						8.0	90.0	45.0	41.2	Yes
NSR7						8.0	120.0	45.0	41.2	Yes
NSR7						8.0	150.0	45.0	41.0	Yes
NSR7						8.0	180.0	45.0	41.1	Yes
NSR7						8.0	210.0	45.0	41.2	Yes
NSR7						8.0	240.0	45.0	41.2	Yes
NSR7						8.0	270.0	45.0	41.2	Yes
NSR7						8.0	300.0	45.0	41.4	Yes
NSR7						8.0	330.0	45.0	41.4	Yes

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Calculated:
10/19/2016 11:07 AM/3.1.579

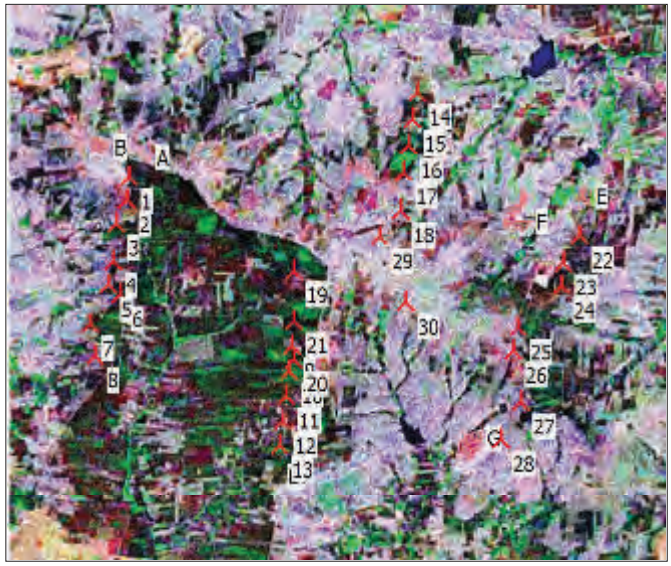
NORD2000 - Main Result

Calculation: Most downwind (nighttime)

Assumptions

Weather stability	
Relative humidity	50.0 %
Air temperature	10.0 °C
Height for air temperature	2.0 m
Stability parameters	Night;Clouded
Inverse Monin Obukhov lenght	0.0000
Temperature scale T*	0.0000
Terrain	
Elevation based on object	
Elevation Grid Data Object: ReNew_Batkurki_EMDGrid_0.wpg (1)	
Roughness based on area object	
Area object (Roughness): REGIONS_ReNew_Batkurki_1.w2r (1)	
Terrain type based on area object	
Area object (Roughness): REGIONS_ReNew_Batkurki_1.w2r (1)	
Month for calculation	January
Wind speed criteria	
Uniform wind speed at 10 m agl.	
Height above ground level for receiver	1.5 m
Wind speed has been extrapolated to calculation height using	
IEC profile shear (z0 = 0.05m)	
No stability correction	
Version	3.1.0.0

All coordinates are in
UTM (north)-WGS84 Zone: 43



Scale 1:100,000

New WTG Noise sensitive area

WTGs

	Easting	Northing	Z [m]	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Noise data Creator	Name
1	535,533	1,774,841	684.5	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
2	535,504	1,774,535	677.0	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
3	535,373	1,774,234	670.8	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
4	535,330	1,773,733	673.8	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
5	535,267	1,773,418	667.0	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
6	535,424	1,773,296	669.0	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
7	535,024	1,772,915	666.1	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
8	535,088	1,772,496	661.6	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
9	537,691	1,772,619	675.6	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
10	537,649	1,772,291	681.0	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
11	537,616	1,771,963	677.4	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
12	537,571	1,771,635	666.8	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
13	537,529	1,771,314	659.4	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
14	539,343	1,775,946	661.0	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
15	539,280	1,775,597	660.4	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
16	539,227	1,775,251	663.5	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
17	539,165	1,774,907	668.7	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
18	539,129	1,774,395	664.1	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
19	537,717	1,773,609	678.6	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
20	537,722	1,772,444	680.2	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
21	537,712	1,772,949	671.1	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
22	541,483	1,774,063	657.5	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
23	541,269	1,773,711	667.0	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
24	541,252	1,773,414	670.3	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
25	540,671	1,772,862	670.1	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
26	540,616	1,772,562	674.0	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
27	540,712	1,771,882	665.3	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
28	540,451	1,771,392	661.3	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
29	538,846	1,774,053	679.0	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012
30	539,192	1,773,189	684.9	GAMESA G97 2000 97...	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	USER	Level 0 - Estimated - - 07-2012

Calculation Results

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Naval Chaudhary / naval.chaudhary@erm.com
Calculated:
10/19/2016 11:07 AM/3.1.579

NORD2000 - Main Result

Calculation: Most downwind (nighttime)

Sound level

Noise sensitive area						Demands	Sound level	Demands fulfilled?
No.	Name	Easting	Northing	Z [m]	Imission height [m]	Wind speed [m/s]	Noise [dB(A)]	From WTGs [dB(A)]	Noise [dB(A)]
A	Noise sensitive area: (1)	535,806	1,775,091	678.5	1.5	8.0	45.0	43.0	Yes
B	Noise sensitive area: (2)	535,149	1,775,235	678.9	1.5	8.0	45.0	40.6	Yes
C	Noise sensitive area: (3)	537,604	1,770,903	658.0	1.5	8.0	45.0	42.4	Yes
D	Noise sensitive area: (4)	537,546	1,770,900	661.0	1.5	8.0	45.0	42.4	Yes
E	Noise sensitive area: (5)	541,553	1,774,591	650.1	1.5	8.0	45.0	40.2	Yes
F	Noise sensitive area: (6)	540,661	1,774,326	657.3	1.5	8.0	45.0	39.8	Yes
G	Noise sensitive area: (7)	540,048	1,771,331	650.9	1.5	8.0	45.0	42.0	Yes

Sound level

Noise sensitive area							Demands	Sound level	Demands fulfilled?
No.	Name	Easting	Northing	Z [m]	Imission height [m]	Wind speed [m/s]	Dir [°]	Noise [dB(A)]	From WTGs [dB(A)]	Noise [dB(A)]
A	Noise sensitive area: (1)	535,806	1,775,091	678.5	1.5	8.0	0.0	45.0	42.1	Yes
A						8.0	30.0	45.0	42.1	Yes
A						8.0	60.0	45.0	42.2	Yes
A						8.0	90.0	45.0	42.4	Yes
A						8.0	120.0	45.0	42.6	Yes
A						8.0	150.0	45.0	42.9	Yes
A						8.0	180.0	45.0	43.0	Yes
A						8.0	210.0	45.0	42.9	Yes
A						8.0	240.0	45.0	42.8	Yes
A						8.0	270.0	45.0	42.6	Yes
A						8.0	300.0	45.0	42.4	Yes
A						8.0	330.0	45.0	42.2	Yes
B	Noise sensitive area: (2)	535,149	1,775,235	678.9	1.5	8.0	0.0	45.0	38.9	Yes
B						8.0	30.0	45.0	39.2	Yes
B						8.0	60.0	45.0	39.8	Yes
B						8.0	90.0	45.0	40.2	Yes
B						8.0	120.0	45.0	40.5	Yes
B						8.0	150.0	45.0	40.6	Yes
B						8.0	180.0	45.0	40.5	Yes
B						8.0	210.0	45.0	40.3	Yes
B						8.0	240.0	45.0	40.0	Yes
B						8.0	270.0	45.0	39.6	Yes
B						8.0	300.0	45.0	39.0	Yes
B						8.0	330.0	45.0	38.7	Yes
C	Noise sensitive area: (3)	537,604	1,770,903	658.0	1.5	8.0	0.0	45.0	42.4	Yes
C						8.0	30.0	45.0	42.3	Yes
C						8.0	60.0	45.0	42.2	Yes
C						8.0	90.0	45.0	42.0	Yes
C						8.0	120.0	45.0	41.6	Yes
C						8.0	150.0	45.0	41.4	Yes
C						8.0	180.0	45.0	41.3	Yes
C						8.0	210.0	45.0	41.4	Yes
C						8.0	240.0	45.0	41.5	Yes
C						8.0	270.0	45.0	41.9	Yes
C						8.0	300.0	45.0	42.1	Yes
C						8.0	330.0	45.0	42.3	Yes
D	Noise sensitive area: (4)	537,546	1,770,900	661.0	1.5	8.0	0.0	45.0	42.4	Yes
D						8.0	30.0	45.0	42.4	Yes
D						8.0	60.0	45.0	42.3	Yes
D						8.0	90.0	45.0	42.4	Yes
D						8.0	120.0	45.0	42.2	Yes
D						8.0	150.0	45.0	42.0	Yes
D						8.0	180.0	45.0	42.0	Yes
D						8.0	210.0	45.0	42.0	Yes
D						8.0	240.0	45.0	42.2	Yes
D						8.0	270.0	45.0	42.4	Yes
D						8.0	300.0	45.0	42.4	Yes
D						8.0	330.0	45.0	42.3	Yes
E	Noise sensitive area: (5)	541,553	1,774,591	650.1	1.5	8.0	0.0	45.0	39.5	Yes
E						8.0	30.0	45.0	39.2	Yes
E						8.0	60.0	45.0	39.2	Yes
E						8.0	90.0	45.0	39.4	Yes

To be continued on next page...

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Calculated:
10/19/2016 11:07 AM/3.1.579

NORD2000 - Main Result

Calculation: Most downwind (nighttime)

...continued from previous page

Noise sensitive area								Demands	Sound level	Demands fulfilled?
No.	Name	Easting	Northing	Z [m]	Imission height [m]	Wind speed [m/s]	Dir [°]	Noise [dB(A)]	From WTGs [dB(A)]	Noise [dB(A)]
E						8.0	120.0	45.0	39.8	Yes
E						8.0	150.0	45.0	39.8	Yes
E						8.0	180.0	45.0	40.1	Yes
E						8.0	210.0	45.0	40.2	Yes
E						8.0	240.0	45.0	40.2	Yes
E						8.0	270.0	45.0	40.2	Yes
E						8.0	300.0	45.0	40.0	Yes
E						8.0	330.0	45.0	39.7	Yes
F	Noise sensitive area: (6)	540,661	1,774,326	657.3	1.5	8.0	0.0	45.0	38.8	Yes
F						8.0	30.0	45.0	38.3	Yes
F						8.0	60.0	45.0	37.8	Yes
F						8.0	90.0	45.0	37.9	Yes
F						8.0	120.0	45.0	38.0	Yes
F						8.0	150.0	45.0	38.3	Yes
F						8.0	180.0	45.0	38.9	Yes
F						8.0	210.0	45.0	39.4	Yes
F						8.0	240.0	45.0	39.7	Yes
F						8.0	270.0	45.0	39.8	Yes
F						8.0	300.0	45.0	39.3	Yes
F						8.0	330.0	45.0	38.8	Yes
G	Noise sensitive area: (7)	540,048	1,771,331	650.9	1.5	8.0	0.0	45.0	42.0	Yes
G						8.0	30.0	45.0	41.9	Yes
G						8.0	60.0	45.0	41.8	Yes
G						8.0	90.0	45.0	41.7	Yes
G						8.0	120.0	45.0	41.6	Yes
G						8.0	150.0	45.0	41.4	Yes
G						8.0	180.0	45.0	41.6	Yes
G						8.0	210.0	45.0	41.6	Yes
G						8.0	240.0	45.0	41.6	Yes
G						8.0	270.0	45.0	41.7	Yes
G						8.0	300.0	45.0	41.9	Yes
G						8.0	330.0	45.0	41.9	Yes

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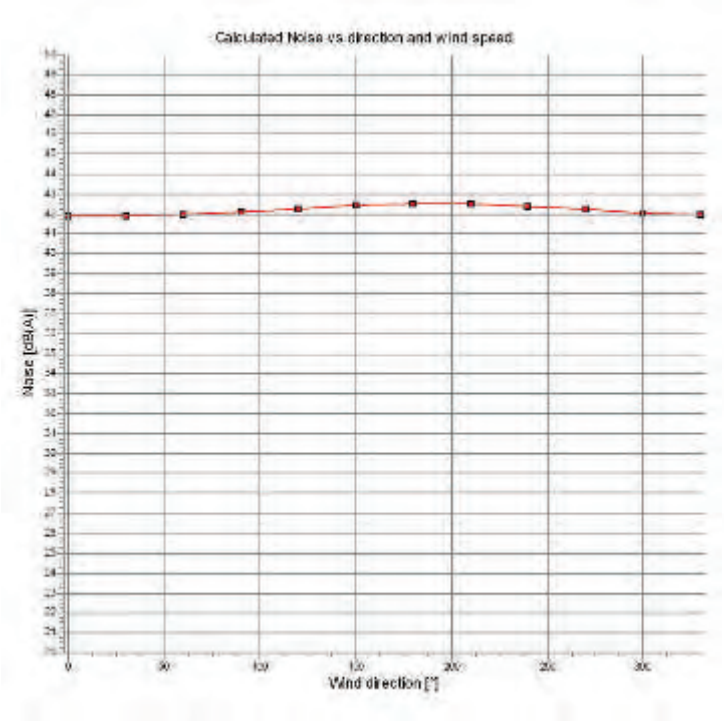
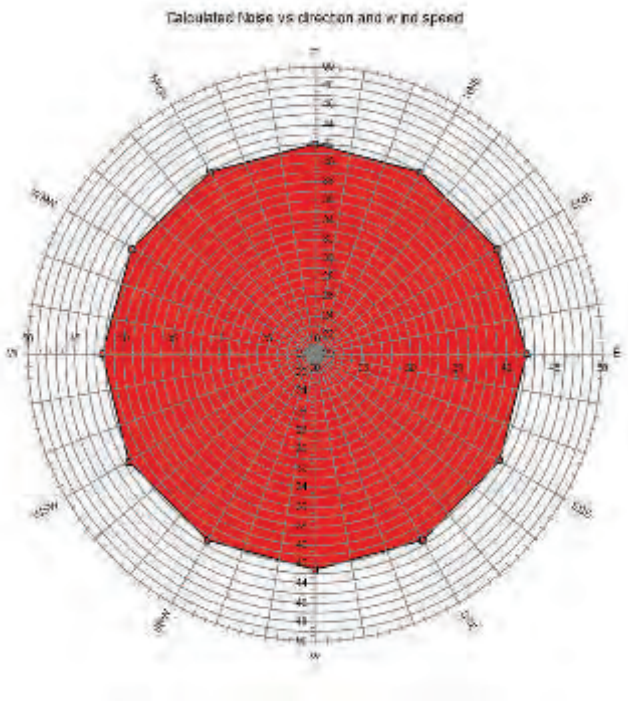
Calculated:
10/18/2016 3:46 PM/3.1.579

NORD2000 - Speed/Directional analysis

Calculation: Most downwind **NSA:** A - Noise sensitive area: (1)

Direction	**Wind speed**
	8.0
Degrees	[m/s]
0.0	41.9
30.0	41.9
60.0	42.0
90.0	42.1
120.0	42.2
150.0	42.5
180.0	42.5
210.0	42.5
240.0	42.4
270.0	42.3
300.0	42.1
330.0	42.0





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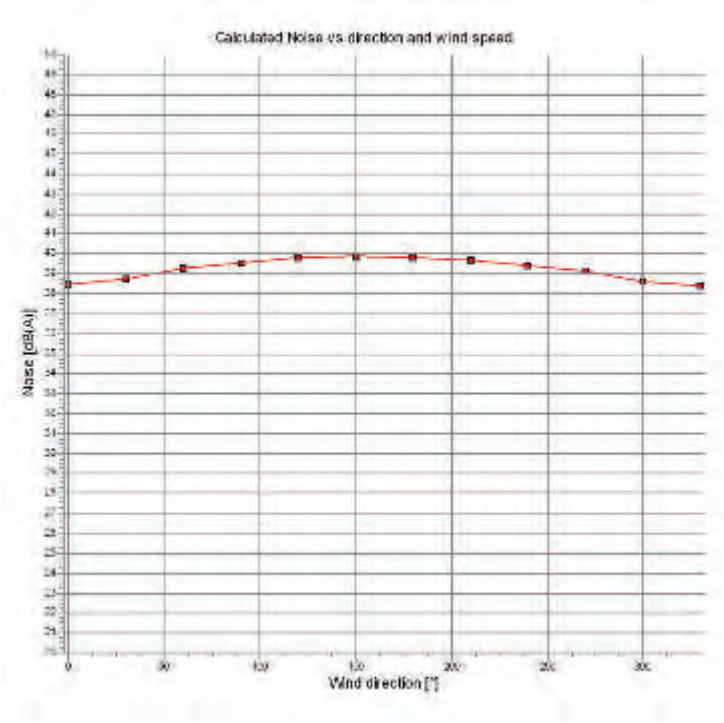
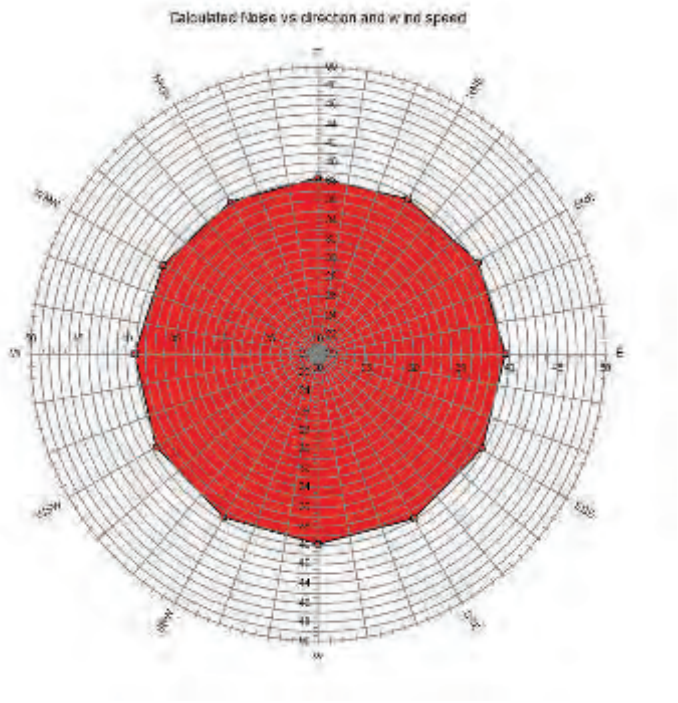
Calculated:
10/18/2016 3:46 PM/3.1.579

NORD2000 - Speed/Directional analysis

Calculation: Most downwind **NSA:** B - Noise sensitive area: (2)

Direction	**Wind speed**
	8.0
Degrees	[m/s]
0.0	38.5
30.0	38.7
60.0	39.3
90.0	39.6
120.0	39.8
150.0	39.9
180.0	39.8
210.0	39.7
240.0	39.4
270.0	39.1
300.0	38.6
330.0	38.4





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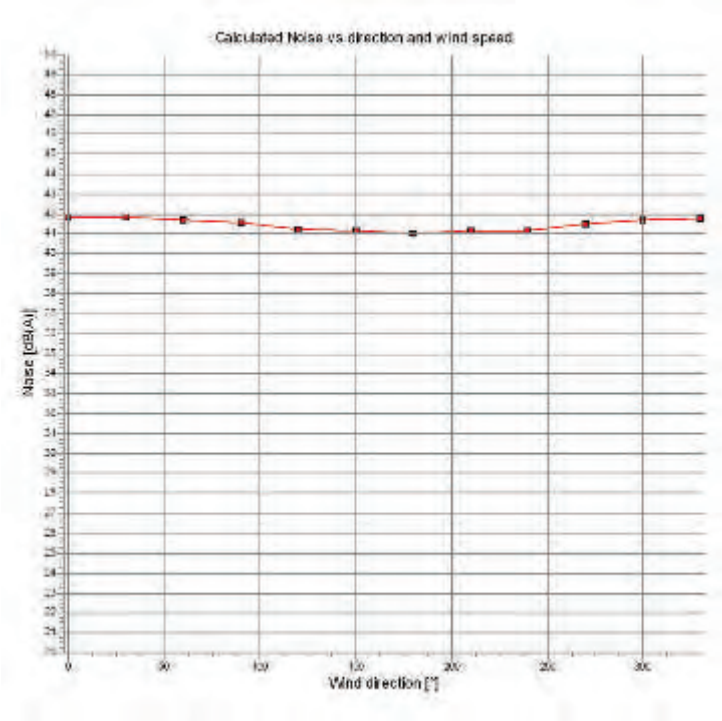
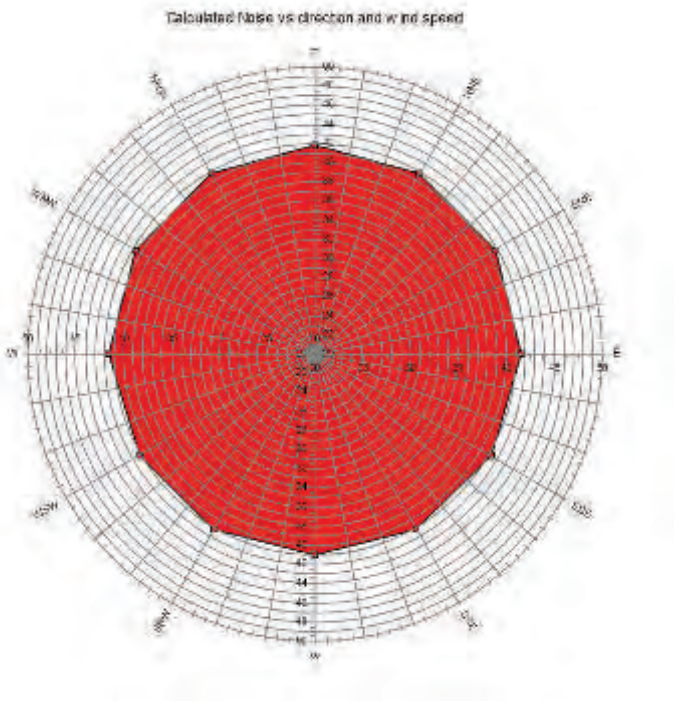
NORD2000 - Speed/Directional analysis

Calculation: Most downwind **NSA:** C - Noise sensitive area: (3)

Direction	**Wind speed**
	8.0
Degrees	[m/s]
0.0	41.8
30.0	41.8
60.0	41.7
90.0	41.6
120.0	41.2
150.0	41.1
180.0	41.0
210.0	41.1
240.0	41.2
270.0	41.5
300.0	41.7
330.0	41.8





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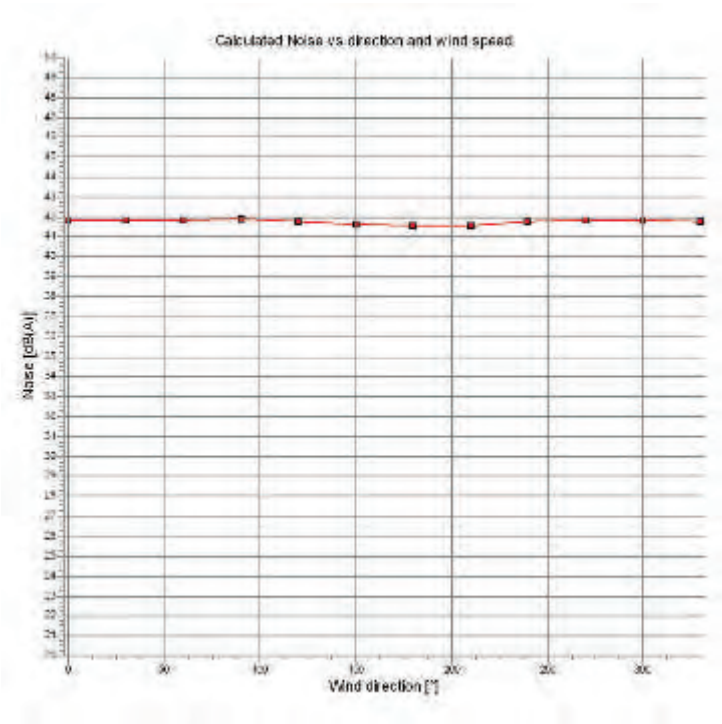
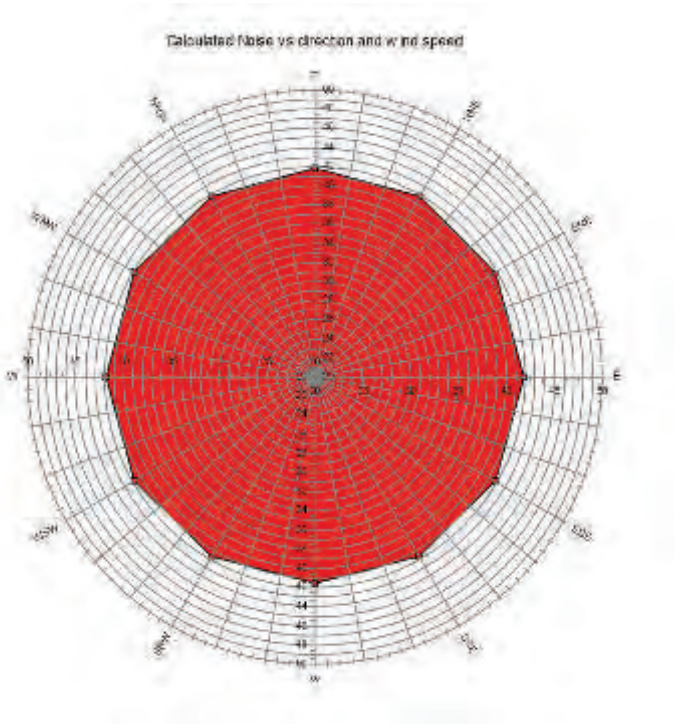
NORD2000 - Speed/Directional analysis

Calculation: Most downwind **NSA:** D - Noise sensitive area: (4)

Direction	**Wind speed**
	8.0
Degrees	[m/s]
0.0	41.8
30.0	41.8
60.0	41.8
90.0	41.9
120.0	41.7
150.0	41.6
180.0	41.6
210.0	41.6
240.0	41.7
270.0	41.9
300.0	41.9
330.0	41.8





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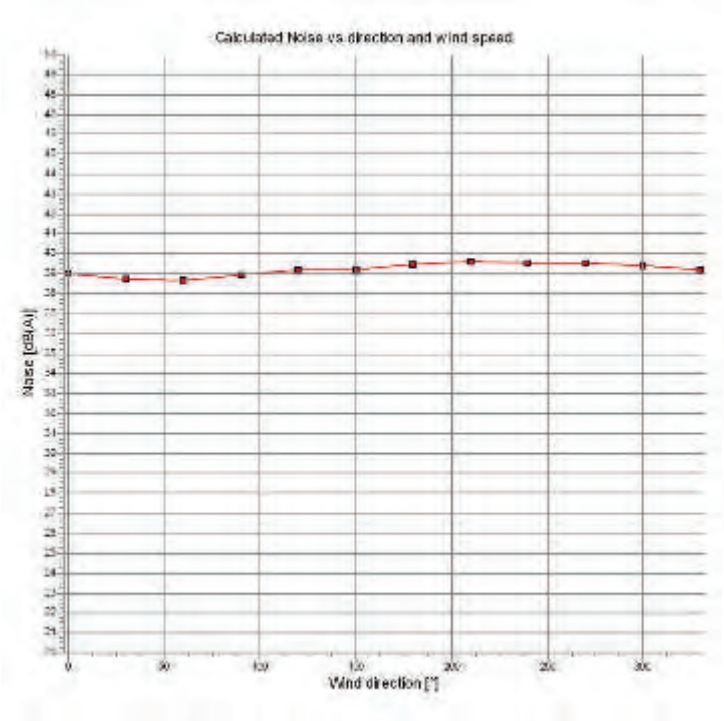
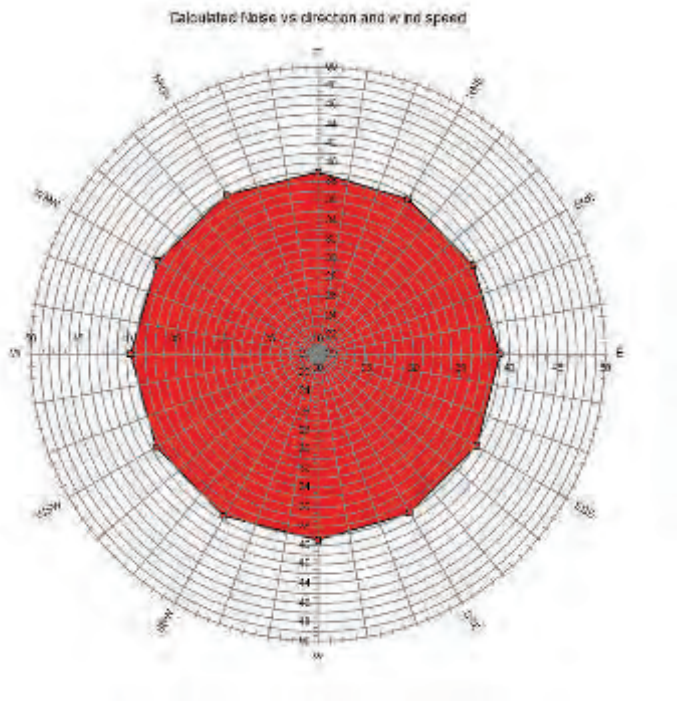
NORD2000 - Speed/Directional analysis

Calculation: Most downwind **NSA:** E - Noise sensitive area: (5)

Direction	**Wind speed**
	8.0
Degrees	[m/s]
0.0	39.0
30.0	38.7
60.0	38.7
90.0	39.0
120.0	39.2
150.0	39.2
180.0	39.5
210.0	39.6
240.0	39.5
270.0	39.5
300.0	39.4
330.0	39.2





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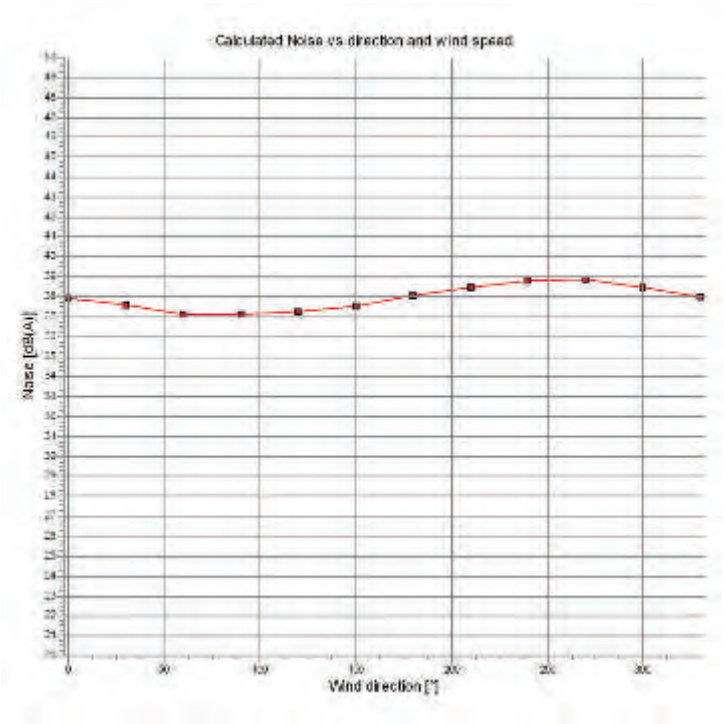
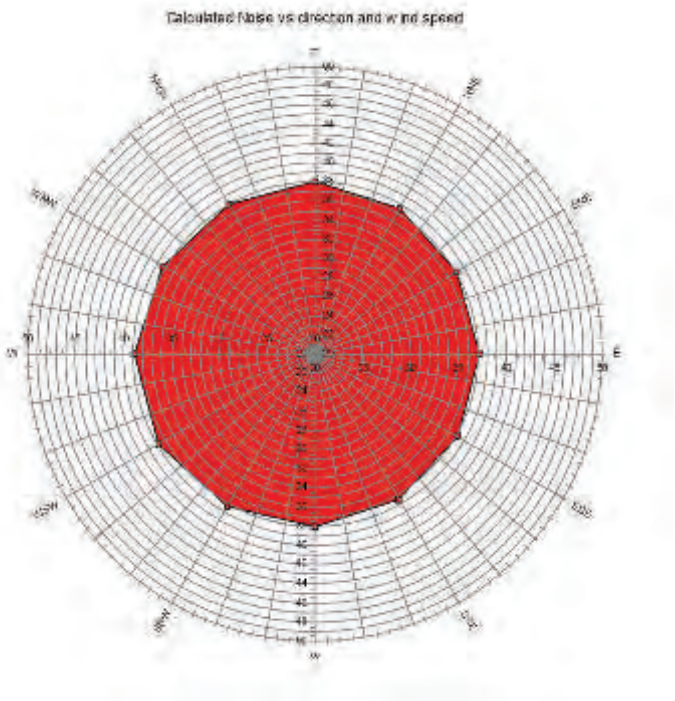
NORD2000 - Speed/Directional analysis

Calculation: Most downwind **NSA:** F - Noise sensitive area: (6)

Direction	**Wind speed**
	8.0
Degrees	[m/s]
0.0	38.0
30.0	37.6
60.0	37.1
90.0	37.1
120.0	37.2
150.0	37.5
180.0	38.0
210.0	38.4
240.0	38.8
270.0	38.9
300.0	38.4
330.0	38.0





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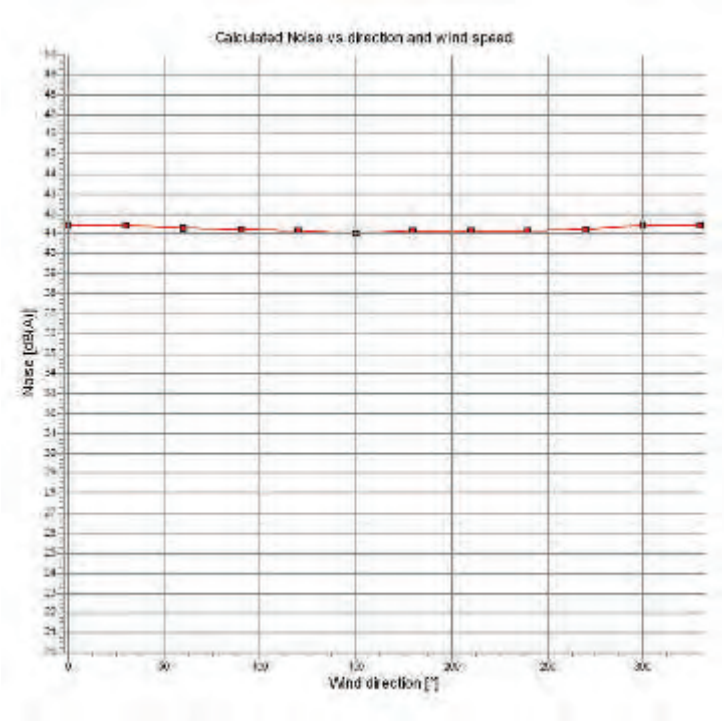
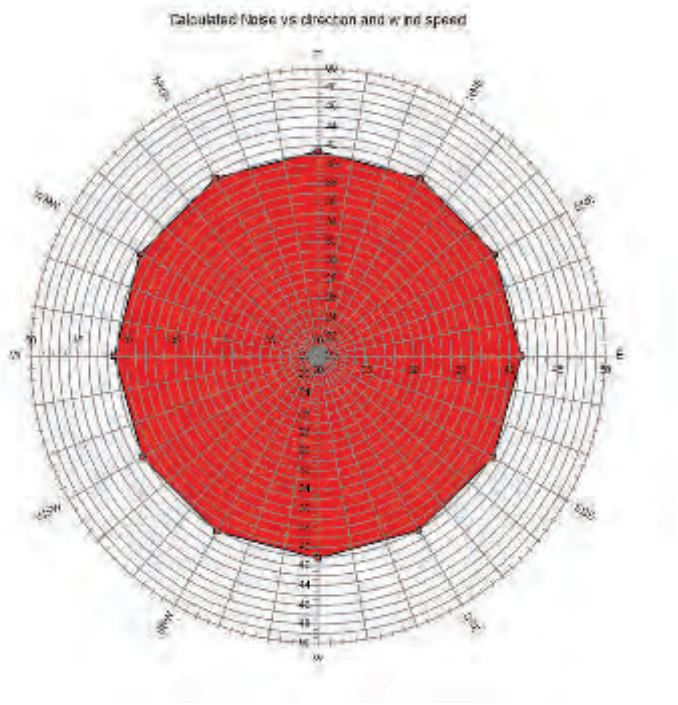
NORD2000 - Speed/Directional analysis

Calculation: Most downwind **NSA:** G - Noise sensitive area: (7)

Direction	**Wind speed**
	8.0
Degrees	[m/s]
0.0	41.5
30.0	41.4
60.0	41.3
90.0	41.2
120.0	41.2
150.0	41.0
180.0	41.1
210.0	41.2
240.0	41.2
270.0	41.2
300.0	41.4
330.0	41.4





Annex D

Shadow – Project Data Overview

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Calculated:
10/18/2016 11:08 AM/3.1.579

BASIS - Project data overview

Calculation: Basis - Project Data Overview
Country: India

Maps

Name	Format	Path
OnlineMap_10_10.00_0	Bitmap map	C:\Users\Naval.Chaudhary\Documents\WindPRO Data\Projects\ReNew_Batkurki\OnlineMap_10_10.00_0.BMI
Open Street Map 003	Bitmap map	C:\Users\Naval.Chaudhary\Documents\WindPRO Data\Projects\ReNew_Batkurki\Maps\Open Street Map 003.bmi
Basemap	Bitmap map	C:\Users\Naval.Chaudhary\Documents\WindPRO Data\Projects\ReNew_Batkurki\Maps\Basemap.bmi

Site center: UTM (north)-WGS84 Zone: 43 East: 538,951 North: 1,773,545

WTGs

	UTM (north)-WGS84 Zone: 43					WTG type						
	Easting	Northing	Z	Row data/Description	Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Circle radius
			[m]					[kW]	[m]	[m]	[m]
GBK01	535,533	1,774,841	684.5	GAMESA G97 2000 97.0 !O! New	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	500.0
GBK02	535,504	1,774,535	677.0	GAMESA G97 2000 97.0 !O! New	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	500.0
GBK03	535,373	1,774,234	670.8	GAMESA G97 2000 97.0 !O! New	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	500.0
GBK04	535,330	1,773,733	673.8	GAMESA G97 2000 97.0 !O! New	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	500.0
GBK05	535,267	1,773,418	667.0	GAMESA G97 2000 97.0 !O! New	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	500.0
GBK06	535,424	1,773,296	669.0	GAMESA G97 2000 97.0 !O! New	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	500.0
GBK07	535,024	1,772,915	666.1	GAMESA G97 2000 97.0 !O! New	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	500.0
GBK08	535,088	1,772,496	661.6	GAMESA G97 2000 97.0 !O! New	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	500.0
GBK09	537,691	1,772,619	675.6	GAMESA G97 2000 97.0 !O! New	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	500.0
GBK10	537,649	1,772,291	681.0	GAMESA G97 2000 97.0 !O! New	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	500.0
GBK11	537,616	1,771,963	677.4	GAMESA G97 2000 97.0 !O! New	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	500.0
GBK12	537,571	1,771,635	666.8	GAMESA G97 2000 97.0 !O! New	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	500.0
GBK13	537,529	1,771,314	659.4	GAMESA G97 2000 97.0 !O! New	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	500.0
GBK14	539,343	1,775,946	661.0	GAMESA G97 2000 97.0 !O! New	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	500.0
GBK15	539,280	1,775,597	660.4	GAMESA G97 2000 97.0 !O! New	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	500.0
GBK16	539,227	1,775,251	663.5	GAMESA G97 2000 97.0 !O! New	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	500.0
GBK17	539,165	1,774,907	668.7	GAMESA G97 2000 97.0 !O! New	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	500.0
GBK18	539,129	1,774,395	664.1	GAMESA G97 2000 97.0 !O! New	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	500.0
GBK20	537,717	1,773,609	678.6	GAMESA G97 2000 97.0 !O! New	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	500.0
GBK21	537,722	1,772,444	680.2	GAMESA G97 2000 97.0 !O! New	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	500.0
GBK22	537,712	1,772,949	671.1	GAMESA G97 2000 97.0 !O! New	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	500.0
GBK23	541,483	1,774,063	657.5	GAMESA G97 2000 97.0 !O! New	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	500.0
GBK24	541,269	1,773,711	667.0	GAMESA G97 2000 97.0 !O! New	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	500.0
GBK25	541,252	1,773,414	670.3	GAMESA G97 2000 97.0 !O! New	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	500.0
GBK26	540,671	1,772,862	670.1	GAMESA G97 2000 97.0 !O! New	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	500.0
GBK27	540,616	1,772,562	674.0	GAMESA G97 2000 97.0 !O! New	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	500.0
GBK29	540,712	1,771,882	665.3	GAMESA G97 2000 97.0 !O! New	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	500.0
GBK30	540,451	1,771,392	661.3	GAMESA G97 2000 97.0 !O! New	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	500.0
GBK31	538,846	1,774,053	679.0	GAMESA G97 2000 97.0 !O! New	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	500.0
GBK36	539,192	1,773,189	684.9	GAMESA G97 2000 97.0 !O! New	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	500.0

Noise sensitive area

	UTM (north)-WGS84 Zone: 43					
	Easting	Northing	Z	Object name	Noise limit	Distance demand	Type
			[m]		[dB(A)]	[m]	
NSR1	535,806	1,775,091	678.5	Noise sensitive area: (1)	0.0		Area
NSR2	535,149	1,775,235	678.9	Noise sensitive area: (2)	0.0		Area
NSR3	537,604	1,770,903	658.0	Noise sensitive area: (3)	0.0		Area
NSR4	537,546	1,770,900	661.0	Noise sensitive area: (4)	0.0		Area
NSR5	541,553	1,774,591	650.1	Noise sensitive area: (5)	0.0		Area
NSR6	540,661	1,774,326	657.3	Noise sensitive area: (6)	0.0		Area
NSR7	540,048	1,771,331	650.9	Noise sensitive area: (7)	0.0		Area

Shadow receptor

	UTM (north)-WGS84 Zone: 43								
	Easting	Northing	Z	Object name	Orientation	Length	Height	Height a.g.l.	Angle
			[m]		[°]	[m]	[m]	[m]	[°]
A	535,807	1,775,088	678.5	House (Permanent)	231.2	1.0	1.0	1.0	90.0
B	535,240	1,775,217	675.0	House (Permanent)	157.7	1.0	1.0	1.0	90.0
C	535,204	1,775,187	680.6	House (Permanent)	144.9	1.0	1.0	1.0	90.0

To be continued on next page...

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BASIS - Project data overview

Calculation: Basis - Project Data Overview

...continued from previous page

UTM (north)-WGS84 Zone: 43

	Easting	Northing	Z [m]	Object name	Orientation [°]	Length [m]	Height [m]	Height a.g.l. [m]	Angle [°]
D	535,185	1,775,178	682.2	House (Permanent)	133.3	1.0	1.0	1.0	90.0
E	535,157	1,775,160	683.0	House (Permanent)	133.9	1.0	1.0	1.0	90.0
F	535,154	1,775,152	683.0	House (Permanent)	129.2	1.0	1.0	1.0	90.0
G	535,313	1,775,181	679.1	Temple	157.4	1.0	1.0	1.0	90.0
H	535,482	1,775,134	684.2	Shrine	165.9	1.0	1.0	1.0	90.0
I	537,547	1,770,879	660.2	House (Temporary)	-2.4	1.0	1.0	1.0	90.0
J	537,614	1,770,882	658.2	Bus Stop	-14.9	1.0	1.0	1.0	90.0
K	541,581	1,774,496	652.7	House (Permanent)	201.7	1.0	1.0	1.0	90.0
L	541,535	1,774,513	651.5	House (Permanent)	191.9	1.0	1.0	1.0	90.0
M	541,518	1,774,520	650.5	House (Permanent)	195.3	1.0	1.0	1.0	90.0
N	541,508	1,774,526	650.0	House (Permanent)	193.9	1.0	1.0	1.0	90.0
O	541,477	1,774,534	648.0	House (Permanent)	180.0	1.0	1.0	1.0	90.0
P	541,458	1,774,538	648.0	House (Permanent)	180.0	1.0	1.0	1.0	90.0
Q	540,665	1,771,411	660.6	Cabin (Stone Quarry)	262.1	1.0	1.0	1.0	90.0
R	540,175	1,771,429	651.9	House (Permanent)	97.3	1.0	1.0	1.0	90.0
S	540,162	1,771,348	654.3	House (Permanent)	76.8	1.0	1.0	1.0	90.0
T	540,108	1,771,266	654.4	House (Permanent)	68.6	1.0	1.0	1.0	90.0

Elevation grid

UTM (north)-WGS84 Zone: 43

	Easting	Northing	Z [m]	File
A	538,884	1,773,570	0.0	C:\Users\Naval.Chaudhary\Documents\WindPRO Data\Projects\ReNew_Batkurki\ReNew_Batkurki_EMDGrid_0.wpg

Annex E

Shadow – WTG Minimum Distances

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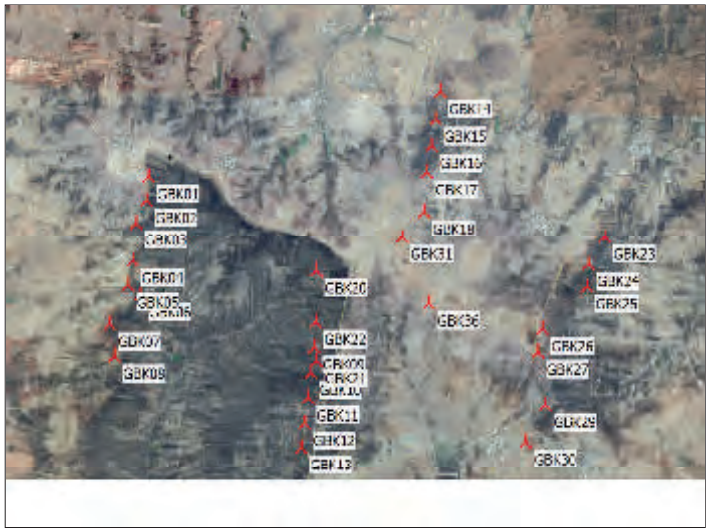
Naval Chaudhary / naval.chaudhary@erm.com
Calculated:
10/18/2016 11:08 AM/3.1.579

BASIS - WTG distances

Calculation: Basis - Project Data Overview

WTG distances

	Z	Nearest WTG	Z	Horizontal distance	Distance in rotor diameters
	[m]		[m]	[m]	
GBK01	684.5	GBK02	677.0	307	3.2
GBK02	677.0	GBK01	684.5	307	3.2
GBK03	670.8	GBK02	677.0	328	3.4
GBK04	673.8	GBK05	667.0	321	3.3
GBK05	667.0	GBK06	669.0	199	2.0
GBK06	669.0	GBK05	667.0	199	2.0
GBK07	666.1	GBK08	661.6	424	4.4
GBK08	661.6	GBK07	666.1	424	4.4
GBK09	675.6	GBK21	680.2	178	1.8
GBK10	681.0	GBK21	680.2	170	1.7
GBK11	677.4	GBK10	681.0	330	3.4
GBK12	666.8	GBK13	659.4	324	3.3
GBK13	659.4	GBK12	666.8	324	3.3
GBK14	661.0	GBK15	660.4	355	3.7
GBK15	660.4	GBK16	663.5	350	3.6
GBK16	663.5	GBK17	668.7	350	3.6
GBK17	668.7	GBK16	663.5	350	3.6
GBK18	664.1	GBK31	679.0	444	4.6
GBK20	678.6	GBK22	671.1	660	6.8
GBK21	680.2	GBK10	681.0	170	1.7
GBK22	671.1	GBK09	675.6	331	3.4
GBK23	657.5	GBK24	667.0	412	4.2
GBK24	667.0	GBK25	670.3	297	3.1
GBK25	670.3	GBK24	667.0	297	3.1
GBK26	670.1	GBK27	674.0	305	3.1
GBK27	674.0	GBK26	670.1	305	3.1
GBK29	665.3	GBK30	661.3	555	5.7
GBK30	661.3	GBK29	665.3	555	5.7
GBK31	679.0	GBK18	664.1	444	4.6
GBK36	684.9	GBK31	679.0	931	9.6
Min	**657.5**		**659.4**	**170**	**1.7**
Max	**684.9**		**684.5**	**931**	**9.6**



Scale 1:70,000

New WTG

Annex F

Shadow – Main Results

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Calculated:
10/18/2016 11:14 AM/3.1.579

SHADOW - Main Result

Calculation: Shadow - Real Case Scenario

Assumptions for shadow calculations

Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

Minimum sun height over horizon for influence	3 °
Day step for calculation	1 days
Time step for calculation	1 minutes

Sunshine probability S (Average daily sunshine hours) [GOA / PANJIM]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
10.04	10.28	9.34	9.65	9.45	4.31	3.22	4.18	5.94	7.85	9.14	9.61

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW
180	794	197	409	596	648	500	208	89	73	134	367

W	WNW	NW	NNW	Sum
1,433	1,384	438	138	7,588

Idle start wind speed: Cut in wind speed from power curve

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Elevation Grid Data Object: ReNew_Batkurki_EMDGrid_(
Obstacles used in calculation
Eye height: 1.5 m
Grid resolution: 10.0 m

All coordinates are in
UTM (north)-WGS84 Zone: 43

Scale 1:75,000

New WTG Shadow receptor

WTGs

	Easting	Northing	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Shadow data Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
GBK01	535,533	1,774,841	684.5	GAMESA G97 2000 97.0 !O!	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	2,500	0.0
GBK02	535,504	1,774,535	677.0	GAMESA G97 2000 97.0 !O!	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	2,500	0.0
GBK03	535,373	1,774,234	670.8	GAMESA G97 2000 97.0 !O!	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	2,500	0.0
GBK04	535,330	1,773,733	673.8	GAMESA G97 2000 97.0 !O!	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	2,500	0.0
GBK05	535,267	1,773,418	667.0	GAMESA G97 2000 97.0 !O!	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	2,500	0.0
GBK06	535,424	1,773,296	669.0	GAMESA G97 2000 97.0 !O!	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	2,500	0.0
GBK07	535,024	1,772,915	666.1	GAMESA G97 2000 97.0 !O!	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	2,500	0.0
GBK08	535,088	1,772,496	661.6	GAMESA G97 2000 97.0 !O!	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	2,500	0.0
GBK09	537,691	1,772,619	675.6	GAMESA G97 2000 97.0 !O!	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	2,500	0.0
GBK10	537,649	1,772,291	681.0	GAMESA G97 2000 97.0 !O!	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	2,500	0.0
GBK11	537,616	1,771,963	677.4	GAMESA G97 2000 97.0 !O!	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	2,500	0.0
GBK12	537,571	1,771,635	666.8	GAMESA G97 2000 97.0 !O!	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	2,500	0.0
GBK13	537,529	1,771,314	659.4	GAMESA G97 2000 97.0 !O!	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	2,500	0.0
GBK14	539,343	1,775,946	661.0	GAMESA G97 2000 97.0 !O!	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	2,500	0.0
GBK15	539,280	1,775,597	660.4	GAMESA G97 2000 97.0 !O!	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	2,500	0.0
GBK16	539,227	1,775,251	663.5	GAMESA G97 2000 97.0 !O!	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	2,500	0.0
GBK17	539,165	1,774,907	668.7	GAMESA G97 2000 97.0 !O!	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	2,500	0.0
GBK18	539,129	1,774,395	664.1	GAMESA G97 2000 97.0 !O!	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	2,500	0.0
GBK20	537,717	1,773,609	678.6	GAMESA G97 2000 97.0 !O!	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	2,500	0.0
GBK21	537,722	1,772,444	680.2	GAMESA G97 2000 97.0 !O!	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	2,500	0.0
GBK22	537,712	1,772,949	671.1	GAMESA G97 2000 97.0 !O!	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	2,500	0.0
GBK23	541,483	1,774,063	657.5	GAMESA G97 2000 97.0 !O!	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	2,500	0.0
GBK24	541,269	1,773,711	667.0	GAMESA G97 2000 97.0 !O!	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	2,500	0.0
GBK25	541,252	1,773,414	670.3	GAMESA G97 2000 97.0 !O!	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	2,500	0.0
GBK26	540,671	1,772,862	670.1	GAMESA G97 2000 97.0 !O!	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	2,500	0.0
GBK27	540,616	1,772,562	674.0	GAMESA G97 2000 97.0 !O!	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	2,500	0.0
GBK29	540,712	1,771,882	665.3	GAMESA G97 2000 97.0 !O!	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	2,500	0.0
GBK30	540,451	1,771,392	661.3	GAMESA G97 2000 97.0 !O!	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	2,500	0.0
GBK31	538,846	1,774,053	679.0	GAMESA G97 2000 97.0 !O!	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	2,500	0.0
GBK36	539,192	1,773,189	684.9	GAMESA G97 2000 97.0 !O!	Yes	GAMESA	G97-2,000	2,000	97.0	104.0	2,500	0.0

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SHADOW - Main Result

Calculation: Shadow - Real Case Scenario

Shadow receptor-Input

No.	Name	Easting	Northing	Z [m]	Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
A	House (Permanent)	535,807	1,775,088	678.5	1.0	1.0	1.0	51.2	90.0	Fixed direction
B	House (Permanent)	535,240	1,775,217	675.0	1.0	1.0	1.0	-22.3	90.0	Fixed direction
C	House (Permanent)	535,204	1,775,187	680.6	1.0	1.0	1.0	-35.1	90.0	Fixed direction
D	House (Permanent)	535,185	1,775,178	682.2	1.0	1.0	1.0	-46.7	90.0	Fixed direction
E	House (Permanent)	535,157	1,775,160	683.0	1.0	1.0	1.0	-46.1	90.0	Fixed direction
F	House (Permanent)	535,154	1,775,152	683.0	1.0	1.0	1.0	-50.8	90.0	Fixed direction
G	Temple	535,313	1,775,181	679.1	1.0	1.0	1.0	-22.6	90.0	Fixed direction
H	Shrine	535,482	1,775,134	684.2	1.0	1.0	1.0	-14.1	90.0	Fixed direction
I	House (Temporary)	537,547	1,770,879	660.2	1.0	1.0	1.0	-182.4	90.0	Fixed direction
J	Bus Stop	537,614	1,770,882	658.2	1.0	1.0	1.0	-194.9	90.0	Fixed direction
K	House (Permanent)	541,581	1,774,496	652.7	1.0	1.0	1.0	21.7	90.0	Fixed direction
L	House (Permanent)	541,535	1,774,513	651.5	1.0	1.0	1.0	11.9	90.0	Fixed direction
M	House (Permanent)	541,518	1,774,520	650.5	1.0	1.0	1.0	15.3	90.0	Fixed direction
N	House (Permanent)	541,508	1,774,526	650.0	1.0	1.0	1.0	13.9	90.0	Fixed direction
O	House (Permanent)	541,477	1,774,534	648.0	1.0	1.0	1.0	0.0	90.0	Fixed direction
P	House (Permanent)	541,458	1,774,538	648.0	1.0	1.0	1.0	0.0	90.0	Fixed direction
Q	Cabin (Stone Quarry)	540,665	1,771,411	660.6	1.0	1.0	1.0	82.1	90.0	Fixed direction
R	House (Permanent)	540,175	1,771,429	651.9	1.0	1.0	1.0	-82.7	90.0	Fixed direction
S	House (Permanent)	540,162	1,771,348	654.3	1.0	1.0	1.0	-103.2	90.0	Fixed direction
T	House (Permanent)	540,108	1,771,266	654.4	1.0	1.0	1.0	-111.4	90.0	Fixed direction

Calculation Results

Shadow receptor

		Shadow, worst case			**Shadow, expected values**
No.	Name	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
A	House (Permanent)	0:00	0	0:00	0:00
B	House (Permanent)	0:00	0	0:00	0:00
C	House (Permanent)	0:00	0	0:00	0:00
D	House (Permanent)	0:00	0	0:00	0:00
E	House (Permanent)	0:00	0	0:00	0:00
F	House (Permanent)	0:00	0	0:00	0:00
G	Temple	0:00	0	0:00	0:00
H	Shrine	0:00	0	0:00	0:00
I	House (Temporary)	0:00	0	0:00	0:00
J	Bus Stop	0:00	0	0:00	0:00
K	House (Permanent)	1:22	36	0:03	0:30
L	House (Permanent)	0:57	21	0:04	0:22
M	House (Permanent)	1:07	23	0:04	0:26
N	House (Permanent)	1:09	22	0:05	0:26
O	House (Permanent)	0:35	12	0:04	0:15
P	House (Permanent)	0:36	11	0:05	0:16
Q	Cabin (Stone Quarry)	142:04	127	1:26	61:59
R	House (Permanent)	89:37	99	1:10	40:16
S	House (Permanent)	112:47	130	1:10	41:36
T	House (Permanent)	86:36	97	1:02	23:35

Total amount of flickering on the shadow receptors caused by each WTG

No.	Name	Worst case [h/year]	Expected [h/year]
GBK01	GAMESA G97 2000 97.0 !O!	0:00	0:00
GBK02	GAMESA G97 2000 97.0 !O!	0:00	0:00
GBK03	GAMESA G97 2000 97.0 !O!	0:00	0:00
GBK04	GAMESA G97 2000 97.0 !O!	0:00	0:00
GBK05	GAMESA G97 2000 97.0 !O!	0:00	0:00
GBK06	GAMESA G97 2000 97.0 !O!	0:00	0:00
GBK07	GAMESA G97 2000 97.0 !O!	0:00	0:00
GBK08	GAMESA G97 2000 97.0 !O!	0:00	0:00
GBK09	GAMESA G97 2000 97.0 !O!	0:00	0:00
GBK10	GAMESA G97 2000 97.0 !O!	0:00	0:00
GBK11	GAMESA G97 2000 97.0 !O!	0:00	0:00
GBK12	GAMESA G97 2000 97.0 !O!	0:00	0:00

To be continued on next page...

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SHADOW - Main Result

Calculation: Shadow - Real Case Scenario

...continued from previous page

No.	Name	Worst case [h/year]	Expected [h/year]
GBK13	GAMESA G97 2000 97.0 !O!	0:00	0:00
GBK14	GAMESA G97 2000 97.0 !O!	0:00	0:00
GBK15	GAMESA G97 2000 97.0 !O!	0:00	0:00
GBK16	GAMESA G97 2000 97.0 !O!	0:32	0:10
GBK17	GAMESA G97 2000 97.0 !O!	0:44	0:15
GBK18	GAMESA G97 2000 97.0 !O!	0:48	0:21
GBK20	GAMESA G97 2000 97.0 !O!	0:00	0:00
GBK21	GAMESA G97 2000 97.0 !O!	0:00	0:00
GBK22	GAMESA G97 2000 97.0 !O!	0:00	0:00
GBK23	GAMESA G97 2000 97.0 !O!	0:00	0:00
GBK24	GAMESA G97 2000 97.0 !O!	0:00	0:00
GBK25	GAMESA G97 2000 97.0 !O!	0:00	0:00
GBK26	GAMESA G97 2000 97.0 !O!	0:00	0:00
GBK27	GAMESA G97 2000 97.0 !O!	0:00	0:00
GBK29	GAMESA G97 2000 97.0 !O!	0:00	0:00
GBK30	GAMESA G97 2000 97.0 !O!	399:25	156:11
GBK31	GAMESA G97 2000 97.0 !O!	0:00	0:00
GBK36	GAMESA G97 2000 97.0 !O!	0:00	0:00

Total times in Receptor wise and WTG wise tables can differ, as a WTG can lead to flicker at 2 or more receptors simultaneously and/or receptors may receive flicker from 2 or more WTGs simultaneously.

Annex G

Shadow – Calendar Graphical

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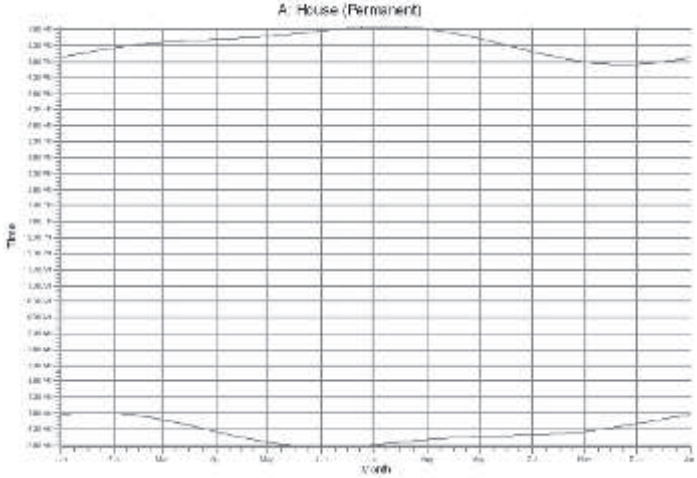
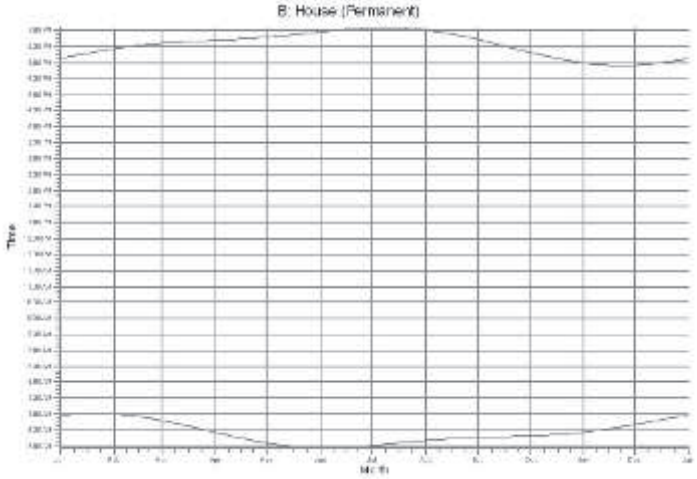
SHADOW - Calendar, graphical

Calculation: Shadow - Real Case Scenario

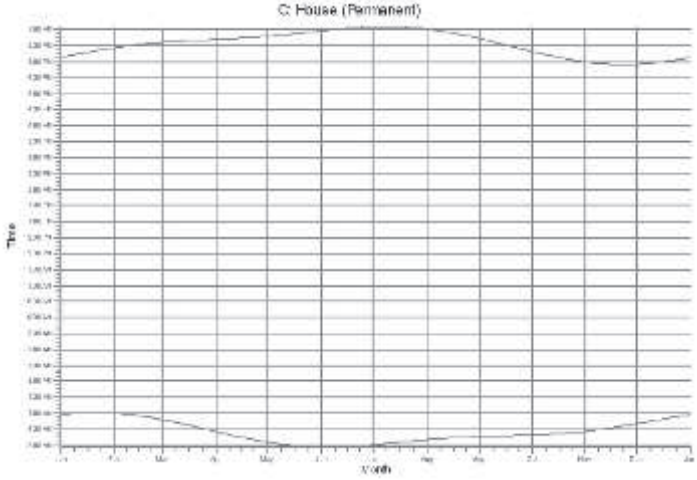
A: House (Permanent)



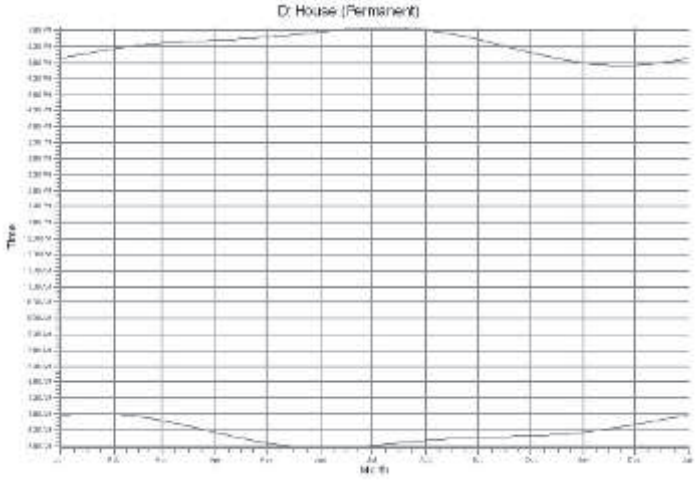
B: House (Permanent)



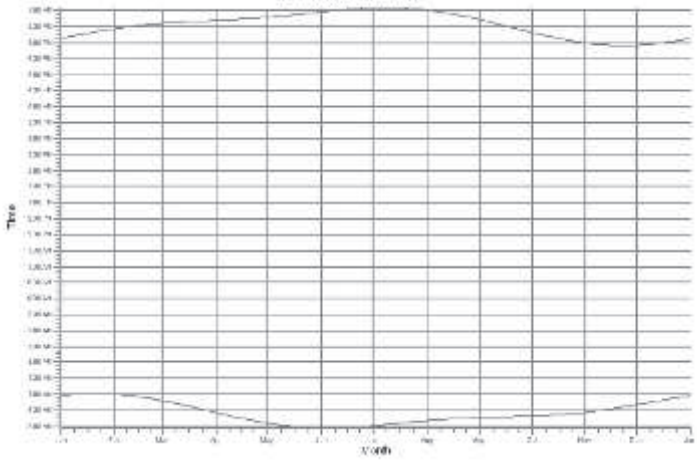
C: House (Permanent)



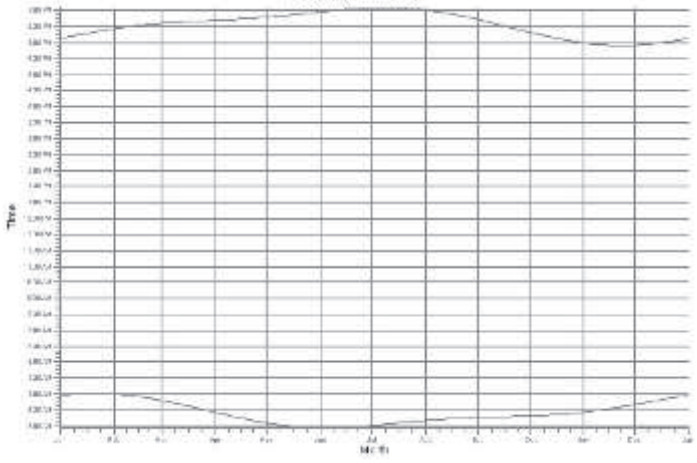
D: House (Permanent)



E: House (Permanent)



F: House (Permanent)



WTGs

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Calculated:
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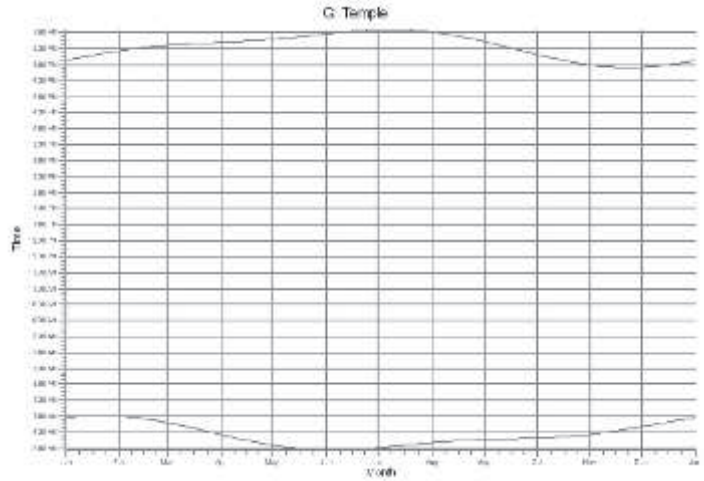
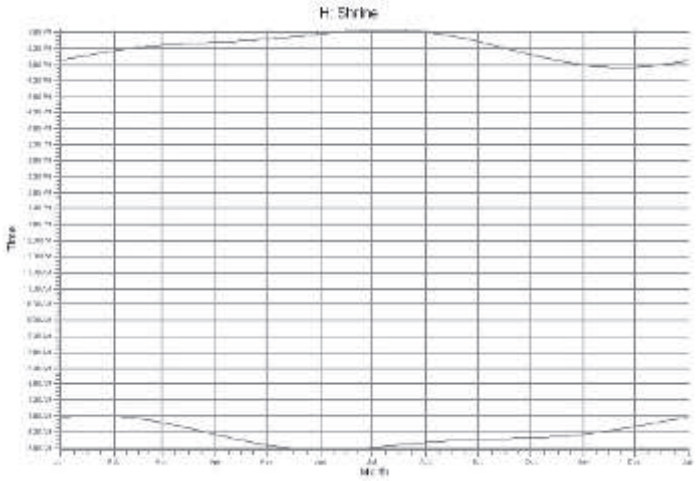
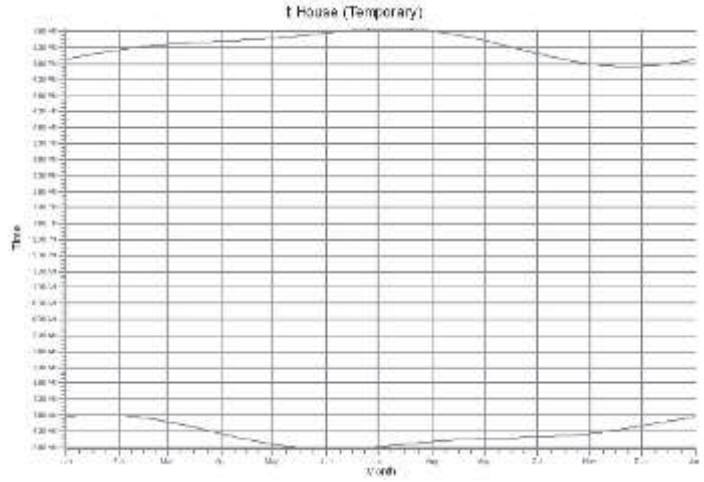
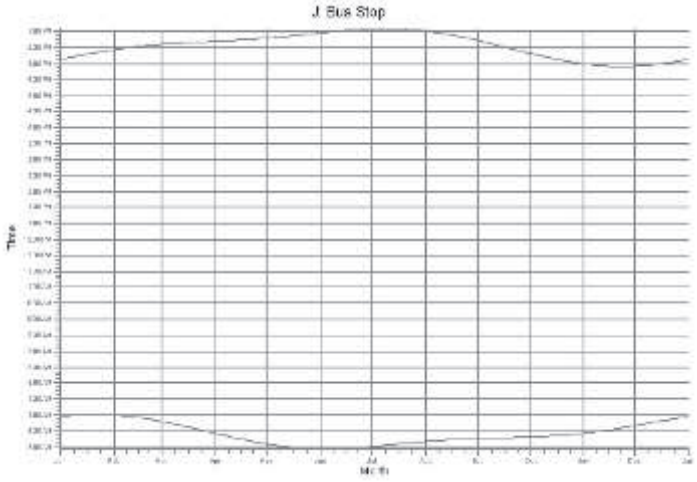
SHADOW - Calendar, graphical

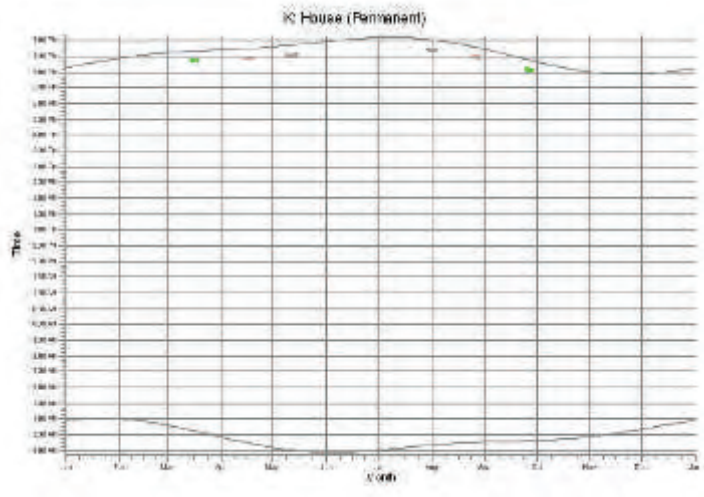
Calculation: Shadow - Real Case Scenario

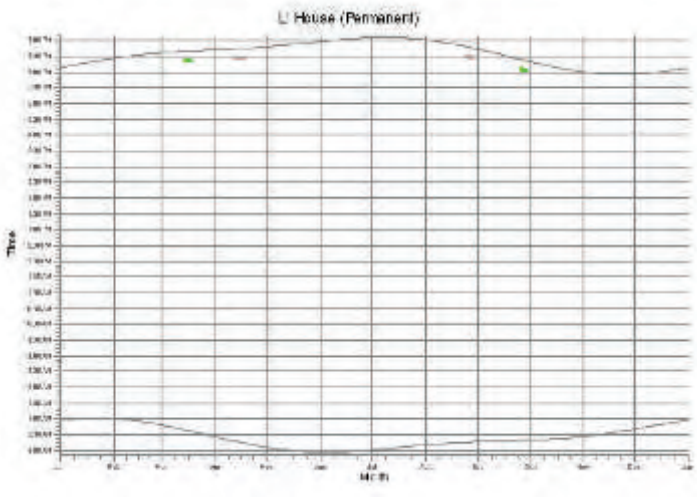












WTGs

GBK16: GAMESA G97 2000 97.0 !O! GBK17: GAMESA G97 2000 97.0 !O! GBK18: GAMESA G97 2000 97.0 !O!

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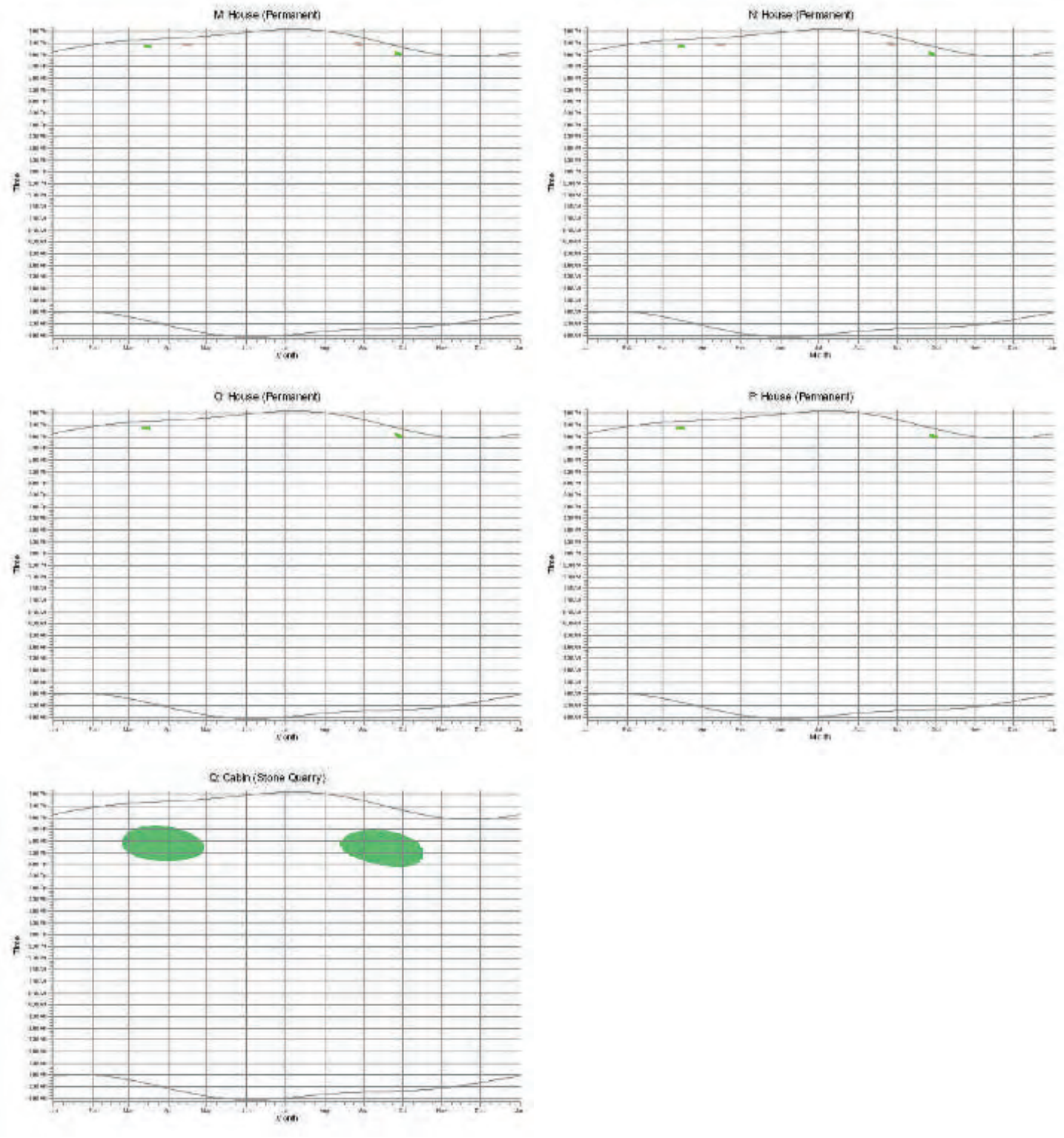
SHADOW - Calendar, graphical

Calculation: Shadow - Real Case Scenario



WTGs

GBK17: GAMESA G97 2000 97.0 !O!

GBK18: GAMESA G97 2000 97.0 !O!

GBK30: GAMESA G97 2000 97.0 !O!



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