Environment and Social Impact Assessment Report

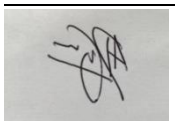
40 MW Operational Solar Power Project, Sindhanur, Karnataka

Hero Future Energies Private Limited

September 2019

Hero Future Energies Private Limited
3rd Floor,
Plot 201 Okhla Industrial Estate, Phase III,
New Delhi 110020

Quality information

Prepared by	Checked by	Verified by	Approved by
			
Nishu Goel Environment Consultant	Susan Vauquelin Senior Consultant	Susan Vauquelin Senior Consultant	Chetan Zaveri Executive Director, Environment
			
Prajakta Pathare Shivaji Ecological Consultant	Deepti Bapat Associate		
			
Susan Vauquelin Senior Consultant			
			
Aditi Deopujari Senior GIS Consultant			

Revision History

Revision	Revision date	Details	Authorized	Name	Position
00					

Distribution List

# Hard Copies	PDF Required	Association / Company Name
00		

Prepared for:

Hero Future Energies Private Limited
3rd Floor,
Plot 201 Okhla Industrial Estate, Phase III,
New Delhi 110020

Prepared by:

AECOM India Private Limited
19th Floor
Building No.5
Tower C
Cyber City
Gurgaon 122002
Haryana
India

CIN: U74210KA2005PTC037770

T: +91 124 4682700/800
aecom.com

1. Table of Contents

2. Figures

3. Tables

1. Introduction

1.1 Project Overview

M/s Clean Solar Power (Gulbarga) Private Limited (hereinafter referred to as 'CSPGPL'), a Special Purpose Vehicle of Hero Future Energies Pvt. Ltd. (hereinafter referred to as 'HFE') has developed a 40 MW Solar Power Project (hereinafter referred to as 'Project') spread across two Talukas/ Sub-Districts namely, Sindhanur and Lingsugur[1] of Raichur District, Karnataka, India.

As per the Power Purchase Agreement (PPA) signed between CSPGPL and Solar Energy Corporation of India Limited (hereinafter referred to as 'SECI') dated 2nd August 2016, the switchyard has been connected to capacity of 110/33/11 kV grid substation at Turvihar in Gulbarga District, Karnataka under Gulbarga Electricity Supply Company Limited (GESCOM).

1.2 Background and Rationale of the Study

AECOM India Pvt. Ltd. (hereinafter referred to as 'AECOM') understands that HFE intends to invest in the solar power project with financial assistance from international lenders/ multilaterals. In this context, the project requires evaluation of Environmental and Social risks associated with its operations. Evaluating such risks will help determining mitigation measures to avoid adverse impacts identified as part of the study.

As HFE is seeking project finance from international lenders, it is required to comply with the applicable International Finance Corporation (IFC) guidelines relating to Environment, Social and Occupational Health and Safety aspects, in addition to regional and national laws and regulations.

HFE has commissioned AECOM to undertake an Environment and Social Impact Assessment (ESIA) in order to meet requirements as per the following reference framework:

- Applicable national, state and local regulatory requirements;
- IFC Sustainability Framework and performance Standards (2012);
- IFC/World Bank General EHS Guidelines
- IFC/World Bank EHS Guidelines for Electric Power Transmission and Distribution (2007).

1.3 Objective and Scope of Work

The scope of work for the ESIA broadly includes the following,

1.3.1 Defining the Project/Project Description

The project information includes providing project description with focus on understanding the environmental and social setting and sensitivities for the solar power project. This also includes any associated facilities that may be required (e.g., access roads, transmission lines, etc.). Also, description of the larger setting in which the project is located.

1.3.2 Outlining Policy, Legal, and Administrative Framework

Discussing the policy, legal and administrative framework within which the assessment is carried out, including host country regulations, obligations under relevant international social and environmental treaties, agreements, and conventions, IFC Performance Standards and subsequently reviewing the Social and Environmental compliance requirements against afore mentioned requirements.

[1] It is to be noted that the project area villages of Gadratigi and Talekat were under the administrative jurisdiction of Sindhanur and Lingsugur, however, in January 2019, the jurisdiction of these villages have come under the purview of Maski Taluka (Sub-District). As this has been a recent change, all data pertaining to the baseline chapter have taken into consideration the previous Talukas as all Government data relate to the old Talukas.

1.3.3 Generating Baseline Data

Collecting and generating relevant baseline social and environmental data (primary & secondary) relevant to decisions about project location, design, operation, or mitigation measures. The baseline data generation is specifically focused on issues around a) cumulative impact assessment due to operation of existing solar power projects in the vicinity of the project, if any, b) traffic, c) water- its quality, availability and adequacy vis-à-vis the requirements during different operation phase of the project life cycle, d) land and land use e) ecology/ biodiversity, f) physical or cultural heritage (if any), g) other environmental sensitivities like wetlands, forests etc. Review of the land purchase process to assess any legacy or current/existing issues (like informal settlers, livelihood dependence, other usage etc.) on the purchased land is also assessed.

1.3.4 Consultation

Consultation with land sellers and representative of the local governing institution was carried out to review land procurement and compensation process and assess compliance to IFC PS 5 standards.

1.3.5 Assessing Social and Environmental Impacts and Mitigation Measures

Evaluating potential Environment and Social impacts of the Project and its components (including associated facilities like transmission line, access roads etc. as per the details available) and developing mitigation measures and plans to maximize project benefits in consultation with affected communities including, potential assessment of Cumulative impacts (linked to development or other solar projects), if relevant and as appropriate.

The impact assessment will identify mitigation measures for any residual negative impacts that may not be mitigated and also evaluate impacts and risks from associated facilities and other third party activities.

1.3.6 Analysing Alternatives

Comparing reasonable alternatives against project site, technology, design, and operation in terms of their potential social and environmental impacts is to be undertaken. The feasibility of mitigating these impacts, capital and recurrent costs, suitability under local conditions, and institutional, training, and monitoring requirements also has been considered. The resultant alternative will state the basis for selecting a particular site and project design by justifying recommended approaches to pollution prevention and abatement.

1.3.7 Providing Management Program

The final step includes formulating management plan for mitigation of impacts as identified during assessment. This also entails developing Environmental and Social Management Plan (ESMP) based on the ESIA and procedures development for mitigation and monitoring of environment and social impacts on an ongoing basis and to identify any impacts/mitigation requirements that may occur subsequent to the completion of the ESIA.

Where the client identifies measures and actions necessary for the project to comply with applicable laws and regulations and to meet the Performance Standards, the management program will include an Action Plan, which is subject to be implemented by the Client.

1.4 Limitations

The ESIA study of the project is limited to project information made available by the client, discussion with HFE and other contractor staff, primary monitoring, secondary data collected, consultation with local community and observations made during site survey. Professional judgement and interpretation of facts has been applied for presenting inference from the collected information.

1.5 Layout of Report

The report structure is outlined in the following manner:

- Chapter 2 – outlines Project Description

- Chapter 3 – outlines Environmental and Social Regulatory Framework
- Chapter 4 – outlines Environmental and Socio-Economic Baseline
- Chapter 5 – outlines Alternatives that may be considered for the project
- Chapter 6 – describes Impacts associated with the project
- Chapter 7 – presents the Environmental and Social Management Plan
- Chapter 8 – describes the Project Categorisation and Concluding Remarks

2. Project Description

This section of the report provides a description of the site settings and project components along with other associated facilities. This section also elaborates on project phases along with its implementation mechanism and schedule.

2.1 Site Settings

The project site is spread across two villages namely, Gadratigi and Talekat villages in Sindhanur and Kingsugur Talukas of Raichur District, Karnataka. The nearest highway to the site is the State Highway (SH) – 14, which connects Ramdurg with Manvi via Badami, Pattadakal, Hulgund, Neeralakeri, Mudagal, Maski, Basapura, Pothanal and Chikalaparvi and is located at a distance of 8 km from the site towards the north direction. The site can be accessed through the 1 km long unpaved access road to site connected to village Taluka road of Talekat village which further connects to Bappur – Sindhanur road. The site is located at a distance of 24 km from Sindhanur and 92 km from Raichur. Hyderabad airport is the nearest airport at a distance of 300 km from the Site. ***Figure 2-1*** below presents the site location of the solar power project.

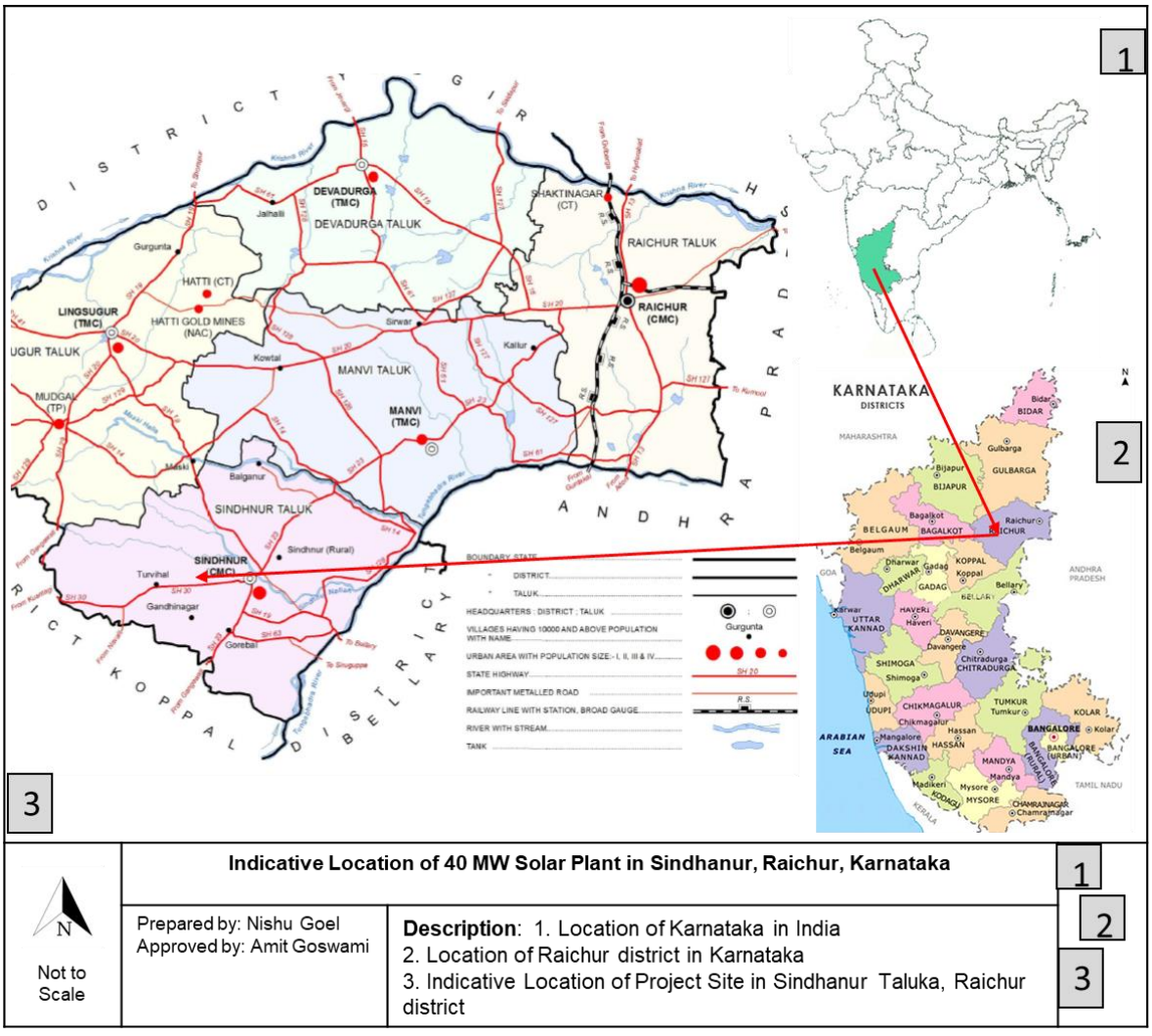


Figure 2-1: Indicative Location of 40 MW Solar Project in Sindhanur & Lingsugur, Raichur District in Karnataka

The site selected for the project comprises of private agricultural land from Gadratigi and Talekat villages of Sindhanur and Lingsugur Talukas which has been identified based on the solar irradiation data, geotechnical

investigations, ease of land procurement, benefit and losses due to irradiation, shading analysis, distance from main substation, line construction length and complexity required for line construction. The average global horizontal irradiation in the region is in the range of 1900 kWh/m^2 to 2050 kWh/m^2. This irradiance is generally suitable for reasonably good energy generation.

The site area comprises of privately-owned agricultural land which is characterised by mainly black cotton soil. The project site is slightly undulating and has an average elevation of about 454 metres above mean sea level (amsl). As informed, site area was previously used for rain-fed agriculture. The site comprises of scanty vegetation in form of shrubs and grasses. The site entry is through south side from 3 m wide access road connecting to Talekat village road which runs parallel to the site followed by an internal road in the site. The project is spread over 237.27 acres of land and is divided into two (02) zones with 50% of project land falling under Gadratigi village and 50% land in Talekat village. Zone 1 (70 acres) and Zone 2 (160 acres) are connected by a Panchayat Taluka unpaved road leading to Talekat village. Three land parcels admeasuring 15 acres are present between Zone 1 and Zone 2 at the site which could not be procured for the project as the landowners were not willing to sell their land parcels. A temple which was redeveloped by CSPGPL is present near the site boundary on the Village road for which land measuring 5 Guntas was purchased. Approximately 50% of the project land was previously used for rain-fed seasonal cultivation of Toor dal (*Cajanus cajan*) and Jowar (*Sorghum*) and 50% of land was barren prior to the construction of the project. Grazing by livestock was observed in land adjoining to the project site as the area was noted to be open and spread across barren fields.

A natural seasonal drain passes through the site. Three (03) culverts have been constructed at the site to maintain the drainage of the site and three (03) more culverts are proposed to be constructed near the site boundary and at the site. Three (03) existing rain water harvesting ponds were noted to be present at site which is proposed to be used for collecting rainwater for domestic usage at site in future.

Bagalapur village (a village of ~50 households) under Sindhanur Taluka is the nearest habitation located at an aerial distance of about 800 m from the site in eastern direction. Gadratigi village is at an aerial distance of 900 km in south direction and Talekat village is at a distance of ~2 km aerial distance in north-west direction from the site. There are no industries within 5 km radius of the project site. The physical features located near the Project site are represented in ***Figure 2-2.***

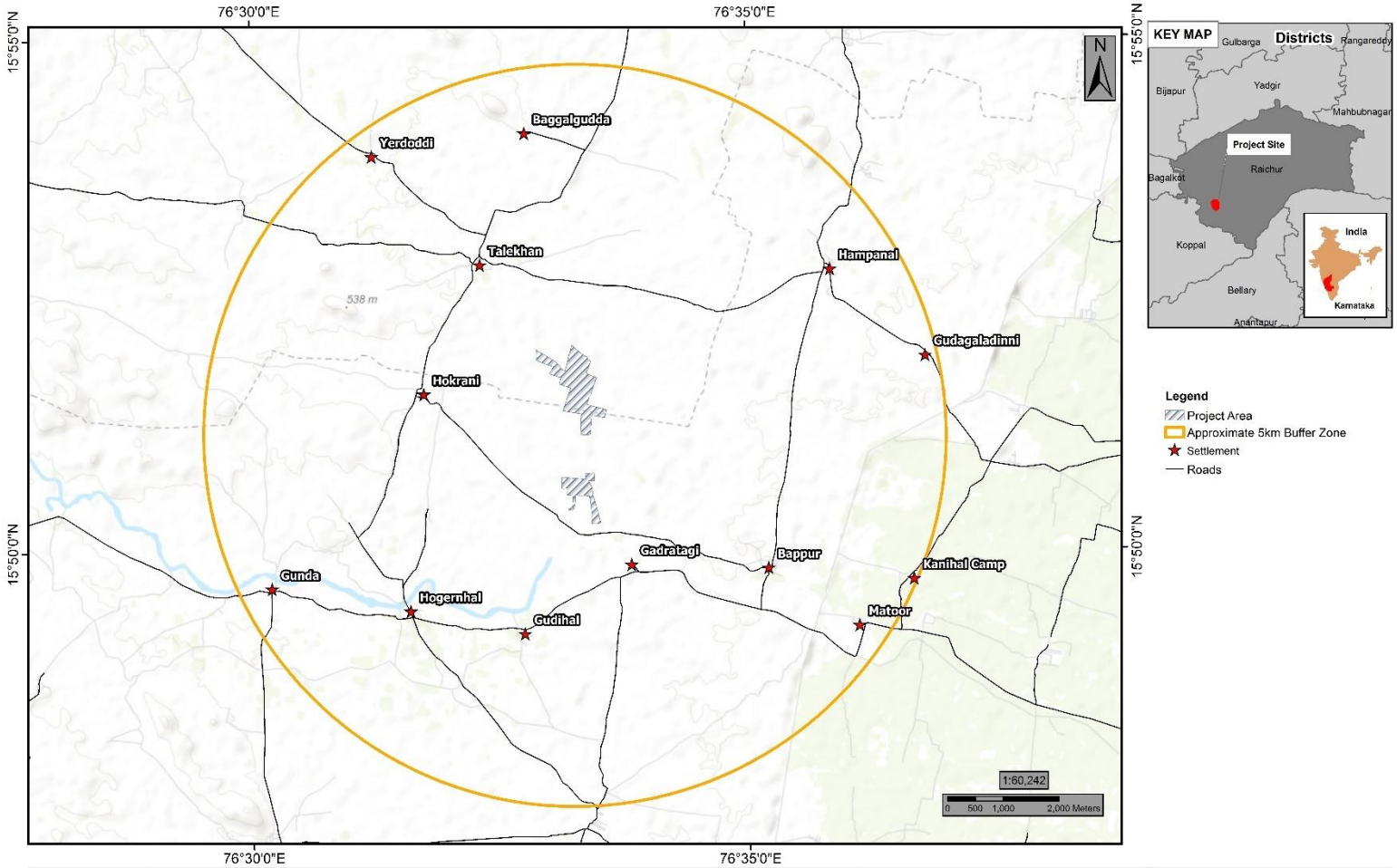


Figure 2-2: Physical Features of Project Area

2.2 Project Schedule

CSPGPL had conducted site assessment based on solar radiation data available, identification of land and land procurement for the project. After hand over of land, CSPGPL had performed site clearing works and soil testing works to monitor the soil quality of the project site. CSPGPL had engaged M/s L&T Construction as EPC (Erection, Procurement and Construction) contractor on turnkey basis for provision of construction works pertaining to the project. The works comprised of carrying out geotechnical investigations, foundation works, installation of switch yard, array yard installation, SCADA system, inverter modules and equipment installation. CSPGPL had also engaged M/s Sri Vinayaka Surveyors to undertake survey of transmission line, assessment of land required for construction of transmission poles and execution of works for installation of one (01) number of 110 kV bay at 110/ 33 kV Turvihar Grid Sub- Station of Gulbarga Electricity Supply Company Limited (GESCOM). The construction work for the project as informed by the site representative started in November 2017 and the project was commissioned in March 2018.

CSPGPL has entered into a Separate Operations and Maintenance (O&M) Agreement with M/s Ritis Meera Infra Energy LLP for O&M of the project.

2.3 Current Status of Project

The 40 MW solar plant was informed to be spread over 237.27 acres of land and is divided into two (02) zones. The project was observed to be in Operational Phase on the day of Site Visit in March 2019 with construction work for the project ~90% completed. The construction of internal roads, site boundary and street light installation was noted to be under progress at site and was informed to be completed by April 2019. It was informed by the site personnel that the drainage work is yet to be initiated at the site and will be undertaken before the onset of monsoon (June—July).

The power plant is divided into ten (10) blocks with four (04) invertors of capacity 4.4 MW in each block. The power generated from the plant is being evacuated at Turvihar substation of Gulbarga Electricity Supply Company Limited (GESCOM). Forty—seven (47) transmission towers of height ~76 m have been installed for transmission of power through transmission line. Four (04) watch towers are also present at the site.

Eleven (11) employees of M/s Ritis Meera have been engaged at the site for O&M phase of the project which include Site technicians and Site Engineers for management and maintenance of the project. Additionally, one (01) Site In charge of HFE has been deployed at the site for overall management of the project. At present, fifteen (15) technical employees of the EPC contractor along with Managers, Administrative staff, Store manager have been engaged at the site for completion of remaining construction works and twenty-seven (27) security guards have been deployed through engagement of a security agency, M/s Top Crew Security Agency at the site. One (01) armed guard has also been deployed through M/s Ritis Meera for security services at the site.

One (01) site office has been constructed at site for operation and management of the plant with Main Control Room (MCR), SCADA system and a meeting room. The Site office has also been provided with one (01) pantry, one (01) store room and two (02) washrooms. It was reported that the Site Management has an agreement with the government hospital in Turvihar for any medical emergency, including emergency situations. Two (02) anti-venoms have been provided at site in case of snake bite.

	
Solar Panels installed at the site	*Boundary wall work in progress at site*
	
Rain water harvesting pond at site	*Solid waste placed in demarcated area at the site*
	
Unpaved road between Zone I and II	*Access road to the site*

2.4 Project Components

The 40 MW (AC) solar power project is based on crystalline silicon (c-Si) Solar Photo Voltaic technology using Module Make Talesun (320Wp and 325 Wp) Model no- TP 672P and Trina Solar (320Wp and 325 Wp) Model no- TSM-320PD-14 which are Poly Crystalline Silicon Modules with 72 cells each for power generation. The energy generated is being evacuated at the 110 KV utility substation of GESCOM located at Turvihar Village. The length of the 110KV Single circuit (SC) transmission line between power plant and utility substation is ~ 12.3 km. The plant is expected to generate energy about 76 KWh in the first year of operation. The salient features of the project components have been presented in ***Table 2-1*** below and the details have been provided in subsequent sections. The array layout of the facility (Zone 1) has been presented in ***Figure 2-3.***

Table 2-1: Technical Details of PV Power Plant

Parameter	Make
Solar PV Modules -320/325 Wp	Trina/Talesun (34293/96138)
Module mounting structure	HFE Design
Grid interactive inverter	SMA Sunny Central 1000CP XT
String Combiner Box (SCB)	Statcon (241 number)
Cables as per design DC	KEC
Cables as per design AC	KEC
Invertors Capacity AC/DC	1122/1100
Number of Blocks	10
Number of Invertor	40
Invertor Transformer Make	Toshiba (4.4 MVA)
Invertor Block	Capacity: 4.4 MW 4 Invertor/Block
Substation: Transformer, CTs, Pts, isolators, circuit breakers, surge arrestors	Siemens
Outdoor HT Panel make and Rating	ABB (12 KV)
Lightning arrestor	Jef/Sabo/equivalent (53 number)
Earthing pit	Jef/Sabo/equivalent (220 number)
Tracker	MSAT (Mahindra) Single Axis

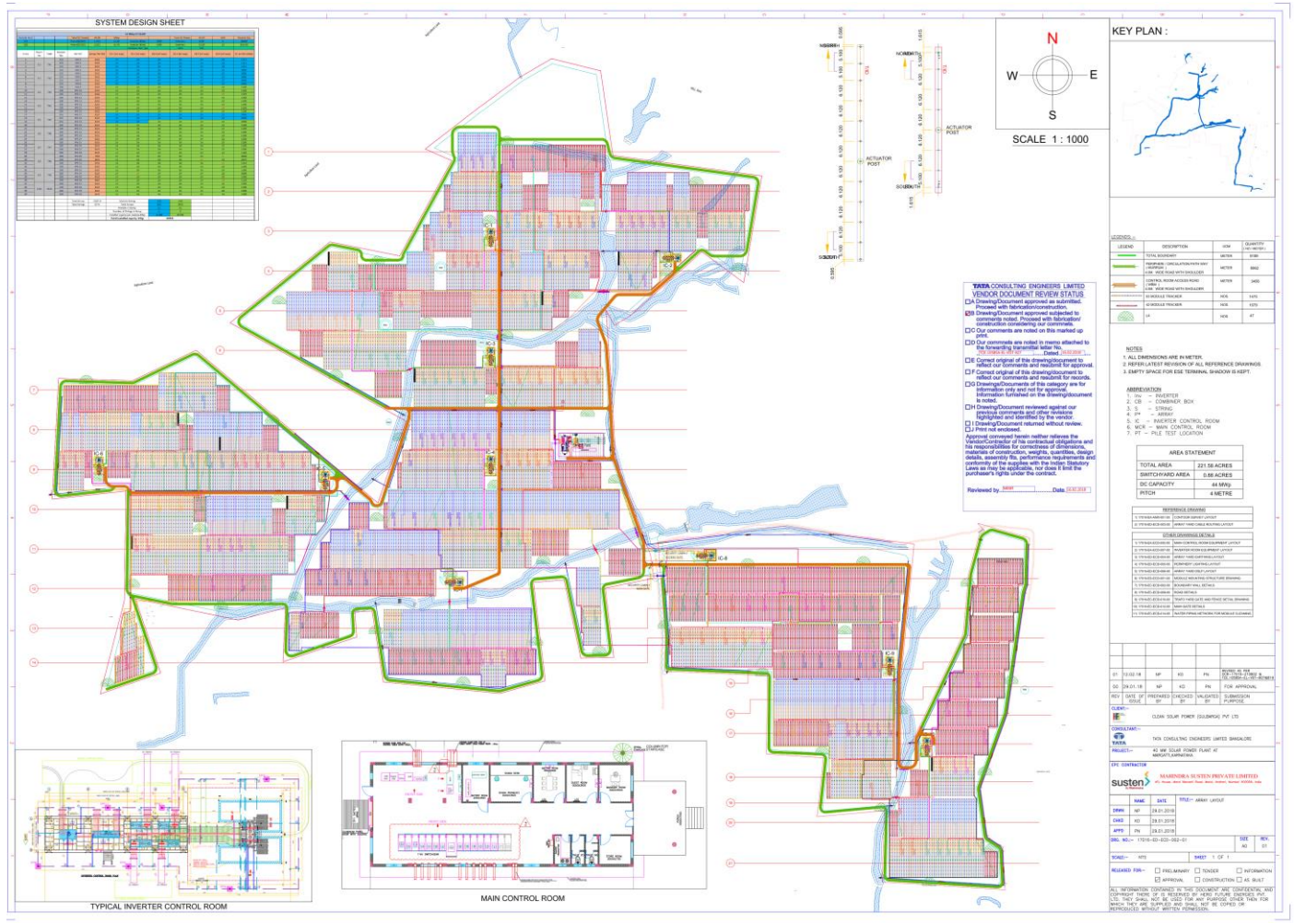


Figure 2-3: Array Layout of 40 MW PV Power Plant, Sindhanur

2.5 Technical Details of the PV Modules

2.5.1 DC Components

PV Module

All solar PV modules mandatorily have to adhere to IEC specifications given in IEC 61215 for Crystalline Silicon modules. The solar PV modules, utilized for the project, must be tested and certified by an independent international testing laboratory. For optimum energy generation, Crystalline Silicon 320 and 325 Wp modules of Talseun and Trina Solar have been chosen for this project.

Module Mounting Structure

Single axis tracking ground mounted structures have been used for this project. Each of this structure can support 21 modules. The structure is made of galvanized steel profiles and is inclined (-45 to +45) degree to horizontal. PV modules are directly mounted on the module support members. The aluminum frame of each solar module is galvanically isolated from the steel supporting beam to prevent localized corrosion and high-quality stainless-steel fixings which are used throughout.

The mounting structure is designed for holding the designed number of modules in series. The frames and leg assemblies of the array structures are made of structural steel sections. The composition of steel conforms to IS 2062, suitable for welding purposes.

The structure has been designed to allow easy replacement of any module. It shall support solar PV modules at a given orientation, absorb and transfer the mechanical loads to the ground properly. The legs of the structures with appropriate strength are fixed in the foundation columns as per design based on site soil condition.

Inverters

Inverters/ Power Conditioning Units (PCU) act as the interface between the PV array and the Grid. As the PV array output varies with the solar radiation the inverter has to effectively interface with the grid to remain synchronized. Main functions of Inverters are:

- Convert the incoming DC received from PV modules into AC with suitable power quality.
- The inverter also has to act as a protective device of the system. It needs to trip if the voltage, current or frequency goes outside acceptable ranges

For the current project, a 1100/1122 kW AC/DC SMA Sunny Central make inverter (three phases with compact and weatherproof enclosures for indoor use) has been selected.

2.5.2 AC Components

The AC subsystem commences from the output of the inverters and comprises of the transformers, the associated switchgear, metering and protection circuits and terminates at the two-pole structure from where the transmission lines would start.

Transformer

Each Inverter transformer will be 3 phases of 4.4 MVA capacity. The transformer steps up the inverter transformer output of 365 V to 465 V.

Cables

The cables used for this connection will be cross-linked polyethylene insulated and as per standards IS-7098-part I.

HT Panel

The HT panel is an interface between the transformers and grid providing the protection required for the system. HT panel shall consist of VCB and the associated C & R Panel for each PV quadrant. VCB shall conform to IEC-

62271-100. The switchgear will contain all equipment viz. Circuit breakers, CTs, PTs, relays and associated equipment.

Metering

The metering arrangement will be compatible with the Availability-Based-Tariff (ABT) mechanism along with a check meter with Modbus arrangement and facility to provide remote monitoring. The meter will have web communication facility and will be visible at the State Load Dispatch Centre (SLDC).

2.5.3 Civil Structures

Inverter room and Control Room

The inverter rooms are pre-fabricated FRP structures and control room is the standard RCC framed structures.

Boundary Wall

The complete plant boundary covering module yard, control room, switchgear room and switch-yard, security cabin, etc. will be provided with a compound wall made of pre-cast slabs.

Security Cabin

The security cabin made of FRP (Fiber-reinforced plastic) is provided near the site entry gate.

Transformer Foundation

The power transformer has been placed on gravel filled foundation if placed on the ground/ raised foundation.

Pile Foundation

Pile foundation design depends on soil conditions, geographical condition, regional wind speed, bearing capacity, slope stability, etc.

Internal Roads

Internal roads have been developed for the project site which is approximately 3 m in width. Peripheral roads around the boundary shall be WBM road as per IRC 37 with at least 4 m width.

2.5.4 Earthing

There is dedicated earthing stations for transformer, MV switch boards and high voltage panels. Maintenance free earthing stations are considered preferable for the design due to long-term trouble-free performance in comparison to conventional pipe earthing. All the modules have been appropriately earthed in accordance to the NEC (National Electrical Code). Grounding of the modules has been done as recommended by manufacturer. A total of 227 earth pits have been provided at the site in order to limit the grid resistance to below 1 ohm.

2.5.5 Lighting and Over Voltage Protection

The MV stations comprising of transformers, inverters, etc. have been provided with adequate lightning protection. Similarly, the entire main control room building, and four pole structure arrangement has been protected as per IS standards.

Necessary concrete foundation for holding the lightning conductor in position has been made after giving due consideration to the maximum wind speed and maintenance requirement at site in future. Each lightning conductor is fitted with individual separate earth pit as per required Standards including accessories and provided with iron cover plate having a lock arrangement, watering pipe using charcoal or coke and salt as per required provisions of Indian Standards (IS). A total of 50 Lightning Arrestors have been provided at the site.

2.5.6 Supervisory Control and Data Acquisition (SCADA) System

The entire solar PV power plant has been integrated with Supervisory Control and Data Acquisition (SCADA) system which communicates with all the inverters and monitoring boxes (SMB) for displaying parameters

mentioned below. The integrated SCADA has the feature to be used either locally via a local computer or also remotely via the Web using either a standard modem or a GSM / WIFI modem and broadband. SCADA have provision of tracking the status of breakers and relays. Following parameters are shown in the SCADA system:

- Data from weather station;
- PV module back surface temp;
- Line and phase currents;
- Cumulative energy exported;
- Power at 110 kV terminal;
- AC and DC side power of each inverter;
- Voltage of the HT Side; and
- Current and voltage of each sub-array/string.

2.5.7 Access Roads

The site can be accessed through the south direction from a 3m wide access road connecting Talekat village road which runs parallel to the site. The approach road branches off from the Taluka Road connecting Bappur village to Talekat village and leads to the site which further connects as a shortcut to Talekat village. The site is located at a distance of 24 km from Sindhanur and 92 km from Raichur city.

2.5.8 Power Evacuation

Power from the solar PV plant is being evacuated to the 110/33/11 kV grid substation at Turvihar with terminal bay along with the required matching control equipment at both ends of the lines as per the technical specifications and layout approved by KPTCL. The Turvihar sub-station is located at a distance of about 16 km from the site. CSPGPL has already received approval dated 21th March 2017 for construction of 110 kV line of ~16 km length with Lynx ACSR Conductor from project site to 110/33/11 kV substation of GESCOM. According to the approval obtained, CSPGPL was required to purchase land adjacent to Turvihar Sub-Station of Gulbarga Electricity Supply Company Limited (GESCOM) for construction of 110 kV TB with metering and shall hand over the land along with 110kV TB to GESCOM for maintenance.

The metering required for power purchase is done at the utility substation end. The Power Purchase Agreement is signed for 25 years.

2.6 Resource Requirement

2.6.1 Manpower Requirement

2.6.1.1 Construction Phase

Through documents reviewed and discussions held with the EPC representatives during the site visit, it was noted that there were ~300 skilled and unskilled labours during peak time period required for the construction phase works. The EPC, L&T sourced labour for civil works from M/s FK Associate wherein approximately 60 labourers, M/s Namaza Constructions wherein approximately 35 labourers and M/s SD Constructions were approximately 35 labourers; M/s KCC with 40 labourers, M/s Future with 50 labourers and M/s RSB with 50 labourers were sourced from both local and outside areas of the State. A labour accommodation was provided to the labourers adjacent to the project area, reportedly which was already dismantled and removed on the day of the site visit.

2.6.1.2 Operation Phase

Eleven (11) employees of M/s Ritis Meera have been engaged at the site for O&M phase of the project which include Site technicians and Site Engineers for management and maintenance of the project. Additionally, one (01) Site In charge of HFE has been deployed at the site for overall management of the project. At present, fifteen (15) technical employees of the EPC contractor along with Managers, Administrative staff, Store manager have

been engaged at the site for completion of remaining construction works and twenty-seven (27) security guards have been deployed through engagement of a security agency, M/s Top Crew Security Agency at the site. One (01) armed guard has also been deployed through M/s Ritis Meera for security services at the site.

2.6.2 Water Requirement

2.6.2.1 Construction Phase

Water for construction phase (including water for construction activity and domestic and drinking water requirement for workers) was sourced through the three (03) existing dug wells at the site and water tankers procured by the EPC contractor sourced through authorized vendors to meet the water demand for the project.

2.6.2.2 Operation Phase

The water requirement for the plant during operation phase will be predominantly for washing of solar PV modules periodically to remove bird droppings, dust and other dirt. Assuming a minimum of 1 litres of water per module, the water requirement for cleaning the whole plant (i.e. 1,30,431 modules) will be approximately 150-200 kilo litres, at one time. With a cleaning schedule of twice a month, it is estimated that approximately 300-400 kilo litres of water will be required for cleaning purpose on monthly basis and the requirements will be met through the dug wells present at the site. Five (05) aboveground tanks of capacity, i.e. three (03) tanks for RO treated water of capacity ~12 KL and two (02) tanks of capacity 50 KL and 12 KL each for raw water have been constructed at the site, which will be filled by the water received from dug wells for module cleaning. A Reverse Osmosis (RO) plant of capacity 5000 L has been installed at site for treatment of ground water for module cleaning. Water for domestic purpose such as toilets and cleaning in the site office will also be sourced through dug well. Drinking water requirement at the site for operation phase is 60- 80L/day and is sourced through a RO plant in Sindhanur. Additionally, rainwater collected in the ponds at the site is proposed to be used for domestic purpose at the site.

2.6.3 Power Requirement

During the construction phase, power was sourced through five (05) Diesel Generator (DG) sets of capacity ~25-30 KVA. The DG sets were provided and maintained regularly on the site by the EPC contractor.

For operation phase, power requirement will be met through the power generated through the PV power plant. For backup purpose, a UPS of capacity 1000 KVA has been installed at site.

2.6.4 Land Requirement

A total land of ~237.27 acres of private land has been purchased by CSPGPL through a land aggregator, Mr. Raju Gowda based in Gulbarga who in turn engaged a local aggregator, Mr. Amresh Gowda of Gadratigi village to aggregate land from 37 titleholders from Gadratigi and Talekat villages for settling up of the solar power plant and its associated facilities such as internal roads, office buildings, switch yard etc. No Objection Certificate (NOC) has been obtained by CSPGPL from Boppur Gram Panchayat on 4th June 2018 for 50% of land coming under Gadratigi village and from Sindhanur Gram Panchayat for 50% of land under Talekhan village. For the external transmission line up to the Grid Sub Station of ~12.3 km comprising of 47 towers, ~500-700 sq. ft. has been used and a one-time compensation paid to the respective landowners.

2.6.5 Waste Generation

2.6.6 Waste Water

During construction phase, waste water was generated from the two (02) labour camps at the site. Adequate number of portable toilets was provided by the EPC contractor at site, reportedly and a septic tank with soak pit was provided for disposal of domestic waste water generated. Waste water from construction activity was limited to cleaning and washing activities.

During the operation phase, waste water will be limited to domestic waste water discharged from the site office. Two (02) number of toilets have been provided with a septic tank and soak pit of capacity ~12 KL for handling and disposal of waste water at the site.

2.6.7 Hazardous Waste

During construction phase, hazardous waste such as used oil from DG sets, oil-soaked cotton, oil lined containers, paints etc. were generated at the site. The Hazardous waste was disposed through a KSPCB authorized hazardous waste vendor, M/s KarRecycle Centre LLP within 90 days of generation.

During operation phase, no DG set has been installed at site and thus, the hazardous waste generation will be limited to used oil from transformer. The oil will be reused after filtration and the waste oil will be disposed through a KSPCB approved Hazardous waste vendor.

2.6.8 Solid Waste

Solid waste generation during the construction phase consisted primarily of scrapped building materials, excess concrete and cement, rejected components and materials, packing and shipping materials (pallets, crates, Styrofoam, plastics etc.) and domestic waste from the labour camp. The waste was disposed by the EPC contractor by following designated solid waste management practices.

During operation phase, the waste generated is limited to paper, plastic waste and food waste from the site office. The waste is collected in designated bins at site and disposed at a regular interval through municipal vehicle.

2.6.9 Operation and Maintenance

The solar photovoltaic system requires least maintenance among all power generation facilities due to the absence of fuel, intense heat, rotating machinery, waste disposal, etc. However, keeping the photovoltaic panels in good condition, monitoring and correcting faults in the connected equipment and cabling are still required in order to get maximum energy from the plant. The maintenance functions of a typical solar PV power plant can be categorized as given.

1) Scheduled or preventative maintenance – Planned in advance and aimed at preventing faults from occurring, as well as keeping the plant operating at its optimum level.
2) Breakdown maintenance – carried out in response to failures.

Maintenance Requirement

The main objective of the plant maintenance is to keep the plant running reliably and efficiently as long as possible. Efficient operation implies close control not only over the cost of production but also over the cost of maintenance. There are two components in maintenance cost: one is the direct cost of maintenance, (i.e. the material and labour), and the other is the cost of production loss.

Routine Maintenance

Several maintenance activities need to be completed at regular intervals during the lifetime of the system. The energy yield of the plant will be monitored using the remote data acquisition system connected to each inverter. Significant reduction in energy yield will trigger specific maintenance requirements, such as inverter servicing or module replacement. Typical activities required are described below:

1) ***General maintenance***: Vegetation will need to be cut back if it starts to cause a fire risk or introduce shading;
2) ***Modules***: Visual inspection and replacement of damaged modules will be required. Cleaning of the module glass surface during long dry periods may be considered. Module cleaning needs to be carried out periodically to remove dust, bird dropping etc.;
3) ***Wiring and junction box***: Visual inspection for corrosion, damage such as chafing and damage by rodents and birds and for overheating of cables and connections;
4) ***Inverter Servicing***: Inverter faults are the most common cause of system downtime in PV power plants and therefore, the scheduled maintenance of inverters should be treated as a centrally important part of the O&M strategy. The preventive maintenance of inverters includes visual inspection, cleaning/replacing cooling fan filters, removal of dust from electronic components, tightening of any loose connections etc.

Breakdown Maintenance

Breakdowns can occur due to lack of routine or preventive maintenance, bad climatic conditions, disturbance in utility grid etc. As breakdowns affect energy generation and hence revenue generation, these kind of faults needs to be immediately corrected. Breakdown can occur at any part of the system between solar PV modules to substation end.

2.6.10 EPC Contractors and Subcontractors

M/s L&T Construction was engaged for EPC (Erection, Procurement and Construction) contractor on turnkey basis for provision of construction works pertaining to the project. The works comprised of carrying out geotechnical investigations, foundation works, installation of switch yard, array yard installation, SCADA system, inverters modules and equipment installation. Approximately, 300 workers were engaged at site during peak construction phase wherein 100 workers were local people from nearby villages. Six (06) sub-contractors, i.e. FK Associates, Namaza Construction, SD Construction, KCC Construction, Future Construction, RSB Construction were engaged at the site during the construction phase for piling and structure work.

2.6.11 Monitoring and Reporting

It was informed by the site personnel that the Site In charge of O&M contractor is responsible for overall management of the project. Site technicians, Safety In charge, and Site engineer deployed at the site through O&M contractor report to the Site In charge. The O&M Site In charge reports to HFE Site In charge deployed at the site. HFE Site In charge was informed to be responsible to Health and Safety (H&S) aspects at the site and reports to the Head Chief Engineer at the Corporate O&M level of HFE. The Head Chief Engineer reports to the Project Head (Vice President) of HFE at Corporate Level.

For the operation phase of the Project, the following records are being maintained by O&M team at the site office;

- Data logging records for power generation, Solar Irradiation data, grid availability, machine availability, Machine breakdown, etc.;
- Daily and Monthly performance reports;
- Monthly meter reading for State Electricity Board;
- Record of accidents/incidents;
- Record of work permits;
- Records pertaining to Lock-out Tag-out of turbines/ transformers under maintenance;
- Records pertaining to EHS training of the staffs at site and training calendar for a year; and
- Quality check records of personal protective equipment (PPEs) at the site office.

3. Environment and Social Regulatory Framework

3.1 Introduction

This section highlights the environmental and social regulations applicable to the solar power project. The section broadly focuses on the institutional framework, applicable environment, health & safety and social legislative requirements, World Bank Operational Policies and IFC Performance Standards relevant to the Operational Project.

3.1.1 National and Regional Enforcement Authorities

In India, Ministry of New and Renewable Energy (MNRE) is the nodal agency to manage the upcoming solar power projects and the environmental aspects are governed by Ministry of Environment, Forests and Climate Change (MoEF&CC), Central Pollution Control Board (CPCB) Central Electricity Authority (CEA) and Central Electricity Regulatory Commission (CERC).

All the permissions and the approvals have to be taken from the concerned ministries, line departments and the local civic bodies for any upcoming project in India. The environmental and social governance approach in the country consists of –

1. Regulatory and implementing entities;
2. Legal framework including policies, acts and laws; and
3. Permitting system.

Table 3-1: Enforcement Agencies and their Functions

S. No	Agencies	Description	Functions
1.	Ministry of Environment, Forest and Climate Change (MoEF&CC)	Nodal Agency for planning, promotion, co-ordination and overseeing the implementation of environmental and forestry policies and programmes	• Environmental policy planning; • Effective implementation of legislation; • Monitoring and control of pollution; • Environmental Clearances for industrial and development projects covered under EIA notification; • Promotion of environmental education, training and awareness; and • Forest conservation, development, and wildlife protection.
2.	Central Pollution Control Board (CPCB)	For the implementation of the Water (Prevention and Control of Pollution) Act, 1974	• Prevent pollution of streams and wells; • Advise the Central Government on matters concerning prevention, control and abatement of water and air pollution; • Co-ordinate the activities of State Pollution Control Board's (SPCB's) and provide them with technical and research assistance; • Establish and keep under review quality standards for surface and groundwater and for air quality; • Planning and execution of national programme for the prevention, control and abatement of pollution through the Water and Air Acts; and • The CPCB is also responsible for the overall implementation and monitoring of air and water pollution control under the Water Act, 1974, and the Air Act, 1981

S. No	Agencies	Description	Functions
3.	Karnataka State Pollution Control Board (KSPCB)	To implements various environmental legislations in the State of Karnataka, Such as Water (Prevention and Control of Pollution) Act, 1974; Air (Prevention and Control of Pollution) Act, 1981; some of the provisions under Environmental (Protection) Act, 1986 and the rules framed there under like, Biomedical Waste (Material and Handling) Rules, 2016; Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2016 and Solid Waste Management Rules, 2016, E-Waste (Management) Rules, 2016, etc.	• To plan comprehensive program for the prevention, control or abatement of pollution and secure executions thereof; • To collect and disseminate information relating to pollution and the prevention, control or abatement thereof; • To inspect sewage or trade effluent treatment and disposal facilities, and air pollution control systems and to review plans, specification or any other data relating to the treatment plants, disposal systems and air pollution control systems in connection with the consent granted; • Supporting and encouraging the developments in the fields of pollution control, wastes recycle reuse and eco-friendly practices;
4.	Department of Ecology and Environment, Karnataka	Headed by the Principal Secretary, Forest, Ecology and Environment and is under the administrative control of minister of cabinet rank for Forest, Ecology & Environment.	Responsible for the enforcement of various environment related Acts, Rules, Notifications etc., including; • Implementation of Air (Prevention and Control of Pollution) Act, 1981 • Water (Prevention and Control of Pollution) Act, 1974 • Environment Protection Act 1986 and notifications issued under the Environment Protection Act. • Implementation of National River Conservation Plan and National Lake Conservation Plan. • To accord Environmental Clearances in respect of certain categories of industries • To take up activities for the protection of Bio-diversity in the State • To oversee the activities / functioning of Karnataka State Pollution Control Board • To oversee Coastal Zone Management of Karnataka.
5.	Ministry of Renewable Energy	Nodal ministry of Government of India for all matters related to new and renewable energy	To develop and deploy new and renewable energy for supplementing the energy requirements of the country as stated on its website.
6.	Karnataka Renewable Energy Development Limited (KREDL)	Agency under the purview of Energy Department, Government of Karnataka. Devoted to promoting projects for harnessing energy from wind, small-hydro, biomass, solar energy and energy recovery from wastes through private investment.	• Promotion and Installation of renewable energy in the State and to initiate all necessary actions for Energy Conservation in the State • Generation of awareness about new and Renewable Energy technologies; • Act as a channel for evaluation of challenges and opportunities arising from law and policy for the promotion of clean energy; • Implementation of demonstration projects based on Energy Efficiency and Renewable Energy; *CSPGPL to obtain a Certificate of Commissioning from KREDL after commissioning of the project. Project should also be registered under the State Nodal Agency.*
7.	Central Electricity Authority (CEA)	Statutory Body constituted under the erstwhile Electricity (Supply) Act, 1948, hereinafter replaced by the Electricity Act, 2003, where similar provisions exists, the office of the CEA is an "Attached Office" of the Ministry of Power.	Responsible for the technical coordination and supervision of programmes and is also entrusted with a number of statutory functions.
8.	Central Regulatory Electricity	To promote competition, efficiency and economy in bulk power markets,	• Improve the operations and management of the regional transmission systems through Indian

S. No	Agencies	Description	Functions
	Commission	improve the quality of supply, promote investments and advise government on the removal of institutional barriers to bridge the demand supply gap and thus foster the interests of consumers	Electricity Grid Code (IEGC), Availability Based Tariff (ABT), etc.; • Formulate an efficient tariff setting mechanism, which ensures speedy and time bound disposal of tariff petitions, promotes competition, economy and efficiency in the pricing of bulk power and transmission services and ensures least cost investments; facilitate open access in inter-state transmission; • Facilitate inter-state trading; • Promote development of power market; and • Improve access to information for all stakeholders.
9.	Central Ground Water Authority	Constituted under Sub-section (3) of Section 3 of the Environment (Protection) Act, 1986 for the purposes of regulation and control of ground water development and management	• To resort the penal provisions contained in section 15 to 21 of the said act; • To regulate and control, management and development of ground water in the country and to issue necessary regulatory directions for the purpose; and • Exercise of powers under Section 4 of Environment (Protection) Act, 1986 for the appointment of Officers. *CSPGPL and the O&M Contractor for module cleaning to obtain a Non- Objection Certificate (NOC) from Karnataka Ground Water Authority for utilisation of groundwater at site through dug well for cleaning of solar panels and domestic purpose.*
10.	Gram Sabha or the Panchayats	Local bodies which have been defined by the 73rd Constitutional Amendment Act, 1992	• Preparation of plans for economic development and social justice and the implementation of such schemes for economic development and social justice, as may be assigned to them. *CSPGPL has obtained a Non- Objection Certificate (NOC) for the project from the Gram Panchayat of Boppur, Gadratigi and Talekhan Villages for setting up of the project.*
11.	Karnataka Power Transmission Company Limited (KPTCL)	Wholly Owned by Govt of Karnataka. Mainly vested with the functions of Transmission of Power.	• Provide innovative, efficient and tailored electricity products and services with a strong emphasis on risk management for itself and its consumer. • Construction of Stations and Transmission Lines and maintenance of Sub-Stations. • Create more business opportunities for other segments in MP power sector and enhance the profitability for each of that segment. *Approval for route of transmission line from site to 110/33/11 kV substation for power evacuation has been obtained from KPTCL. Approval has also to be obtained from Electrical Inspectorate, Karnataka for interconnection scheme and bay equipment along with protection equipment*.

3.1.2 Applicable Environment and Social Regulations and Policies

The relevant Acts, Rules and Policies pertaining to the project have been summarised in the following ***Table 3-2***.

Table 3-2: Applicable Environment and Social Laws and Regulations and Policies

S. No.	Issues	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
1.	Environmental Protection	Scattering of debris and waste material can contaminate the soil, water and surroundings.	**The Environment (Protection) Act 1986, as amended in April 2003; EPA Rules 1986, as amended in 2002.**	KSPCB MoEF&CC CPCB	Compliance under the rules to maintain stipulated standards and environmental management through various supporting rules promulgated under the Act.
2.	Prevention and Control of Water Pollution	Waste water generation from construction and operation of the Plant	**The Water (Prevention and Control of Pollution) Act, 1974, amended in 1988**	KSPCB	Intimation to KSPCB for the solar power plant and ensure compliance under the Water Act.[2].
3.	License under Factories Act, 1948	Factory license is required as the project is generating, transforming and transmitting power.	**Chapter I of The Factories Act, 1948**	Factories Inspectorate, Karnataka	CSPGPL shall obtain Factory License from the State Government or Chief Inspectorate of Factories, Karnataka before starting operations of the project.
4.	Hazardous Wastes Management	The project will generate broken photo-voltaic cells, waste oil from transformer from switchyard. Solvents and chemicals used or cleaning etc.	**Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 as amended in 2019**	KSPCB	As per the recent amendment dated 1st March 2019, an occupier shall not be required to obtain authorization for collection, reception, storage, transportation and disposal of hazardous wastes if Consent to Operate is not required from SPCB for the project activity. Liability of the occupier, transporter and operator of a facility: • The occupier, transporter and operator of a facility shall be liable for damages caused to the environment resulting due to improper handling and disposal of hazardous waste listed in schedules to the Rules; • The occupier and operator of a facility shall also be liable to reinstate or restore damaged or destroyed elements of the environment; • The occupier and operator of a facility shall be liable to pay a fine as levied by the State Pollution Control Board with the approval of the Central Pollution Control Board for any violation of the provisions under these rules. *All the hazardous waste generated due to the project shall be stored and disposed as per the requirements of the Hazardous Waste Rules i.e., on a paved surface in a designated area with adequate secondary containment, with adequate labelling and before it is disposed to an* ***KSPCB approved vendor.***
5.	Electricity Distribution License	Private sector projects to obtain distribution Licenses from the State	**The Electricity Act 2003**	State Electricity	CSPGPL should ensure to obtain license under the electricity act and ensure that the Health and Safety requirements specified under the

[2] *As per latest directions of Central Pollution Control Board, dated March 2016, Final report on revised categorization of industrial sectors under Red/ Orange/ Green/ White, solar power projects have been classified under White category of industries. As per the CPCB's direction to SPCB/PPCs, "there shall be no necessity of obtaining Consent to Operate for White Category of industries and intimation to the concerned SPCB/PPC shall suffice." And as per KSPCB (https://www.kspcb.gov.in/consentCategory.html) "white category industries shall not be included in the Consent Mechanism. As per CPCB order dated 18th January 2017, the White category includes Solar Power Plants of all capacities. (*http://kredlinfo.in/scrollfiles/exemption%20from%20pollution%20board.pdf)

S. No.	Issues	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
		Electricity Regulation Committee and to have open access to the transmission lines		Regulation Committee	rules are compiled to.
6.	Surface Transportation	Movement of vehicles during operational phase	**The Motor Vehicles Act 1988, as amended by Motor Vehicles (Amendment) Act 2000, dated 14th August 2000** **The Central Motor Vehicles Rules 1989, as amended through 20th October 2004 by the Central Motor Vehicles (Fourth Amendment) Rules 2004.**	State Transport Authority	CSPGPL should ensure compliance of stipulated standards under rule 115. Safety compliance under the rules.
7.	Labour	Engagement of Labour at site	**Workmen's Compensation Act, 1923 & Rules 1924**	Deputy Chief Inspector of Factories	CSPGPL to ensure that compensation in accordance with the Act is paid to the workers in case of personal injury caused by accident arising out of and in the course of his employment.
8.	Labour	Engagement of bonded Labour at site	**Bonded Labour (Abolition) Act 1976**	Deputy Chief Inspector of Factories	All forms of bonded labour is abolished CSPGPL to ensure compliance to the Act.
9.	Labour	Working conditions of contracted Labour working at the site	**The Contract Labour (Regulation and Abolition) Rules, 1971**	The Commissioner of Labour, Karnataka	Ensure that all the contracted workers are provided with condition of services, rate of wages, holidays, hours of work as stipulated in the act and rules
10.	Labour	Engagement of Child Labour at site	**The Child Labour (Prohibition and Regulation) Act, 1986**	Deputy Chief Inspector of Factories	The Act prohibits employment of children in certain occupation and processes. The Act also specifies conditions of work for children, if permitted to work. CSPGPL to ensure compliance to the Act.
11.	Labour	Provision of wages to labour engaged at the site	**Minimum Wages Act, 1948**	Deputy Chief Inspector of Factories	Requires the Government to fix minimum rates of wages and reviews this at an interval of not more than 5 years. Every employer shall be responsible for the payment to persons employed by him of all wages required to be paid under this Act. CSPGPL to ensure compliance to the Act.
12.	Labour	Equal wages to male and female workers at site	**Equal Remuneration Act 1976**	Deputy Chief Inspector of Factories	It is the duty of an employer to pay equal remuneration to men and women workers for same work or work of a similar nature. CSPGPL to ensure compliance to the Act.

S. No.	Issues	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
13.	Labour	Engagement of Labour at site	**Workmen's Compensation Act, 1923 & Rules 1924**	Deputy Chief Inspector of Factories	CSPGPL to ensure that compensation in accordance with the Act is paid to the workers in case of personal injury caused by accident arising out of and in the course of his employment.

3.1.3 Policies Framework in India

Various policies released by the Government of India from time to time needs to be addressed while undertaking the projects. Some of the policies (including sector specific) have been discussed briefly in the table below.

Table 3-3: National and State Level Policies Applicable to the Project

Name of the Policy	Agency	Description
National Environmental Policy, 2006	KSPCB	Government of India released the National Environment Policy in 2006. The present national policies for environmental management are contained in the National Forest Policy, 1988, the National Conservation Strategy and Policy Statement on Environment and Development, 1992; and the Policy Statement on Abatement of Pollution, 1992. Some sector policies such as the National Agriculture Policy, 2000; National Population Policy, 2000; and National Water Policy, 2002; have also contributed towards environmental management. All of these policies have recognized the need for sustainable development in their specific contexts and formulated necessary strategies to give effect to such recognition. The dominant theme of this policy is that while conservation of environmental resources is necessary to secure livelihoods and well-being of all, the most secure basis for conservation is to ensure that people dependent on particular resources obtain better livelihoods from the fact of conservation, than from degradation of the resource.
National Electricity Policy 2005	Ministry of Power, Government of India	The National Electricity Policy 2005 states that environmental concerns would be suitably addressed through appropriate advance action by way of comprehensive Environmental Impact Assessment and implementation of Environment Action Plan (EAP). As per the Policy, adequate safeguards for environmental protection with suitable mechanism for monitoring of implementation of Environmental Action Plan and R&R Schemes should be put in place. Open access in transmission has been introduced to promote competition amongst the generating companies who can now sell to different distribution licensees across the country. This should lead to availability of cheaper power.
National Solar Mission	Government of Karnataka	The objective of the Jawaharlal Nehru National Solar Mission (JNNSM) under the brand 'Solar India' is to establish India as a global leader in solar energy, by creating the policy conditions for its diffusion across the country as quickly as possible. The Mission has set a target of 20,000 MW and stipulates implementation and achievement of the target in three phases (first phase up to 2012-13, second phase from 2013 to 2017 and the third phase from 2017 to 2022) for various components, including grid connected solar power. The successful implementation of the JNNSM requires the identification of resources to overcome the financial, investment, technology, institutional and other related barriers which confront solar power development in India. The penetration of solar power, therefore, requires substantial support. The policy framework of the Mission will facilitate the process of achieving grid parity by 2022.
The Karnataka Solar Policy 2014-2020	Karnataka Renewable Energy Development Limited	To harness the potential of the solar resource in the state, Government of Karnataka (GoK) had issued a Solar Policy for the period 2011-2016. In light of the technological advantages unfolding in the sector and achievements made by Solar forefront states, the Karnataka Government formed a Technical Committee vide G.O. No EN 61 NCE 2011 dated

Name of the Policy	Agency	Description
		05.09.2013 for suggesting amendments to the existing Solar Policy 2011-16. The Government of Karnataka revised its Solar Policy to Karnataka Solar Policy 2014-21. The Solar Policy has been formulated by KREDL with the following objectives: • To add solar generation of minimum 2000 MW by 2021 in a phased manner by creating a favourable industrial atmosphere; • To translate Karnataka into an investor friendly state; • To encourage public private participation in the sector; • To encourage decentralized generation & distribution of energy where access to grid is difficult; • To promote Research and Development and innovations, skill development in the sector. CSPGPL holds the responsibility for development of power evacuation facilities along with interconnection scheme and bay equipment along with protection equipment from the project till the grid sub-station of GESCOM.

3.1.4 IFC Performance Standards

The IFC Performance Standards stipulates that any proposed project shall meet the following requirements throughout the life of an investment by IFC or other relevant financial institution:

- **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 Peoples; and
- **Performance Standard 8:** Cultural Heritage.

These performance standards and guidelines provide ways and means to identify impacts and affected stakeholders and lay down processes for management and mitigation of adverse impacts. The applicability of the Performance Standards is discussed in the ***Table 3-4*** below:

Table 3-4: Applicability of the IFC Performance Standards for the Project

S. No.	Performance Standard	Description and Applicability
1.	PS1 – Assessment and Management of Environmental and Social Risks and Impacts	***APPLICABLE*** PS 1 establishes the importance of: • Integrated assessment to identify the environmental and social impacts, risks, and opportunities of projects; • Effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and • The project proponent's management of environmental and social performance throughout the life of the project. The PS 1 is applicable to projects with environment and/or social risks and/or impacts. Hence, PS 1 is applicable to the project necessitating an Environmental and Social Impact Assessment (ESIA) study to be conducted prior to commencement of the project.

S. No.	Performance Standard	Description and Applicability
		The project is a solar power project and will have environmental and social impacts such as stress on existing water resources, waste generation etc. Hero Future Energies has developed and implemented an Environmental and Social Management System to manage the risks associated with its operations. The ESMS will be implemented by CSPGPL at the project level.
2.	PS2 – Labour and Working Conditions	***APPLICABLE*** PS-2 recognizes that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental rights of workers. The applicability of PS 2 will be for the operation phase even though there would be fewer numbers of workers. It will not only cover the main plant employees, but all employees/workers, even those working through contractors. CSPGPL shall provide adequate provisions such as access to clean water, sanitary facilities and other necessary facilities at the site in the operational phase. CSPGPL is to take measures to prevent child labour, forced labour and discrimination at site. Freedom of association and collective bargaining shall be provided. Wages, work hours and other benefits shall be as per the national labour and employment laws. CSPGPL will provide a grievance mechanism for workers (and their organizations, where they exist) to raise workplace concerns. In providing a grievance mechanism through which workers may raise workplace concerns, CSPGPL should ensure that matters are brought to management's attention and addressed expeditiously. CSPGPL needs to document all grievances and follow up on any corrective actions. CSPGPL to extend a safe and healthy work environment to contracted workers and to any other workers who provide project-related work and services. CSPGPL to ensure that training is provided to all workers on relevant aspects of OHS associated with their daily work, including emergency arrangements and OHS briefing for visitors and other third parties accessing the premises. All occupational injuries, illnesses and fatalities are to be documented.
3.	PS3 - Resource Efficiency and Pollution Prevention	***APPLICABLE*** PS3 recognizes that increased economic activity and urbanization often generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels. The objectives of PS 3 are: • To avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities. • To promote more sustainable use of resources, including energy and water. • To reduce project-related GHG emissions. The solar project is a clean energy project and will not have major pollution sources associated with it. The construction works for the development of project entailed generation of wastes like wastewater, used oil from DG sets and construction debris. The operation phase will result in generation of minor quantities of waste such as used transformer oil, broken and defunct solar panels and waste water from cleaning of solar panels. CSPGPL to monitor emissions and manage waste to ensure that the requirements of PS 3 are being met.
4.	PS4 – Community Health, Safety and Security	***APPLICABLE*** PS 4 recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts. Its main stress is to ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the Affected Communities. The applicability of this PS is to be established during the ESIA process, resulting in preparation of an Action Plan to be disclosed to the community. The Applicability during the operation phase will be limited to Noise levels and glare impacts at adjoining villages which need to be kept within the acceptable norms. Labour and

S. No.	Performance Standard	Description and Applicability
		security staff to be engaged from local community. The Action Plan and any other relevant project-related information is to enable the influenced communities and relevant government agencies to understand these risks and impacts and will engage the influenced communities and agencies on an on -going basis consistent with the requirements of PS 1.
5.	PS5 – Land Acquisition and Involuntary Resettlement	***NOT APPLICABLE*** PS 5 recognizes that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land. Its main aim is to anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use by providing compensation for loss of assets at replacement cost and ensuring that resettlement activities are implemented with appropriate disclosure of Information, consultation, and the informed participation of those affected. For the project, a total of ~237.27 acres of private land has been purchased by CSPGPL through a land aggregator, Mr. Raju Gowda based in Gulbarga from 37 titleholders for settling up of the solar power plant and its associated facilities such as internal roads, office buildings, switch yard etc. The land as informed during discussions held with the sample representatives of landowners was used in undertaking rainfed agricultural activities. The land owners on through their consent willingly sold their land. People unwillingly to sell their land have been left out of the sale process and this can be noted through the three plots between both Zone 1 and 2 which has been carved out of the project footprint because the landowner was not willing to sell his land parcel. Hence, as no physical or economic displacement relating to the land transferred for the project has taken place, the requirements of PS 5 are therefore not applicable to the project.
6.	PS6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources	***APPLICABLE*** PS 6 recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development. This standard is aimed to promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities. The objectives of PS 6 are: • To protect and conserve biodiversity. • To maintain the benefits from ecosystem services. • To promote the sustainable management of living natural resources through the • adoption of practices that integrate conservation needs and development priorities. The project involved various activities such as removal of vegetation cover, levelling of land for site preparation, laying of new access roads, movement of vehicles and physical presence of solar panels which are likely to cause habitat loss.
7.	PS7 – Indigenous People	***NOT APPLICABLE*** Performance Standard 7 recognizes that Indigenous Peoples, as social groups with identities that are distinct from mainstream groups in national societies, are often among the most marginalized and vulnerable segments of the population. In many cases, their economic, social, and legal status limits their capacity to defend their rights to, and interests in, lands and natural and cultural resources, and may restrict their ability to participate in and benefit from development. The project area or its surroundings does not support indigenous people. No material degradation or adverse impact is there on land resources on which indigenous peoples are dependent.
8.	PS8 – Cultural Heritage	***NOT APPLICABLE*** For the purposes of this Performance Standard, cultural heritage refers to tangible forms of cultural heritage, such as tangible moveable or immovable objects, property, sites, structures, or groups of structures, having archaeological

S. No.	Performance Standard	Description and Applicability
		(prehistoric), paleontological, historical, cultural, artistic, and religious values. There are no culturally important sites in or around the project site. The requirements of PS 8 are therefore not applicable to the project.

3.1.5 IFC Categorisation of Project

As part of its review of a project's expected social and environmental impacts, IFC uses a system of social and environmental categorization. This categorization is used to reflect the size of impacts understood as a result of the client's social and environmental assessment and to specify IFC's institutional requirements. The following categories are used by the IFC:

- Category A Projects: Projects with potential significant adverse social or environmental impacts that are diverse, irreversible or unprecedented;
- Category B Projects: Projects with potential limited adverse social or environmental impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures;
- Category C Projects: Projects with minimal or no adverse social or environmental impacts, including certain financial intermediary (FI) projects with minimal or no adverse risks;
- Category FI Projects: All FI projects excluding those that are Category C projects.

IFC therefore, categorizes projects primarily according to the significance and nature of impacts. IFC defines the project's area of influence as the primary project site(s) and related facilities that the client (including its contractors) develops or controls; associated facilities that are not funded as part of the project (funding may be provided separately by a client or a third party including the government), and whose viability and existence depend exclusively on the project and whose goods or services are essential for the successful operation of the project; areas potentially impacted by cumulative impacts from further planned development of the project; and areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location. The area of influence does not include potential impacts that would occur without the project or independently of the project.

3.1.6 World Bank EHS Guidelines

The Equator Principle 3 requires follow up of the environmental, health and safety requirements as per the following guidelines released by IFC on 30th April 2007:

- Environmental, Health, and Safety General Guidelines
- Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution issued on 30th April 2007.

3.1.6.1 Applicable Environmental Standards

3.1.6.2 Ambient Air Quality

As per the IFC EHS guidelines (April 2007), "the ambient air quality standards are ambient air quality levels established and published through national legislative and regulatory processes and ambient quality guidelines refer to ambient quality levels primarily developed through clinical, toxicological, and epidemiological evidence (such as those published by the World Health Organization)". National Ambient Air Quality Standards (NAAQS), as notified under Environment (Protection) Rules 1986 and revised through Environment (Protection) Seventh Amendment Rules, 2009 are given ***Table 3-5***:

Table 3-5: National Ambient Air Quality Standards

Pollutant	Time Weighted Average	Concentration in Ambient Air	
		Industrial, Residential, Rural and other Areas	Ecologically Sensitive Area (notified by Central Government)

Pollutant	Time Weighted Average	Concentration in Ambient Air	
		Industrial, Residential, Rural and other Areas	Ecologically Sensitive Area (notified by Central Government)
Sulphur Dioxide (SO_2), µg/m^3	Annual*	50	20
	24 Hours**	80	80
Nitrogen Dioxide (NO_2), µg/m^3	Annual*	40	30
	24 Hours**	80	80
Particulate Matter (size less than 10 µm) or PM_{10}, µg/m^3	Annual*	60	60
	24 Hours**	100	100
Particulate Matter (size less than 2.5 µm) or PM $_{2.5}$, µg/m^3	Annual*	40	40
	24 Hours**	60	60
Ozone (O_3), µg/m^3	8 Hours**	100	100
	1 Hour**	180	180
Lead (Pb), µg/m^3	Annual*	0.5	0.5
	24 Hours**	1	1
Carbon Monoxide (CO), mg/m^3	8 Hours**	2	2
	1 Hour**	4	4
Ammonia (NH_3), µg/m^3	Annual*	100	100
	24 Hours**	400	400
Benzene (C_6H_6), µg/m^3	Annual*	5	5
Benzo (O) Pyrene (BaP), particulate phase only, ng/m^3	Annual*	1	1
Arsenic (As), ng/m^3	Annual*	6	6
Nickel (Ni), ng/m^3	Annual*	20	20

**Annual arithmetic mean of minimum 104 measurements in a year taken twice a week, 24 hourly at uniform interval*

***24 hourly or 8 hourly or 1 hourly value as applicable shall be complied with 98% of the time in a year. 2% of the time they may exceed, but not on 2 consecutive days. Note: Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or continuous monitoring and further investigation.*

3.1.6.3 Ambient Noise Standards

As per the EHS guidelines of IFC, for residential, institutional and educational area, the one hourly equivalent noise level (Leq hourly) for day time (6.00 a.m. to 10.00 p.m.) is **55 dB (A)** while the Leq hourly for night time (10.00 p.m. to 6.00 a.m.) is prescribed as **45 dB (A).** Noise standards notified by the MoEF&CC vide gazette notification dated 14th February 2000 based on the *A- weighted equivalent noise level (Leq)* are as presented in ***Table 3-6***.

Table 3-6: Ambient Noise Standards

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

**Silence zone is defined as area up to 100 m around premises of hospitals, educational institutions and courts. Use of vehicle horns, loud speakers and bursting of crackers are banned in these zones.*

3.1.6.4 Noise Standards for Occupational Exposure

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

Table 3-7: Standards for Occupational Noise Exposure

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

No exposure in excess of 115 dB (A) is to be permitted.

For any period of exposure falling in between any figure and the next higher or lower figure as indicated in column (1), the permissible level is to be determined by extrapolation on a proportionate scale.

3.1.6.5 Water Quality Standards

The designated best use classification as prescribed by CPCB for surface water is as given in ***Table 3-8***.

Table 3-8: Primary Water Quality Criteria for Designated Best Use Classes

Designated-Best-Use	Class	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	• Total Coliforms Organism MPN/100ml shall be 50 or less • pH between 6.5 and 8.5 • Dissolved Oxygen 6mg/l or more • Biochemical Oxygen Demand 5 days 20°C 2mg/l or less
Outdoor bathing (Organised)	B	• Total Coliforms Organism MPN/100ml shall be 500 or less • pH between 6.5 and 8.5 • Dissolved Oxygen 5mg/l or more • Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	• Total Coliforms Organism MPN/100ml shall be 5000 or less • pH between 6 to 9 • Dissolved Oxygen 4mg/l or more • Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Propagation of Wild life and Fisheries	D	• pH between 6.5 to 8.5 • Dissolved Oxygen 4mg/l or more • Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	• pH between 6.0 to 8.5 • Electrical Conductivity at 25°C micro mhos/cm Max.2250 • Sodium absorption Ratio Max. 26 • Boron Max. 2mg/l

Designated-Best-Use	Class	Criteria
	Below-E	• Not Meeting A, B, C, D & E Criteria

Source: Central Pollution Control Board

As per the IFC EHS guidelines, the treated sewage discharge is required to meet the following guidelines.

Table 3-9: Treated sewage discharge guidelines as per IFC

S. No.	Parameter	Guideline Value
1.	pH	6-9
2.	BOD	30mg/l
3.	COD	125 mg/l
4.	Total Nitrogen	125 mg/l
5.	Oil and Grease	10 mg/l
6.	Total Suspended Solids	50 mg/l
7.	Total coliform bacteria	400 MPN/100 ml

3.1.7 Applicable International Conventions

Environmental problems which migrate beyond the jurisdiction (Trans-boundary) require power to control such issues through international co-operation by either becoming a Contracting Party (CP) i.e. ratifying treaties or as a Signatory by officially signing the treaties and agreeing to carry out provisions of various treaties on environment and social safeguards. The relevant international conventions are as provided in the ***Table 3-10.***

Table 3-10: Relevant International Conventions applicable to the project

S. No	International Conventions	Salient Features
1	Montreal Protocol on Substances That Deplete the Ozone Layer (and subsequent Amendments)	India signed the Montreal Protocol along with its London Amendment on 17th September 1992 and also ratified the Copenhagen, Montreal and Beijing Amendments on 3rd March 2003.
2	UN (Rio) Convention on Biological Diversity	India is a party since: 1994-02-18 by: Ratification; Protocol - Party since: 11th November 2003.
3	Conventions on the Conservation of Migratory species of wild animals and migratory species	India is contracting party to the convention on conservation of migratory species of wild animals and migratory species.
4	Kyoto Protocol	The Kyoto protocol was signed by India in August 2002 and ratified in February 2005. The convention pertains to the United Nations framework on Climate Change. The 3rd Conference of the Parties to the Framework Convention on Climate Change (FCCC) in Kyoto in December 1997 introduced the Clean Development Mechanism (CDM) as a new concept for voluntary greenhouse-gas emission reduction agreements between industrialized and developing countries on the project level.
5	The Rotterdam Convention on the Prior Informed Consent (PIC) Procedure	The Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals & Pesticides in international Trade was adopted by India at the Conference of Plenipotentiaries at Rotterdam in 1998
6	International Labour Organization conventions	India has also ratified many of the International Labour Organization conventions that are relevant to the Project including: • C1 Hours of Work (Industry) Convention, 1919 (14:07:1921, ratified); • C5 Minimum Age (Industry) Convention, 1919 (09:09:1955, ratified): • C11 Right of Association (Agriculture) Convention, 1921 (11:05:1923, ratified): • C14 Weekly Rest (Industry) Convention, 1921 (11:05:1923, ratified); • C29 Forced Labour Convention, 1930 (30:11:1954, ratified) & C105 Abolition of Forced Labour Convention, 1957 (18:05:2000, ratified); • C100 Equal Remuneration Convention, 1951 (25:09:1958, ratified); • C107 Indigenous and Tribal Populations Convention, 1957

S. No	International Conventions	Salient Features
		• C111 discrimination (Employment and Occupation) Convention, 1958 (03:06:1960, ratified)

4. Environmental and Socio-Economic Baseline

4.1 Environmental Baseline

This section of the Environment and Social Impact Assessment (ESIA) presents information on the baseline condition of the physical, chemical, biological and social environment within the project area.

The Environmental and Social baseline study helps determine existing environmental conditions. Local knowledge and scientific field work provided most of the site-specific information used in this report. Existing information from the scientific literature (both published and unpublished), engineering studies and test work results, technical reports, and community socioeconomic studies were used wherever available. These studies were used to validate the baseline information.

The Project is located in Gadratigi and Talekat villages in Sindhanur and Lingsugur Talukas of Raichur District in Karnataka. A study area of 5 km from the project area was considered for the evaluation of environmental existing status and potential impacts and 2 km for the social baseline and impacts. Activities that facilitated establishment of the baseline data include: site survey, ecological surveys, social surveys and interviews, processing of satellite imagery and secondary data review from established sources such as Indian Meteorological Department and Census of India amongst others.

This section covers the following topics:

- Physiography
- Geology
- Drainage
- Land Use
- Soil Classification
- Hydrogeology
- Climate and Meteorology
- Natural Hazards
- Noise Monitoring
- Ambient Air Quality
- Water Quality

4.1.1 Physiography

Raichur district can be broadly classified into three major zones:

- The Northern rugged plateau;
- The Southern lower plains with inselbergs and isolated hillocks; and
- Valley fills

Continuous range of hills are absent in the district, but a few clusters of hills are seen towards east, west, northwest, centre, and southwest. The general slope of the terrain is towards the Krishna River in the northern part of the district and towards the Tungabhadra River in the southern part.

Raichur falls within the well-defined macro region of Deccan Plateau, one of the two regions, into which the State has been divided. Within the State, Raichur is a part of the Central Karnataka Plateau; one of the four micro regions into which the State has been further divided. The main physiographic feature of the district is that its western portion is plain, barren and scanty in vegetation and its eastern portion is adorned with few hillocks and has scrub jungles. Except for a few hillocks on the east, there is no continuous range of hills found in the district. Few clusters include a range of hill extending from northwest of Raichur towards Yergera for a distance of about

15 miles, another range runs in Raichur and Manvi Taluks for about 10 miles and a third range extends from south of Raichur towards Alampur in Andhra Pradesh. Most of the clusters are made up of granite rocks. These rocks are the results of the erosional remnant of an uplifted plateau and these are made up of metamorphic schist and granitic gneisses of Precambrian age. The important peaks include Marigudda (1992 feet) and Durgadagudda (1911 feet) in Sindhanur, Mallabad (1762 feet) in Raichur, Manvi (1836 feet) and Masarkal (1774 feet) in Devadurga taluk. The elevation of the district is 407m above mean sea level (MSL).

Figure 4-1 presents the Physiographical map of Karnataka with project location indicated on the Map.

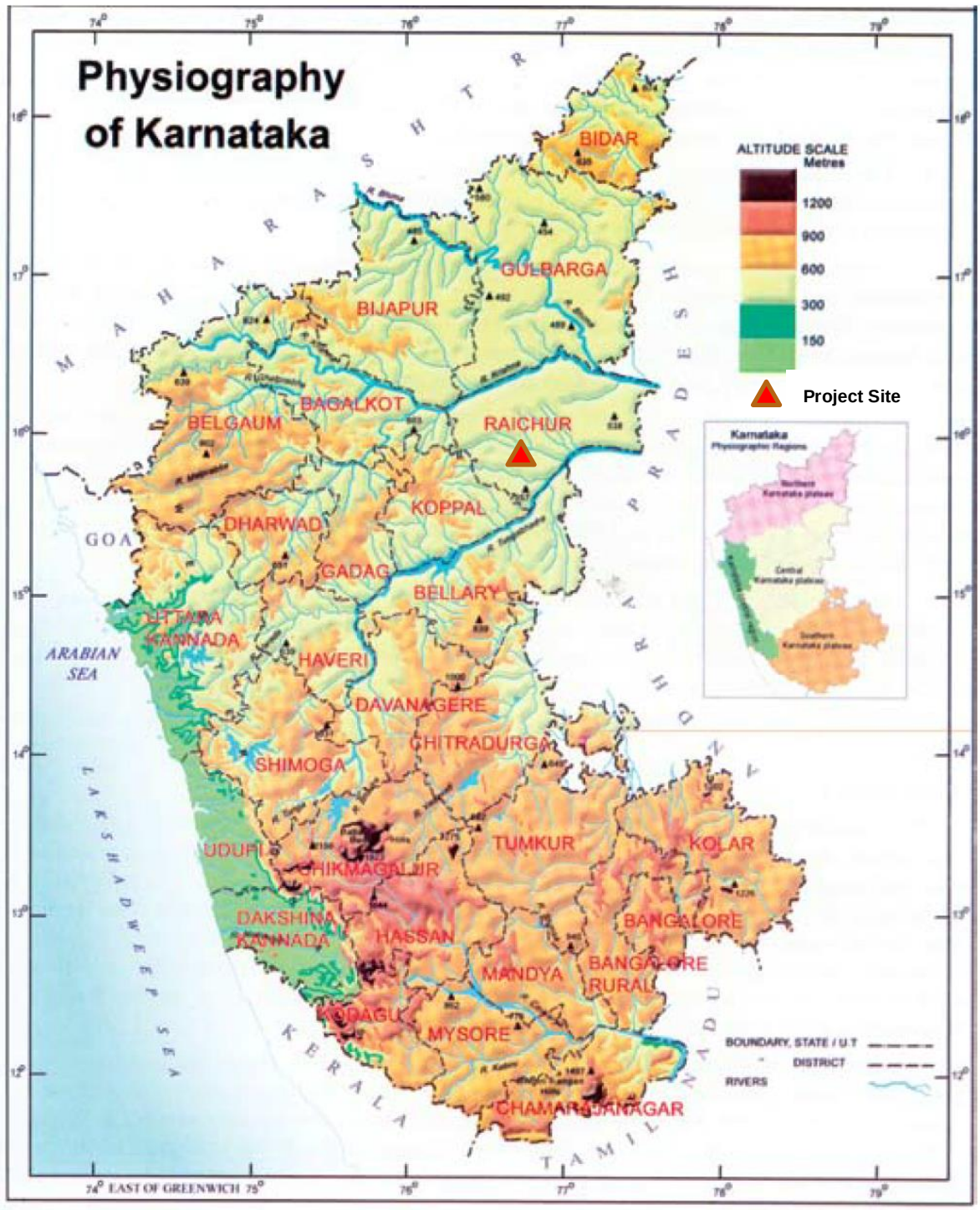


Figure 4-1:Physiographical map of Karnataka indicating Project Location

Source: A Handbook of Karnataka, Government of Karnataka

4.1.2 Geology

The major rock types occurring in the Raichur district may be classified as Dharwars, Peninsular gneissic complex and Dykes. The Dharwar series of rocks occur in the Maski band and Raichur band. The rocks occurring in Raichur band consist of chlorite, hornblende and dibasic schist and their reconstituted varieties.

Granites, gneisses and Dharwar schists are the main rock formations in the district. These formations are grouped under 'hard rock', as they do not have any primary porosity. However, secondary porosity is developed due to faults, fractures, joints, and due to weathering, which improved permeability and water yielding capacity of these rocks. Ground water occurs under water table conditions in the weathered and jointed hard rock, and under confined to semi-confined conditions in the fractured rock. Since the district is covered predominantly by black cotton soils, which inhibit percolation and circulation of water, there are pockets of poor-quality ground water in the area.

Figure 4-2 shows the Geological Map of Karnataka state.

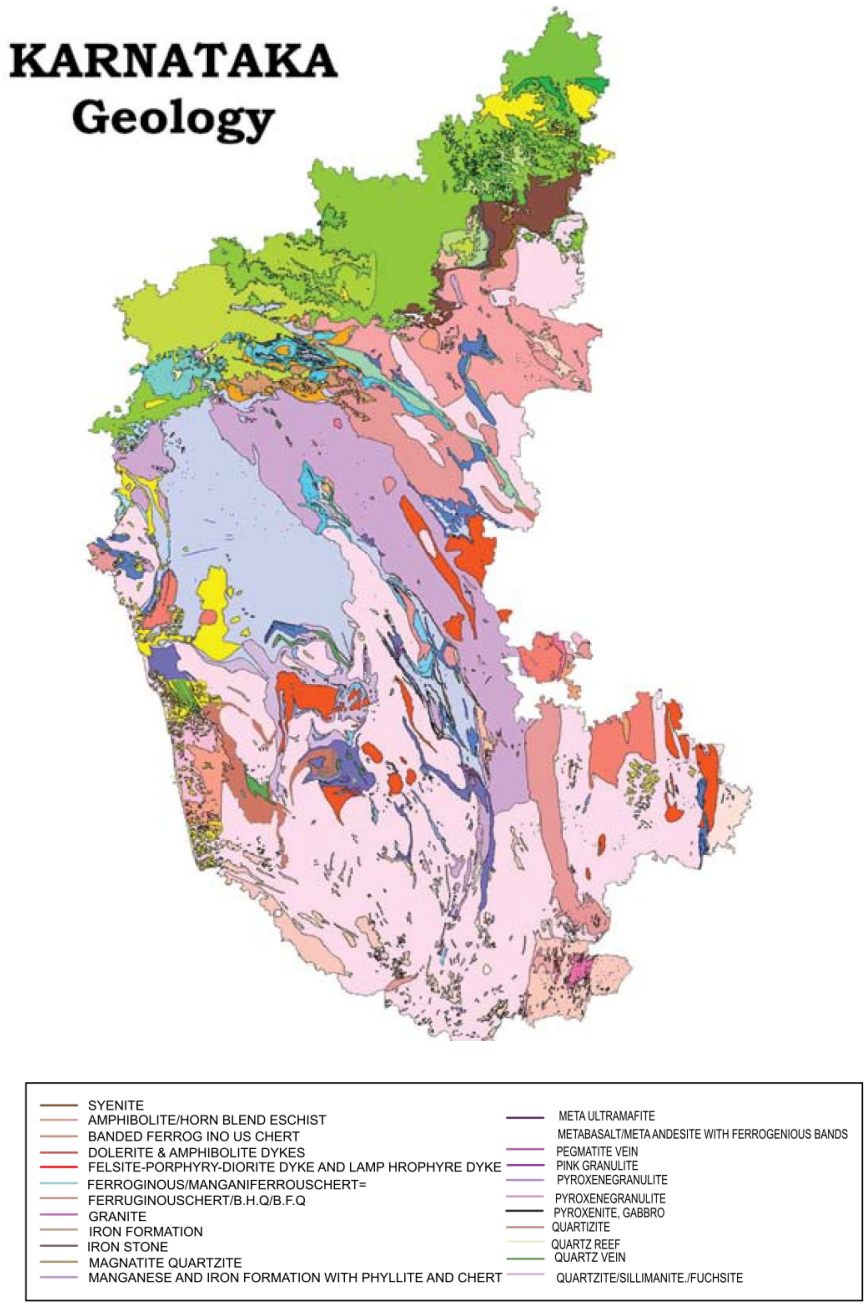


Figure 4-2: Geological Map of Karnataka

Source: A Handbook of Karnataka, Government of Karnataka

4.1.3 Drainage

Raichur district forms part of Krishna catchment in northern part, while southern part forms the Lower Tungabhadra catchment area. The two important rivers in the district are the Krishna and the Tungabhadra, which form the northern and southern boundary of the district respectively and are perennial in nature. River Bhima is an important tributary of the River Krishna. The drainage pattern is highly dendritic in nature.

River Krishna enters Raichur district to the North of Uppinhal village in Lingsugur taluk and flows for a distance of about 269 sq. km. Krishna River flows in the district in a general west-north-east and east-south-east direction till it meets the Tungabhadra in Andhra Pradesh. River Bhima confluences with River Krishna to the North of Kadlur in Raichur Taluka. Some of the major streams that join river Krishna are Huttinala, Chiksugurnala, Ramdurgnala, Mandarginala, Kodihallanala and Ramanhallanala.

River Tungabhadra enters the district near Singapura village of Sindhanur taluk. Major tributaries of Tungabhadra flowing in the district are Maski nala and Sindhanur nala. After flowing in north-west direction for about ten miles till western portion of district, the Tungabhadra turns eastwards, and making a loop near Kurnool, it flows northeast again, to join the Krishna at Arlapadu in Andhra Pradesh. The drainage is mainly towards the Tungabhadra. The drainage pattern in the area has been altered due to the irrigation practices in the area.

The drainage map of Karnataka state with indicative project location has been shown in the ***Figure 4-3*** below.

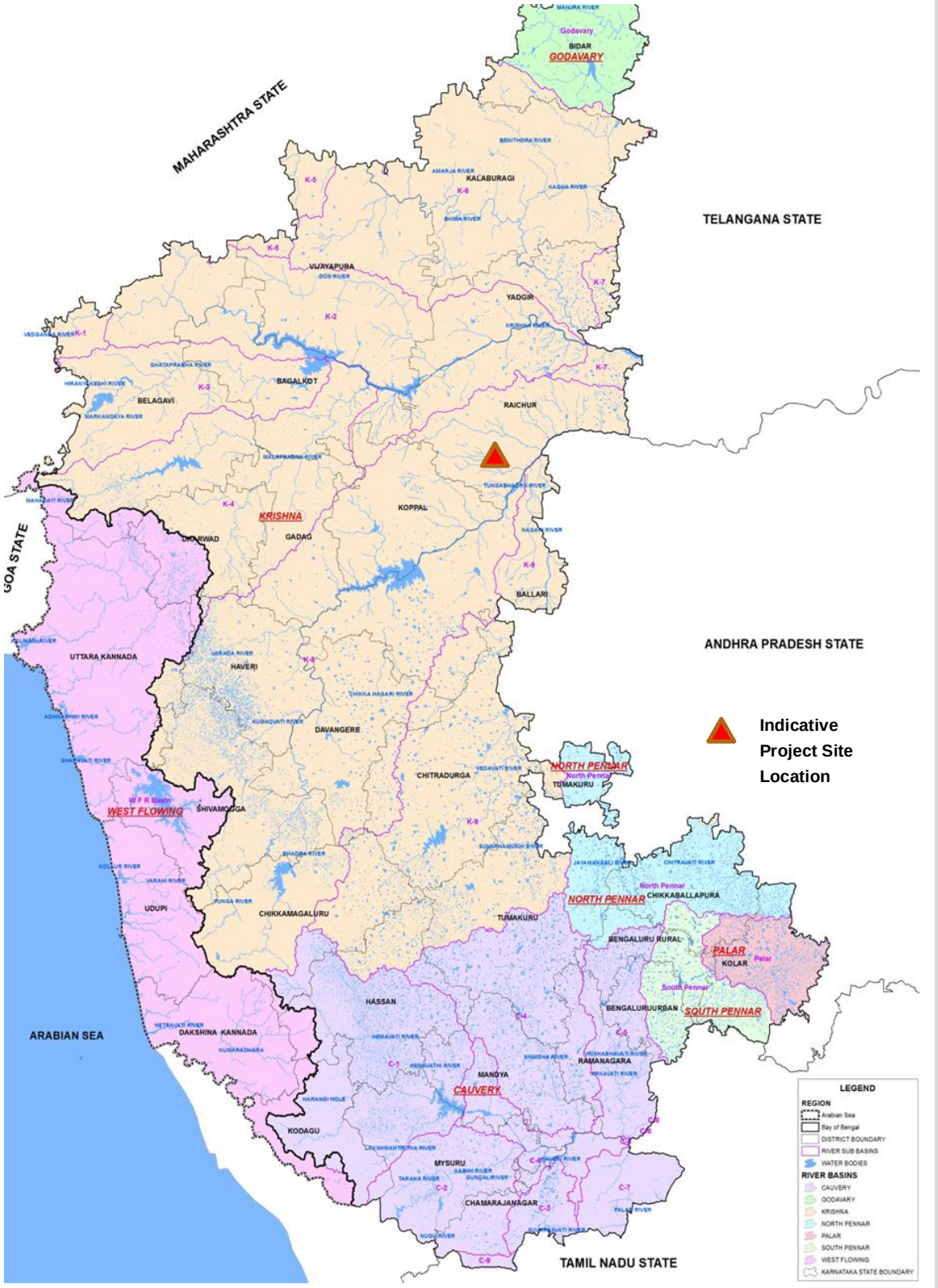


Figure 4-3: Drainage Map of Karnataka

Source: Government of Karnataka

The drainage pattern specific to the Project site has been shown in the ***Figure 4-4.***

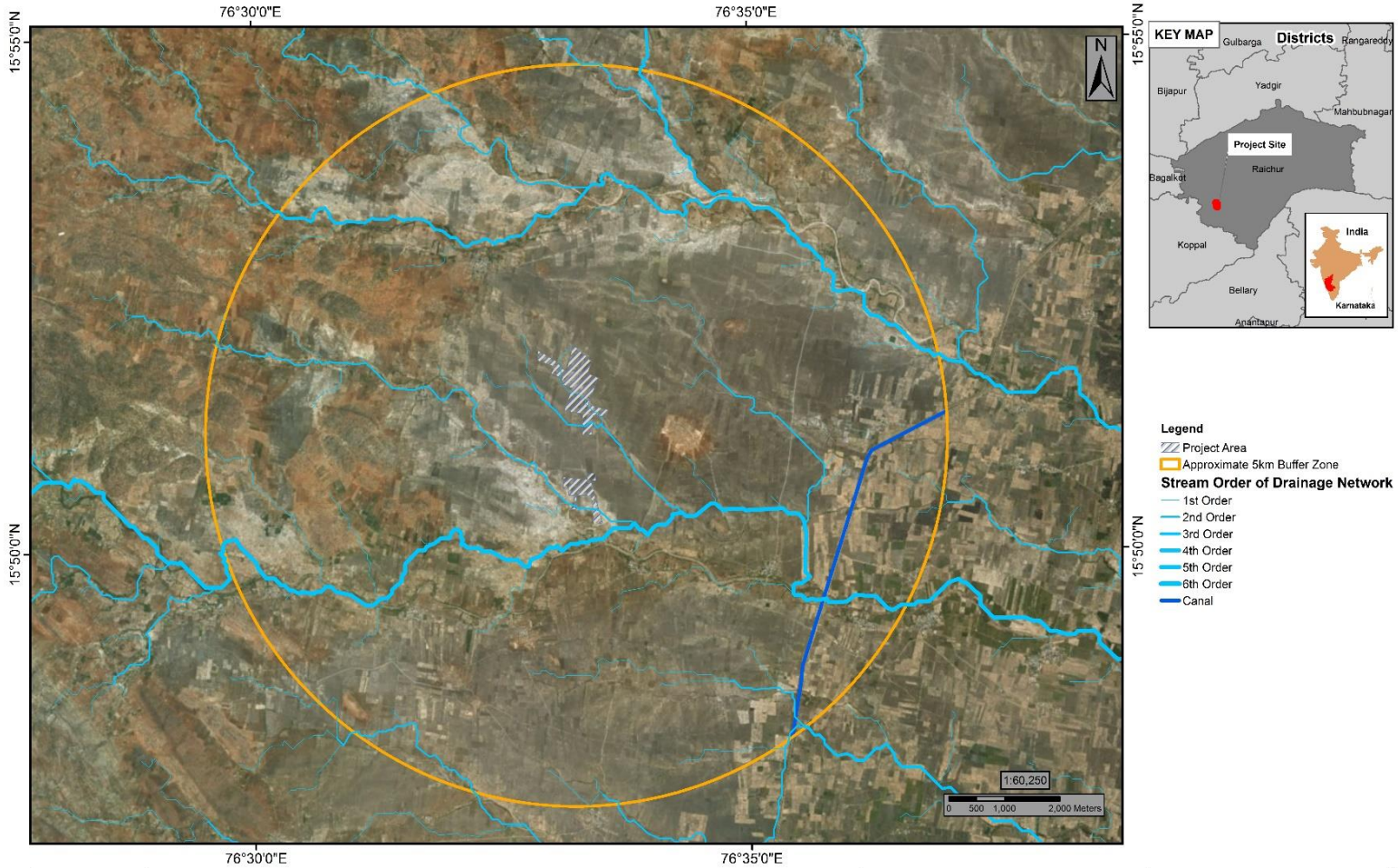


Figure 4-4: Drainage map of the Study Area

4.1.4 Land Use and Land Cover

The total land resource of Raichur District is 8,442 sq. km. It has been utilized for various purposes. The district consists of five taluks' viz., Devdurga, Lingsugur, Raichur, Manvi and Sindhanur. The Sindhanur Taluka represents 18.3 percent of total geographical area of the district (1,546 sq. km).

The total area of the district has been put under many types of uses. The dominant land use types in Raichur district include forest area, non-agricultural area, barren land, cultivable waste land, permanent pasture land, area under trees and grooves, fallow land, net sown area and others. The area under others category includes the area put to roads, railways, urban and rural settlements, quarrying and industrial etc.

Land use/ land cover map of the Raichur district has been presented in the ***Figure 4-5*** and project area specific landuse has been represented in the ***Figure 4-6***.

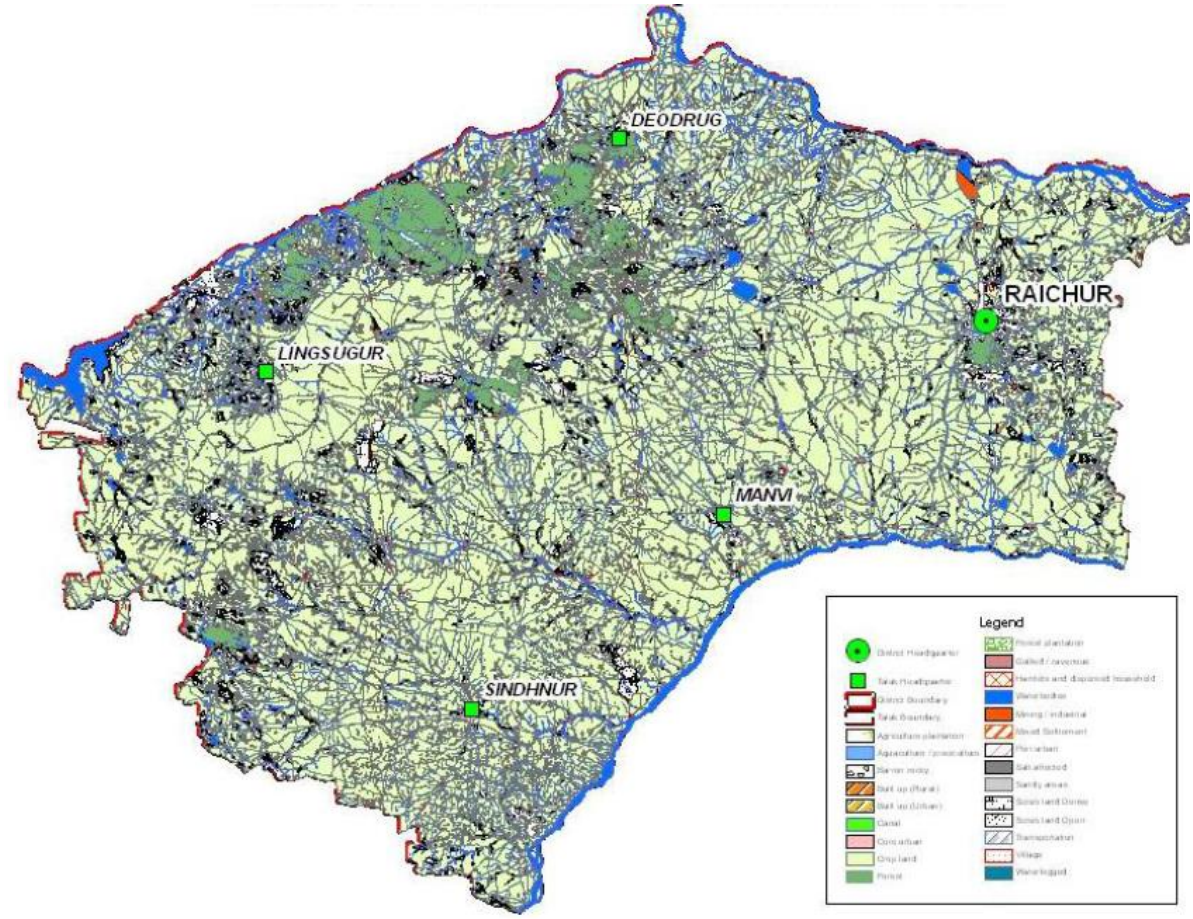


Figure 4-5: Land use classification of Raichur district

Source: District Irrigation Plan (2016-2017), Government of Karnataka

The Taluka has a total geographical area of 1, 51,415 ha, out of which net sown area is 99,275 ha with once sown area of 9,096 ha, forest area is 401 ha, land under non-agricultural use is 784 ha, cultivable waste is 931 ha, barren land is 1,388 ha, Permanent pasture is 2,722 ha, fallow land is 35,445 ha and uncultivable land is 11,113 ha.

Canals, tanks, wells, bore wells and lift irrigation are the important sources for irrigation in the Taluka. A major dam has been constructed across the river Tungabhadra in Bellary district. The Left Bank Canal of the project provides irrigation facility to an area of 1, 23,127 hectares of land in parts of Deodurg, Manvi, Raichur, Sindhanur and Lingsugur taluks of the district.

Project site specific Landuse has been presented in the following ***Table 4-1.***

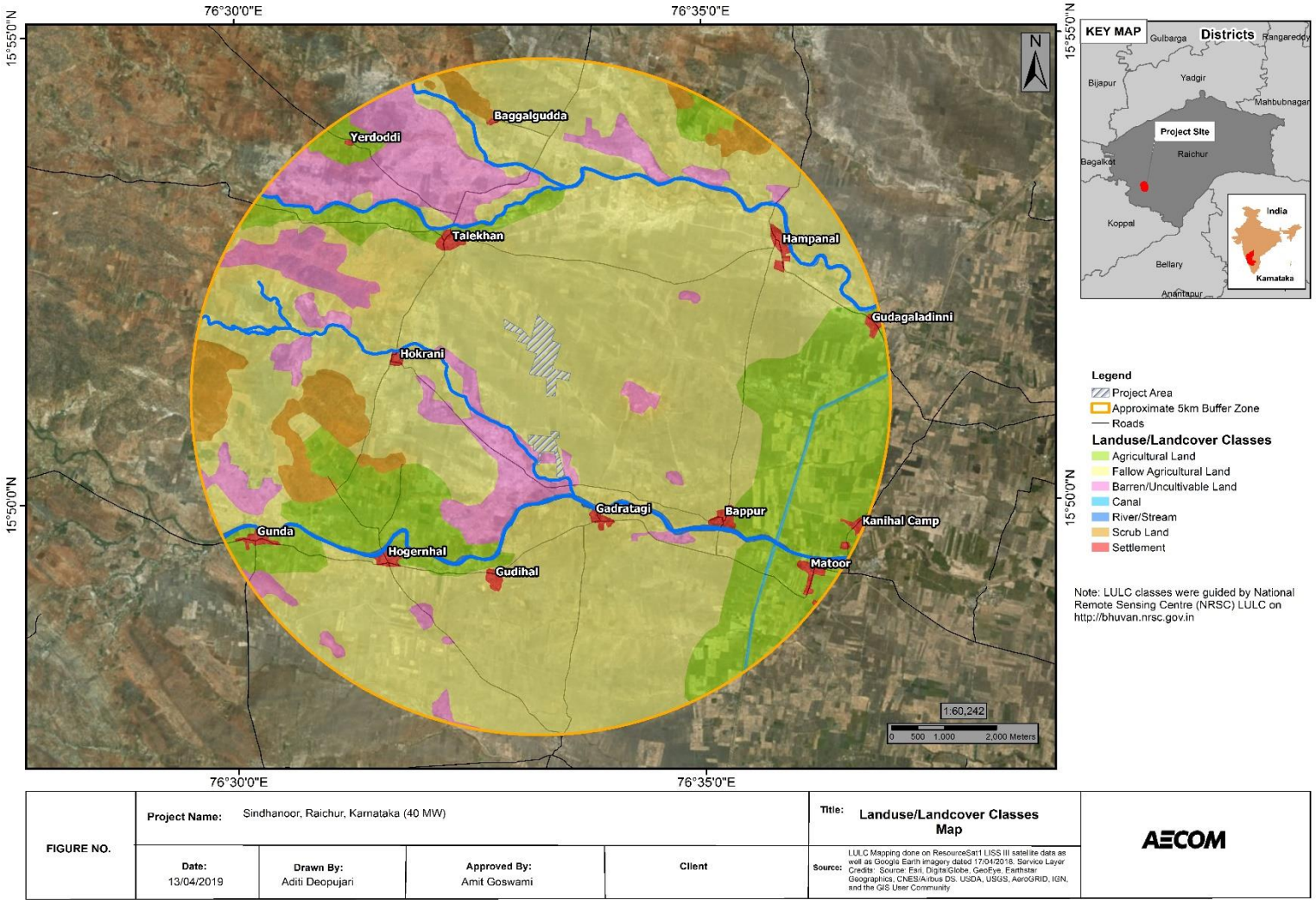


Figure 4-6: Landuse map of Study Area

Table 4-1: Landuse specific to project area

S. No.	Landuse Type	Area in Sq. km	% of total area
1.	Agricultural land	24.94	17.79
2.	Barren/Uncultivable land	16.26	11.60
3.	Canal	0.43	0.30
4.	Fallow Agricultural land	89.50	63.84
5.	River/stream	2.41	1.72
6.	Scrub land	5.23	3.73
7.	Settlements	1.42	1.01
Total Area in sq. km.		**140.18**	**100**

4.1.5 Soil Types

The soils of the district Raichur can be classified broadly into the following four types namely: Mixed red and black soils, Medium black soils, deep black soils and Red sandy soils.

The district comprises soil resources comprising 57.6 per cent of black soil and 42.4 per cent of red soil. Within the black soil, 44.2 per cent is deep black soil followed by 41.6 per cent medium black and 14.2 per cent shallow soils. Among the red soils, 48.9 per cent area is constituted by loamy soils while remaining 51.1 per cent comprises of sandy soils. The soils are poor in nitrogen, phosphorous, zinc and iron but rich in potassium.

The deep black soils have developed on schist and meta-basalts. Alluvial black soils are found along the Krishna river bank. They are clayey with shrinking and swelling characteristics and are well drained to moderately well drained with moderately slow to slow permeability. The red soils developed from granite are shallow to moderately deep, sandy to loamy with high gravel content. These soils are excessively drained to well drained with rapid to moderately rapid permeability.

Soil texture map of Raichur district is shown in the ***Figure 4-7*** below.

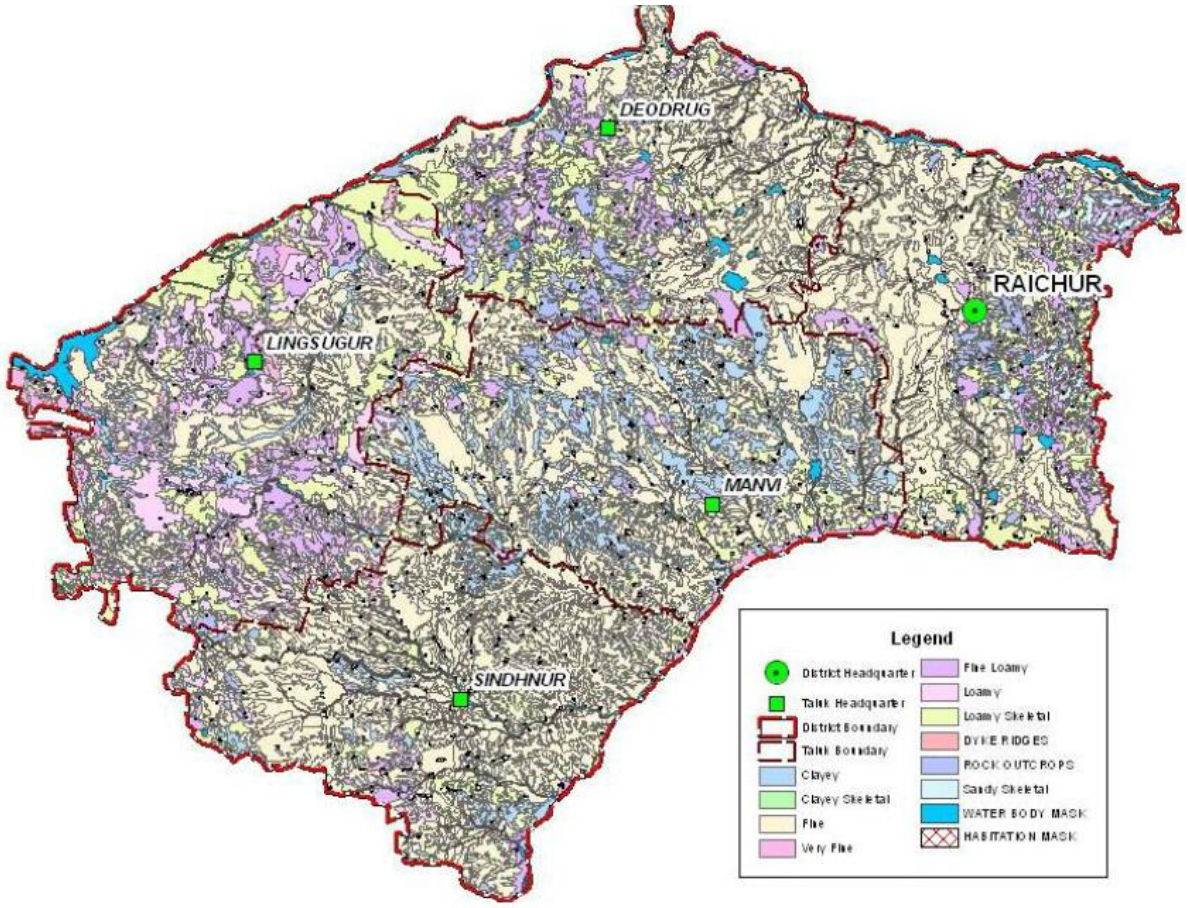


Figure 4-7: Soil Map of Raichur District

Source: Karnataka State Remote Sensing Application Centre (KSRSAC)

4.1.6 Hydrogeology

Granites, gneisses and Dharwar schists are the main rock formations in the district. These formations are grouped under 'hard rock', as they do not have any primary porosity. However, secondary porosity is developed due to faults, fractures, joints, and due to weathering, which improved permeability and water yielding capacity of these rocks. Ground water occurs under water table conditions in the weathered and jointed hard rock, and under confined to semi-confined conditions in the fractured rock. Since the district is covered predominantly by black cotton soils, which inhibit percolation and circulation of water, there are pockets of poor-quality ground water in the area. The hydrogeology of the Raichur district is shown in the ***Figure 4-8***.

The depth to water level in general varies from 0.65-m.bgl to10.70 m bgl in the area during the pre-monsoon period (May) and from 0.05m.bgl to 11.00 m bgl during the post monsoon (November) period.

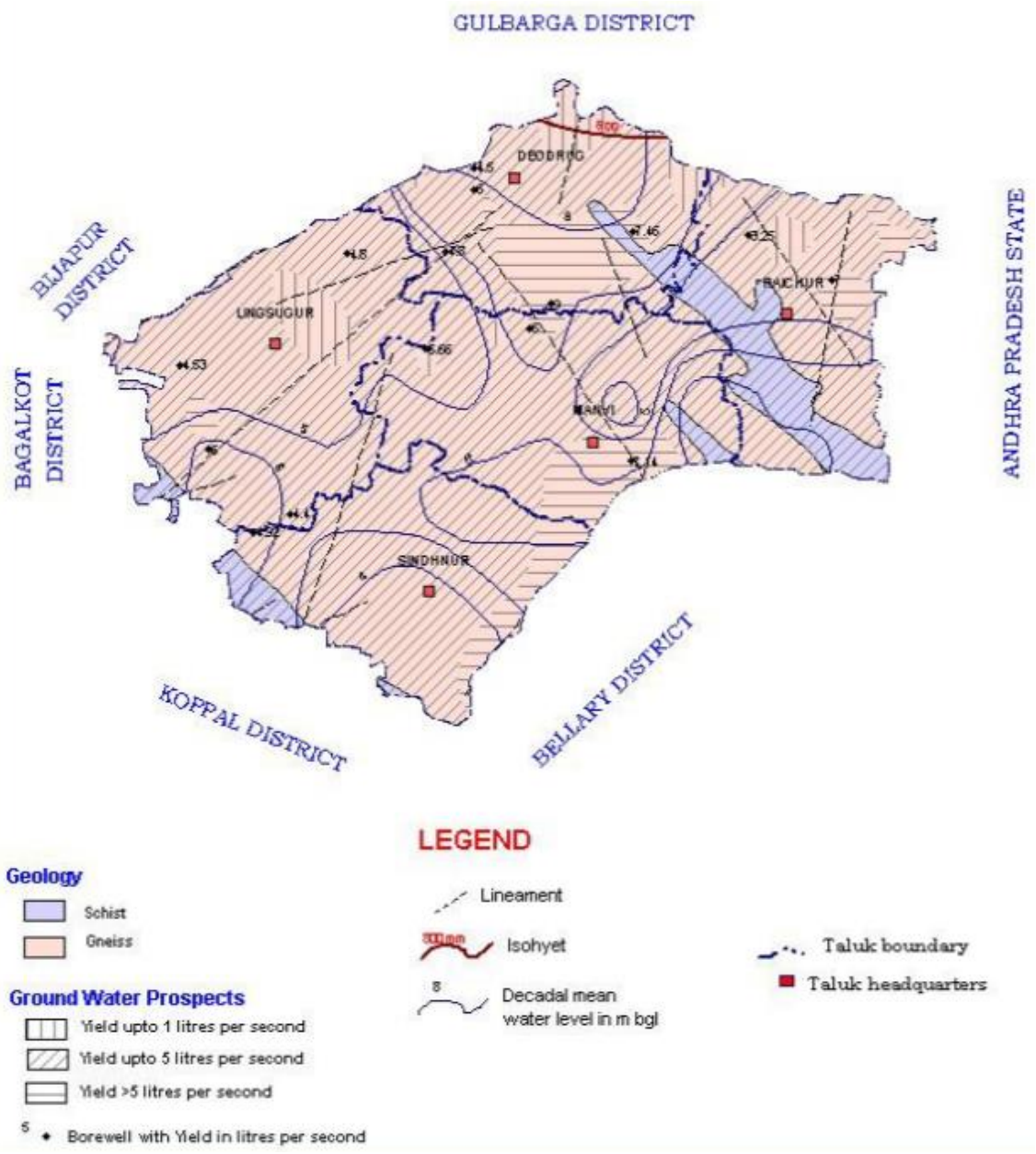


Figure 4-8: Hydrogeological map of Raichur District

Source: Ground Water Brochure, Raichur District, Karnataka, 2013

4.1.7 Climate and Meteorology

Karnataka located on the western coast, gets most of the precipitation form the southwest monsoon. The State enjoys three distinct climates varying with the seasons. The winter season from January to February is followed by summer season from March to May. The period from October to December forms the post-monsoon season.

Raichur district is located in the northern Maidan region of Karnataka state, which is drought prone and falls in the arid tract of the country.

The climate of Raichur district can be termed as mild to severe, with mild winters and hot summers. December is the coldest month with mean daily minimum of 17.7°C; while May is the hottest month with mean daily maximum temperature of 39.8°C. The day temperature in May often touches 45.0°C. Relative humidity of over 75% is common during monsoon period. Wind speed exceeding 15 km/h is common during the months of June and July.

The climate of the district is dry throughout the year except in the south-West monsoon months. The relative humidity is high during the South-West monsoon season and lower in the summer. The district enjoys four seasons:

- Summer season from middle of February to first week of June;
- Monsoon season from middle of June till the end of September;
- Post monsoon season during October and November months; and
- Cold season from December to middle of February.

The normal annual rainfall of the district is 621mm. The annual number of the rainy days is about 49 days. Nearly 67% of the rain is received during the southwest monsoon period (June- Sept) and the northeast monsoon contributes about 24%, during the post monsoon period.

4.1.7.1 Rainfall

The normal annual rainfall of the district is 621mm. The annual number of the rainy days is about 49 days. Nearly 67% of the rain is received during the southwest monsoon period (June- Sept) and the northeast monsoon contributes about 24%, during the post monsoon period.

Climate data published by Indian Meteorological Department (IMD), for Raichur for the period of 1981 to 2010 is given below in ***Table 4-2.***

Table 4-2: Meteorological Data based on observation from 1981 to 2010 for Raichur

Month	Mean Temperature		Relative Humidity (%)	Rainfall (mm)
	Daily Max (°C)	Daily Min (°C)		
January I[3]	31.1	17	53	3.2
II[4]			35	
February I	34.4	18.8	47	4
II			29	
March I	38	21.9	42	3.6
II			23	
April I	40.1	24.5	44	17.7
II			24	
May I	40.4	25	49	45.5
II			28	
June I	36	23.3	63	106.2
II			46	
July I	33	22.5	71	124.6
II			56	
August I	31.9	21.9	73	128.5
II			59	
September I	32.4	22.1	74	152.4
II			59	
October I	32.1	21.3	71	117.7
II			54	
November I	31	18.9	61	19.7
II			46	
December I	30.1	16.6	56	5.1
II			40	

[3] Average (Mean) value of the parameter at 0300 UTC for the month
[4] Average value of the parameter at 1200 UTC for the month

Month	Mean Temperature		Relative Humidity (%)	Rainfall (mm)
	Daily Max (°C)	Daily Min (°C)		
Total Annual Mean I			59	
Mean II	34.2	21.2	42	728.2
No. of Years			30	

Source: Climatological Tables of Observations in India (1981-2010), IMD report published 2015

Recent data for last five (05) years shows large variation in rainfall as shown in ***Table 4-3.***

Table 4-3: Average Annual Rainfall for Raichur District

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total Annual
2013	0.0	14.3	0.0	19.8	53.7	105.8	125.1	90.2	220.7	123.6	3.9	0.0	757.1
2014	0.0	2.6	27.6	17.6	95.0	32.4	62.6	249.4	91.2	61.5	3.5	8.1	651.5
2015	2.8	0.0	15.5	69.4	28.7	25.1	33.0	60.0	270.4	57.9	3.1	2.3	568.2
2016	1.2	0.0	0.0	2.4	33.7	125.8	119.0	53.3	213.6	16.2	0.0	2.0	565.2
2017	0.0	0.0	17.3	1.7	31.7	89.7	18.2	144.0	264.6	200.3	0.0	0.0	767.5
Monthly average	0.8	3.38	12.08	22.18	48.56	75.76	71.58	119.38	212.1	91.9	2.1	2.48	

Source: IMD (http://hydro.imd.gov.in/hydrometweb/(S(nse1kkuewh41dp45j3uc0iag))/DistrictRaifall.aspx)

4.1.7.2 Wind Speed

The wind blows in westerly to south-westerly direction during the southwest monsoon season. Strong wind prevails during this period. At the beginning of post monsoon and the cold season, the district experiences light winds and it blows in the directions between northeast and southeast. It blows in the same direction during the months of March and April. In the month of May, the winds are stronger than in March and April. The direction of the wind during the month is between southwest and northwest in the morning and changes its direction in the evening. Sometimes the depressions from Bay of Bengal after becoming diffused while crossing the eastern coast, causes strong winds and widespread rain in the district. Also, frequent thunderstorm occurs from March to June, September and October. Wind speeds exceeding 15km/h are common in Raichur district during the months of June and July.

Wind Hazard Map of Karnataka showing the project site is presented as ***Figure 4-9*** below. It can be noted that the Project site falls in Low damage risk zone B (V_b=33 m/s).

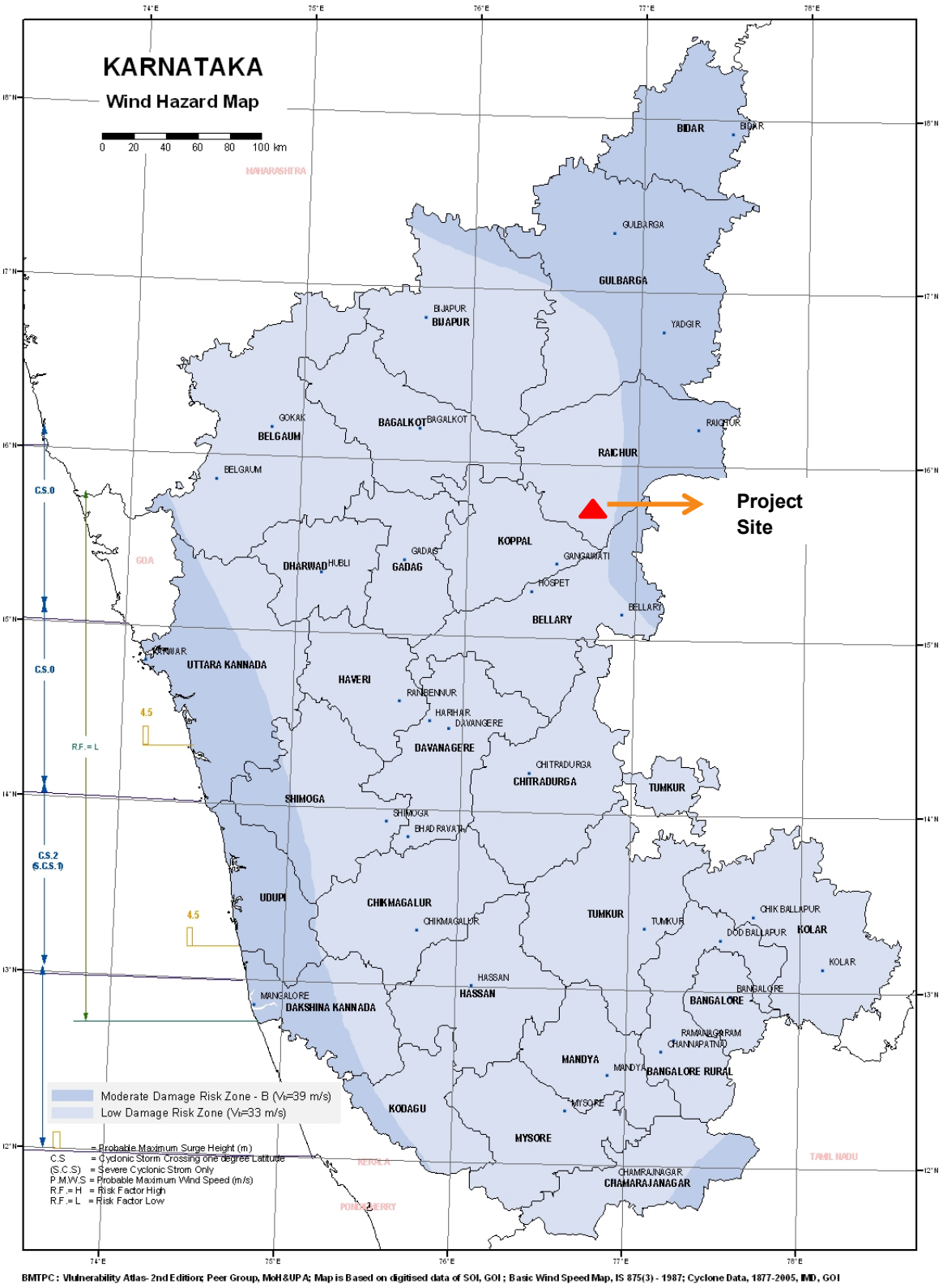


Figure 4-9: Wind Hazard Map of Karnataka showing Project District

Source: BMTPC Vulnerability Atlas: 2nd Edition, digitised on GOI Maps

4.1.7.3 Drought

Raichur district is located in the northern Maidan Region of Karnataka State, which is drought prone and falls in the arid tract. The Taluka Sindhanur and Lingsugur falls under the Northern dry Agro Climatic Zones (Zone 3) of the Karnataka State.

The Government of Karnataka has declared talukas as affected by the drought in 2018 for Kharif and Rabi season in 2018. Sindhanur Taluka in Raichur district has been declared as drought affected for Rabi season in 2018.

4.1.8 Seismicity

As per the Revised Earthquake Hazard Mapping, 22.13% of the total geographical area of the state is under 'moderate' earthquake damage risk zone and remaining area of the state is under 'low' damage risk zone. The Karnataka state is categorized as moderate to low seismic risk zone.

The solar power project under the Raichur District of Karnataka lies in seismic zone II (Low Damage Risk Zone (MSK VI) as can be seen in ***Figure 4-10*** below.

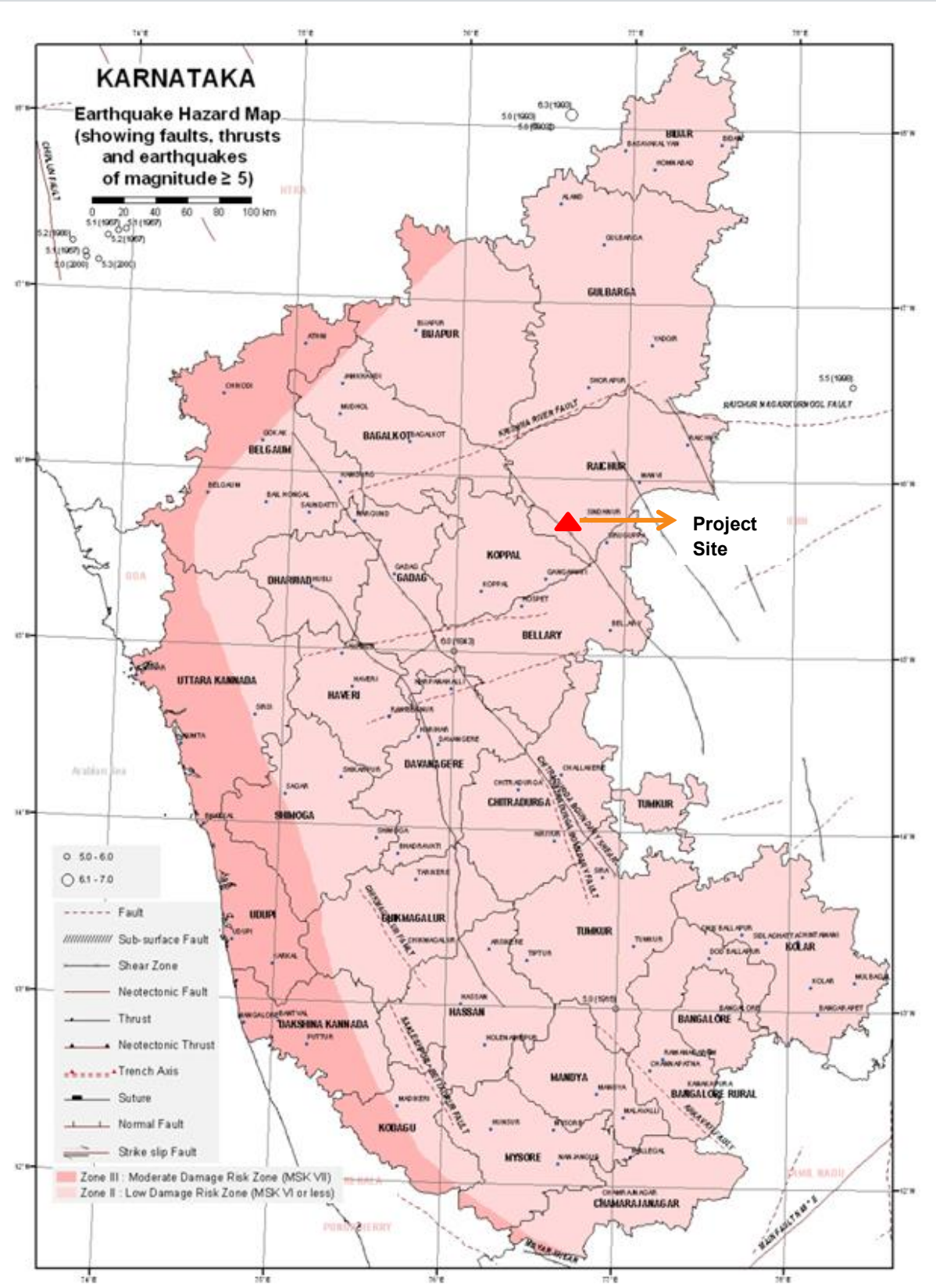


Figure 4-10:Earthquake Hazard Map of Karnataka State

Source: BMTPC Vulnerability Atlas: 2nd Edition, digitised on GOI Maps

4.1.9 Air, Water, Noise and Soil Baseline

In order to evaluate the environmental quality in the study area, monitoring was carried out for one season in the month of March 2019 at all the identified locations during site survey by an external laboratory, M/s Eco Services India Private Limited, which is accredited to National Accreditation Board for Testing and Calibration Laboratories (NABL) in accordance with ISO/IEC 17025:2005. The monitoring locations for Ambient air, noise, water quality and soil quality have been represented in the ***Figure 4-11*** below.

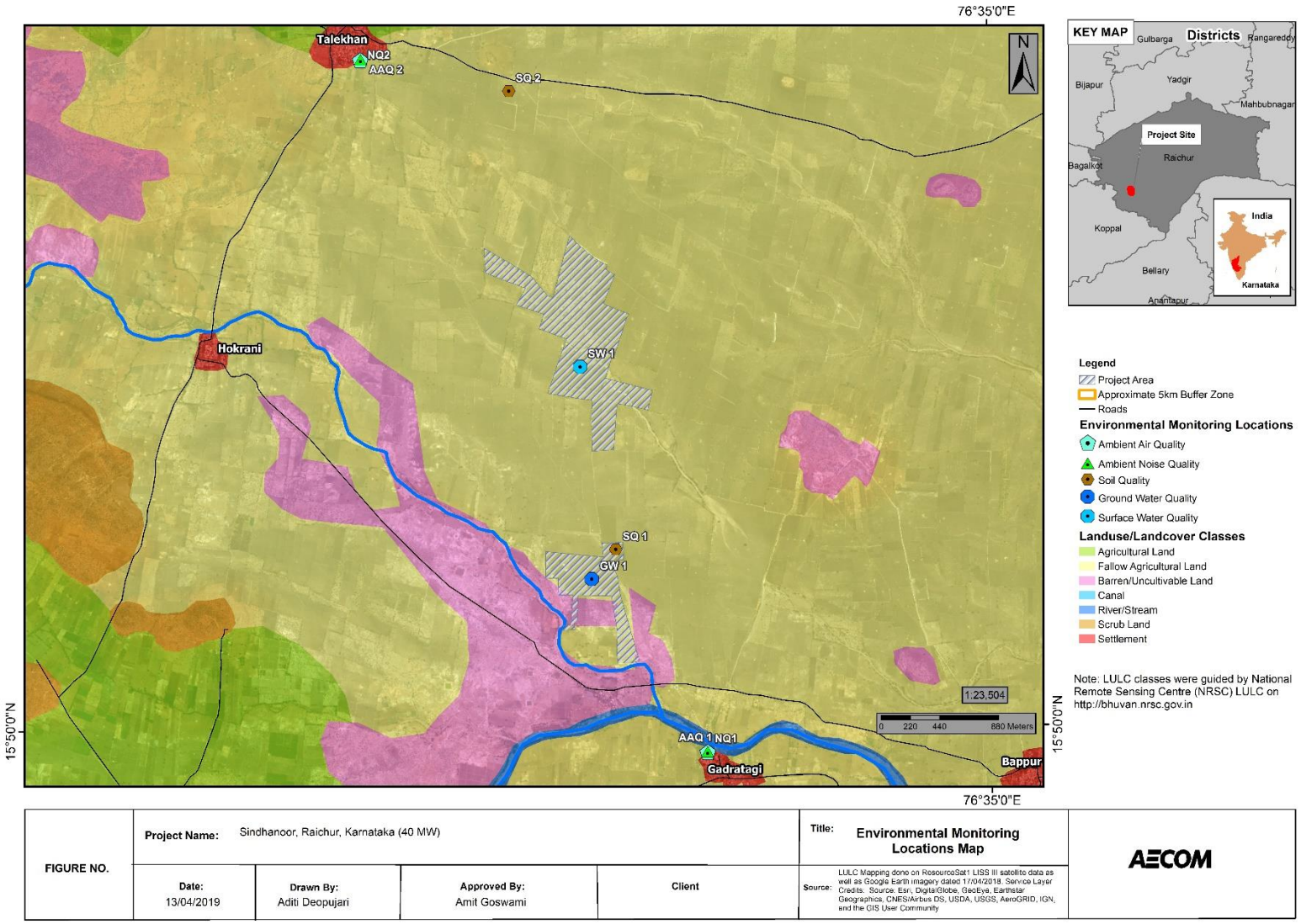


Figure 4-11: Environment Monitoring Locations for 40 MW Solar Project in Sindhanur

4.1.9.1 Ambient Air Quality

Solar power projects in particular do not cause any emissions during its operation phase and fugitive dust emissions are witnessed only during construction phase of the project.

Ambient air was monitored in the project area for the month of March to estimate the quality of ambient air. The air quality was analysed at two (02) locations to estimate the concentration of primary pollutants in the ambient air. The sampling locations were selected considering the presence of habitation nearby and their accessibility. The geographical coordinates of the ambient air monitoring locations selected has been provided in ***Table 4-4.***

Table 4-4: Air Quality Monitoring Locations

Sample Code	Geo-graphical Coordinates	Sampling Location
AAQ-1	15° 49.898'N, 76° 33.797'E	Gadratigi village (Sensitive receptor near to Site)
AAQ-2	15° 52.733'N, 76° 32.352'E	Talekat Village (Sensitive receptor near to Site)

Source: AECOM Site Survey, March 2019

The ambient air quality results were compared to the National Ambient Air Quality Standards (NAAQS, 2009) for residential area and the analysis results of air quality have been presented below in the ***Table 4-5***.

Table 4-5: Results of Ambient Air Monitoring

Pollutant	Time Weighted Average	*Concentration in Ambient Air (Industrial, Residential, Rural and Other Areas)*	AAQ-1	AAQ-2
Sulphur Dioxide (SO_2), µg/m^3	24 Hours	*80*	8.3	8.0
Nitrogen Dioxide (NO_2), µg/m^3	24 Hours	*80*	14.5	14.2
Particulate Matter (size less than 10 µm) or PM_{10}, µg/m^3	24 Hours	*100*	43	38
Particulate Matter (size less than 2.5 µm) or PM $_{2.5}$, µg/m^3	24 Hours	*60*	17	13
Ozone (O_3), µg/m^3	8 Hours	*100*	BDL (<5.0)	BDL (<5.0)
Lead (Pb), µg/m^3	24 Hours	*1*	BDL (<0.001)	BDL (<0.001)
Carbon Monoxide (CO), mg/m^3	8 Hours	*2*	BDL (<1.14)	BDL (<1.14)
Ammonia (NH_3), µg/m^3	24 Hours	*400*	BDL (<5.0)	BDL (<5.0)
Benzene (C_6H_6), µg/m^3	Annual	*5*	BDL (<1.0)	BDL (<1.0)
Benzo (O) Pyrene (BaP), particulate phase only, ng/m^3	Annual	*1*	BDL (<0.8)	BDL (<0.8)
Arsenic (As), ng/m^3	Annual	*6*	BDL (<1.0)	BDL (<1.0)
Nickel (Ni), ng/m^3	Annual	20	BDL (<0.3)	BDL (<0.3)

Source: Laboratory Results, April 2019

BDL: Below Detectable Limit

Inference

It was observed that the concentration of oxides of sulphur and oxides of nitrogen were well within the limits prescribed in NAAQS, 2009. The particulate matter was also observed to be well below the standards prescribed for residential area. Other parameters were not detected in the air samples at the locations sampled.

4.1.9.2 Ambient Noise Quality

Ambient Noise level was monitored continuously for 24 hours at two (02) locations around the project area at the identified receptor locations using Sound Level Meter. The noise levels obtained were analysed to arrive at the equivalent continuous noise level (Leq) for day and night time. The day and night time hours ranged from 06:00 to 22:00 hrs and 22:00 to 06:00 hrs respectively.

The sampling locations can be categorised as residential area. Therefore, the results of the ambient noise level monitoring presented in ***Table 4-7*** are compared with National Ambient Air Quality Standards (NAAQS) in respect of noise limits for day time and night time for residential area. The description and geographical coordinates of the monitoring locations is provided in the ***Table 4-6*** below.

Table 4-6: Details of noise quality monitoring locations

Sample Code	Geo-graphical Coordinates	Sampling Location
NQ-1	15° 49.898'N, 76° 33.797'E	Gadratigi village (Sensitive receptor near to Site)
NQ-2	15° 52.733'N, 76° 32.352'E	Talekat Village (Sensitive receptor near to Site)

Source: AECOM Site Survey, March 2019

Table 4-7: Results of Ambient Noise level monitoring

Location Code	*Noise Standard (Residential Area)*	NQ-1	NQ-2
L_{eq} Day dB (A)	*55*	47.7	51.6
L_{eq} Night dB (A)	*45*	43.1	43.6

Source: Laboratory Results, April 2019

Inference

It is observed that the noise levels at the monitoring locations was 47.7 dB (A) at Gadratigi village and 51.6 dB (A) at Talekat village during the daytime and 43.1 dB (A) and 43.6 dB (A) during night time respectively at the locations. The ambient noise levels at all the sampling locations were found to be within the noise standards for day time and night time for Residential Area.

4.1.9.3 Water Quality

The inhabitants of the Project villages near the Project site source their drinking and domestic use water from underground bore-wells in the villages. The households are also supplied with pipelined water from government supply.

Two (02) water samples, one from bore well at the Project Site, used for domestic purpose and module washing and one surface water sample from an artificial pond created at site by collecting rain water, proposed to be used for domestic purpose at the site were taken to assess the water quality of the Project area. Sample of groundwater was examined for physico-chemical, heavy metals and biological parameters as per standard testing procedures and compared to Drinking Water Standards, IS 10500: 2012. The results of the surface water sample are compared with the CPCB classification of quality for the inland surface water. Location details and geographical coordinates of the sampling locations are presented in ***Table 4-8.***

Table 4-8: Details of Water Quality Monitoring Locations

S. No.	Location Code	Geographical Coordinates	Sampling Locations
1.	GW 1	15° 50.607'N, 76° 33.312'E	Borewell at site (Ground water source)
2.	SW 1	15° 51.474'N, 76° 33.270'E	Artificial Pond at site (to be used in future for domestic purpose)

Source: AECOM Site Survey, March 2019

Table 4-9 presents the results of analysis of the ground water samples which are compared with acceptable and permissible limits as specified in the drinking water standards IS 10500:2012.

Table 4-9: Results of Ground Water and Surface Water Quality Analysis

S. No.	Parameters	Unit	GW1	SW1	*AL(PL) as per IS: 10500 (2012)*
1.	Colour	Hazen	BDL	BDL	*5 (15)*
2.	Odour	-	Agreeable	Agreeable	*Agreeable*
3.	Taste	-	Agreeable	Agreeable	*Agreeable*
4.	Turbidity	NTU	BDL (<1.0)	40	*1(5)*
5.	pH	-	7.25	8.07	*6.5-8.5 (NR)*
6.	Dissolved Oxygen (DO)	mg/l	-	6.3	-
7.	Biological Oxygen Demand (BOD)	mg/l	-	5	-
8.	Chemical Oxygen Demand (COD)	mg/l	-	16	-
9.	Electrical Conductivity	µmhos/cm	2071	384	-
10.	Total Dissolved Solids	mg/l	**1160**	215	*500 (2000)*
11.	Total Alkalinity as $CaCO_3$	mg/l	**352**	120	*200 (600)*
12.	Total Hardness as $CaCO_3$	mg/l	**472**	62	*200 (600)*
13.	Chloride as Cl	mg/l	208	10	*250 (1000)*
14.	Sulphate as SO_4	mg/l	241	22	*200 (600)*
15.	Fluoride as F	mg/l	0.8	1.1	*200 (600)*
16.	Nitrate as NO_3	mg/l	10	2	*250 (1000)*
17.	Phenolic Compound as C_6H_5OH	mg/l	BDL	BDL	*0.001 (0.002)*
18.	Sulphide as S^{2-}	mg/l	BDL	BDL	*0.05 (NR)*
19.	Calcium as Ca	mg/l	**101**	20	*75 (200)*
20.	Magnesium as Mg	mg/l	**53**	3	*30 (100)*
21.	Iron as Fe	mg/l	BDL	0.5	*0.3 (NR)*
22.	Mercury as Hg	mg/l	BDL	BDL	*0.001 (NR)*
23.	Cadmium as Cd	mg/l	BDL	BDL	*0.003 (NR)*
24.	Arsenic as As	mg/l	BDL	BDL	*0.01 (0.05)*
25.	Lead as Pb	mg/l	BDL	BDL	*0.01 (NR)*
26.	Manganese as Mn	mg/l	BDL	BDL	*0.1 (0.3)*
27.	Zinc as Zn	mg/l	BDL	BDL	*5 (15)*
28.	Total Chromium as Cr	mg/l	BDL	BDL	*0.05 (NR)*
29.	Copper as Cu	mg/l	BDL	BDL	*0.05 (1.5)*
30.	Boron as B	mg/l	BDL	BDL	*0.5 (1.0)*
31.	Nickel as Ni	mg/l	BDL	BDL	*0.02 (NR)*
32.	Selenium as Se	mg/l	BDL	BDL	*0.01 (NR)*
33.	Free Residual Chlorine	mg/l	BDL	BDL	*0.2 (1.0)*
34.	Aluminium as Al	mg/l	BDL	BDL	*0.03 (0.2)*
35.	Ammonia as N	mg/l	BDL	BDL	*0.5 (NR)*
36.	Barium as Ba	mg/l	BDL	BDL	*0.7 (NR)*
37.	Pesticides	-	ND	ND	*- (NR)*
38.	Mineral Oil	mg/l	BDL	BDL	*0.5 (NR)*
39.	Silver as Ag	mg/l	BDL	BDL	*0.1 (NR)*
40.	Cyanide as CN	mg/l	ND	ND	*0.01 (NR)*

S. No.	Parameters	Unit	GW1	SW1	*AL(PL) as per IS: 10500 (2012)*
41.	Molybdenum as Mo	mg/l	BDL	BDL	*0.07 (NR)*
42.	Chloramines as Cl_2	mg/l	ND	ND	*4.0 (NR)*
43.	Polychlorinated Biphenyl (PCB)	mg/l	ND	ND	*0.005 (NR)*
44.	Polynuclear aromatic hydrocarbons (PAH)	mg/l	ND	ND	*0.0001 (NR)*
45.	Anionic Detergents as MBAS	mg/l	BDL	BDL	*0.2 (1.0)*
46.	Total Coliform	MPN/100 ml	110	<2	*Shall not be detectable in any 100 ml sample*
47.	E. Coli	-	<2	<2	*Shall not be detectable in any 100 ml sample*

Source: Laboratory Results, April 2019, ND- Not Detected

Note: AL- Acceptable Limit; PL – Permissible Limit; NR – No Relaxation as per IS10500:2012

Inference

- **Ground Water:** The pH value of the sample was observed to be within the prescribed range indicating neutral balance. The Hardness, Total dissolved solids and alkalinity value in the ground water sample exceeds the acceptable limit but is within the permissible limit. It can be inferred that water is hard in nature. Chemical parameters such as Chloride, Sulphate and Fluoride are within the acceptable limit. Calcium and Magnesium were noted to be exceeding the Acceptable limit but is within the Permissible limit. Other heavy metal parameters are below detectable limit. The ground water sample also shows presence of significant number of total coliforms. The presence of bacterial contamination is an indicator that a potential health risk exists for individuals consuming this water directly without disinfection. Coliform bacteria may occur in water samples as a result of the overflow of domestic sewage or nonpoint sources of human and animal waste. All other parameters were observed to be within the Acceptable limits as specified in the drinking water standard of IS 10500:2012.
- **Surface Water:** The surface water sample has DO of 6.3 mg/l with pH value of 8.07, BOD of 5 mg/l and Total coliform of <2/100ml. Mineral and metal parameters such as Magnesium, Ammonia and Iron were found to be well within the Acceptable Limits.

4.1.9.4 Soil Environment

Soil samples from two (02) locations were collected and analysed to evaluate the soil quality for physio-chemicals and heavy metals concentration in soil in the environment study area. The details of the soil quality monitoring locations are given in the ***Table 4-10.***

Table 4-10: Details of Soil Quality Monitoring Locations

S. No.	Sampling Locations	Location Code	Geographical Location
1	SQ 1	15° 50.728'N, 76° 33.415'E	Project Site (Labour camp site during construction phase)
2	SQ 2	15° 52.602'N 76° 32.978'E	Soil quality of Farmlands near Site

Source: AECOM Site Survey, March 2019

The physical and chemical characteristics of the soil samples were evaluated and compared with the standard soil classification provided by the Indian Council of Agricultural Research (ICAR) as depicted in the ***Table 4-11 below:***

Table 4-11: Standard Soil Classification

Soil Parameters	Classification	
pH	Normal to saline	6.0 to 8.5
	Tending to become alkaline	8.5-9.0
	Alkaline	Above 9.0
Electrical conductivity (mmhos/cm)	Up to 1.00 – Normal	

Soil Parameters	Classification
	1.01- 2.00- Critical to germination
	2.01-4.00- Critical for growth of the sensitive crops
	Above 4.00 – Injurious to most crops

Source: Indian Council of Agricultural Research, New Delhi

The results of soil quality analysis have been presented in the ***Table 4-12*** below:

Table 4-12: Results of Soil Quality Analysis

S. No.	Parameters	Unit	Sampling Locations	
			SQ1	SQ2
1	pH	-	7.72	8.74
2	Electrical Conductivity	µmhos/cm	481	988
3	**Texture**			
	Sand	%	10	12
	Silt	%	5	6
	Clay	%	83	80
4	Phosphorous (as P)	µg/g	0.2	0.3
5	Potassium (as K)	m.eq/100g	3.2	5
6	Sodium (as Na)	m.eq/100g	10	12
7	Total Nitrogen (as N)	%	0.22	0.168
8	Cation Exchange Capacity	Meq/l	48	40
9	Permeability	%	2	2
10	Porosity	%	5	5.3
11	**Particle Size Distribution**			
	10 mm	%	0.2	0.16
	4.75 mm	%	18	19
	2 mm	%	3.4	21
	425 microns	%	40	43
	75 microns	%	2.0	5

Source: Laboratory Results, April 2019

Inference

It can be inferred from the results that the soil samples analysed show varied characteristics. The pH value of the soil sample SQ1 indicates normal to saline condition whereas SQ 2 is tending to become alkaline. Electrical conductivity of soil samples varies from 481-988 µmhos/cm indicating that soil falls under Normal category. The Phosphorous value in the sample SQ1 is 0.2 µg/g whereas in SQ 2 is 0.3 µg/g. Nitrogen values in the samples ranges from 0.22-0.168% and the Sodium concentration ranges from 10-12 m.eq/100g. The cation exchange capacity ranges from 40-48 for the samples. The samples are about 5—5.3% porous whereas the permeability in of both of the samples is 2%.

As per the Soil texture diagram (shown below in the Figure 4-12) prescribed by the United States Department of Agriculture (USDA), it can be deciphered that the texture of soil sample SQ 1, i.e. the soil at the project site is “Clay soil”, and the texture of soil sample SQ 2, the soil in the Farmlands near Project site is also “Clay soil”.

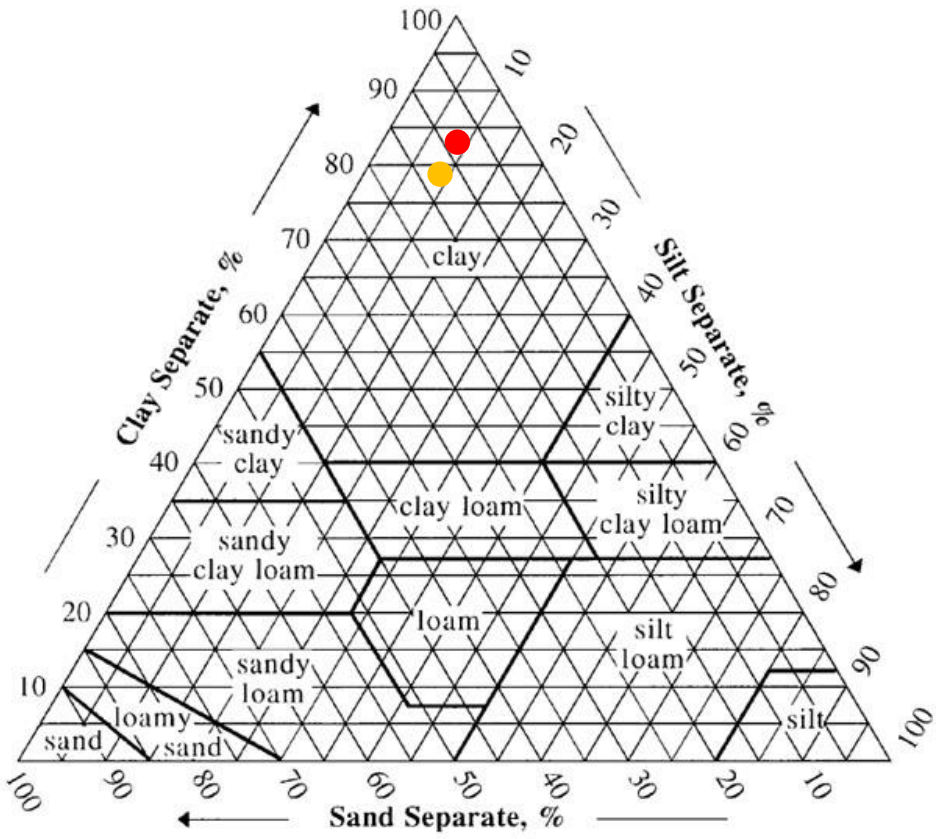


Figure 4-12: Soil Texture Diagram

(Source: United States Department of Agriculture
https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/?cid=nrcs142p2_054167)

4.2 Ecological Environment

This section of the report provides a summary of the terrestrial ecology assessment carried out towards the ESIA for the project. It outlines the survey methodology used and describes the study area's existing ecological baseline conditions. This baseline data is used to predict potential impacts of the project on the biodiversity of the study area and suggest mitigation measures to manage the predicted impacts.

The area falling under the direct footprint of the project infrastructure is referred to in this section as the 'Project Site'. The project site, along with an area extending outward up to a distance of approximately 5 km from the Project Site boundary, was delineated as the area to be studied towards this ecological assessment and is referred to in this section as the 'Study Area'.

The project was observed to be in operation on the days of the site visit on 3rd and 4th March 2019, with approximately 90 % construction work for the project completed. The construction of internal roads, culverts, storm water channels and some sections of the site boundary wall, as also, installation of street-lights was noted to be in progress at the site and was expected to be completed by April 2019.

4.2.1 Ecological Description of the Study Area

The Study Area represents a tract of land located in the Deccan plateau region of Karnataka State. The overall terrain of the Study Area is flat, fragmented by a few ridges and hills. All the solar panels occupy plains of the Study Area, mainly uncultivated farmlands.

The natural habitats in the Study Area are mainly represented by patches of natural vegetation on the slopes of ridges and hills, uncultivated patches, as well as, along the banks of seasonal streams. Other natural habitats in the Study Area include seasonal distributaries of Tungabhadra river and a few seasonal streams and lakes. The

modified habitats in the Study Area are represented by agricultural lands, tar and dirt roads, ponds, bore-wells, habitations and solar power installations. Most of the cultivable plains in the Study Area are utilized for agricultural purposes. The soil in the Study Area is black cotton soil that supports various food, fibre, timber crops.

Significant waterbodies in the Study Area are seasonal distributaries of Tungabhadra river flowing through the northern and southern parts of the Study Area. Habitat fragmenting features are mainly represented by a number of minor metalled roads, dirt roads, small canals and power transmission lines, which interrupt the terrestrial and aerial habitats of the Study Area.

4.2.2 Methodology

The ecological baseline of the Study Area is generated on the basis of primary data recorded through field studies conducted on 3rd and 4th March, 2019 and supported by secondary data collated from a range of legitimate sources. The information sources are quoted at the pertinent places in the sub-sections.

4.2.2.1 Primary Data

Primary data on floristic and faunal species was collected at 10 sites representing the observed habitat-profile of the Study Area.

At each site, floristic diversity was recorded using the standard quadrat study methodology. Quadrats of size 20 m x 20 m were laid for recording trees, large shrubs and large woody climbers, 5 m x 5 m for small shrubs and 1m x 1 m for herbs. For each quadrat, the different species and the number of individuals of each species present within the quadrat area were noted.

At each site, faunal diversity was recorded through both, direct evidence, that is, visual sightings, and indirect evidence, such as calls, nests, burrows, droppings, scats, moults and tracks. While recording primary data on fauna, only occurrence of a species at a given site was noted, without enumerating the individuals sighted.

The timing of the primary data collection covered most of the diurnal faunal activity-period, from mid-morning till early evening. The focus of the primary data collection was limited to the higher flora, namely angiosperms, and the higher fauna, namely vertebrates.

Based on the primary data, percentage-frequency, abundance and density per hectare were calculated for each plant-species recorded, while percentage frequency was calculated for each bird-species recorded. The following formulae for calculating % frequency, abundance and density were used:

% Frequency of species A = Number of quadrats of occurrence of species A/ Total number of quadrats studied X100

Abundance of species A = Number of individuals of species A in total quadrats studied/ Number of quadrats of occurrence of species A

Density of species A = Number of individuals of species A in total quadrats studied/ Total area studied for species A (in hectares)

Table 4-13 presents the details of the 10 quadrat sites, including the assigned code, location co-ordinates, elevation above mean sea level (amsl), distance and direction from the Project Site boundary and associated habitat type(s) of each quadrat site. **Figure 4-13** presents a map showing the locations of the quadrat sites.

Table 4-13: Details of the Quadrat Sites

Quadrat Site	Location Co-ordinates	Elevation (m)	Direction and distance (km) from the Project Site boundary	Habitat Type(s)
Q1	15° 51' 58.19" N, 76° 33' 10.53" E	465	W, 0.07	Natural vegetation
Q2	15° 50' 58.82" N, 76° 34' 22.63" E	460	E, 1.57	Natural vegetation
Q3	15° 49' 41.45" N, 76° 35' 08.74" E	437	E, 3.12	River
Q4	15° 49' 56.01" N, 76° 34' 42.15" E	443	E, 2.27	Natural vegetation
Q5	15° 50' 13.32" N, 76° 33' 24.73" E	447	S, 0.06	Seasonal stream

Q6	15° 49' 59.66" N, 76° 33' 11.22" E	446	SW, 0.58	River, Natural vegetation
Q7	15° 49' 19.87" N, 76° 32' 07.58" E	456	SW, 2.55	Natural vegetation
Q8	15° 50' 48.66" N, 76° 31' 18.24" E	491	W, 3.25	Knoll, Natural vegetation
Q9	15° 51' 38.79" N, 76° 31' 42.08" E	468	W, 2.29	River, Natural vegetation
Q10	15° 52' 57.82" N, 76° 32' 22.13" E	472	N, 2.22	River, Natural vegetation

Source: AECOM Primary Survey

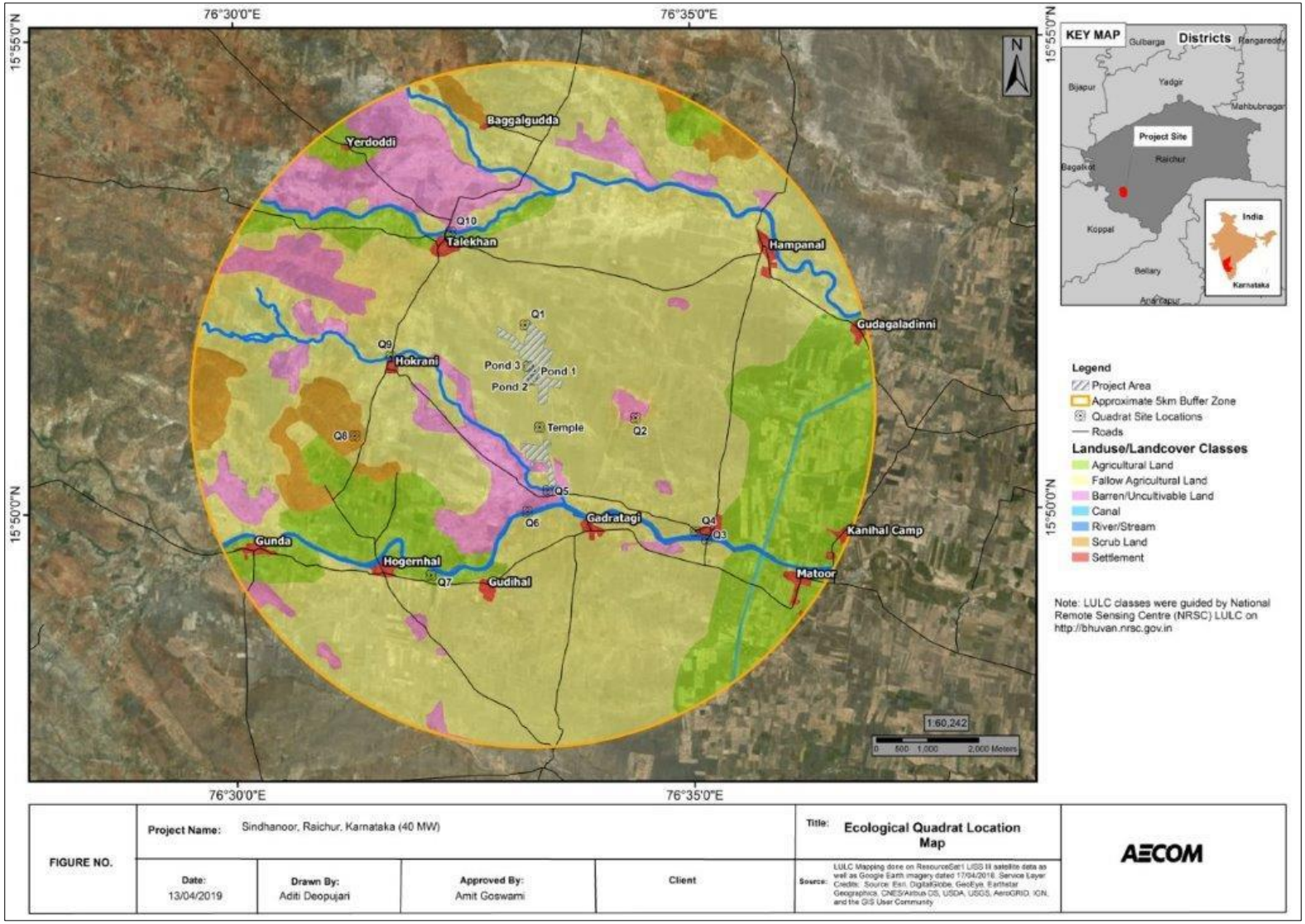


Table 4-14: Map showing the Quadrat Site locations

4.2.2.2 Secondary Data

Study Area-specific secondary data was collected, as available, from local government offices, project site-personnel and members of the local community. Additional suitably authenticated secondary data was collated from sources in the public domain, including research journals, standard field guides and websites maintained by internationally recognized conservation organizations, such as IUCN, Birdlife International, WWF & Wetlands International.

4.2.3 Higher Flora of the Study Area

4.2.3.1 Forest Types

According to the Champion and Seth Classification of Indian Forests, the natural vegetation of the Study Area represents the following forest-type.

Type 6A/C1 (Sub-group 6A - Southern Tropical Thorn Forest, Sub-division C1 – Southern Thorn Forest)

These forests are seen in peninsular India, throughout the dry tract to the lee of the Western Ghats. They are met with on shallow dry soil, or deep but sandy soil. The ground is usually flat or in the form of low undulating hills and plateaux.

It is an open and low forest dominated by thorny species. The trees tend to be short with low-branching crowns that rarely meet to form a canopy. There is an ill-defined lower storey of large and small shrubs which tend to be spiny and show various xerophytic characters. A thin growth of grass appears during the moist season, but the ground remains largely bare through the rest of the year. Climbers are few, with most showing xerophytic adaptations.

The formation of this forest type is usually resulted from excessive tree cutting and browsing. If given protection, such areas are likely to experience regeneration of elements of a Tropical Dry Deciduous Forest.

Species associated with this forest-type include:

Trees such as *Vachellia* spp.*, Albizia* spp.*, Azadirachta indica, Butea monosperma, Grewia* spp.*, Pongamia pinnata, Morinda citrifolia* and *Ziziphus* spp.;

Shrubs such as *Capparis* spp., *Gymnosporia senegalensis*, *Gymnosporia montana, Calotropis gigantea* and *Calotropis procera;*

Herbs such as *Alternanthera sessilis, Celosia argentea, Croton bonplandianus, Euphorbia hirta, Hyptis suaveolens*, *Rungia* spp. and *Sida* spp.;

Climbers such as, *Cocculus hirsutus, Cucumis* sp., *Cyclea peltata* and *Rhynchosia* sp.;

Grasses such as *Anderopogon* sp., *Apluda mutica*, *Aristida* sp., *Dimeria* sp., *Eleusine* sp. *Heteropogon contortus* and *Themeda* sp.

Source: H.G. Champion & S. K. Seth (2005). A Revised Survey of the Forest Types of India. Natraj Publishers, Dehradun.

Thorn forest patch in the Study Area

Source: AECOM Primary Survey

4.2.3.2 Flora Recorded in the Quadrats

A total of 37 species of angiosperms has been recorded in the quadrats studied during the field studies. These include 18 woody species, which predominantly form the perennial ground-cover of the Study Area, and 19 non-woody species, which largely form the annual or seasonal ground-cover of the Study Area.

Table 4-14 lists the plant species and presents details of quantitative floristic data recorded during the quadrat studies carried out at the 10 aforementioned locations. The woody and non-woody floristic species are listed in separate sections, along with details of each species, including its scientific name, local name, habit, the family in which it is placed as per the APG-IV classification system for angiosperms, percentage frequency, abundance and density.

Table 4-15: Details of floristic species recorded in the quadrats

S. No.	Scientific Name	Local Name	Habit	Family	% frequency	Abundance	Density
Woody Species							
1	*Aegle marmelos*	Bilvapatre	Tree	Rutaceae	30.00	01.00	07.50
2	*Azadirachta indica*	Bevu mara	Tree	Meliaceae	70.00	01.71	30.00
3	*Balanites aegyptiaca*	-	Tree	Zygophyllaceae	20.00	01.50	07.50
4	*Calotropis gigantea*	Ekkada gida	Shrub	Apocynaceae	60.00	01.00	15.00
5	*Calotropis procera*	Bili ekkada gida	Shrub	Apocynaceae	30.00	01.00	07.50
6	*Capparis decidua*	Kariuppi gida	Tree	Capparaceae	40.00	01.50	15.00
7	*Cryptostegia grandiflora*	Hambu rubber gida	Shrub	Apocynaceae	50.00	01.00	12.50
8	*Dicrostachys cinerea*	Vadavarda gida	Tree	Fabaceae	30.00	01.33	10.00
9	*Jatropha glandulifera*	Thotali gida	Shrub	Euphorbiaceae	20.00	01.00	05.00
10	*Ipomoea carnea*	-	Shrub	Convolvulaceae	40.00	04.50	45.00
11	*Phoenix sylvestris*	Ichalu mara	Tree	Arecaceae	50.00	02.40	30.00
12	*Prosopis cineraria*	Banni	Tree	Fabaceae	40.00	02.25	22.50
13	*Prosopis juliflora*	Sarkari jali	Tree	Fabaceae	80.00	03.25	65.00
14	*Salvadora persica*	Krigoni mara	Tree	Salvadoraceae	10.00	01.00	02.50
15	*Senna auriculata*	Honambre gida	Undershrub	Fabaceae	50.00	02.80	35.00

S. No.	Scientific Name	Local Name	Habit	Family	% frequency	Abundance	Density
16	*Vachellia nilotica* subsp. *nilotica*	Gobli	Tree	Fabaceae	80.00	01.12	22.50
17	*Vachellia nilotica* subsp. *cupressiformis*	-	Tree	Fabaceae	40.00	01.00	10.00
18	*Ziziphus jujuba*	Bugari mara	Tree	Rhamnaceae	50.00	01.60	20.00
Non-woody Species							
19	*Aristida* sp.	-	Herb	Poaceae	60.00	02.00	30.00
20	*Arundinella* sp.	-	Herb	Poaceae	20.00	02.50	12.50
21	*Chloris barbata*	Manchada kalu hullu	Herb	Poaceae	20.00	03.00	15.00
22	*Cocculus hirsutus*	Dhagadiballi	Climber	Menispermaceae	50.00	01.60	20.00
23	*Coelachne* sp.	-	Herb	Poaceae	20.00	01.50	07.50
24	*Dicanthium* sp.	-	Herb	Poaceae	30.00	02.67	20.00
25	*Dimeria* sp.	-	Herb	Poaceae	40.00	03.00	30.00
26	*Eleusine* sp.	-	Herb	Poaceae	60.00	01.67	25.00
27	*Eragrostis* sp.	-	Herb	Poaceae	40.00	02.25	22.50
28	*Euphorbia heterophylla*	Halalubu	Herb	Euphorbiaceae	30.00	01.67	12.50
29	*Euphorbia hirta*	Halukudi	Herb	Euphorbiaceae	20.00	02.00	10.00
30	*Heteropogon contortus*	Oobu hullu	Herb	Poaceae	40.00	03.50	35.00
31	*Hyptis suaveolens*	Natitulasi	Herb	Lamiaceae	50.00	02.40	30.00
32	*Parthenium hysterophorus*	-	Herb	Asteraceae	40.00	01.50	15.00
33	*Sida acuta*	Bheemana kaddi	Herb	Malvaceae	30.00	01.00	07.50
34	*Themeda quadrivalvis*	-	Herb	Poaceae	50.00	01.60	20.00
35	*Themeda triandra*	-	Herb	Poaceae	30.00	01.67	12.50
36	*Tridax procumbens*	Kari balli	Herb	Asteraceae	60.00	03.33	50.00
37	*Typha angustifolia*	Aapu gida	Herb	Typhaceae	10.00	28.00	70.00

Source: AECOM Primary Survey

Capparis decidua

Senna auriculata

	
Balanites aegyptiaca	*Jatropha glandulifera*
	
Salvadora persica	*Prosopis cineraria*

Source: AECOM Primary Survey

4.2.3.3 Higher Fauna of the Study Area

This section of the report presents the details of the higher faunal species, namely vertebrates, comprising mammals, birds, reptiles, amphibians and fishes, having recorded ranges that include the Study Area. The detailed species-tables are provided as annexures to this report. Each annexed table gives the scientific and common names of each species, the conservation status assigned to it by the International Union for Nature and Natural Resources (IUCN) and the Schedule of the Wildlife Protection Act, 1972 (WPA) under which it is listed. Names of the species recorded during the field studies appear in **bold** font in each annexed table.

Mammals

At least 40 species of mammals have recorded ranges that include the study area. None of these species was recorded during the field studies. Significant species with respect to IUCN include 3 globally threatened species, comprising 01 designated as Endangered, namely, Indian Pangolin (*Manis crassicaudata*) and 03 designated as Vulnerable, namely, Four-Horned Antelope (*Tetracerus quadricornis*), Sambar (*Rusa unicolor*) and Asian Small-clawed Otter (*Aonyx cinereus*). Significant species with respect to the WPA include 09 species that are listed in Schedule I, namely, Indian Chevrotain (*Moschiola indica*), Four-Horned Antelope (*Tetracerus quadricornis*), Blackbuck (*Antilope cervicapra*), Leopard (*Panthera pardus*), Fishing Cat (*Prionailurus viverrinus*), Grey Wolf (*Canis lupus*), Honey Badger (*Mellivora capensis*), Asian Small-clawed Otter (*Aonyx cinereus*) and Indian Pangolin (*Manis crassicaudata*). All of these species have large known ranges beyond the study area and hence, are not deemed as species of conservation concern with respect to the Study Area.

Appendix D presents details of the mammals of the Study Area.

Birds

At least 236 species of birds, including 166 resident and 70 migratory species, have recorded ranges that include the Study Area. Of these, 17 species were recorded in the Study Area during the field studies. Significant species

with respect to IUCN include 7 globally threatened species, comprising 03 designated as Critically Endangered, namely White-rumped Vulture (*Gyps bengalensis*), Indian Vulture (*Gyps indicus*) and Red-headed Vulture (*Sarcogyps calvus*), 02 designated as Endangered, namely, Lesser Florican (*Sypheotides indicus*) and Egyptian Vulture (*Neophron percnopterus*) and 2 designated as Vulnerable, namely, Woolly-necked Stork (*Ciconia episcopus*) and Common Pochard (*Aythya ferina*) and 10 designated as Near Threatened, namely, Painted Stork (*Mycteria leucocephala*), Black-headed Ibis (*Threskiornis melanocephalus*), Red-necked Falcon (*Falco chicquera*), Laggar Falcon (*Falco jugger*), Great Thick-knee (*Esacus recurvirostris*), River Tern (*Sterna aurantia*), Darter (*Anhinga melanogaster*), Pallid Harrier (*Circus macrourus*), Black-tailed Godwit (*Limosa limosa*) and Eurasian Curlew (*Numenius arquata*). Significant species with respect to the WPA schedule include 10 species that are listed in schedule I, namely, Indian Peafowl (*Pavo cristatus*) Eurasian Spoonbill (*Platalea leucorodia*), Red-necked Falcon (*Falco chicquera*), Laggar Falcon (*Falco jugger*), White-rumped Vulture (*Gyps bengalensis*), Indian Vulture (*Gyps indicus*), Shikra (*Accipiter badius*), Lesser Florican (*Sypheotides indicus*), Peregrine Falcon (*Falco peregrinus*) and Osprey (*Pandion haliaetus*) All these species have large known ranges beyond the study area and hence, are not deemed as species of conservation concern with respect to the Study Area.

Appendix E presents details of the resident birds and ***Appendix F*** presents details of the migratory birds of the Study Area.

Birds Recorded in the Study Area

Table 4-15 presents the details of bird species recorded during field studies in the Study Area along with scientific name, common name, type and % frequency of each species.

Table 4-16: Details of bird species recorded in the Study Area

S. No.	Scientific Name	Common Name	Type	% Frequency
1	*Threskiornis melanocephalus*	Black-headed Ibis	Resident	10.00
2	*Ardeola grayii*	Indian Pond Heron	Resident	10.00
3	*Bubulcus ibis*	Cattle Egret	Resident	20.00
4	*Mesophoyx intermedia*	Intermediate Egret	Resident	10.00
5	*Vanellus indicus*	Red-wattled Lapwing	Resident	20.00
6	*Columba livia*	Common Pigeon	Resident	30.00
7	*Centropus (sinensis) parroti*	Southern Coucal	Resident	20.00
8	*Coracias benghalensis*	Indian Roller	Resident	20.00
9	*Halcyon smyrnensis*	White-throated Kingfisher	Resident	10.00
10	*Merops orientalis*	Green Bee-eater	Resident	40.00
11	*Lanius vittatus*	Bay-backed Shrike	Resident	20.00
12	*Corvus splendens*	House Crow	Resident	30.00
13	*Ammomanes phoenicura*	Rufous-tailed Lark	Resident	10.00
14	*Eremopterix griseus*	Ashy-crowned Sparrow Lark	Resident	20.00
15	*Saxicoloides fulicatus*	Indian Robin	Resident	30.00
16	*Plegadis falcinellus*	Glossy Ibis	Migratory	10.00
17	*Ardea cinerea*	Grey Heron	Migratory	10.00

Source: AECOM Primary Survey

	
Black-headed Ibis (Threskiornis melanocephalus)	*Intermediate Egret (Mesophoyx intermedia)*
	
Bay-backed Shrike (Lanius vittatus)	*Ashy-crowned Sparrow Lark (Eremopterix griseus)*
	
Glossy Ibis (Plegadis falcinellus)	*Grey Heron (Ardea cinerea)*

Source: AECOM Primary Survey

Reptiles

At least 24 reptile species have recorded ranges that include the Study Area. None of these species was recorded during the field studies. None of these species is designated by the IUCN as threatened, but 01 species, namely Indian Python (*Python molurus*) is listed in Schedule I of the WPA. All of the species have large known ranges beyond the Study Area and hence, are not deemed as species of conservation concern with respect to the Study Area.

Appendix G presents details of the reptile species of the Study Area.

Amphibians

At least 10 amphibian species have recorded ranges that include the Study Area. None of these species was recorded during the field studies. None of these species is designated by the IUCN as threatened or is listed in Schedule I of the WPA.

Appendix H presents details of the amphibians of the Study Area.

Fishes

At least 41 fish species have recorded ranges that include the Study Area. None of these species was recorded during the field studies. Significant species with respect to IUCN include 01 species designated as Endangered, namely Yellow Mahseer (*Tor khudree*) and 2 species designated as Near Threatened, namely Indian Butter-Catfish (*Ompok bimaculatus*) and Shark Catfish (*Wallago attu*). None of these species is listed in Schedule I of the WPA.

Appendix I present details of the fishes of the Study Area.

4.2.4 Habitat Profile of the Study Area

4.2.4.1 Natural Habitats

Natural habitats in the Study Area are represented by patches or individuals of species associated with thorny scrub forests, grasslands, hills and knolls and wetlands.

Patches of natural vegetation covering the hill ranges represent the most significant natural habitat in the Study Area. River distributaries and a few seasonal streams flowing to or through the Study Area present another significant natural habitat feature in the area. While none of these natural habitats, as observed in the Study Area, is in a pristine state, they show typical and diverse floristic profiles which are likely to support the presence of some characteristic species of wild fauna.

Natural vegetation along the dry river channel in the Study Area

Natural vegetation along the dry stream channel in the Study Area

Natural vegetation on the plains in the Study Area	*Natural vegetation on the hill-slopes in the Study Area*

Source: AECOM Primary Survey

4.2.4.2 Modified Habitats

Modified habitats of the Study Area include cultivated and fallow farmlands, plantations, roads, ponds, tanks, habitations, a canal, and a solar power project. Aerial habitats in the Study Area are largely modified by power transmission lines.

The modified habitats of the Study Area are likely to be supporting habitat-specialist species associated with wetlands, as well as, generalist species associated with cultivation and habitation.

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Pond in Bappur village in the Study Area</td><td>Inundated paddy fields in the Study Area</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Canal in the Study Area</td><td>Cultivated farms in the Study Area</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Pond in the Project Site</td><td>Dirt road adjacent to the Project Site</td></tr>
</table>

	
Solar panels in the Project Site	*Transmission power lines in the Study Area*

Source: AECOM Primary Survey

4.2.4.3 Critical Habitats

Habitats, either natural or modified, that are critical for the survival of IUCN-designated Critically Endangered (CR) or Endangered (EN) species, migratory species, congregatory species and endemic or restricted range species are considered to be critical habitats.

This section lists such species having recorded ranges that include the study area. However, available data indicates that the habitats of the Study Area are unlikely to be of critical importance to the survival of any of the species listed.

Critically Endangered or Endangered Species

At least 7 IUCN-designated Critically Endangered or Endangered species have recorded ranges that include the Study Area. **Table 4-16** presents the details of these species, including the scientific and common names of each species and the conservation status assigned to it by the IUCN. None of these species was recorded in the Study Area during the field studies.

Table 4-17: Critically Endangered or Endangered Species of the Study area

S. No.	Scientific Name	Common Name	IUCN Status*
Mammals			
1	*Manis crassicaudata*	Indian Pangolin	EN
Birds			
2	*Neophron percnopterus*	Egyptian Vulture	EN
3	*Gyps bengalensis*	White-rumped Vulture	CR
4	*Gyps indicus*	Indian Vulture	CR
5	*Sarcogyps calvus*	Red-headed Vulture	CR
6	*Sypheotides indicus*	Lesser Florican	EN
Fishes			
7	*Tor khudree*	Yellow Mahseer	EN

***** *Status assigned by the International Union for Conservation of Nature and Natural Resources, where CR – Critically Endangered and EN– Endangered*

Sources: R. Grimmett, C. Inskipp & T. Inskipp (2011). Birds of the Indian Subcontinent. Oxford University Press, pp 1-528; Salim Ali (2012) reprinted. The Book of Indian Birds. Oxford University Press; Vivek Menon (2014) Indian Mammals: A Field Guide. Hachette Book Publishing India Pvt. Ltd., Gurgaon, India; R. J. Ranjit Daniels, (2002). Freshwater Fishes of Peninsular

India, Indian Academy of Sciences, Universities Press; IUCN (2019). The IUCN Red List of Threatened Species. Version 2019-1.

Migratory Species

The entire Indian subcontinent, including the Study Area, falls within the limits of the Central Asian Flyway (CAF), a major global flyway. The CAF connects a large swathe of the Palaearctic region with the Indian subcontinent and contains several well-established routes along which a number of bird-species migrate annually. This flyway covers a large part of the continental area of Eurasia and includes the whole of the Indian sub-continent. Thus, the Study Area is very likely to be situated in the flight-paths of the various winter, summer and passage visitor-birds migrating either to or through the region in which it is situated.

At least 70 migratory species, all birds, have recorded ranges that include the study area. Details of these species are available in ***Appendix F***. Two of these species, namely Glossy Ibis (*Plegadis falcinellus*) and Grey Heron (*Ardea cinerea*) were recorded in the Study Area during the field studies.

Congregatory Species

Congregatory species are species that gather in globally significant numbers at a particular site and at a particular time in their life cycle for feeding, breeding or resting (during migration).

At least 4 congregatory species, all birds, have recorded ranges that include the study area. One of these species namely, Little Cormorant (*Phalacrocorax niger*), was recorded in the Study Area during the field studies.

The Table presents details of the congregatory species of the Study Area, including the scientific and common names of each species, its IUCN Red List status and the Schedule of the Wildlife Protection Act, 1972 (WPA) under which it is listed.

Table 4-18: Congregatory Species of the Study Area

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
1	*Phalacrocorax niger*	Little Cormorant	LC	IV
2	*Phalacrocorax fuscicollis*	Indian Cormorant	LC	IV
3	*Phalacrocorax carbo*	Great Cormorant	LC	IV
4	*Mycteria leucocephala*	Painted Stork	NT	IV

** Status assigned by the International Union for Conservation of Nature and Natural Resources, where NT – Near Threatened and LC –Least Concern.*
***Schedules I to VI: Indian Wildlife (Protection) Act, 1972.*

Sources: R. Grimmett, C. Inskipp & T. Inskipp (2011). Birds of the Indian Subcontinent. Oxford University Press, pp 1-528; Salim Ali (2012) reprinted. The Book of Indian Birds. Oxford University Press, pp 1-326; IUCN (2019). The IUCN Red List of Threatened Species. Version 2019-1.

Endemic / Restricted Range Species

Endemic or Restricted Range species are species that have ranges restricted to a limited geographical area. At least 10 species have recorded ranges restricted to a particular region that includes the Study Area. None of these was recorded in the Study Area during the field studies.

The Table below presents the details of these species, including the scientific and common names of each species and the distribution range to which it is endemic.

Table 4-19: Endemic / Restricted Range Species of the Study Area

S. No.	Scientific Name	Common Name	Distribution Range
Mammals			
1	*Anathana ellioti*	Southern Tree Shrew	Peninsular India

S. No.	Scientific Name	Common Name	Distribution Range
2	*Macaca radiata*	Bonnet Macaque	Peninsular India
3	*Vulpes bengalensis*	Indian Fox	Indian Subcontinent
4	*Millardia meltada*	Soft-furred Field Rat	South Asia
Birds			
5	*Galloperdix lunulata*	Painted Spurfowl	Peninsular India
6	*Galloperdix spadicea*	Red Spurfowl	Peninsular India
7	*Perdicula argoondah*	Rock Bush Quail	Western & Central India
8	*Gallus sonneratii*	Grey Junglefowl	Southern Peninsula
9	*Strix ocellata*	Mottled Wood Owl	Peninsular India
10	*Rhipidura (albicollis) albogularis*	White-spotted Fantail	Peninsular India

Sources: http://florakarnataka.ces.iisc.ac.in; Vivek Menon (2014) Indian Mammals: A Field Guide. Hachette Book Publishing India Pvt. Ltd., Gurgaon, India; Jathar, G.A. & Rahmani, A.R. (2006). Endemic Birds of India. Buceros: ENVIS Newsletter: Avian Ecology & Inland Wetlands. Vol. 11, No.2 & 3.

4.2.5 Designated Areas

Designated areas include legally protected areas, such as Wildlife Sanctuaries or National Parks notified by the Government of India, as also, internationally recognized areas, such as Important Bird Areas (IBA) or Ramsar Wetlands. There is no legally protected area or internationally recognized area falling in the Study Area.

4.2.5.1 Legally Protected Areas

Tungabhadra Otter Conservation Reserve (approximate location: 15° 26' 15.21" N, 76° 36' 24.79" E), covering a 34 km stretch of the Tungabhadra river channel, from Hole Madlapura Bridge in Koppal district to Kampli Kote Bridge in Bellary district, is the nearest protected area. It is located approximately 44 km south of the nearest point on the Study Area boundary.

4.2.5.2 Internationally Recognized Areas

Important Bird Area

Hampi and Daroji Bear Sanctuary (approximate location: 15° 19' 28.40" N, 76° 27' 27.56" E), covering approximately 26 sq. km, is the nearest Important Bird Area (IN 189). It is located approximately 53 km south of the Study Area. The area is known to hold a significant population of Yellow-throated Bulbul (*Pycnonotus xantholaemus)*, a globally threatened species, of which it is a well-known habitat.

Source: *http://datazone.birdlife.org/site/factsheet/hampi-and-daroji-bear-sanctuary-iba-india*

Ramsar Sites

Kolleru Lake (approximate location: 16° 37' 00" N 81° 12' 00" E), covering an area of approximately 901 sq. km, forming a part of Kolleru Wildlife Sanctuary is the nearest Ramsar Site (Site No. 1209). It is located approximately 503 km east of the Study Area boundary.

It is a natural eutrophic lake, situated between the two major river basins of the Godavari and the Krishna and provides habitats to a number of resident and migratory birds, including declining numbers of the Spot-billed Pelican (*Pelecanus philippensis*), designated as Vulnerable by IUCN. The lake is known to regularly support more than 50,000 waterfowls and provides habitats to almost 61 species of fishes and 12 species of prawns. It also sustains culture and capture fisheries, agriculture and related occupations of the people in the area.

Source: *https://rsis.ramsar.org/RISapp/files/RISrep/IN1209RIS.pdf?language=en*

4.2.6 Ecological Services

4.2.6.1 Provisioning Services

The Study Area provides provisioning ecosystem services through natural and artificial water-bodies which fulfil the water-requirements of the local communities, the soil in which agricultural crops are cultivated by the local communities, as also, wild plants that serve the fodder, fuel-wood and timber needs of the local communities. Details of each of these provisioning services are given below.

Water

Natural water-bodies, such as lakes and seasonal streams, and artificial ones, such as farm-ponds and bore-wells, situated in the Study Area fulfil the domestic and irrigation water requirements of the local communities. Of these water-bodies, 03 ponds and 02 bore wells are situated within the Project Site.

Cultivated Food Species

The Study Area provides arable soils which are used by the local community to cultivate agricultural produce that provides for their food, fibre, oilseed and timber needs.

The table below presents the details of the cultivated produce of the Study Area, including types of provisioning services provided and the cultivated species providing them.

Table 4-20: Food species cultivated in the Study Area

Type of Provisioning Service	Associated Cultivated Species
Food	Onion (*Allium cepa*), Sorghum (*Sorghum bicolor*), Rice (*Oryza sativa*), and Coconut (*Cocos nucifera*) are the major bulb, grain and fruit species respectively, cultivated in the Study Area.
Fibre	*Cotton (Gossypium* sp.) is the major fibre crop cultivated in the Study Area
Oilseed	Sunflower (*Helianthus* sp.) is the major oilseed crop cultivated in the Study Area
Timber	*Acacia auriculiformis* is the major timber crop cultivated in the Study Area.

Source: AECOM Primary Survey

Uncultivated Produce

The natural vegetation of the Study Area provides for the fodder and timber needs of the local communities. Some of this natural vegetation is situated within the Project Site.

The table below presents the details of the uncultivated produce of the Study Area, including types of provisioning services provided and the natural vegetation providing them.

Table 4-21: Uncultivated produce in the Study Area

Type of Provisioning Service	Associated Natural Vegetation
Fodder	The natural vegetation of the Study Area, including the regenerated ground cover of fallow farmlands and roadsides provide fodder to the livestock of the local communities, mainly goats and cattle.
Fuelwood	Trees and shrubs growing naturally in the Study Area provide fuelwood to the local communities.
Timber	Trees growing naturally in the Study Area provide timber to the local communities.

Source: AECOM Primary Survey

	
Rice (Oryza sativa) fields in the Study Area	*Sorghum (Sorghum bicolor) fields in the Study Area*
	
Cotton (Gossypium sp.) fields in the Study Area	*Coconut (Cocos nucifera) plantations in the Study Area*
	
Livestock grazing adjacent to the Project Site	*Acacia auriculiformis plantations in the Study Area*

Source: AECOM Primary Survey

4.2.6.2 Regulating Services

The natural functioning of the ecosystems in the Study Area leads to the following processes that provide both, direct and indirect benefits to the local communities.

Ground Water Recharge

The natural and seasonal water-flows in the Study Area contribute to the recharge of wells, ponds and lakes of the area, which provide the freshwater needs of the local communities. The vegetation cover of the area also helps to slow down the surface run-off, which in turn increases the percolation of water into sub-surface layers, thereby promoting the recharge of groundwater.

Surface Water Purification

The microorganisms of the Study Area chemically recycle wastes, thereby purifying surface water. The vegetation of the Study Area physically filters out particulate matter from water flows, thereby purifying surface water. The microorganisms and vegetation of the Project Site contribute to this surface water purification service.

Soil Erosion Control

The vegetation of the Study Area anchors soil-particles and binds them together, lowering the rate of soil erosion by water and wind. The vegetation of the Project Site contributes to this soil erosion-control service.

Pollination and Pest Control

The vegetation of the Study Area provides habitats to pollinator species, such as, pollen or nectar feeding insects and birds, as well as, insectivorous species, including frogs, lizards, birds and bats. By harbouring such species, the Study Area provides pollinator-services and pest-control services to natural, as well as, agricultural plants in the area. The vegetation of the Project Site contributes to these pollinator and pest-control services.

4.2.6.3 Supporting Services

The natural functioning of the ecosystems of the Study Area leads to the following processes that create or maintain basic natural resources, such as soil-nutrients and photosynthetic production, that support human life-sustaining activities, such as farming, food-gathering, cooking and livestock-grazing.

Nutrient Capture and Recycling

The food-chains constituted by the organisms of the Study Area capture, transfer and recycle the macro and micro nutrients in the soil, water and air, making them available in the nutrient-sinks of the local ecosystems. The biomass generated by the organisms of the Study Area, and transferred physically by water and wind, helps recharge the soil-fertility in the surrounding area. The organisms of the Project Site contribute to these nutrient capture and recycling services.

Primary Production

The photosynthetic organisms of the Study Area produce food that directly or indirectly support the consumer organisms of the area, including the local human communities. The photosynthetic organisms of the Project Site contribute to this primary production service.

4.2.6.4 Cultural Services

A large *Prosopis cineraria* tree supporting a temple (approximate location: 15° 50' 45.25" N, 76° 33' 21.24" E) located adjacent to the Project Site boundary provides cultural services to the local communities. Local people offer harvested crops at this temple during the Ugadi festival.

Temple located adjacent to Project Site

Sorghum produce offered at the temple

Source: AECOM Primary Survey

4.3 Socio-economic Profile

This section of the report primarily summarises the socio economic characteristics of the project area and the area of influence from the macro district level to the micro village level. The data collected through desk-based review have been studied and analysed to present a comprehensive analysis of the socio economic characteristics of the project area and its influenced area. Information gathered through consultations undertaken with landowners and representative of the village falling within the project area have also been analysed and presented below,

4.3.1 Approach and Methodology

The scope of work as detailed earlier in the proposal has been the guiding criteria for the undertaking the Social Impact Assessment (SIA) Study. The project location and the associated facilities fall primarily in the Raichur District of the state of Karnataka. In order to undertake the representative sample comprising the primary survey and identification and consultation of the stakeholders, the location of the project and its associated facilities was considered for the study.

A structured questionnaire was prepared to undertake the interviews and evaluate the socio-economic status of the representative sample of the project affected families comprising the landowners. In addition, discussions were also held with representatives of the villages falling within the project area to provide an understanding of the socio-economic status of the people residing in the area.

Secondary Data Review:

A detailed review and assessment of the secondary data available on the project location was done wherein the project and its associated facilities operate. Detailed reviews of available documents on the socio- economic characteristics of the project-influenced areas were undertaken. The documents referred to for the desk-based research are,

- Primary Census Abstract (PCA), 2011; Office of the Registrar General & Census Commissioner, India; Ministry of Home Affairs
- Village Directory Data (VDA), 2011; Office of the Registrar General & Census Commissioner, India; Ministry of Home Affairs
- Statistical Abstract Karnataka, 2015-16
- Brief Industrial Profile of Raichur District (MSME), 2012

Primary Data:

Primary data was collected on the socio- economic status of the villages wherein the project is located through identification of stakeholders and thereafter consultations undertaken with them. The data collected have been collated and analysed to understand the impact of the project on the area.

4.3.2 Administrative Profile

Raichur district lies in the north eastern part of Karnataka state with geographical area of 8, 38, 600 hectares. It is bounded by Yadgir District in the north, Bijapur and Bagalkot District in thenorth west, Koppal District in the West, Bellary District in the south, Mahbubnagar and Kurnool District of Andhra Pradesh in the east.

Gulbarga district is constituted by five (05) talukas/sub-districts i.e. Riachur, Deodurga, Lingsugur, Manvi and Sindhanur with Raichur being the headquarters of the district. There are 883 revenue villages and 164 Gram Panchayats within the District.

4.3.3 Project Area

The project area is spread across two villages, namely Gadratigi in Sindhanur Taluka and Talekat in Lingsugur Taluka, both under Raichur District. The section below provides information regarding details of the socio-economic profile of the project area.

Study Area

To assess the impacts of the project in the surrounding area, an area of 2 km radius has been considered as the project area of influence from the project area. The project area (comprising of villages Gadratigi and Talekat) and its area of influence (Bagalapur) have been cumulatively termed as 'study area'. The table below represents the villages falling within the two (02) kilometre radii of the project location:

Table 4-22: Villages within 2-kilometre radii of Project location

District	Sub-District (Taluka)	Villages
Raichur	Sindhanur	Gadratigi
		Bagalapur
	Lingsugur	Talekat

4.3.4 Demographic Profile of the Study Area

The demographic profile section below intends to present an understanding of the prevalent demography in the study area. The population of the study area has been analysed below with a focus on the size and its composition.

4.3.4.1 Population

District Level

The District level population has been represented in the table below:

Table 4-23: District Level Population in the Study Area

District	Total Population (2011)	Male Population (2011)	Female Population (2011)	Sex Ratio (female as per 1000 males)
Raichur	1,928,812	964,511	964,301	999
		(50%)	(50%)	

Source: Primary Census Abstract 2011

The table above represents that the sex ratio of Raichur District is 999 females per 1000 males. Female population of Raichur comprises of 50% (964,301) of the total population of the district.

Taluka Level

The Taluka level population has been represented in the table below:

Table 4-24: Taluka level Population in the Study Area

Taluka	Total Population (2011)	Male Population (2011)	Female Population (2011)	Sex Ratio (females as per 1000 males)
Sindhanur	393,200	196,264	196,936	1003
		(50%)	(50%)	
Lingsugur	385,699	194,363	191,336	984
		(50%)	(50%)	

Source: Primary Census Abstract 2011

The table above represents that the sex ratio of Sindhanur and Lingsugur Talukas wherein it can be noted that in Sindhanur the female sex ratios is higher at 1003 per 1000 males while that of Lingsugur is 984 females to 1000 males. The male and female population in both the talukas is proportionate to each other.

Village Level

The village level population in the study area has been represented in the table below:

Table 4-25: Village Level Population in the Study Area

Taluka	Village	Total Population (2011)	Male Population (2011)	Female Population (2011)	Sex Ratio (females as per 1000 males)
Sindhanur	Gadratigi	1246	621	625	1006
			(49.8%)	(50.2%)	
	Bagalapur	141	73	68	931
			(51.7%)	(48.2%)	
Lingsugur	Talekat	715	362	353	975
			(50.6%)	(49.3%)	

Source: Primary Census Abstract 2011

The table above represents that the highest population amongst the study area villages is Gadratigi village at 1246 followed by Talekat village at 715 and lastly Bagalapur village at 141. Sex ratio amongst the villages is highest in Gadratigi village at 1006 followed by Talekat village at 975 and lastly Bagalapur village at 931 females to every 1000 males.

4.3.4.2 Status of Literacy Level

Literacy indicates the ability of a person to read and write. For the purpose of identifying literate persons for the Census in India, the benchmark taken is that of an individual above the age of seven (07) years who can both read and write in any Indian language. Analysis of literate population in the country is essential as education is considered a vehicle for development and progress and the increase of female educated persons is an indicator of inclusive growth and social progress.

District Level

The District level literate population has been represented in the table below,

Table 4-26: District Literacy Level in the Study Area

District	Total Population (2011)	Total Literate Population (2011)	Male Literate Population (2011)	Female Literate Population (2011)
Raichur	1,928,812	979,769	577,213	402,556
		(50.7%)	(58.9%)	(41%)

Source: Primary Census Abstract 2011

It can be noted from the above table that at the district level the literacy level comprises of 50.7% (979,769) to the total population of 1,928,812. The female population comprises of 41% (402,556) of the literate population (979,769) of Raichur District.

Taluka Level

The Taluka level literate population has been represented in the table below:

Table 4-27: Taluka Literacy Level in the Study Area

District	Taluka	Total Population (2011)	Total Literate Population (2011)	Male Literate Population (2011)	Female Literate Population (2011)
Raichur	Sindhanur	393,200	212,046	123,909	88,137
			(53.9%)	(58.4%)	(41.5%)
	Lingsugur	385,699	199,217	119,483	79,734
			(51.6%)	(59.9%)	(40%)

Source: Primary Census Abstract 2011

It can be noted that the literacy level of Sindhanur Taluka is at 53.9% (212,046) in relation to its total population of 393,200 while that of Lingsugur Taluka is at 51.6% (199,217) in relation to its total population of 385,699.The female literate population is marginally higher in Sindhanur Taluka at 41.5% as compared to Lingsugur Taluka at 40% of the total literate population.

Village Level

The Village level literate population has been represented in the table below:

Table 4-28: Village Literacy Level in the Study Area

Taluka	Village(s)	Total Population (2011)	Total Literate Population (2011)	Male Literate Population (2011)	Female Literate Population (2011)
Sindhanur	Gadratigi	1246	431	271	160
			(34.5%)	(62.8%)	(37.1%)
	Bagalapur	141	78	53	25
			(55.3%)	(67.9%)	(32%)
Lingsugur	Talekat	715	**433**	**242**	**191**
			(60.5%)	**(55.8%)**	**(44.1%)**

Source: Primary Census Abstract 2011

It can be noted in the table above that Talekat village has the highest literacy level at 60.5% (433) followed by Bagalapur village at 55.3% (78) and lastly Gadratigi village at 34.5%(431). Female literacy levels in all study area villages is less than 45% with the lowest female literacy in Bagalapur village at 32% (25) followed by Gadratigi village at 37.1% (160) and lastly Talekat village at 44.1% (191).

4.3.5 Presence of Vulnerable Communities and Groups

Vulnerable groups are those groups of people who may find it difficult to lead a comfortable life, and lack developmental opportunities due to their disadvantageous positions. Further, due to adverse socio-economical, cultural, and other practices present in each society, they find it difficult many a times to exercise their human rights fully[5].

The accessibility to development opportunities or its absence thereof can be attributed to the level of integration and responsiveness to mediums which enhance and improve livelihoods. Marginalization from the resources can be a result of social exclusion thereafter hindering all round development and improvement of livelihood of these groups. Categories such as scheduled tribes, scheduled castes primitive tribal group, legally released bonded labour and manual scavengers and other backward classes are recognised as socially excluded categories by the constitution of India. Recognising the relative backwardness of these weaker/socio-economically disadvantaged sections of the society, the Constitution of India guarantees equality before the law (Article 14) and enjoins the State to make special provisions for the advancement of any socially and educationally backward classes or for SCs (Article 15(4)).

The section below aims to define the status of these socially excluded categories/ groups within the study area.

4.3.5.1 Schedules Caste and Scheduled Tribe Population

The tables below depict the representation of Scheduled Castes (SC) and Scheduled Tribes (ST) in the District, Taluka and Village levels:

District Level

The table below represents the SC and ST population at the District Level,

[5] Human Rights of Vulnerable & Disadvantaged Groups; Dr. T. S. N. Sastry; University of Pune; 2012

Table 4-29. District Level SC and ST Population in the Study Area

District	Total Population (2011)	SC Population (2011)	SC Male Population (2011)	SC Female Population (2011)	ST Population (2011)	ST Male Population (2011)	ST Female Population (2011)
Raichur	1,928,812	400,933	200,359	200,574	367,071	182,101	184,970
		(20.7%)	(49.9%)	(50%)	(19%)	(49.6%)	(50.3%)

Source: Primary Census Abstract 2011

It can be noted from the table above that the Scheduled Tribe population in Raichur district is 19% (367,071) and the Scheduled Caste population is 20.7%(400,933) of the total population. The female SC and ST population is at 50% (200,574) and 50.3% (184,970) of the total SC and ST population, respectively.

Taluka Level

The table below represents the SC and ST population at the Sub District Level:

Table 4-30. Taluka Level SC and ST Population in the Study Area

Taluka	Total Population (2011)	SC Population (2011)	SC Male Population (2011)	SC Female Population (2011)	ST Population (2011)	ST Male Population (2011)	ST Female Population (2011)
Sindhanur	393,200	67,858	33,674	34,184	52,579	25,948	26,631
		(17.2%)	(49.6%)	(50.3%)	(13.3%)	(49.3%)	(50.6%)
Lingsugur	385,699	89,692	45,351	44,341	65,589	32,796	32,793
		(23.2%)	(50.5%)	(49.4%)	(17%)	(50%)	(50%)

Source: Primary Census Abstract 2011

It can be noted from the table above that the Scheduled Tribe population in Lingsugur is higher at 17% (65,589) as compared to Sindhanur Taluka at 13.3% (52,579) of the total population in the respective Talukas. The Scheduled Caste population likewise is higher in Lingsugur at 23.2% (89,692) as compared to 17.2% (67,858) in Sindhanur Taluka.

Village Level

The table below represents the SC and ST population at village level:

Table 4-31. Village Level SC and ST Population in the Study Area

Mandal	Villages	Total Population (2011)	SC Population (2011)	SC Male Population (2011)	SC Female Population (2011)	ST Population (2011)	ST Male Population (2011)	ST Female Population (2011)
Sindhanur	Gadratigi	1246	104	51	53	662	336	326
			(8.3%)	(49%)	(51%)	(49.9%)	(50.7%)	(49.2%)
	Bagalapur	141	-	-	-	137	72	65
			(-)	(-)	(-)	(97%)	(52.5%)	(47.4%)
Lingsugur	Talekat	715	281	138	143	26	12	14
			(39.3%)	(49%)	(50.8%)	(3.6%)	(46%)	(53.8%)

Source: Primary Census Abstract 2011

The table above represents that the highest Scheduled Tribe population amongst the study area villages falls in Bagalapur village at 97% (137) to its total population of 141. Villages of Gadratigi and Talekat have 49.9% and 3.6% Scheduled Tribe population to its total population of 1246 and 715 respectively. Talekat has around 39.3% of population under the SC category while Gadratigi has around 8.3% of SC population. Bagalapur has nil SC category of population.

4.3.6 Workforce Population

The working population of the area means the population of the area who is engaged in productive activity and contribute towards economic and social growth of the area.

The section below will elaborate on the number and type of workforce population in the study area:

District Level

The table below represents the district level workforce population:

Table 4-32. District Level Workforce in the Study Area

District	Total Population (2011)	Total Workforce Population (2011)	Male Workforce Population (2011)	Female Workforce Population (2011)
Raichur	1,928,812	903,413	530,373	373,040
		(46.8%)	(58.7%)	(41.2%)

Source: Primary Census Abstract 2011

The table above indicates that the total workforce population of Raichur district comprises of 46.8% (903,413) of the total population (1,928,812). Female workforce population comprises of 341.2% (373,040) of the total working population.

Taluka Level

The table below represents the sub district level workforce population:

Table 4-33. Taluka Level Workforce in the Study Area

District	Taluka	Total Population (2011)	Total Workforce Population (2011)	Male Workforce Population (2011)	Female Workforce Population (2011)
Raichur	Sindhanur	393,200	190,874	110,814	80,060
			(48.5%)	(58%)	(41.9%)
	Lingsugur	385,699	171,402	102,458	68,944
			(44.4%)	(59.7%)	(40.2%)

Source: Primary Census Abstract 2011

The table above represents that the total workforce population of Sindhanur and Lingsugur Talukas which comprises of 48.5% and 44.4% of the respective total population at the taluka level. Female workforce population comprises of 41.9% and 40.2% in Sindhanur and Lingsugur talukas of the total working population.

Village Level

The table below represents the village level workforce population:

Table 4-34. Village level Workforce Population in the Study Area

Taluka	Villages	Total Population (2011)	Total Workforce Population (2011)	Male Workforce Population (2011)	Female Workforce Population (2011)
Sindhanur	Gadratigi	1246	384	368	16
			(30.8%)	(95.8%)	(4.1%)
	Bagalapur	141	100	53	47
			(70.9%)	(53%)	(47%)
Lingsugur	Talekat	715	213	179	34

Taluka	Villages	Total Population (2011)	Total Workforce Population (2011)	Male Workforce Population (2011)	Female Workforce Population (2011)
			(29.7%)	(84%)	(15.9%)

Source: Primary Census Abstract 2011

It can be noted in the table above that Bagalapur village has the highest workforce population at 70.9% (100) to its total population of 141. It is followed by Gadratigi village at 30.8% (384) and lastly by Talekat village at 29.7% (213) to its total population of 1246 and 715 respectively. Female representation in the total workforce is lowest in Gadratigi village at 4.1% (16) to its total workforce population of 384.

4.3.6.1 Main and Marginal Workforce Population

The workforce population can be further segregated into Main and Marginal Workers. Main workers are those who have been engaged in economically productive activities for more than one hundred eighty-three (183) days and Marginal workers are those workers who have been engaged in any economically productive activity for less than one hundred eighty -three days (183) days. This section of the report represents the Main and Marginal Workforce population in the study area.

District Level

The table below represents the district level Main and Marginal Workforce population,

Table 4-35. Type of Workforce Population in the District Level

District	Total Workforce Population (2011)	Main Workforce Population (2011)	Main Male Workforce Population (2011)	Main Female Workforce Population (2011)	Marginal Workforce Population (2011)	Marginal Male Workforce Population (2011)	Marginal Female Workforce Population (2011)
Raichur	903,413	725,985	461,421	264,564	177,428	68,952	108,476
		(80.3%)	(63.5%)	(36.4%)	(19.6%)	(38.8%)	(61.1%)

Source: Primary Census Abstract 2011

The table above represents that 80.3% (725,985) of the total workforce population (1,928,812) of Raichur district is engaged as Main workforce population. It can be noted that the main female workforce population comprises of only 36.4% (264,564) of the total working population. However, in the marginal workforce population it can be noted that the women's participation in the workforce (61.1%) is higher than that of males (38.8%) working population.

Taluka Level

Main and Marginal workforce population in the Taluka level has been represented in the figure below,

Table 4-36. Type of Workforce Population in the Taluka Level

Taluka	Total Workforce Population (2011)	Main Workforce Population (2011)	Male Main Workforce Population (2011)	Female Main Workforce Population (2011)	Marginal Workforce Population (2011)	Male Marginal Workforce Population (2011)	Female Marginal Workforce Population (2011)
Sindhanur	190,874	159,018	98,931	60,087	31,856	11,883	19,973
		(83.3%)	(62.2%)	(37.7%)	(16.6%)	(37.3%)	(62.6%)
Lingsugur	171,402	129,046	87,145	41,901	42,356	15,313	27,043
		(75.2%)	(50.8%)	(32.4%)	(24.7%)	(36.1%)	(63.8%)

Source: Primary Census Abstract 2011

The table above represents that 83.3% (159,018) of the total workforce population (190,874) of Sindhanur Taluka and 75.2% (129,046) of the total working population (171,402) of Lingsugur Taluka are engaged as Main

workforce population. It can be noted that the main female workforce population comprises of only 37.7% and 32.4% of the total working population in Sindhanur and Lingsugur Talukas respectively. However, in the marginal workforce population it can be noted that the women's participation in the workforce is at 62.6% and 63.8% in Sindhanur and Lingsugur Talukas which is higher than that of male marginal workforce population.

Village Level

The table below represents Main and Marginal Workforce Population at the Village level.

Table 4-37. Main and Marginal Workforce Population in the Study Area

Taluka	Villages	Total Workforce Population (2011)	Main Workforce Population (2011)	Main Male Workforce Population (2011)	Main Female Workforce Population (2011)	Marginal Workforce Population (2011)	Marginal Male Workforce Population (2011)	Marginal Female Workforce Population (2011)
Sindhanur	Gadratigi	384	375	360	15	9	8	1
			(97.6%)	(96%)	(4%)	(2.3%)	(2%)	(11.1%)
	Bagalapur	100	66	33	33	34	20	14
			(66%)	(50%)	(50%)	(34%)	(58.8%)	(41.1%)
Lingsugur	Talekat	213	192	163	29	21	16	5
			(90.1%)	(84.8%)	(15.1%)	(9.8%)	(76.1%)	(23.8%)

Source: Primary Census Abstract 2011

The table above represents that the highest main workforce population amongst the study area villages is in Gadratigi village at 97.6% (375) to its total workforce population of 384 with 4% (15) of female representation in the main workforce population. Talekat village has the second highest main workforce population at 90.1% (192) with female representation in the main workforce population at 15.1% (29). Marginal workforce population comprises of 2.3% (9), 34% (34) and 9.8% (21) in Gadratigi, Bagalapur and Talekat villages respectively.

4.3.6.2 Occupational Pattern

Occupational pattern distribution of a population in an area indicates the development and diversification of an economy. The trend suggests that developed countries have higher distribution of population in the services and secondary sectors and the developing or underdeveloped countries have higher concentration of population in the primary (i.e. the agricultural) sector. For the Census Survey, the occupations are classified into Cultivators, Agricultural Labourers, Household (HH) Industries and Others[6].

As main workforce population comprises majority of the workforce population in the state, district and village levels. The Occupational Pattern of the Main Workforce population in the study area has been represented in the section below.

District Level

The District level occupational pattern has been presented in the table below:

Table 4-38 District Level Occupational Pattern of Study Area

District	Main Workforce Population (2011)	Main Cultivator Population (2011)	Male Cultivator Population (2011)	Female Cultivator Population (2011)	Main Agri. Labourers Population (2011)	Male Agri. Labourers Population (2011)	Female Agri. Labourers Population (2011)	Main HH Industries (2011)	Male HH Industries (2011)	Female HH Industries (2011)	Others Occupation (2011)	Male Others Occupation (2011)	Female Others Occupation (2011)
Raichur	725,985	233,257	172,348	60,909	269,528	120,968	148,560	13,243	8,522	4,721	209,957	159,583	50,374

[6] the type of workers that come under this category of 'Other Workers' include all government servants, municipal employees, teachers, factory workers, plantation workers, those engaged in trade, commerce, business, transport banking, mining, construction, political or social work, priests, entertainment artists, etc.

	(32.1%)	(73.8%)	(26.1%)	(37.1%)	(44.8%)	(55.1%)	(1.8%)	(64.3%)	(35.6%)	(28.9%)	(76%)	(23.9%)

Source: Primary Census Abstract 2011

The table above represents that the agricultural activities related occupations comprises of 69.2% of the main occupation in the district. Cultivators are at 32.1% (233,257) and Agricultural Labourers is at 37.1% (269,528) of the total workforce population. The highest percentage of the main workforce population is engaged as Agricultural Labourers at 37.1%. The highest female population are engaged as Agricultural Labourers at 55.1% (148,560) of the total main workforce population.

Taluka Level

The Taluka level occupational pattern has been presented in the table below,

Table 4-39 Taluka Level Occupational Pattern of Study Area

Taluka	Main Workforce Population (2011)	Main Cultivator Population (2011)	Male Cultivator Population (2011)	Female Cultivator Population (2011)	Main Agri. Labourers Population (2011)	Male Agri. Labourers Population (2011)	Female Agri. Labourers Population (2011)	Main HH Industries (2011)	Male HH Industries (2011)	Female HH Industries (2011)	Others Occupation (2011)	Male Others Occupation (2011)	Female Others Occupation (2011)
Sindhanur	159,018	53,265	39,316	13,949	64,765	29,508	35,257	2,993	1,878	1,115	37,995	28,229	9,766
		(33.4%)	(73.8%)	(26.1%)	(40.7%)	(45.5%)	(54.4%)	(1.8%)	(62.7%)	(37.2%)	(23.8%)	(74.2%)	(25.7%)
Lingsugur	129,046	49,704	39,537	10,167	37,135	15,320	21,815	3,169	2,080	1,089	39,038	30,208	8,830
		(38.5%)	(79.5%)	(20.4%0	(28.7%)	(41.2%)	(58.7%)	(2.4%)	(65.6%)	(34.3%)	(30.2%)	(77.3%)	(22.6%)

Source: Primary Census Abstract 2011

The table above represents that the agricultural activities related occupation engages a sizable population in both Sindhanur and Lingsugur Talukas. Besides agricultural activities, 23.8% and 30.2% of main workforce population is engaged as Others in Sindhanur and Lingsugur Talukas. The highest female population is engaged as Agricultural Labourers at 54.4% and 58.7% of the total main workforce population at Sindhanur and Lingsugur Talukas.

Village Level

The village level occupational pattern has been presented in the table below,

Table 4-40 Village Level Occupational Pattern of Study Area

Village	Main Workforce Population (2011)	Main Cultivator Population (2011)	Male Cultivator Population (2011)	Female Cultivator Population (2011)	Main Agri. Labourers Population (2011)	Male Agri. Labourers Population (2011)	Female Agri. Labourers Population (2011)	Main HH Industries (2011)	Male HH Industries (2011)	Female HH Industries (2011)	Others Occupation (2011)	Male Others Occupation (2011)	Female Others Occupation (2011)
Gadratigi	375	159	158	1	202	192	10	7	6	1	7	4	3
		(42.4%)	(99.3%)	(0.6%)	(53.8%)	(95%)	(5%)	(1.8%)	(85.7%)	(14.2%)	(1.8%)	(57.1%)	(42.8%)
Bagalapur	66	-	-	-	58	29	29	3	1	2	5	3	2
		(-)	(-)	(-)	(87.8%)	(50%)	(50%)	(4.5%)	(33.3%)	(66.6%)	(7.5%)	(60%)	(40%)
Taleka t	192	134	129	5	43	22	21	1	1	0	14	11	3
		(69.7%)	(96.2%)	(3.7%)	(22.3%)	(51.1%)	(48.8%)	(0.5%)	(100%)	(-)	(7.2%)	(78.5%)	(21.4%)

Source: Primary Census Abstract 2011

It can be noted from the table above that Bagalapur village has the highest number of main workforce population engaged in occupations related to agricultural labour activities at 87.8%. Talekat has the highest number of people engaged as cultivators at 69.7%. Female representation is highest in the household industries occupation in Bagalapur village at 66.6%. Amongst the study area villages it is noted that lowest representation of women is found in Talekat village across all occupations as in household activities no women are involved, cultivators has 3.7%(5), agricultural labourers has only 48.8% (21) females and others 21.4%(03).

4.3.7 Public Amenities

Village Data Abstract (VDA) 2011, a publication of the Directorate of Census Operations has been taken as the primary source of information for the data on existing infrastructure facilities at the village level of the study area. It has been further supplemented on recent data based on the consultations undertaken during the site visit.

4.3.7.1 Educational Facilities

According to Village Data Abstract 2011, there is one (01) government primary school each present in the villages of Gadratigi, Bagalapur and Talekat. There is one (01) middle school each in Gadratigi and Talekat. However, there are no high schools present in these areas. Students residing in these villages have to travel to Turvihal to pursue higher education which is located at a distance of more than ten (10) kilometres. For college and technical education, students have to travel to Sindhanur and Raichur which is approximately 20 km from the respective villages.

4.3.7.2 Healthcare Infrastructure Facilities

Amongst the study area villages, none of them have a Primary Sub health centre (PHSC) and family welfare centres present. Specialised clinics such as Maternity care etc. local population have to traverse to Sindhanur and Raichur to avail this facility. Veterinary hospital is also not present in any of the study area villages.

4.3.7.3 Road Infrastructure

According to VDA 2011, road infrastructure in all three (03) study area villages is a combination of black topped (pucca), gravel (kuccha) and all weather roads.

4.3.7.4 Transportation and Communication Facilities

According to VDA 2011, government bus services ply in all the study area villages. This is further supplemented by the private vehicles such as buses and vans. Amongst the study area villages, according to VDA 2011, none of the study area villages have a sub post office.

4.3.7.5 Banking Facilities

According to VDA 2011, there are no commercial banks and cooperative societies in all three (03) study area villages. Gadratigi village has an agricultural credit society.

4.3.7.6 Other Infrastructural Facilities

Water Supply

Government Water supply is the primary source of water supply in all three villages. All study area villages have borewells and handpumps as their water supply infrastructure.

Sanitation Facilities

According to VDA 2011, none of the study area villages have drainage facilities present in the village. During consultations, it was informed that about 40% of the households in Nagoora village have sanitation facilities present.

Electricity Supply Facilities

All the study area villages have access to electricity.

Cooking Fuel Facilities

In the study area villages, combination of LPG cylinders and wood are used by the local population as cooking fuel.

4.3.8 Stakeholder Engagement and Consultation

Stakeholder consultations are an important process through which a two way dialogue is created between the project proponent and the stakeholders. Stakeholders are persons or groups who are directly or indirectly affected by a project, as well as those who may have interests in a project and/ or the ability to influence its outcome, either positively or negatively.

4.3.8.1 Stakeholder Consultation Objective and Scope

The stakeholders for the project were prioritized by identifying their direct and indirect influence and interest level with the project. The key stakeholders that were consulted as part of the study included the following,

- Land Owners who sold their land for the project
- Representative of Member of Boppur Gram Panchayat
- Local Land Aggregator involved in aggregating land parcels for purchase of the project
- Site Representatives of CSPGPL and HFE Representatives

A questionnaire with a list of open-ended questions was used to initiate the discussion process, details of the responses of which have been presented in the following sections. Additionally, signatures of the stakeholders consulted during the site visit have been provided as ***Appendix A***.

4.3.8.2 Views expressed by Landowners

Two (02) landowners were consulted during the site visit to understand the process of purchase including the determination of payments from Gadratigi and Talekat villages. The respondents were uniform in their replies that land prices were determined on the basis of one to one negotiation with the Main Land Aggregator (Raju Gowda) used by CSPGPL who they were introduced to by the local land aggregator, Amresh Gowda from Gadratigi village. It was further mentioned that all landowners received INR 3, 00, 000 for an acre which was two times over and above the prevailing market rates. Payments have been disbursed to all sellers and received by them, respectively. The landowners were informed about the project that was to be set up in the area and did not have any concerns or issues regarding the development. It was further mentioned that the land was sold primarily because of the reduction of rainfall over the years which resulted in lesser land being used for agricultural purposes. As most of the land in the villages was rainfed, this led to most of the landowners with land of no productive use, hence, leading them to sell their land and use the payment for their own benefits. Sample sale deeds were provided by the client for review. Additionally, details of the information provided for all land purchased for the project as received by HFE has been provided below,

Table 4-41. Details of Land Purchased for the Project

S. No.	Survey Number	Land Owner Name	Land Extent		
			Acres	Guntas	Kharab
1.	9/K	Sri Amaresh S/O Ayyappa	8	35	0
2.	9/K	Sri Amaresh S/O Ayyappa	10	0	0
3.	11/2	Sri. Amarnath Slo Basavaraj Gundad	3	29	0
4.	140	SMT Nagamma W/O Devappa	15	24	0
5.	3/p1/paiki	Sri. Basavaraj Slo Late Pakirappa	4	17	0
6.	3/p2/paiki		4	17	0

S. No.	Survey Number	Land Owner Name	Land Extent		
			Acres	Guntas	Kharab
7.	5/P1	Sri Bhimacharya S/O Late ramacharya	5	29	0
8.	7/K	Sri Chaowdappa S/O Hanumanthappa	5	11	0
9.	7	Sri Devappa S/O Chowdamma	5	12	0
10.	142/1	Smt Lokamathamma W/O Gundaiahswamy	10	11	0
11.	7/A	Sri Manappa S/O Hanumantha	5	12	0
12.	147/3	Sri Nagamma W/O Sri Late Amarappa	8	6	0
13.	149/2	Smt Ratnamma W/O Late Basavraj	2	11	0
14.	147/2	Smt Ratnamma W/O Shekharappa	7	0	0
15.	137*	Smt Shankramma W/O Late Basappa	15	0	0
16.	142/3	Smt Shanthamma W/O Rudraiah	10	11	10
17.	20/1	Sri Sharane Gowda S/O Mallana Gowda	5	4	0
18.	146/1	Sri Shivalingappa S/O Mariyappa	13	15	4
19.	20/4	Sri Shivappa S/O Mallappa	2	0	0
20.	26/1	Sri Somashekhara S/O Shambanna	8	5	0
21.	26/3	Sri Somashekhariah S/O Siddaaiah	5	15	0
22.	11/1	Sri. Suhhamuneppa S/o Kare Hanumappa	0	10	0
23.	6/b	Sri Timmanagouda S/O Late Koranagouda	3	0	0
24.	139/2	Smt Uma Devi D/O Late Virupakshappa	4	0	0
25.	142/2	Sri T. Veeresha S/O Veerabhadraiah	10	12	0
26.	26/2	Sri M. Vijaya Mahanthesa S/O Siddaiah	2	30	0
27.	141/1	Yankamma Eramma D/O Rudragouda	2	0	0
28.	141	Yankana Gouda S/O Rudra Gouda	5	6	0
29.	141/2	Yenkana gouda Dlo Rudragouda	6	0	0
30.	147/1	Sri Hanamappa S/o Late Mahadevappa	13	20	20
31.	141/1	Yankamma/Eramma D/o Rudragouda	5	30	0
32.	138	Channamma W/O Sangayya	5	20	6
33.	139/1	Sri Sangayya S/O Amarayya	14	37	0
34.	10/A	Sri Dyamanna S/O Late Chattrappa	0	6	0
35.	10/A1	Sri Mudukappa S/O Late Hampayya	0	7	0
36.	10/B	Smt Hanumamma W/O Amarappa	0	5	0
37.	139/4	Sri Nagabhusan Hiremath S/O Pampayya Hiremath	4	3	3
38.	139/3	Sri Channaviramma S/O Pampayya Hiremath	4	1	1
		Total Land Area (in acres)	**237.27**		

Source: CSPGPL and Review of Sample Sale Deeds and Authority to Sell (ATS) Agreements

Besides the details provided above by the landowners, information pertaining to Gadratigi village which falls under Boppur Gram Panchayat was also obtained during the said discussions. It was mentioned that about 70% of the households in the area practice agriculture and cultivate, Jowar and Channa Dal (Lentil) while the remaining 30% of the population are engaged as migrant construction labourers. Due to less rainfall over the last few years, the practice of agriculture has suffered and people are taking up opportunities as construction labourers. The entire population in the area practice Hinduism. It was further mentioned that the population in the area were aware of the project developments in the area. The land primarily used for the project was partly barren and partly used as rainfed agriculture for sowing jowar and channa dal. No issues or concerns were

highlighted or informed by the local population. Employment opportunities in the form of security guards, cleaners and local suppliers have benefitted the local population.

Gender Profile of the Villages

To comprehend the existing living pattern of the local population residing across the project area, a look at the socio-economic status of women and the role that women have been playing both at the domestic and economic level needs to be taken into consideration. As the patriarchal values are entrenched in Indian society, women often play a more subordinated and dependent role. Even though they constitute almost half the population, various indicators pertaining to literacy level, labour force participation, mortality rate etc. reveal the dismal status of women to that of men.

According to the UN Gender Development Index, 2014 India ranks 132 out of 187 countries worldwide. As per the 2011 Census data, Karnataka has a total female population of 30,128,640 with sex ratio of 973 females to every 1000 males. A total of 68.08% of the female population are literates in the State.

While interacting with the landowners, information relating to the gender profile in the area was also gathered. It was reported that the Mahila Shakti Sangh Scheme for women empowerment has been introduced in the Gram Panchayat of Gadratigi. The main activities undertaken by women were mostly in the form of engagement of agriculture activities and household chores. It was informed that women do not have any access to maternal hospitals in the area and have to travel to Sindhanur and Raichur at a distance of around 20 km for child delivery related concerns. There are around four (04) women Self-Help Groups (SHGs) which are prominent in the area. The SHGs usually consist of 11 members and funds collected within the SHGs are utilised in the agricultural activities and livestock rearing.

4.3.8.3 Views expressed by Local Land Aggregator, Gadratigi

During the site visit, the local land aggregator was consulted to understand the process of land procurement and method adopted for land procurement of the project. It was mentioned that the local land aggregator was intimated by the Land Aggregator, Raju Gowda of Gulbarga of CSPGPL's intention of setting up of a solar project in the area. On the basis of this, the local aggregator approached landowners to find out if they were willing to sell their land for the project. It was informed that three plots between Zone I and II of the site could not be purchased from the landowners as they refused to sell their land parcel. On the basis of this, the project site was demarcated into two (02) Zones, namely, Zone I and Zone II leaving the parcels in the middle out of the project footprint. In reference to the land price of the project, it was mentioned that the offer of the land price took place between the main Land Aggregator and the landowner directly, whilst he just arranged for the meeting of the two. It was further mentioned that the project area comprised of ~50% rainfed agricultural land while the remaining ~50% barren land. Land falling under Gadratigi village was 50% while that of Talekat village, was 50% of the project area. No concerns and issues were raised by the landowners during the purchase and sale of land parcels for the project including the rates that were determined and accepted by the landowners.

4.3.8.4 Views expressed by CSPGCL and HFE Representatives

During discussions held with representatives of CSPGPL and HFE, it was noted that all land for the project activities were private agricultural land. The price for the land purchase was determined based on the prevailing market value. All land parcels procured for the project were directly negotiated individually by the land aggregator (Raju Gowda) who with the help of the local land aggregator (Amresh Gowda) interacted with the land owners. All land sellers have been provided payments higher (twice) than the prevailing market value. All payments have been disbursed to the 37 land sellers. No Objection Certificates (NOC) from Boppur Gram Panchayat has been obtained by the Company and attached as ***Appendix B*** to the report. NOC from Sindhanur Gram Panchayat obtained by the company has been presented as Appendix J.

The community around the vicinity of the project site are aware of the project development and are aware of the Site Supervisor identity. In case of any issues/concerns, it was stated that they directly contact the Supervisor.

A formal grievance redressal mechanism has been set up for the project based on a Procedure developed by the Corporate Office. In terms of community development activities, formal decision on this aspect is yet to be finalised and implemented by the Corporate Social Responsibility (CSR) Cell of the company. It was stated that the Company will plan activities based on the community needs and this will be initiated once all construction activities onsite will be completed.

4.3.9 Cultural Heritage

A small temple in between Zone I and Zone II near the track road is present which has been developed by CSPGCL. Local population from the Gadratigi and Talekat uses the temple for worship purposes. A total of .5 gunta as informed by CSPGCL has been purchased near the temple to develop the temple area from a private land seller so that the local population can use the area for their own benefit.

<table>
<tr><td>  </td><td> 
</td></tr>
<tr><td>Consultation with Site Employees</td><td>Consultation with land sellers</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Consultation with local people engaged at site</td><td>Temple between Zone I and Zone II</td></tr>
</table>

5. Analysis of Alternatives

This section of the report presents the analysis of the alternatives considered for the 40 MW solar power project. The following scenarios have been considered:

- No Project Scenario;
- Alternate Location for the project;
- Alternate Source of power generation;
- Alternate routes for transmission lines.

5.1 No Project Scenario

According to a survey conducted by the World Energy Council, as the population increases and as the growing rate of electrification places huge requirements on energy supplies, the total primary energy demand of India is expected to increase by almost 150% by 2035.

During the last four years, the state has undertaken extensive electrification under Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) scheme. As on March 2015, there were 12, 56,592 (10, 15,586 rural and 2, 41,006 urban) households left for electrification. As per the Load Generation Report 2018- 2019, Ministry of Power, Government of India, the anticipated peak power demand for the state of Karnataka for year 2018-2019, will be 11,000 MW against the availability of 10,947 MW and hence will experience a power deficit of 0.5%. Whereas, the peak powers demand for the state of Karnataka for year 2017-2018, was 11,138 MW against the availability of 10, 534 MW and hence experienced power deficit of 5.4%. The anticipated power supply position of Karnataka in terms of Energy requirement and Peak demand for the year 2018-19 is given in the ***Table 5-1*** below:

Table 5-1: Power supply position of Karnataka during 2018-19

State	Energy				Peak			
	Requirement	Availability	Surplus (+)/ Deficit (-)		Requirement	Availability	Surplus (+)/ Deficit (-)	
	(MU)	(MU)	(MU)	%	(MW)	(MW)	(MW)	%
Karnataka	73,621	77,140	+3,519	4.8	11,000	10,947	-53	0.5

Source: Load Generation Balance Report 2018-19, Central Electricity Authority (http://www.cea.nic.in/reports/annual/lgbr/lgbr-2018.pdf)

It can be seen from the above table that the State of Karnataka will have power surplus of about 4.8% through the year 2018-2019 however, there will be a power deficit of 0.5% for peak energy requirement.

Based on the data extracted from Load Generation Balance Report, Month-wise, power supply position of Karnataka met during the year 2017-18 in terms of peak demand and energy is represented in the ***Table 5-2*** below.

Table 5-2: Power Supply position of Karnataka during 2017-2018

	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18
Month-wise power supply position of Karnataka during the year 2017-18 (in terms of peak demand)												
Peak Demand (MW)	9,992	9,376	8,648	8,980	8,970	8,450	8,404	9,715	10,144	10,381	10,235	10,857
Peak Availability (MW)	9,987	9,358	8,612	8,978	8,970	8,407	8,404	9,688	10,100	10,347	10,212	10,802
Surplus (+)/Deficit (-) (MW)	-5	-18	-36	-2	0	-43	0	-27	-44	-34	-23	-55
(%)	-0.1	-0.2	-0.4	0.0	0.0	-0.5	0.0	-0.3	-0.4	-0.3	-0.2	-0.5
Month-wise power supply position of Karnataka during the year 2017-18 (in terms of energy)												
Requirement (MU)	6,229	5,455	4,958	5,411	5,339	4,526	4,463	5,784	6,165	6,471	6,007	7,061
Availability (MU)	6,226	5,453	4,957	5,410	5,333	4,520	4,455	5,723	6,160	6,464	6,002	6,999

	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18
Surplus (+)/Deficit (-) (MU)	-3	-2	-1	-1	-6	-6	-8	-61	-5	-7	-5	-62
(%)	-0.1	-0.1	0.0	0.0	0.0	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	-0.9

As on 30th September 2018, Karnataka state has a total power generation capacity of 27,170.35 MW from all the sources. Out of which, 9,960.82 MW is contributed by thermal and 698 MW is contributed by nuclear. Hydro (renewable) and RES (MNRE) contribute 3,599.80 MW and 12,911.73 MW respectively. The details have been presented in the ***Table 5-3*** below.

Table 5-3: Installed Capacity (in MW) of power utilities in Karnataka State (as on 30th September 2018)

Ownership/ Sector	Model wise break up							Grand Total
	Thermal				Nuclear	Hydro (Renewable)	RES* (MNRE)	
	Coal	Gas	Diesel	Total				
State	5020.00	0.00	127.92	5147.92	0.00	3599.80	155.33	8903.05
Private	1958.50	0.00	25.20	1983.70	0.00	0.00	12756.40	14740.10
Central	2829.20	0.00	0.00	2829.20	698.00	0.00	0.00	3527.20
Sub-total	9807.70	0.00	153.12	9960.82	698.00	3599.80	12911.73	27170.35

** RES includes SHP, BP, U&I, Solar and Wind Energy as on 30.09.2018*

SHP = Small Hydro Projects (≤ 25 MW), BP=Biomass Power, U&I=Urban & Industrial Waste Power, RES=Renewable Energy MNRE=Ministry of New and Renewable Energy

Source: CEA (http://www.cea.nic.in/reports/monthly/installedcapacity/2018/installed_capacity-09.pdf)

Karnataka is rich in solar resources and solar energy will complement the conventional sources of energy in a large way. The state of Karnataka is blessed with about 240 to 300 sunny days with good solar radiation. Karnataka was the first southern state to notify its solar policy in 2011 and the first state to commission utility scale solar power project in India.

Karnataka receives an average insolation of 5.55 kWh/m^2/day annually. Insolation varies from 4.5 to 7.0 kWh/m^2/day throughout the year. All districts of the state receive average insolation of 5.5 to 6.5 kWh/m^2/day annually except Kodagu (5-5.5 kWh/m^2/day) as presented in ***Figure 5-1***.

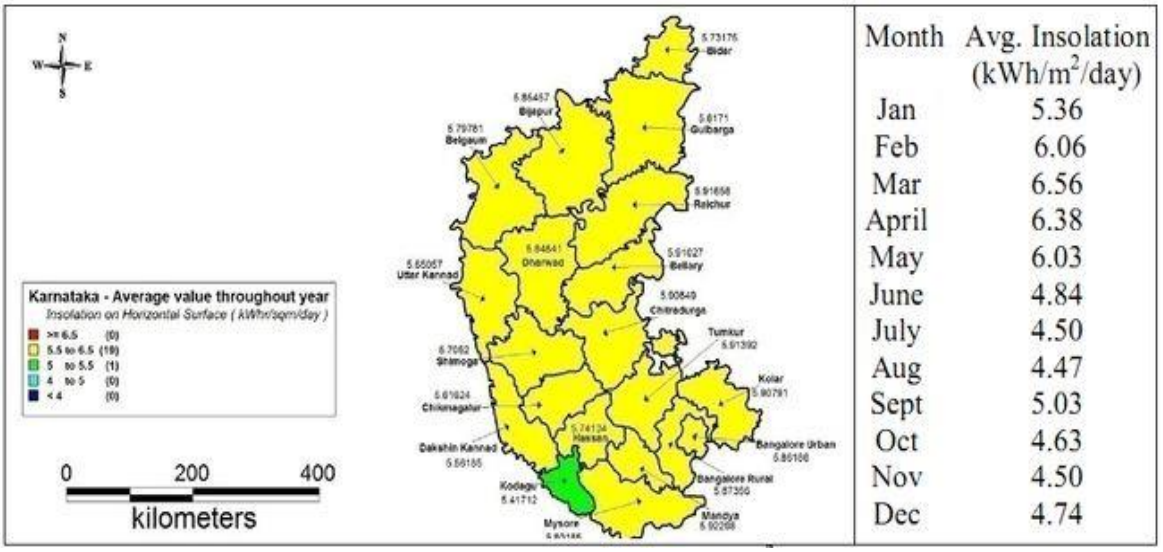


Figure 5-1: Average Annual Solar Insolation (kWh/m^2/day) in Karnataka

As per the prevailing technical norms, any place with DNI more than or equal to 5.00 kWh/m^2/day is considered suitable for solar thermal power projects that use only direct solar radiation. As regards with SPV power projects, they use both direct and diffuse radiation and hence values below 5.00 kWh/m^2/day are also acceptable.

However, as per Karnataka Renewable Energy Development Limited (KREDL), annual average global horizontal irradiation at Sindhanur taluka is 5.92 kWh/m^2 as presented in ***Table 5-4.***

Table 5-4: Average GHI and DNI values at Project Taluka

Taluka	Latitude	Longitude	Altitude	Annual Average GHI (kWh/m^2)	Annual Average DNI (kWh/m^2)
Gulbarga	17° 46' 48"	76° 46' 12"	377	5.92	5.39

Source: Karnataka Renewable Energy Development Limited (KREDL)
GHI: Global Horizontal Irradiance
DNI: Direct Normal Irradiance

Solar Radiation at Site

The project site experiences an average global horizontal irradiance on month basis falling in range of 1900 to 2050 kWh/m^2 as detailed in Table 5-5. This irradiance is generally suitable for the reasonably good energy generation. ***Table 5-5*** below presents the levels of irradiance (month wise) at the project site.

Table 5-5: Month wise level of Irradiance for the site region

Months	Average Monthly Global Horizontal Irradiance (kWh/m^2/month)
January	142
February	155
March	203
April	213
May	225
June	189
July	145
August	138
September	161
October	174
November	144
December	136
Average	**168**

Source: Detailed Project Report (March 2017)

The project is an opportunity to utilize the solar potential of the area for power generation. A "No Project Scenario" will not address the issue of power shortage. An alternative without the project is undesirable, as it would worsen the power supply-demand scenario, which would be a constraint on economic growth.

To evaluate further, both the options of 'Current Project' and 'No- Project' Alternative have been assessed against potential environment and social impacts that are envisaged. Going forward with the current project alternative is considered the best possible option as opposed to 'No Project' since the project is considered a green and environmental solution to meet energy requirements as the solar energy is renewable clean technology with no emissions as well as the global and local trend for energy generation.

Table 5-6: Comparison of overall environmental impacts as a result of the Current Project against the 'No-Project' Alternative

Environmental and Social Components	Current Project	No-Project Alternative
Terrestrial Ecology	S-	*
Air Quality	*	*
Noise Generation	*	*
Wastewater Generation	S-	*
Waste Generation / Disposal	S-	*
Soil & Groundwater Quality	X	*
Health & Safety	S-	*
Socio-economic Impacts	S+	X
Traffic Disturbance	X	*
Land Use	X	*
Archaeology / Cultural Property	X	*
Energy Production	S+	*

Environmental and Social Components	Current Project	No-Project Alternative
Employment and Job Opportunity	S+	*

Notes:
X: Denotes potential for impact, which is not considered significant
S-: Denotes Potential Significant Adverse Impact
S+: Denotes Potential Significant Beneficial Impact
**: Denotes no change to the existing situation*

5.2 Alternate Location for Project

Solar power projects are non-polluting energy generation projects and are dependent on the availability of sufficient solar irradiation. The State of Karnataka receives good amount of solar irradiation. The project proponent has carried out assessment studies in order to understand the power generation potential of the site. The following additional criteria have been considered for site selection:

- ***Easy Access:*** Easy access to site or connectivity with main road or highways helped in transportation of materials, man and machinery required during construction; the site is well connected by road and rail to Bangalore, Mumbai, Hyderabad and other major cities like connectivity with SH 14.
- ***Shadow***: Shadow free or minimum shadow area improves plant generation. There are no major structures within 1 km of the site.
- ***Settlements***: Site is located away from major settlements and villages.
- ***Ecologically Protected Area:*** The site does not fall under any ecologically protected area. The land procured for the project comprises of rain-fed agricultural land which has been purchased through willing-buyer/ willing-seller arrangement.
- ***Electrical infrastructure***: Nearest Grid sub-station is present at a distance of about 16 km from the site, will allow minimum transmission losses and also saves transmission cost of project.
- ***Climate***: The site experiences moderate rainfall, solar irradiation in the range of 1900-2050 kWh/m^2/month, low relative humidity, is good for setting up of a Solar power plant.
- ***Topography***: Minimum undulation of land with minimum vegetation is good for solar power plant. Site selected is a large stretch of land with minimum shading and little undulation. Site is covered with black soil with very less vegetation, mainly comprising shrubs and grasses.

Therefore, considering all the above details of the location and site settings, the identified site was chosen as a suitable option for the project.

5.3 Alternate Source of Power Generation

India has an installed capacity of 3, 50,162 MW GW as on 28th February 2019 as per the Ministry of Power. In terms of fuel, coal-fired plants account for 54.6% of India's installed electricity capacity followed by renewable energy and hydropower which accounts for 21.2% and 13.0% respectively. Nuclear plants account for 1.9% of power generated. The source wise installed capacity in India is presented in ***Figure 5-2.*** The various power generation options as discussed in the earlier section can be evaluated on the levelised cost of power generation which includes the capital and O&M costs, reliability of power generation in terms of plant load factor and the greenhouse gas (GHG) emission. The comparative analysis of various power generation options based on these factors has been presented in ***Table 5-7.***

The power generation options using conventional sources offer advantages such as lower levelised costs of power generation and higher plant load factors. The operation and maintenance of solar power projects does not typically involve air emissions or effluent discharges.

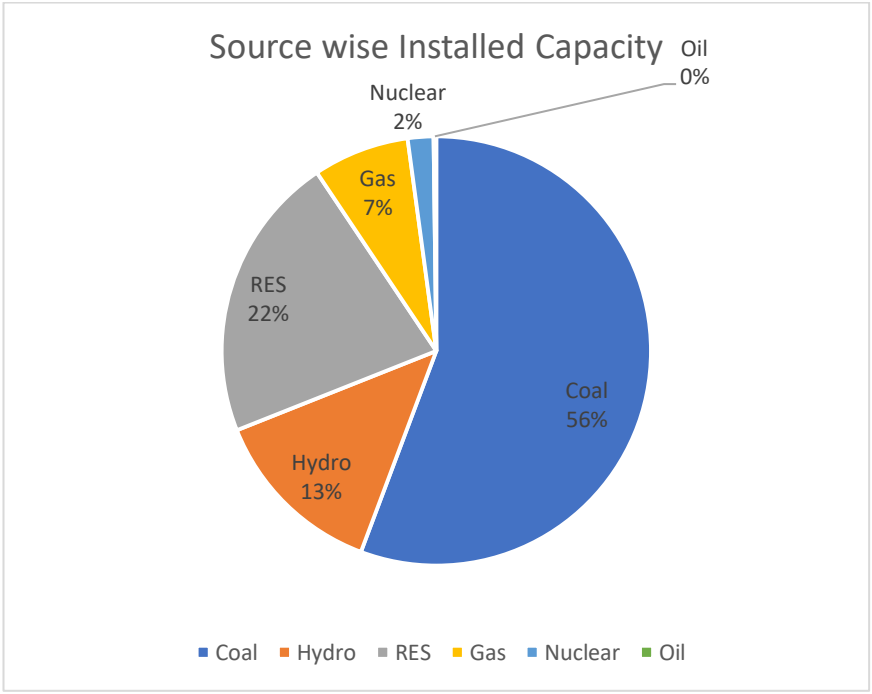


Figure 5-2: Source wise Installed Capacity in India as on 28th February 2019

Source: Ministry of Power (2019)

There are no fuel requirements or large quantities of water required for the operation of the solar plant. GHG emissions and other environmental pollution (stack emissions, ash management etc.) issues are also insignificant. Also, there are no significant social issues associated with solar power projects.

Table 5-7: Comparative analysis of Various Power Generation Options

Alternative	Cost (₹/kWh) *	Plant Load Factor **	Average Lifecycle GHG Emission (tonnes CO_2e/GWh) ***
Coal	2.5	65-85%	888
Natural Gas	3.9	70-85%	500
Hydro	3.8	30-50%	26
Nuclear power	2.5-5.7	65-85%	28
Wind Energy	4.2	25-40%	26
Solar	15.3-17.1	10-15%	85

*Source: * - LBNL, CERC, CSTEP & NPCIL*
***- Renewable UK*
**** - World Nuclear Association Report*

India being a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) has formulated a National Action Plan on Climate Change (released in June 2008) to promote the development of renewable energy in the country. The Ministry of New and Renewable Energy (MNRE), GOI has been promoting new and renewable energy sources in a big way in India. The government of India envisages a target of renewable energy capacity to 175 GW by the year 2022. While about 100 GW is expected to be generated from solar, the balance is to be realized by wind and other renewable energy systems. The Electricity Act 2003 clearly mandates state electricity boards to adopt a minimum percentage for the procurement of electricity from renewable energy sources.

Various policy measures such as Jawaharlal Nehru National Solar Mission (JNNSM) Feed-in-Tariff, Accelerated Depreciation (AD), Generation Based Incentives (GBI), Renewable Purchase Obligations (RPO) and Renewable Energy Certificates (RECs) have helped in the rapid growth of Renewable Energy deployment in the country.

Along with above demand and supply side measures to promote Renewable Energy growth in India, various states have come up with their state Solar Policies to provide an enabling framework for growth of Renewable Energy in India.

The power plant has been allotted by Solar Energy Corporation of India (SECI) under Jawaharlal Nehru National Solar Mission (JNNSM) Phase II, Batch III for Karnataka. The benefits of the Jawaharlal Nehru National Solar Mission (JNNSM) which is part of the eight mission documents under India's National Action Plan on Climate Change (NAPCC), and a significant contribution to low carbon sustainable development strategy for the Indian economy are as follows:

1. To create an enabling policy framework for the deployment of 20,000 MW of solar power by 2022
2. To create favourable conditions for solar manufacturing capability, particularly solar thermal for indigenous production and market leadership
3. To promote programmes for off-grid applications, reaching 1000 MW by 2017 and 2000 MW by 2022
4. To achieve 15 million sq. meters solar thermal collector area by 2017 and 20 million by 2022
5. To deploy 20 million solar lighting systems for rural areas by 2022.

Therefore, considering various factors such as favourable environmental and social settings; low GHG emissions during the entire project life cycle; availability of lands, solar power generation is the most appropriate alternative in the Project area.

5.4 Alternate Route for Transmission Line

Power from the solar PV plant is being evacuated to the 110/33/11 kV grid substation at Turvihar (owned by GESCOM) which is located at a distance of about 16 km from the site. The route for the transmission line has been selected based on the following factors:

1. Transmission line route has been planned to avoid any habitations along the route;
2. No house or community structure are located under the transmission line;
3. Any route which has the presence of a monument of cultural or historical importance, community structures, or houses is exempted;
4. Only Right of way has been secured by providing adequate compensation to the land owners where transmission poles have been installed in villages;
5. Areas requiring extensive clearing of vegetation have been avoided; and
6. Selection of the transmission route avoids any environmental sensitive site if identified.

The shortest possible route after considering the above factors has been selected for the transmission lines. The land has been leased for the entire duration of the project by paying a one-time compensation amount to the landowners. The project area is rain fed region and agriculture is limited during rainy season only, and it was reported that habitations, community structures, or residential areas have been avoided and by passed during the procurement stage. The transmission route therefore has been chosen considering the above social conditions, in addition to the distance to be covered and financial benefits.

Consideration of all the above factors has reduced the environmental and social footprint of the transmission line.

5.5 Conclusion

United Nation's Intergovernmental Panel on Climate Change (IPCC) has projected that renewable energy can provide approximately 77% of global primary energy supply by 2050. The state level incentives provided by the new government of Karnataka are attractive enough to influence the Solar power companies.

As mentioned in the sections above, the project has many advantages like elevating the standard of rural economies and increasing the power supply of the energy deficit state of Karnataka in an environmentally friendly manner. The project with existing options for site, mode of power generation, route of transmission line etc., is the appropriate alternative and is beneficial for the region.

6. Evaluation of Impacts

This chapter describes various environmental and social impacts identified by accessing information gathered through primary and secondary sources. Impacts have been identified based on review of available project information; discussions conducted with the local community; representatives of the project and other sector specific professionals. Impacts during the operation and decommissioning phases have been included and are classified as per impact type.

Additionally, this section presents the identified impacts within a severity range to assess overall significance of impacts on environment, ecology, socio-economic resources, demographics, and livelihoods. Subsequently, mitigation measures have been suggested for impacts outlined in this section.

6.1 Impact Assessment Criteria

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

Table 6-1: Impact Assessment Criteria

Criteria	Sub-Classification	Defining Limit	Remarks
Spread: Refers to area of direct influence from the impact of a particular project activity.	Insignificant/ local spread	impact is restricted within the foot prints of the Project boundary	except for ecology (which is defined as limited loss of vegetation only at site)
	Medium Spread	impact is spread up to 2 km around the project area	except for ecology (which is defined as loss of vegetation at site including large trees with limited disturbance to adjoining flora & fauna)
	High spread	impact is spread beyond 2 km from footprint boundary of the Project	except for ecology (which is defined as loss of vegetation at site and/ or damage to adjoining flora and fauna
Duration: Based on duration of impact and time taken by an environmental aspect to recover to its original state	Insignificant / Short Duration	when impact is likely to be restricted for a duration less than 2 years	the anticipated recovery of the impacted environmental aspect is within 2 years
	Medium Duration	when impact extends up to five years	the anticipated recovery of the impacted environmental aspect is within 5 years
	Long Duration	when impact extends beyond five years	the anticipated recovery of the impacted environmental aspect is more than 5 years
Intensity: Defines the magnitude of impact	Insignificant intensity	when changes in the prevailing (baseline) environmental conditions does not exceed 10%	However, it shall be reconsidered where the baseline values are already high
	Low intensity	when changes in the prevailing (baseline) environmental conditions does not exceed 20%	for ecology it refers to minimal changes in the existing ecology in terms of their reproductive capacity, survival or habitat change
	Moderate intensity	when changes in the prevailing (baseline) environmental conditions does not exceed 30%	for ecology, it refers to changes that are potentially recoverable
	High intensity	when changes in the prevailing (baseline) environmental conditions	While for ecology, high intensity refers to changes that result in serious

Criteria	Sub-Classification	Defining Limit	Remarks
		exceeds 30%	destruction to species, productivity or critical habitat.
Nature: Refers to whether the effect is considered beneficial or adverse	Beneficial	-	Useful to Environment and Community
	Adverse	-	Harmful to Environment and Community

A "significance assessment matrix" has been adopted in order to assess impacts appraised as per criteria mentioned in Table 6-1. The below ***Table 6-2*** provides the impact significance criteria adopted for assessment.

Table 6-2: Impact Significance Criteria

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

6.2 Impact Evaluation Matrix

Table 6-3 below presents the impact identification matrix for operation and decommissioning phases of the project, based on environmental and occupational health and safety variables. Each of the impacts identified has been further discussed and corresponding mitigation measures have been proposed.

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

Environment, Health & Safety impact assessment variables	Operation and Maintenance Phase	Decommissioning Phase
Land Use and Visual Aesthetics		
Site Preparation and Grading		

Site/ Vegetation Clearance		•
Laying of Transmission Lines		
Ecology		
Site Preparation and vegetation Clearance		
Hazardous and Non- Hazardous Material and Waste Management	•	•
Power Transmission	•	
Water Resources and Water Quality		
Material Handling and Storage	•	•
Hazardous and Non- Hazardous Material and Waste Management	•	•
Washing of Solar Panels	•	
Water Requirement for workers	•	•
Ambient Air Quality/ Atmospheric Emissions		
Material Handling and Storage		•
Operation of construction equipment		
De-mobilization of construction equipment		•
Ambient Noise Quality		
Material Handling and Storage		
Repair and Maintenance Works of solar panels	•	•
Demobilization of construction equipment		
Traffic & Transport		
Material Handling and Storage		
Demobilization of construction equipment		
Soil Resources		
Site Preparation and vegetation clearance		
Demobilization of construction equipment		
Hazardous and Non- Hazardous Material and Waste Management	•	•
Material Handling and Storage	•	•
Occupational Health and Safety		
Employment of Workers	•	
Material Handling and Storage	•	•
Construction works		
Laying of transmission lines		
Electrical hazard during solar power generation	•	
Repair and Maintenance Works of solar panels	•	
Land Procurement		
Adequate Compensation		
Loss of Agricultural land		
Changing occupational opportunities		
Influx of migrant Workers		
Presence of an outside agency	•	
Conflicts Between Local Residents and Newcomers	•	
Income generating opportunities	•	
Increase in local employment	•	
Introduction of new Social classes		
Change in the commercial/industrial focus of the community	•	
Stress on local Infrastructure		

Loss of jobs		•
Community Infrastructure and property		
Change in community infrastructure	•	
Land acquisition or disposal		
Initiation of community development activities	•	
Effects on known cultural, historical and archaeological resources		

6.3 Environmental Impacts

6.3.1 Operation Phase

6.3.1.1 Soil Quality

Compaction of soils from increased levelling and grading of areas during the construction phase within the site resulted in lower permeability and therefore decreased infiltration and increased runoff. Without appropriate measures, runoff from PV panels, compacted areas and hard standing areas in addition to erosion by wind may increase erosion and increase the sediment load in run-off.

During the current phase, i.e. the operation phase, there will be limited disturbance to soil however repair and maintenance of underground cables and associated utilities and transformer will lead to generation of hazardous wastes such as used transformer oil. The defunct/damaged photo voltaic cells will also be generated and storage/disposal on unpaved ground can lead to contamination of soil. Accidental spillage of lubricant, fuel and other chemicals may potentially cause soil degradation.

Mitigation Measures

- Disturbance to soil from repair and maintenance activity will be limited and proper restoration of soil wherever excavation is undertaken will be ensured.
- CSPGPL shall make buyback agreements for defunct panels and for replacement and disposal of transformer oil by the supplier, otherwise will make arrangements for disposal of defunct panels and waste oil by Karnataka State pollution Control Board (KSPCB) authorised recyclers.
- Broken or damaged solar panels will immediately be shifted to a designated area in scrap yard to avoid land contamination. These broken cells once collected to a certain number will be sent back to the manufacturer with the photographs taken for proper and safe disposal.
- Fuel and used oil will be stored in demarcated storage areas with adequate secondary containment and appropriate capacity.
- Spill control and prevention mechanism will be developed, and all the staff will be trained.

Significance of Impact

The impact on soil will have minor intensity with a local spread for a short duration (of activity) which will result in an overall insignificant impact without mitigation.

Table 6-4: Impact Significance- Soil Quality

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

6.3.1.2 Visual Impacts and Aesthetics

The presence of a large area of PV panels is not expected to constitute a risk for glare since it is situated far from airport and residential dwellings. Moreover, no potential visual disturbance to birds is expected given the fact that IBAs located are far from the project area.

Therefore, it is not anticipated that visual impacts will be generated due to the PV system design, which is specifically designed to include dark, light-absorbing materials and covered with an anti-reflective coating (ARC) for glass surfaces, which reduces the reflectance from PV panels to 2.5%-2.6% while at the same time improving their efficiency.

6.3.1.3 Water Resources and Quality

The water requirements for the plant during operations will be predominantly for washing of solar PV modules to remove bird droppings, dust and other dirt, and domestic water consumption. Assuming a minimum of 1 liters of water per module, the water requirement for cleaning the whole plant (1, 30, 431 modules) will be approximately 150- 200 kilo liters, at one time. With a cleaning schedule of twice a month, it is estimated that approximately 300- 400 kilo liters of water will be required for cleaning purpose on monthly basis and the requirements will be met through the dug wells present at the site.

Project site falls in safe zone, as per status of groundwater utilization of Raichur District. However, extraction of groundwater is to be undertaken after taking the required approval by CSPGPL. A Reverse Osmosis (RO) plant has been installed at site for treatment of ground water for module cleaning. Water for domestic purpose such as toilets and cleaning in the site office will also be extracted through dug well. Drinking water requirement at the site for operation phase is ~80L/day and is sourced through a RO plant in Sindhanur.

As informed by the site personnel, CSPGPL is evaluating the possibility of Rain water harvesting at site and rain water harvesting system will be implemented after the completion of drainage work at the site.

Waste Water

During Operational phase, 10-12 site engineers, safety in charge, technicians and security guards will be deployed at site. Waste water from the toilets, floor cleaning and similar domestic works, if not channelized, collected and removed properly will lead to pollution of ground water.

Mitigation Measures

- The plant site will be provided with adequate drainage facility to drain off washing wastewater and prevent any water-logging at site or in the surroundings. Wastage of water during cleaning of panels shall be avoided. Various factors such as tilt angle, orientation and tracking are required to be monitored for efficient cleaning of modules. Ground water shall be extracted only after getting proper approvals from competent authority. It shall be ensured that water tankers required during operation phase are sourced from authorised vendor.
- Rainwater harvesting system by making recharge pits shall be utilised to recharge the ground water. The water harvested will be directed to a recharge pit. CSPGPL to ensure that rain water collected from the project site will be utilized to recharge the ground water through onsite rain water harvesting tank/pits. Water use and harvesting/recharging in the project will be a key performance indicator that will be monitored through operation phase of the project.
- Adequate septic tanks and soak pits are to be provided at site and the Septic tanks are to be maintained properly and cleaned at regular intervals.

Significance of Impact

The impact on water resources will have moderate intensity with a local spread for a long duration which will result in an overall minor impact without mitigation.

Table 6-5: Impact Significance - Water Resources

Aspect	Scenario	Spread	Duration	Intensity	Overall
Water Resources and Quality	Without Mitigation	Local	Long	Moderate	**Moderate**
	With Mitigation	Local	Long	Low	**Minor**

6.3.1.4 Air Quality

The baseline air quality will not vary to a considerable extend as the operation of solar farms doesn't involve any significant air polluting activities and there are no direct emissions from the project during the operation phase. Hence, the overall impact on air quality during operation phase is expected to be negligible.

Significance of Impact

The impact on air quality will have low intensity with a local spread for a short duration which will result in an overall insignificant impact without mitigation.

Table 6-6: Impact Significance - Air Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Air Quality	Without Mitigation	Local	Short	Low	**Minor**
	With Mitigation	Local	Short	Low	**Insignificant**

6.4 Ecological Impacts

6.4.1 Operation Phase

Habitat loss/degradation/fragmentation

Physical Presence of Installations

The physical presence of the solar panels and related transmission line installations is likely to act as an obstacle and physically hinder or restrict faunal movement and ecological flows within and through the Study Area. This can lead to fragmentation of existing faunal habitats and effectively reduce faunal access to habitats. It is also likely to affect the habitat features such as roosts, feeding grounds, nest sites, tools and nesting materials. There is also a likelihood of death or injury to animals, especially aerially moving fauna, through electrocution with the project installations.

The presence of the large, geometrically arranged, reflective surfaces of solar panelling into a natural area can cause considerable disturbance to the natural fauna associated with the area through visual obstruction or visual irritation. The overall visual effect of the solar panelling is also known to degrade the aesthetic qualities of the natural landscape, thus affecting the cultural services hitherto proffered by the area.

Project-site Illumination

Use of artificial lighting at the project site will lead to unnatural illumination in the area during the night. Interruption of the natural night period by light is known to disrupt the natural biological cycles of many floristic and faunal species.

Project-related Traffic

The movement of project-related vehicles and personnel to, from and around the project-site is apt to increase the ambient levels of vehicular emissions, dust, noise, vibrations and artificial illumination in and around the project site. These effects lead to pollution of natural resources and consequent degradation of habitats and ecosystem-services.

Waste Disposal

Construction debris including cement and plastic wastes generated during the construction phase were noted to be scattered in many parts of the project site. Dumping of these waste materials on bare soil is likely to damage the ground flora and micro-fauna in the area. These waste materials tend to get mixed with the waste water generated during solar panel cleaning, a key routine activity during the operational phase of the project. Accidental mixing of these waste materials into natural water resources in the area will result in contamination of the water bodies in the surrounding. Water soluble chemicals from the waste materials are likely to get dissolved in the water flowing through the project area and likely to result in contamination of water sources and degradation of food-chains in the area.

Construction and plastic waste material dumped at the Project Site

Mitigation Measures

- Electrocution of fauna through accidental contact with the project-installations could be mitigated by ensuring that all its electrical components are adequately insulated.
- The collision risk of aerially moving fauna with the transmission towers and cables could be reduced by installing bird-deflectors.
- The impact of artificial illumination could be mitigated by restricting project- operation activities to the daytime and avoiding use of artificial lighting in and around the project site as far as possible.
- The impact of visual irritation could be somewhat mitigated by plantation of relatively tall-growing native vegetation at a suitable distance along the boundary of the project site to visually screen it from wild habitats and habitations in the surrounding area.
- The impacts caused due to movement of project-related vehicles could be mitigated by ensuring that vehicles and machinery used in the project activities comply with the prescribed emission standards and their movement is strictly restricted to existing routes.
- The impacts of leaching of hazardous chemicals could be effectively mitigated through institution of good operational practices and training of the project-related personnel to ensure prevention of such spillages and installation of effective containment systems to prevent any accidental spillage from leaching into the local environment. Waste materials generated in course of project activities should be meticulously collected and regularly disposed of through legally authorized agencies.

Significance of Impact

Table 6-7: Impact Significance – Habitat loss/degradation/fragmentation

Aspect	Scenario	Spread	Duration	Intensity	Overall
Habitat loss	Without Mitigation	Local	Long	Moderate	**Moderate**
	With Mitigation	Local	Long	Low	**Minor**
Habitat degradation	Without Mitigation	High	Long	Moderate	**Major**
	With Mitigation	Local	Long	Low	**Minor**
Habitat fragmentation	Without Mitigation	High	Long	High	**Major**
	With Mitigation	High	Long	Low	Moderate

6.5 Occupational Health and Safety

During the operation phase, the risks will be quite limited due to nature of operation activities; the activities will be limited to guarding and on call and/or onsite technical support (maintenance and cleaning). There will be potential impacts on personnel health and safety during operation phase due to exposure to risks such as:

- Slipping and tripping;

- Falling during working at height;
- Exposure to hazards such as electric shock and thermal burn hazards;
- Exposure to chemicals, hazardous and flammable materials; and
- Maintenance activities are expected to be carried out in hot weather conditions, thus workers are exposed to dehydration, heat exhaustion and heat stroke.

Mitigation Measures

CSPGPL will prepare and implement Occupational Health and Safety Plan (OHSP); it will clearly identify roles and responsibilities of the personnel involved within the project. The OHSP to include but not limited to the following: site specific safety plan, electrical safety, fire safety, heat stress, personnel protective equipment, emergency response plan, reporting and investigation and others.

Mitigation measures to be implemented shall include:

- Regular electrical safety training to workers;
- Implement Lock out/ Tag Out (LOTO) system;
- Use work equipment or other methods to prevent a fall from occurring. Collective protection systems, such as edge protection or guardrails, should be implemented before resorting to individual fall arrest equipment. In addition, safety nets or airbags can be used to minimize the consequences of a fall, should it occur.
- Personal Protective Equipment (PPEs) e.g., shock resistant rubber gloves, shoes, other protective gear etc. should be provided to workers handling electricity and related components;
- The transformer yard should be provided with fire extinguishers and sand buckets at all strategic locations to deal with any incident of fire;
- Employees involved in electrical works shall be trained in and familiar with the safety-related work practices, safety procedures and other safety requirements that pertain to their respective job assignments; and
- An accident/ incident reporting, and monitoring record shall be maintained.

Significance of the Impact

The impact on health and safety will have moderate intensity with a local spread for a long duration which will result in an overall moderate impact without mitigation. However, with proper health and safety measures, the intensity of impact can be reduced to low resulting in an overall minor impact.

Table 6-8: Impact Significance – Health and Safety

Aspect	Scenario	Spread	Duration	Intensity	Overall
Health and Safety	Without Mitigation	Local	Long	Moderate	**Moderate**
	With Mitigation	Local	Long	Low	**Minor**

6.6 Socio- Economic Impacts

6.6.1 Operation Phase

The socio-economic impacts during the operation phase have been provided below:

- Impact on Local Economy: During the operation phase, the impact on the local economy is anticipated to be positive. The local vendors and contractors are expected to get work orders for operation of the project. There is a likelihood of increase in employment opportunities of the local people as security personnel and house-keeping workforce.
- Upgradation of Local Infrastructure: With the coming of the project proponent to the area, it is expected that the project proponent will invest in the local infrastructure development such as existing village road and corporate social responsibilities (CSR) activities for the welfare of the local communities.

Mitigation Measures

The mitigation measures that can be adopted during this phase are:

- The project proponent should wherever possible engage the local workforce population for unskilled jobs.
- The project proponent to ensure that while engaging contractors and sub-contractors during the operation phase agreements on priority basis to be made with local contractors and vendors.
- CSPGPL is to undertake a needs assessment of the local communities residing in the vicinity of the project area and develop and implement CSR activities for the welfare of the local communities.

Significance of Impact

The socio-economic impact value during the operation phase has been provided below,

Table 6-9: Socio Economic Impact during Operation Phase

Aspect	Scenario	Spread	Duration	Intensity	Overall Significance
Impact on Local Economy	Without Mitigation	Local	Long	Moderate	**Moderate**
	With Mitigation	Local	Long	Low	**Minor**
Upgradation of Local Infrastructure	Without Mitigation	Local	Long	Moderate	**Moderate**
	With Mitigation	Local	Long	Low	**Minor**
Implementation of CSR activities	Without Mitigation	Local	Long	Moderate	**Moderate**
	With Mitigation	Local	Long	Low	**Beneficial**

6.7 Decommissioning Phase

6.7.1 Environment Impact

Typical activities during the solar energy facility decommissioning and site reclamation phase include facility removal, breaking up of concrete pads and foundations, removal of access roads that are not maintained for other uses, recontouring the surface, and revegetation.

Dismantling operation however, will have impact on environment due to noise and dust arising out of it. During de-installation, a specific strategy shall be adopted in order to handle each type of item to keep the impact during the actual activity low. The decommissioning activities will also have social impact. The impact due to decommissioning on power, social and environmental scenario will be guided by applicable laws and guidelines. The key issues associated with demobilization phase will include:

- Issue of loss of job when the workers will be asked to leave;
- Improper disposal of demolition waste and obsolete machineries will lead to contamination of soil and discontent of community;
- Demolition activity is anticipated to generate dust and exhaust emissions which can be carried downwind to habitations;
- Risks associated with health and safety issues such as trip and fall, electrical hazard etc.;
- The decommissioning activities of dismantling the solar power plant and removing the ancillary facilities can lead to increased noise levels;
- During the dismantling of the solar power plant, visual intrusions will be likely by removal of ancillary facilities, but their consequence will be negligible due to fact that such impact would be temporary (over a short period);
- Depending on the type used, photovoltaic cells may contain toxic substances such as gallium arsenide, copper-indium-gallium-diselenide and cadmium telluride. If any solar panel is damaged during dismantling

of the facility, these toxins are likely to spill and leach into the soil and water of the area, posing threat to environmental and public health;

- If the solar panels are not handled or disposed of appropriately during the decommissioning phase, any toxic substances contained within them are likely to escape into the surrounding air, water or soil, creating serious environmental and public health risks.

Mitigation Measures

Demobilization will require removal of machinery, workers and other structures. The mitigation measures for decommissioning shall include:

- The proponent shall inform the workers and local community about the duration of work;
- The workers shall be clearly informed about the expected schedule and completion of each activity;
- A transparent mechanism shall be prepared wherever choice is to be made between individuals of similar capability;
- All waste generated from decommissioning phase shall be collected and disposed off at the nearest municipal disposal site;
- All necessary Personal Protection Equipment (PPE) shall be used by the workers during demolition work;
- CSPGPL will be committed to ensure all health and safety measures are in place to prevent accidents and/or reduce the consequences of non-conformance events;
- Institution of suitable training modules for project personnel and labor contractors involved in the dismantling process to ensure avoidance or minimization of solar panel damage as far as possible and adherence to appropriate decontamination protocols in the event of any unavoidable damage and adhere to proper safe disposal methods.

Significance of the Impact

Impact value for decommissioning is assessed to be moderate without mitigation and minor with preventive measures.

Table 6-10: Impact Significance – Decommissioning Phase

Aspect	Scenario	Spread	Duration	Intensity	Overall
Decommissioning	Without Mitigation	Medium	Short	Moderate	**Moderate**
	With Mitigation	Medium	Short	Low	**Minor**

6.7.2 Ecological Impact

Air, soil and water quality

Damage / Unsafe Disposal of Solar Panels

Inappropriate handling or disposal of solar panel during decommissioning phase, are likely to cause damage to the panels. Any damage or unsafe disposal of solar panels will cause release of toxic substances contained within them. These hazardous chemicals are likely to escape into the surrounding air, water or soil, creating serious environmental and public health risks.

Mitigation Measures

This impact could be mitigated by institution of suitable training modules for project-personnel and labour contractors involved in the dismantling process to ensure avoidance or minimization of such damage as far as possible and adherence to appropriate decontamination protocols in the event of any unavoidable damage.

Significance of Impact

Table 6-11: Impact Significance – Air, soil and water quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Air, soil and water quality	Without Mitigation	High	Medium	High	**Major**
	With Mitigation	Local	Short	Low	**Insignificant**

6.7.3 Socio-Economic Impact

The decommissioning phase would involve the dismantling of the solar modules and all associated electrical infrastructure and site buildings. The impacts associated with the decommissioning phase are:

- Improper disposal of demolition waste and obsolete machinery may lead to contamination of soil which may cause discontentment amongst community members.
- Reduction of Workforce
- Demolition activity would lead to generation of dust which would be carried downward to the habitations.

Mitigation Measures

- Designated waste disposal sites should be marked for disposal of redundant and old solar panels;
- All waste generated from decommissioning shall be collected and disposed of at the nearest municipal disposal site. Structures that can be reused will be carried back by the contractors or sold to vendors;
- Reduction of workers shall be done phase wise and corresponding to completion of each activity;
- The local community members shall be intimated prior to the decommissioning phases and communicated about the anticipated dust generation; and
- The contractor shall inform workers and local community about the duration of work.

Significance of Impact

The socio-economic impact value for probable impacts during decommissioning phase has been presented below:

Table 6-12: Socio-Economic Impact during Decommissioning Phase

Aspect	Scenario	Spread	Duration	Intensity	Overall Significance
Waste Disposal	Without Mitigation	Local	Long	Moderate	**Moderate**
	With Mitigation	Local	Short	Low	**Insignificant**
Reduction of Workforce	Without Mitigation	Local	Medium	Moderate	**Minor**
	With Mitigation	Local	Short	Low	**Insignificant**

7. Environment and Social Management Plan

7.1 Introduction

This chapter addresses the requirement of IFC Performance Standard-1 which highlights the importance of managing the social and environmental performance throughout the life of the project. The purpose of an Environmental and Social Management Plan (hereinafter referred as "ESMP") is to ensure that social and environmental impacts, risks and liabilities identified during the ESIA process are effectively managed during the operation and closure of the operational solar power project. Impact due to construction phase is not considered as project is already in operation. The ESMP specifies the mitigation and management measures to which the Proponent is committed and shows how the Project will mobilize organizational capacity and resources to implement these measures. The ESMP also shows how mitigation and management measures will be scheduled. The key objectives of the ESMP are to:

- Formalize and disclose the program for environmental and social management;
- Provide a framework for the implementation of environmental and social management initiatives.

The Environmental and Social Management Plan (ESMP) is specified in order to describe the mitigation measures for all the impacts associated with the project during its operation and maintenance phase and decommissioning phase. The ESMP intends to delineate the monitoring and management measures to minimize such impacts by allocating management responsibility and suggesting skill requirement for implementation of these measures during the operational phase.

CSPGPL is committed to ensure compliance to all the commitments towards Environment, Social, Health and Safety Standards while executing all the project related activities to 40 MW Solar Power Project. This ESMP is applicable to all the employees of CSPGPL, Ritis Meera and the other sub-contractors if any, engaged during the project lifetime.

HFE has formulated an Occupational Health and Safety and Environment policy which has been endorsed by the company CEO.

7.2 Organizational Structure (Environment, Social, Health and Safety)

The enforcement and implementation of the project specific ESMP requires a robust manpower network working towards the common goal of ensuring compliance to the commitments towards ESHS standards for the project. The overall management and coordination of the project will be managed through the Managing Director of HFE. He is supported by and Chief Operating Officer (CEO) who in turn is supported by the Head of Projects and Chief Engineer, O&M.

Head of Projects and Chief Engineer, O&M will overview monitor and control the activities of the HSE Engineer (based out of Bangalore for projects in the South India) and HSE – Coordinator (based out of Delhi, Corporate Office). The overall control of the site-in charge and contractor representative will be with the HSE Engineer.

The project does not foresee any significant adverse social and environment impacts or risks as indicated in the previous sections. The project footprint area is limited to its immediate vicinity and a particular range of stakeholders. CSPGPL provides professional HSE training to the site-in charge so that along with the technical project aspects he will be capable of supervising the environment, health and safety issues at the site. The HSE supervisor/site in-charge will work in coordination with the HSE staff of contractor.

CSPGPL has appointed Ritis Meera as O&M contractor for the project. Ritis Meera has a dedicated EHS Officer for day to day monitoring of activities related to EHS and reports directly to the Ritis Meera Site in charge and HFE Engineer. The organizational structure for project has been presented in ***Figure 7-1*** below:

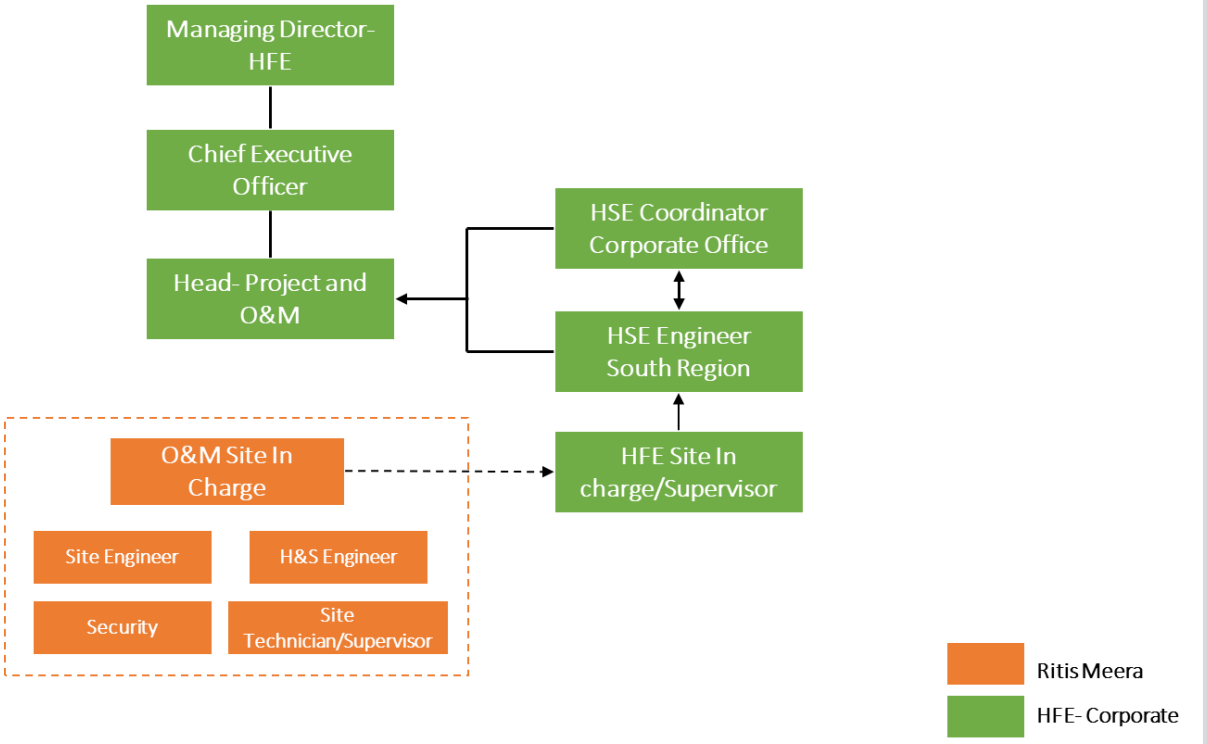


Figure 7-1: Project Organisation Structure

7.2.1 Roles and Responsibilities

This section describes the roles and responsibilities of the key persons responsible for management of onsite activities of the project.

CSPGPL will majorly play a role of supervisor to oversee the project performance pertaining to environment, health, safety and social issues. The O&M Contractor, i.e. Ritis Meera will have a dedicated HSE department for the Project. The HSE department take the overall responsibility for coordination of the actions required for environment and social management, 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 CSPGPL.

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 programs;
- Providing job specific induction training;
- Compliance of regulatory requirements;
- Carrying out internal audits;
- Identify unsafe acts and conditions and suggest remedies;
- Develop safety culture and comply with company's HSE policy and standards requirements;
- Encourage and enforce the use of PPE's;
- Educate all employees for the use of PPE's and safe practices;

- Direct, coordinate and orient the safety activities;
- Promulgate the spread of policy, objectives, rules and/or regulations;
- Perform a thorough investigation of all accidents and review the recommendations to avoid any repetition;
- Monitoring the progress of implementation of ESMP; and
- Reviewing and updating the ESMP as and when required for its effective implementation.

The responsibilities of CSPGPL employees at Site Level have been listed below:

Site In-charge (CSPGPL)

The Site In-charge of CSPGPL is responsible for overall management of the project and ESMP implementation on site during operation phase of the project. The following tasks will fall within his responsibilities:

- Monitor site activities on weekly basis for compliance;
- Conduct internal audits of the site against the ESMP; and
- Keeping a check on operation and maintenance services of solar panels required during operation phase;

HSE Engineer (CSPGPL)

The HSE Engineer will have the following responsibilities and will report to Site In-charge Head O&M of HFE Corporate:

- Ensure availability of resources and appropriate institutional arrangements for implementation of ESMP;
- Compliance of legislative and IFC PS requirements;
- Carry out audits, and inspection of all the project activities with Project Manager;
- Conduct training programs and awareness activities on health and safety for site staff and community;
- Preparation of necessary documents and record keeping system; and
- Review and updating of ESMP for its effective implementation.
- He will have the authority to issue the work permit system for undertaking electrical works during O&M phase of the project;
- Arrangement of first aid and firefighting equipment at the site office;
- Maintenance of the records of near miss and incidents that can happen at site, if any;
- Maintenance of records of hazardous waste generated on site on monthly basis and ensuring its proper disposal to authorized vendors of KSPCB only.

7.2.2 Monitoring and Audit

The ESMP will have to be monitored on a regular basis in order to ensure effective implementation. The EHS team of HFE/CSPGPL, along with Ritis Meera will undertake inspection and monitoring of the environmental and social impacts of operation phase activities in order to ensure the effectiveness of suggested mitigation measures.

- CSPGPL will ensure that Ritis Meera complies with the requirements of conditions for all applicable permits and guidelines;
- The ESMP will be monitored on a regular basis, quarterly or half yearly all outcomes would need to be audited in accordance with EHS commitments of HFE/CSPGPL.
- The monitoring process will cover all stakeholders including the local community impacted by the project activities and associated facilities.
- The inspections and audits will be undertaken by a trained team of external agencies/experts or from HFE/CSPGPL.
- The inspection and audit findings will be implemented by Ritis Meera in the areas of concern.
- The entire process of inspections and audits will be documented.

Sub-Contractors will be required to fully comply with the reporting requirements in terms of timely report submission with acceptable level of details. Reporting will be done in the form of environmental, health, safety and social check list, incident record register, environmental, health, safety and social performance reports (weekly, monthly, quarterly, half yearly, yearly etc.).

7.2.3 Documentation and Record Keeping

Documentation and record keeping system has to be established to ensure updating and recording of requirements specified in ESMP. Responsibilities have to be assigned to relevant personnel for ensuring that the ESMP documentation system is maintained and document control is ensured. The following records shall be maintained at site:

- 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.

7.2.4 Training

The training and competence of personnel working remotely and the readiness of all necessary safety equipment in the location is needed to be assessed. Hence, HFE/CSPGPL shall ensure that the job specific training and EHS Induction Training needs are identified based on the specific requirements of ESMS and project personnel (including the Contractors and Sub-contractors) to undertake the required actions and monitoring activities. Ritis Meera is responsible for ensuring that their workers are provided HSE training as stipulated. A training register should be kept on site for all trainings conducted onsite.

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

A basic occupational training program and specialty courses shall be provided, as needed, to ensure that workers are oriented to the specific hazards of individual work assignments. Training shall be provided to management, supervisors, workers, and occasional visitors to areas of risks and hazards. Workers with rescue and first-aid duties must receive dedicated training so as not to inadvertently aggravate exposures and health hazards to themselves or their co-workers. Through appropriate contract specifications and monitoring, the employer shall ensure that service providers, as well as contracted and subcontracted labour, are trained adequately before assignments begin.

7.2.5 Environment and Social Management Plan and Procedures

HFE, the parent company is committed to ensuring compliance to the national and state level regulatory requirements and mitigating potential adverse environmental impacts resulting from the project activities. It has formally developed a corporate level Environment and Social Management System (ESMS) to ensure smooth functioning of its proposed projects. The ESMS is applicable for all the holding companies of HFE including this project SPV (CSPGPL).

Corporate ESMS of HFE comprises of the following policies and plans:

- Environment and Social Policy
- Occupational Health and Safety Policy
- Labour Management Plan
- Occupational Health and safety Plan
- Stakeholder Engagement Plan
- Construction Waste Management Plan
- Grievance Redressal Mechanism
- Resettlement Action Plan
- Livelihood Restoration Plan

As mentioned above, CSPGPL will adopt all of these while implementing the project specific plans at this project site along with the mitigation measures suggested for each of the potential impacts.

7.2.6 Environment and Social Management Plan

An Environment and Social Management Plan has been developed following the delineation of impacts and mitigation measures. Since project is already in operation phase, an Environment and Social Management Plan (ESMP) has been developed for operation and decommissioning phase of the project. These measures shall be adopted by CSPGPL and imposed as conditions of contract of the sub-contractor(s) employed for respective phases of the solar power project. The mitigation measures suggested during operation will be made part of the regular maintenance and monitoring schedule. The ESMP includes the following:

- Mitigations suggested for adverse environmental and social impacts and associated risks;
- Institutional arrangement - management tools and techniques for the implementation of environmental impacts and risk mitigations;
- Monitoring and reporting of requirements and mechanisms for the effective implementation of the suggested mitigations;
- Monitoring arrangements for effective implementation of suggested mitigations for the project; and
- Reporting requirement to the regulatory agencies and funding institutes.

Table 7-1: Environment and Social Management Plan

S. No	Potential Impact/ Activity	Proposed Mitigation Measures	Monitoring Requirement	Responsibility
A. Operation Phase				
1	Visual Aesthetics	• The solar panels will be installed at a low height and will be kept closer to the ground so that it does not prop out of the general landscape of the area. • The panels will be arranged in a systematic manner which will give an aesthetic sense to it.	Records of grievances received pertaining to visual conflicts.	CSPGPL
2	Water resource and quality	• The plant site will be provided with adequate drainage facility to drain off wash wastewater and prevent any water-logging at site or in the surroundings. • Wastage of water during cleaning of panels shall be avoided. Various factors such as tilt angle, orientation and tracking are required to be monitored for efficient cleaning of modules. • Ground water shall be extracted only after getting proper approvals from competent authority. • It is to be ensured that any water tankers required during operation phase are sourced from authorised vendor. • Rainwater harvesting system by making recharge pits shall be utilised to recharge the ground water. The water harvested will be directed to a recharge pit. • CSPGPL should ensure that rain water collected from the project site will be utilized to recharge the ground water through onsite rain water harvesting tank/pits. • Water use and harvesting/recharging in the project will be a key performance indicator that will be monitored through operation phase of the project.	Ground water sample testing at the project site location. Details of rain water harvesting	CSPGPL
3	Ecology- Loss/ degradation/ fragmentation of habitats by the physical presence of solar panels and transmission lines, project site illumination and project operation-related traffic	• Electrocution of fauna through accidental contact with the project-installations could be mitigated by ensuring that all its electrical components are adequately insulated. • The collision risk of aerially moving fauna with the transmission towers and cables could be reduced by installing bird-deflectors. • The impact of artificial illumination could be mitigated by restricting project-operation activities to the daytime and avoiding use of artificial lighting in and around the project site as far as possible. • The impact of visual irritation could be somewhat mitigated by plantation of relatively tall-growing native vegetation at a suitable distance along the boundary of the project site to visually screen it from wild habitats and habitations in the surrounding area. • The impacts caused due to movement of project-related vehicles could be mitigated by ensuring that vehicles and machinery used in the project activities	Plantations to be done in areas along the boundary of the project site and other suitable areas within project site. Site Engineer to supervise the plantation and other related activities such as watering, pruning, etc. Any evidences of death or injury of aerial fauna due to electrocution or collision with project installations to be monitored. Site Engineer to monitor the use of	CSPGCL

S. No	Potential Impact/ Activity	Proposed Mitigation Measures	Monitoring Requirement	Responsibility
		comply with the prescribed emission standards and their movement is strictly restricted to pre-designated routes. • The impacts of leaching of hazardous chemicals could be effectively mitigated through institution of good operational practices and training of the project-related personnel to ensure prevention of such spillages and installation of effective containment systems to prevent any accidental spillage from leaching into the local environment. Waste materials generated in course of project activities should be meticulously collected and regularly disposed of through legally authorized agencies	artificial illumination during night times Awareness and training to all project personnel and contractors to use pre-designated routes and avoid rerouting or laying new temporary routes and regulate the vehicular emission. H&S Engineer to monitor compliance of emission of machinery and heavy vehicles used for project activities with the prescribed emission standards	
4	Soil Quality	• Ensure proper restoration of soil wherever excavation is undertaken. • Explore the option of buyback agreements for defunct panels and for replacement and disposal of transformer oil by the supplier, otherwise will make arrangements for disposal of defunct panels and waste oil by Karnataka State pollution Control Board (KSPCB) authorised recyclers. • Broken or damaged solar panels will immediately be shifted to a designated area in scrap yard to avoid land contamination. • These broken cells once collected to a certain number will be sent back to the manufacturer with the photographs taken for proper and safe disposal.	Awareness and training about the procedure for proper storage and disposal waste oil and how to act in case of accidental oil spillage; Buy Back agreements for defunct solar panels	CSPGPL
5	Health and Safety	• Regular electrical safety training to workers; • Implement Lock out/ Tag Out (LOTO) system; • Use work equipment or other methods to prevent a fall from occurring. • Personal Protective Equipment (PPEs). should be provided to workers handling electricity and related components; • The transformer yard should be provided with fire extinguishers and sand buckets • Employees involved in electrical works shall be trained in and familiar with the safety-related work practices, safety procedures and other safety requirements that pertain to their respective job assignments; and • An accident reporting, and monitoring record shall be maintained.	Workers to be trained for use of Personal Protection Equipment and its importance. All safety related incidents will be recorded and monitored. Training to be provided to the workers regarding health and safety procedures.	CSPGPL
6	Impacts on economy Upgradation of local Infrastructure	• Details of community development activities to be shared with the Gram Panchayats of the respective villages	Undertaking community development activities as per the	CSPGPL

S. No	Potential Impact/ Activity	Proposed Mitigation Measures	Monitoring Requirement	Responsibility
		• Engage the local workforce population for unskilled jobs whenever possible. • Encourage engagement with local contractors and vendors.	need assessment undertaken for the project Stakeholder Engagement and Grievance Mechanism activities and documentation.	
B. Decommissioning Phase				
1	Impact on Air, Soil, Noise, Ecology and Socio-Economic Aspects	• The proponent shall inform the workers and local community about the duration of work; • The workers shall be clearly informed about the expected schedule and completion of each activity; • A transparent mechanism shall be prepared wherever choice is to be made between individuals of similar capability; • All waste generated from decommissioning phase shall be collected and disposed off at the nearest municipal disposal site; • All necessary Personal Protection Equipment (PPE) shall be used by the workers during demolition work; • CSPGPL will be committed to ensure all health and safety measures are in place to prevent accidents and\or reduce the consequences of non-conformance events; • Institution of suitable training modules for project-personnel and labour contractors involved in the dismantling process to ensure avoidance or minimization of solar panel damage as far as possible and adherence to appropriate decontamination protocols in the event of any unavoidable damage and adhere to proper safe disposal methods.	Information to workers/staffs of close down; Training on safe handling of bulk hazardous wastes generated at site	CSPGPL

7.2.7 Environment Monitoring Plan

Regular monitoring of environmental aspects is important to assess the status of environment during the operation phase of the project. The monitored data can serve as an indicator for any change in environmental quality due to the project with respect to baseline environmental conditions; so that suitable mitigation could be taken in time to safeguard the environment.

Monitoring indicators have been developed for each of the activity considering the mitigation measures proposed. Monitoring results would be documented, analysed and reported internally. Monitoring requirements (including monitoring frequency) have been presented in ***Table 7-2.***

Table 7-2: Environmental Performance Monitoring

S. No	Environment Performance Indicator (EPI)	Monitoring Parameter	Period & Frequency
Environment Performance Monitoring			
1.	Fugitive emissions	• Visual observation of dust generated • Water sprinkling details viz. frequency and quantity	Daily during operational phase
2.	Domestic Waste generation, storage, handling and disposal	Quantity of waste generated and recycled	Monthly during operational phase
		Visual observation of waste segregation and storage conditions viz.	
		Usage of labelled and covered bins, insect repellents	
		Awareness level of operational workforce	
3.	Community health and safety	• Complaints registered by the local communities • Number of Accidents	Monthly during operational phase
4.	Occupational health and safety	Health surveillance of staffs and other workers	Monthly during operational phase
		Sanitation status of onsite office building and canteen	
		Potable nature of drinking water viz. coliform, pH, TSS, residual chlorine	
		Usage of proper PPEs	Daily during operational phase
		Safety performance indicators viz. Near misses, fatalities etc.	
Environment Quality Monitoring			
5.	Ground Water Quality	Depth of ground water table IS: 10500 parameters at site	Quarterly during Operational phase

7.2.7.1 Occupational Health and Safety Plan for Operational Phase

The Occupational Health and Safety (OHS) of the employees and contractual laborers will be maintained at the work sites during the operation phase. The OHS Management measures shall comply with the Indian Regulatory requirements under OHSAS and the Factories Act.

Although no significant occupational health and safety risks are identified during operations, the following mitigation measures need to be adopted:

- Operators to be provided with adequate PPEs depending upon nature of the operation and occupation health and safety risks associated with it viz. electrical maintenance activities;
- Special emphasis on electrical safety will be laid and all employees will be trained in electrical safety and First Aid;
- Standard Operation Procedures (SOPs) will be developed for operational activities likely to have potential occupational health and safety risks;
- Periodic medical examination will be undertaken for workers including contractor and subcontractor of the plant.

- Periodic inspections will be carried out to ensure all the above are implemented and any non-conformances will be recorded along with grievance related to OHS issues.

An EHS coordinator will effectively implement and monitor the OHS Management System and ESMP.

7.2.7.2 Waste Management Plan

The Waste Management Plan (WMP) will be applicable to the wastes arising during operation of the solar power plant of CSPGPL. Major waste streams from the project include non-hazardous solid waste, wash water generated from panel washing and sewage.

WMP is intended to serve as a guideline for CSPGPL and the contractor(s) to manage wastes effectively during the project life cycle. The WMP describes how wastes will be managed during the project life cycle and how the project will:

- Minimize the potential to cause harm to human health and the environment.
- Comply with Indian Environmental Regulation and IFC Performance Standards.
- Reduce operational costs and reduce any potential liabilities which may arise from waste handling operations.

This plan also ensures that every waste stream and solid waste materials from the main plant site and bracketed facilities will be managed effectively. CSPGPL should implement the WMP throughout the operational phase.

7.2.7.3 Waste Characterisation

Operations and maintenance of the PV power facility is not expected to generate any significant amount of waste. PV panels, array enclosures and inverter/transformer enclosures will not produce waste during operation except the following:

- Defunct solar panels;
- Broken solar panels generated during cleaning and other maintenance activities;
- Fuel requirements like greasing, transformer oil etc.
- Used oil; and
- Oily rags

7.2.7.4 Waste Handling, Management and Disposal

Damaged panels would need to be characterized and managed as hazardous waste. Following measures to be taken for management of waste:

- Module Developers need to have buy back agreements for defunct solar panels;
- A designated area needs to be demarcated within the module premises for storage of defunct and broken solar panels with restricted access and on impervious surface;
- All fuel storage should be equipped with secondary containment and spillage trays;
- All used oil is required to send off to KSPCB approved vendors and recyclers; and
- Transportation of defunct solar panels is required to be undertaken as per the procedures specified by the Manufacture of Solar Panels.

Handling of Broken Solar Modules generated due to cleaning and other maintenance activities

- Broken or damaged solar panels are required to be shifted to a designated area in scrap yard to avoid any type of land contamination;
- The designated area should be isolated and to be established on an impervious surface;
- Proper PPEs are provided to the workers handling the broken solar panels;
- The workers at site are also on regular basis appraised about the potential health risks associated with handling of solar panels.

Detailed waste management plan should be prepared for decommissioning phase. However, following measures should be considered while preparing waste management plan for decommissioning of the solar farm.

- The recyclable and non-recyclable non-hazardous solid waste generated onsite should be collected and stored in a temporary waste storage facility from where all wastes will be sent for recycling and disposal to appropriate facilities; and
- The reusable wastes like wooden waste and cardboards from packing materials, empty cement bags, construction debris, etc. can also be given to locals for their use or give it back to original equipment manufacturer (OEM).

7.2.7.5 Stakeholder Engagement Plan

Stakeholder Engagement is the process of engaging the stakeholders. Stakeholders are persons or groups who are directly or indirectly affected by a project as well as those who may have interests in a project and/or ability to influence its outcome either positively or negatively. Stakeholders may include locally affected communities or individuals and their formal and informal representatives, national or local government authorities, politicians, religious leaders, civil society organizations and groups with special interest, the academic community and other businesses.

Stakeholder Engagement Process can be described as a process which engages stakeholders with an aim to achieve certain outcomes. The process enables communication between the community members and the project proponent. Increased communication between them would lead to a favourable condition and would thereby increase the viability of a project.

To ensure the systematic implementation and execution of the stakeholder engagement process certain resources and frame work is required to be in place. Certain defined roles and responsibilities of designated personnel can assist in smooth implementation of the stakeholder engagement process. The following personnel shall be involved:

- ***Community Liaison Officer/CSR Officer/Grievance Officer at the Site level***: The Community Liaison Project Liaison Officer shall be responsible for the implementation of the stakeholder engagement and consultation activities. The Community Liaison Officer in consultation with the HSE Supervisor at the site level shall develop resources and plan for the consultation activities to be conducted. Documentation of all processes such as identification and engagement activities with stakeholders is imperative and shall be done by the Community Project Liaison Officer/CSR Officer.
- ***HSE Supervisor at the Site Level***: The HSE Supervisor shall assist the Community Liaison Officer/CSR Officer/Grievance Officer to develop stakeholder engagement activity plan for the financial year. The responsibility for assistance with the execution and implementation of the activity would also be the incumbent's responsibility.
- ***CSR Head/Human Resource (HR) Head at the corporate level:*** The CSR Head/HR Head shall be responsible for the overall budgeting and monitoring of the stakeholder engagement activities undertaken at the site level. Impact Assessment reports should be reviewed by the CSR Head/HR Head and shall determine the feasibility of the implementation of the activity.

To engage the stakeholders, certain process can be followed. The process includes the following procedures:

- Stakeholder Identification and Analysis.
- Stakeholders Engagement.
- Information Disclosure.
- Monitoring and Reporting.

7.2.7.5.1 Stakeholder Identification and Analysis

The first step involves the identification of all affected communities. They should be identified and classified according to the degree of their vulnerability to the impacts of the project. They can be classified into Direct and Indirect Stakeholders according to their degree of influence of the project and vice versa. The Community Liaison officer/CSR officer/Grievance officer shall be responsible in developing a list of stakeholders according to the degree of impact and will utilize the format provided in the ESMS of HFE to identify and classify the stakeholders.

7.2.7.5.2 Methods of Stakeholder Engagement

On identification and classification of Stakeholders, Community Liaison Officer/CSR/Grievance Officer will develop stakeholder engagement activities. These activities would be developed ensuring an effective engagement process with detailed objectives and platforms wherein the views, interests, concerns of different stakeholders are allowed to be communicated. The stakeholder engagement documentation can be done utilizing the format provided in HFE's ESMS. Communicated views and concerns should be taken into account while making project decisions and formulation of development benefits for affected communities. In order to increase and improve communication with the stakeholders certain communicative methods have been outlined below:

Communicative Methods

Communicative Methods are to be developed and adopted to ensure proper information dissemination and communication to the affected communities. These methods may vary according to the target audience and it can comprise of the following detailed out in the following table:

Table 7-3: Communicative Methods

Communicative Methods	Objective	Relevance
Community Meetings	To inform and consult with the local community members regarding the project and its anticipated risks and impacts.	When mass information dissemination is required To get feedback and collaborate with the community stakeholders for input of local knowledge and options.
Focus Group Discussions	To inform and consult a target group and take into account their views and make the project more inclusive in nature.	Relevant when the majority of the affected communities' population comprises of minorities or marginalized groups. When the relevant sub groups are not interactive and hesitant to participate in larger community meetings and there is a need to understand the needs, perception and concerns of the sub-group.
Participatory Workshops	To utilise local knowledge and use it as input to generate options related to the project activities. To increase the involvement of the stakeholders in the project.	Relevant when the stakeholders knowledge are keen in participating in the development of the project When there is a need to engage local people to analyse, share and enhance their knowledge to plan, manage and evaluate developmental projects.
Participatory Rural Appraisal (PRA)	To enable local people to make their own appraisal, analysis and plan. Decentralization and Empowerment of the local people.	Relevant when there is a need for identification of the community problems.

7.2.7.5.3 Information Disclosure

Information disclosure involves delivery of project related information to the community members and ensuring access to such information by other stakeholders. It is a means to communicate with the direct and indirect stakeholders of the project. The disclosure information should be done in the appropriate language (native), accessible and understandable. Disclosure of information can be done through various means such as display/information boards at local authorities' office, through audio-visual methods such as radio, pamphlets and relevant videos.

General Information of the Project: Information related to the entire project cycle should be made available to the project community members. The company website should be updated with the details of the project which should include the purpose, nature and scale of the project. It can also include the list of risks and impacts that are anticipated the project. The information related to the project can be displayed at information boards of the local authority's office as well as and the company website.

Detailed Information of the Project: Documents like the ESIA report, Environment and Social Management Plan, Stakeholder Engagement Plan etc. shall be made available for the stakeholders if asked for. The hard copies of the same should be placed at the project site office.

7.2.7.5.4 Monitoring and Reporting

Internal audits of the stakeholder engagement program should be done. The frequency of the internal audits should be decided upon at the corporate level. Review of the applicability, execution and feedback/response to the programme should to be done. At the site level, the Community Liaison Officer and the HSE Supervisor shall be responsible for the monitoring of the stakeholder engagement activities that have been done and CSR Head/HR Head at the corporate level shall be updated on the stakeholder engagement activities at the site and shall review the stakeholder engagement activities and provide feedback on its implementation.

Record-Keeping of the following should be done:

- Stakeholders Identified.
- Minutes of Meetings.
- Communicative methods used for stakeholders, participation during these engagement activities and feedback/responses received.

7.2.7.6 Grievance Redressal Mechanism

Grievance Redressal Mechanisms assist in reducing and mitigating the anticipated risks that may arise with the project development. An effective grievance mechanism would be one which is transparent and approachable process and would address the concerns promptly in a culturally appropriate manner. The grievance mechanism should be able to inform and complement the existing stakeholder engagement process.

HFE at the Corporate level has developed a Grievance Redressal Mechanism Procedure (***Appendix C)*** to be implemented at the project level. For this site, CSPGPL is to follow the procedure as developed by the Company.

8. Conclusions and Recommendations

The Environmental and Social Assessment study for the Operational 40 MW solar power project in Raichur District of Karnataka has been undertaken in accordance with IFC's Performance Standards and World Bank's Environment Health and Safety (EHS) Guidelines.

The ESIA study aimed to identify and evaluate potential environmental impacts associated with all aspects of the project. The conclusion and recommendations of this study are result of on-site inspections, the evaluation of impacts identified by specialists, and the process of stakeholder consultation.

The impacts due to the project is minimal, site specific and has reversible impacts on the micro environment of the project site owing to the waste water generation from the solar panels.

The project is assessed to generate some environmental and social impacts due to operation of the project. Mitigation measures for potential impacts on air environment, water quality, land, soil, noise, ecology, and socio-economic have been specified through proper -

- Follow up of best practice of compensation, stakeholder engagement, and grievance management;
- Planning and designing of Solar Power plant, access route, drainage, traffic movement etc.;
- Application of standards for Health and Safety; and
- Clearances and permits required for each sub activity

The proposed Environmental and Social Management Plan describes the implementation mechanism for recommended mitigation measures together with monitoring to verify overall project performance. The implementation of the mitigation measures including monitoring schedule will provide a basis for ensuring that the potential positive and negative impacts associated with the operation of the Power Plant are taken care off. This ESIA study together with mitigation measures and follow up of recommendations on management actions will help CSPGPL and the O&M contractor in complying with the environmental standards and meet the IFC performance standards.

The Project is a renewable energy project which uses solar energy for power generation. Renewable energy projects are considered to be cleaner compared to fossil fuel-based energy projects. In accordance to the screening criteria of IFC, AECOM has categorized Project as ***Category B***, which specifies that the project can cause potential and limited adverse social or environmental impacts which are generally site-specific, largely reversible and can be readily addressed through mitigation measures. The rationale for categorisation being:

- Land procurement was based on 'willing buyer-willing seller' with compensation more than prevailing market rates;
- The site is not located in an ecologically sensitive area or forest land;
- There are no issues of resettlement and rehabilitation;
- The operation of solar panels has limited environment and social impacts;
- There are no indigenous communities in the project area; and
- Any adverse environmental and social impacts may be readily addressed through mitigation measures as outlined in the Environmental and Social Management Plan (ESMP).

Appendix A Signature List of Stakeholders Consulted

AECOM

Built to deliver a better world

Participant List

	S.No.	Name	Address	Signature
28/2/2019 Awrad (40 MW)	1	Mallikarjun (member representative of Santhagudu G Panchayat)	Jonnekeri	[illegible]
	2	Sanjay Kumar	Jonnekeri	
	3	Jyotish Gundappa	Jonnekeri	[illegible]
2/3/2019 Maraguthi (40 MW)	1	Chandrakant	Nagoori	[illegible]
	2	Hanumant Raya	Nagoori	[illegible]
	3	Sandip (Local Aggregator)	Karulapur	[illegible]
4/3/2019 Sindhanoor (40 MW)	1	Nirpal	Talakhant	[illegible]
	2	Veerabhadaran	Gaudrahatgi	[illegible]
	3	Anuresh Gowda (Local Aggregator)	"	[illegible]

Date: ....

Appendix B No Objection Certificate (NOC) obtained for the Project from Boppur Gram Panchayat

ಕರ್ನಾಟಕ ಸರ್ಕಾರ

ಗ್ರಾಮ ಪಂಚಾಯತ ಕಾರ್ಯಾಲಯ ತಲೇಖಾನ

ತಾ॥ ಮಸ್ಕಿ ಜಿ॥ ರಾಯಚೂರು

ಸಂಖ್ಯೆ : ಗ್ರಾ.ಪಂ.ಸಂ/ನಿಪ್ರ/2018-19 ದಿನಾಂಕ : 04.06.2018

-:: ನಿರಾಕ್ಷೇಪಣಾ ಪ್ರಮಾಣ ಪತ್ರ ::-

ತಲೇಖಾನ ಗ್ರಾಮ ಪಂಚಾಯತ ವ್ಯಾಪ್ತಿಯಲ್ಲಿ ಬರುವ ಗ್ರಾಮಗಳ ಸ.ನಂ ಗಳಲ್ಲಿ ಶ್ರೀ **M/s Clean Solar Power (Gulbarga) Pvt Ltd** ಇವರು ಸೋಲಾರ್ ಪ್ಲಾಂಟ್ ಸ್ಥಾಪಿಸಲು ತಲೇಖಾನ ಗ್ರಾಮ ಪಂಚಾಯತ ವ್ಯಾಪ್ತಿಯಲ್ಲಿ ಬರುವ ಸಾರ್ವಜನಿಕ ರಸ್ತೆಯನ್ನು ಉಪಯೋಗಿಸಲು ಗ್ರಾಮ ಪಂಚಾಯತಯಿಂದ ಯಾವುದೇ ಆಕ್ಷೇಪಣೆ ಇರುವುದಿಲ್ಲಾ ಹಾಗೂ ಈ ಕೆಳಕಂಡ ಷರತ್ತುಗಳ ಒಳಪಟ್ಟು ನಿರಾಕ್ಷೇಪಣಾ ಪ್ರಮಾಣ ಪತ್ರ ನೀಡಿರುತ್ತೇವೆ.

ಷರತ್ತುಗಳು :-

1. ಗ್ರಾಮ ಪಂಚಾಯಿತಿಯ ಆಸ್ತಿಗಳಿಗೆ ಹಾನಿಯಾಗದಂತೆ ರಸ್ತೆಗಳು ಉಪಯೋಗಿಸಬಹುದು.
2. ಗ್ರಾಮ ಪಂಚಾಯಿತಿಯ ಕುಡಿಯುವ ನೀರಿನ ಪೈಪ್ ರಸ್ತೆ ಹಾಗೂ ಇತರೆ ಏನಾದರೂ ಹಾನಿಯಾಗಿದ್ದಲ್ಲಿ ತಾವೇ ದುರಸ್ತಿ ಮಾಡಿಕೊಡತಕ್ಕದ್ದು.

ಅಧ್ಯಕ್ಷರು
ಗ್ರಾಮ ಪಂಚಾಯತ ತಲೇಖಾನ

ಪಂಚಾಯತ ಅಭಿವೃದ್ಧಿ ಅಧಿಕಾರಿ
ಗ್ರಾಮ ಪಂಚಾಯತ ತಲೇಖಾನ

Appendix C Grievance Redress Mechanism

POLICY NO. HFE/HR16	GRIEVANCE PROCEDURE
HERO FUTURE ENERGIES	HERO FUTURE ENERGIES PVT. LTD.

GRIEVANCE PROCEDURE

0	22.12.2015	First Issue	Bhawna Kirpal Mittal	Sunil Jain	Rahul Munjal
Rev.	Date	Description	Prepared By	Checked and Approved By	Approved By

POLICY NO. HFE/HR16	GRIEVANCE PROCEDURE

HERO FUTURE ENERGIES

HERO FUTURE ENERGIES PVT. LTD.

TABLE OF CONTENTS

First Issue - Dec 22, 2015

POLICY NO. HFE/HR16	GRIEVANCE PROCEDURE

HERO FUTURE ENERGIES

HERO FUTURE ENERGIES PVT. LTD.

1.0 OBJECTIVE

1.1 To provide a platform for fair assessment of employee grievances and their timely redressal.

2.0 APPLICABILITY

2.1 This Procedure is applicable to all employees on permanent rolls of HFE and its Holdco/SPVs irrespective of their posting at Delhi Office or Site/Regional Offices.

3.0 COVERAGE

3.1 This Procedure lays down process for registering a grievance, role of HR, Grievance Committee and redressal mechanism.

4.0 RESPONSIBILITY AND AUTHORITY

4.1 Approval, renewal and change in this Policy is the responsibility of HR, under approval of the CEO and MD.

4.2 Monitoring and Implementation of this Policy is the responsibility of the HR and Grievance Committee.

5.0 REFERENCE

5.1 HR Department Manual – HFE/HR01.

6.0 EFFECTIVE DATE

6.1 This Policy comes into force w.e.f December 22, 2015 and will be valid till next Revision is announced.

7.0 DEFINITIONS

Grievance	Specific complaint of an employee by any other employee related to case of breach of Code of Conduct, Ethics Policy, Negligence, misconduct, employee complaint against Reporting Manager/other employees, complaint by a male employee of sexual harassment by a male or a female employee
Grievance Committee	Committee appointed for conducting enquiry and resolving complaints filed under Grievance Procedure

POLICY NO. HFE/HR16	GRIEVANCE PROCEDURE
HERO FUTURE ENERGIES	HERO FUTURE ENERGIES PVT. LTD.

8.0 REGISTERING A GRIEVANCE

8.1 An aggrieved employee shall first raise his/her grievance to his/her Reporting Manager. Grievance may first be discussed verbally and then put in writing (either thru' mail or hard copy) or either way.

9.0 RESOLVING THE GRIEVANCE

9.1 It is the responsibility of the Reporting Manager to try and resolve the grievance in a prompt manner.

9.1.1 In case, the grievance is solved by the Reporting Manager in a time frame of two weeks and aggrieved employee is satisfied with the solution, then Reporting Manager will inform HR in writing (either thru' mail or hard copy) about the grievance and its solution and acceptance by the aggrieved employee.

9.1.2 In case, the Reporting Manager is not able to solve the grievance or if the solution provided by the Reporting Manager is not acceptable to the aggrieved employee or if the Reporting Manager has exceeded the time limit of two weeks, then both the parties can take the matter to HR.

9.2 Once the matter is escalated to HR, then HR will try to resolve the grievance and if the same is not resolved in a week's time, then the case will be referred to the Grievance Committee by HR keeping the Reporting Manager and the second level supervisor in loop.

9.3 Grievance Committee shall review the employee's grievance and will ask for producing any/all information/evidence deemed pertinent for the grievance and ensure its early resolution. Decision of Grievance Committee shall be considered as the final decision rendered by the Company regarding the employee's grievance.

9.4 Grievance Committee will have to complete all the proceedings and come up with a solution within one month from the time the grievance is handed over to them.

9.5 It is understood that any employee who avails the mechanism will be treated courteously and that the case will be handled as the circumstances permit.

9.6 The aggrieved employee can file for an appeal in the office of CEO or MD against the verdict of Grievance Committee, if required. The appeal filing has to be based on levels.

10.0 GRIEVANCE COMMITTEE

10.1 The Grievance Committee will comprise of 3 members. HR acts as an observer and facilitator.

10.2 Committee members will meet at least once in three months. However, if necessary, it may meet more frequently at the instance of the Convener or at the request of the other members to discuss the various issues received.

10.3 It is important that all three members of the Grievance Committee are present in the meeting.

11.0 ROLE OF GRIEVANCE COMMITTEE

11.1 The Committee shall carry on its proceedings by conducting meetings, discussions with the aggrieved person and the party involved. They will refer to all the relevant documents/information/evidence as deemed pertinent.

11.2 Aggrieved party will be given justifiable time to give a reply to the cause.

11.3 Committee will then give its recommendation based on the proceedings, but within a maximum period of 1 month from the date of petition.

11.4 Recommendations of the Committee will be sent to the CEO for Approval.

11.5 In case there is a deadlock on the verdict between the Committee members, the decision of Chairman of the Committee will be considered final and binding.

11.6 If a member of the Grievance Committee is connected with the grievance of the aggrieved individual, the concerned member of the Grievance Committee will not participate in the proceedings and HR/CEO may nominate any other person as Grievance Committee for specially that case.

11.7 If the aggrieved person happens to be a member of the Grievance Committee, he/she will not participate in the proceedings as Committee member. In such a case, HR/CEO may nominate any other person as Grievance Committee for specially that case.

11.8 The Grievance Committee shall not consider any grievance of general applicability or of collective nature of raised collectively by more than one employee

11.9 The Grievance Committee shall not be affected by any biases towards any party involved in the matter.

12.0 TENURE OF GRIEVANCE COMMITTEE

12.1 Grievance Committee will hold the Office for a tenure of three years.

12.2 Committee members can be changed before completion of their tenure, if it is deemed compulsory, but the same shall take place after Approval of the CEO and the MD.

13.0 DOCUMENTATION

13.1 Grievance Committee will keep all documents related to all the cases. They will give a duplicate copy of all documents to HR for recording in employee personal file.

14.0 ATTACHMENTS

Description	Format No.
Form for Grievance Review	HFE/HR16/F1
Grievance Committee	HFE/HR16/F2

15.0 AMENDMENT

This Policy is subject to change at the sole discretion of the Management.

Appendix D Mammals of the Study Area

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
1	*Macaca radiata*	Bonnet Macaque	LC	II
2	*Semnopithecus hypoleucos achates*	South-western Langur	VU	II
3	*Moschiola indica*	Indian Chevrotain	LC	I
4	*Muntiacus muntjak*	Indian or Red Muntjac	LC	III
5	*Rusa unicolor*	Sambar	VU	III
6	*Axis axis*	Spotted Deer	LC	III
7	*Boselaphus tragocamelus*	Nilgai	LC	III
8	*Tetracerus quadricornis*	Four-Horned Antelope	VU	I
9	*Antilope cervicapra*	Blackbuck	LC	I
10	*Sus scrofa*	Indian Wild Pig	LC	III
11	*Panthera pardus*	Leopard	VU	I
12	*Felis chaus*	Jungle Cat	LC	II
13	*Prionailurus viverrinus*	Fishing Cat	VU	I
14	*Paradoxurus hermaphroditus*	Common Palm Civet	LC	II
15	*Viverricula indica*	Small Indian Civet	LC	II
16	*Herpestes edwardsii*	Grey Mongoose	LC	II
17	*Hyaena hyaena*	Striped Hyaena	NT	III
18	*Canis lupus*	Grey Wolf	LC	I
19	*Canis aureus*	Golden Jackal	LC	II
20	*Vulpes bengalensis*	Indian Fox	LC	II
21	*Mellivora capensis*	Honey Badger	LC	I
22	*Aonyx cinereus*	Asian Small-clawed Otter	VU	I
23	*Lepus nigricollis*	Indian Hare	LC	IV
24	*Manis crassicaudata*	Indian Pangolin	EN	I
25	*Anathana ellioti*	Southern Tree Shrew	LC	II
26	*Suncus murinus*	House Shrew	LC	II
27	*Hystrix indica*	Indian Crested Porcupine	LC	IV
28	*Funambulus palmarum*	Tree-striped Palm Squirrel	LC	IV
29	*Tatera indica*	Indian Gerbil	LC	V
30	*Vandeleuria oleracea*	Indian Long-tailed Tree Mouse	LC	V
31	*Mus musculus*	House Mouse	LC	V
32	*Mus booduga*	Little Indian Field Mouse	LC	V
33	*Millardia meltada*	Soft-furred Field Rat	LC	V

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
34	*Madromys blanfordi*	White-tailed Wood Rat	LC	V
35	*Bandicota indica*	Large Bandicoot Rat	LC	V
36	*Bandicota bengalensis*	Indian Mole Rat	LC	V
37	*Rattus rattus*	House Rat	LC	V
38	*Megaderma lyra*	Greater False Vampire	LC	-
39	*Hipposideros fulvus*	Fulvous Leaf-nosed Bat	LC	-
40	*Pipistrellus ceylonicus*	Kelaart's Pipistrelle	LC	-

**Status assigned by the International Union for Conservation of Nature and Natural Resources, where – EN- Endangered, VU- Vulnerable, NT – Near Threatened and LC – Least Concern.*

***Schedules I to VI: Indian Wildlife (Protection) Act, 1972.*

Sources: Vivek Menon (2014), Indian Mammals: A Field Guide. Hachette Book Publishing India Pvt. Ltd., Gurgaon, India, pp 1-522; N.K. Sinha (1992), Mammals of Haryana, Records of Zoological Survey of India, 91(3-4), pp 399-416; IUCN (2019). The IUCN Red List of Threatened Species. Version 2019-1; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Appendix E Resident Birds of the Study Area

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
1	*Francolinus pictus*	Painted Francolin	LC	IV
2	*Francolinus pondecerianus*	Grey Francolin	LC	IV
3	*Coturnix chinensis*	King Quail	NA	IV
4	*Perdicula asiatica*	Jungle Bush Quail	LC	IV
5	*Perdicula argoondah*	Rock Bush Quail	LC	IV
6	*Galloperdix spadicea*	Red Spurfowl	LC	IV
7	*Galloperdix lunulata*	Painted Spurfowl	LC	IV
8	*Gallus sonneratii*	Grey Junglefowl	LC	IV
9	*Pavo cristatus*	Indian Peafowl	LC	I
10	*Dendrocygna javanica*	Lesser Whistling-duck	LC	IV
11	*Nettapus coromandelianus*	Cotton Pygmy-goose	LC	IV
12	*Anas poecilorhyncha*	Indian Spot-billed Duck	LC	IV
13	*Tachybaptus ruficollis*	Little Grebe	LC	IV
14	*Mycteria leucocephala*	Painted Stork	NT	IV
15	*Anastomus oscitans*	Asian Openbill	LC	IV
16	*Ciconia episcopus*	Woolly-necked Stork	VU	IV
17	***Threskiornis melanocephalus***	**Black-headed Ibis**	NT	IV
18	*Pseudibis papillosa*	Red-naped Ibis	LC	IV
19	*Platalea leucorodia*	Eurasian Spoonbill	LC	I
20	*Butorides striata*	Striated Heron	LC	IV
21	*Nycticorax nycticorax*	Black-crowned Night Heron	LC	IV
22	***Ardeola grayii***	**Indian Pond Heron**	LC	IV
23	*Ardea purpurea*	Purple Heron	LC	IV
24	***Bubulcus ibis***	**Cattle Egret**	LC	IV
25	*Casmerodius albus*	Great Egret	LC	IV
26	***Mesophoyx intermedia***	**Intermediate Egret**	LC	IV
27	*Egretta garzetta*	Little Egret	LC	IV
28	*Microcarbo niger*	Little Cormorant	LC	IV
29	*Falco chicquera*	Red-necked Falcon	NT	I
30	*Falco jugger*	Laggar Falcon	NT	I
31	*Elanus caeruleus*	Black-winged Kite	LC	IV
32	*Milvus migrans*	Black Kite	LC	IV
33	*Haliastur indus*	Brahminy Kite	LC	IV

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
34	*Pernis ptilorhynchus*	Oriental Honey Buzzard	LC	IV
35	*Neophron percnopterus*	Egyptian Vulture	EN	IV
36	*Gyps bengalensis*	White-rumped Vulture	CR	I
37	*Gyps indicus*	Indian Vulture	CR	I
38	*Sarcogyps calvus*	Red-headed Vulture	CR	IV
39	*Circaetus gallicus*	Short-toed Snake Eagle	LC	IV
40	*Spilornis cheela*	Crested Serpent Eagle	LC	IV
41	*Accipiter badius*	Shikra	LC	I
42	*Butastur teesa*	White-eyed Buzzard	LC	IV
43	*Aquila rapax*	Tawny Eagle	LC	IV
44	*Aquila fasciata*	Bonelli's Eagle	LC	IV
45	*Nisaetus cirrhatus*	Crested Hawk Eagle	LC	IV
46	*Sypheotides indicus*	Lesser Florican	EN	I
47	*Amaurornis phoenicurus*	White-breasted Waterhen	LC	IV
48	*Amaurornis akool*	Brown Crake	LC	IV
49	*Turnix sylvaticus*	Small Buttonquail	LC	IV
50	*Turnix suscitator*	Barred Buttonquail	LC	IV
51	*Porphyrio porphyrio*	Purple Swamphen	LC	IV
52	*Gallinula chloropus*	Common Moorhen	LC	IV
53	*Fulica atra*	Eurasian Coot	LC	IV
54	*Burhinus indicus*	Indian Thick-knee	LC	IV
55	*Esacus recurvirostris*	Great Thick-knee	NT	IV
56	*Hydrophasianus chirurgus*	Pheasant-tailed Jacana	LC	IV
57	*Metopidius indicus*	Bronze-winged Jacana	LC	IV
58	*Vanellus malabaricus*	Yellow-wattled Lapwing	LC	IV
59	***Vanellus indicus***	**Red-wattled Lapwing**	LC	IV
60	*Charadrius dubius*	Little Ringed Plover	LC	IV
61	*Rostratula benghalensis*	Greater Painted-snipe	NA	IV
62	*Cursorius coromandelicus*	Indian Courser	LC	-
63	*Glareola lactea*	Small Pratincole	LC	-
64	*Sterna aurantia*	River Tern	NT	-
65	*Pterocles exustus*	Chestnut-bellied Sandgrouse	LC	IV
66	*Pterocles indicus*	Painted Sandgrouse	LC	IV
67	***Columba livia***	**Common Pigeon**	LC	IV
68	*Streptopelia orientalis*	Oriental Turtle Dove	LC	IV
69	*Streptopelia decaocto*	Eurasian Collared Dove	LC	IV
70	*Streptopelia tranquebarica*	Red Collared Dove	LC	IV
71	*Stigmatopelia chinensis*	Spotted Dove	LC	IV

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
72	*Stigmatopelia senegalensis*	Laughing Dove	LC	IV
73	*Treron phoenicopterus*	Yellow-footed Green Pigeon	LC	IV
74	*Psittacula krameri*	Rose-ringed Parakeet	LC	IV
75	*Psittacula cyanocephala*	Plum-headed Parakeet	LC	IV
76	*Clamator jacobinus*	Jacobin Cuckoo	LC	IV
77	*Hierococcyx varius*	Common Hawk Cuckoo	LC	IV
78	*Cacomantis passerinus*	Grey-bellied Cuckoo	LC	IV
79	*Eudynamys scolopaceus*	Asian Koel	LC	IV
80	*Rhopodytes viridirostris*	Blue-faced Malkoha	LC	IV
81	*Taccocua leschenaultii*	Sirkeer Malkoha	LC	IV
82	***Centropus (sinensis) parroti***	**Southern Coucal**	LC	IV
83	*Tyto alba*	Barn Owl	LC	IV
84	*Otus bakkamoena*	Indian Scops Owl	LC	IV
85	*Glaucidium radiatum*	Jungle Owlet	LC	IV
86	*Athene brama*	Spotted Owlet	LC	IV
87	*Bubo (bubo) bengalensis*	Indian Eagle Owl	LC	IV
88	*Ketupa zeylonensis*	Brown Fish Owl	LC	IV
89	*Strix ocellata*	Mottled Wood Owl	LC	IV
90	*Caprimulgus asiaticus*	Indian Nightjar	LC	IV
91	*Caprimulgus affinis*	Savanna Nightjar	LC	IV
92	*Cypsiurus balasiensis*	Asian Palm Swift	LC	-
93	*Hemiprocne coronata*	Crested Treeswift	LC	-
94	*Apus affinis*	Little Swift	LC	-
95	*Upupa epops*	Common Hoopoe	LC	IV
96	***Coracias benghalensis***	**Indian Roller**	LC	IV
97	***Halcyon smyrnensis***	**White-throated Kingfisher**	LC	IV
98	*Alcedo atthis*	Common Kingfisher	LC	IV
99	*Ceryle rudis*	Pied Kingfisher	LC	IV
100	***Merops orientalis***	**Green Bee-eater**	LC	-
101	*Ocyceros birostris*	Indian Grey Hornbill	LC	-
102	*Megalaima zeylanica*	Brown-headed Barbet	LC	IV
103	*Megalaima haemacephala*	Coppersmith Barbet	LC	IV
104	*Dendrocopos nanus*	Brown-capped Pygmy Woodpecker	LC	IV
105	*Dendrocopos mahrattensis*	Yellow-crowned Woodpecker	LC	IV
106	*Dinopium benghalense*	Lesser Goldenback	LC	IV
107	*Tephrodornis pondicerianus*	Common Woodshrike	LC	IV
108	*Artamus fuscus*	Ashy Woodswallow	LC	-
109	*Coracina macei*	Large Cuckooshrike	LC	IV

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
110	*Aegithina tiphia*	Common Iora	LC	IV
111	*Pericrocotus cinnamomeus*	Small Minivet	LC	IV
112	***Lanius vittatus***	**Bay-backed Shrike**	LC	-
113	*Lanius schach*	Long-tailed Shrike	LC	-
114	*Lanius meridionalis*	Southern Grey Shrike	NA	-
115	*Dicrurus macrocercus*	Black Drongo	LC	IV
116	*Dicrurus caerulescens*	White-bellied Drongo	LC	IV
117	*Oriolus xanthornus*	Black-hooded Oriole	LC	-
118	*Rhipidura (albicollis) albogularis*	White-spotted Fantail	LC	-
119	*Rhipidura aureola*	White-browed Fantail	LC	-
120	*Dendrocitta vagabunda*	Rufous Treepie	LC	IV
121	*Corvus (macrorhynchos) culminatus*	Indian Jungle Crow	LC	IV
122	***Corvus splendens***	**House Crow**	LC	V
123	*Ptyonoprogne concolor*	Dusky Crag Martin	LC	-
124	*Petrochelidon fluvicola*	Streak-throated Swallow	LC	-
125	*Hirundo smithii*	Wire-tailed Swallow	LC	-
126	*Mirafra cantillans*	Singing Bushlark	LC	IV
127	***Ammomanes phoenicura***	**Rufous-tailed Lark**	LC	IV
128	***Eremopterix griseus***	**Ashy-crowned Sparrow Lark**	LC	IV
129	*Alauda gulgula*	Oriental Skylark	LC	IV
130	*Pycnonotus jacosus*	Red-whiskered Bulbul	NA	IV
131	*Pycnonotus cafer*	Red-vented Bulbul	LC	IV
132	*Pycnonotus luteolus*	White-browed Bulbul	LC	IV
133	*Prinia hodgsonii*	Grey-breasted Prinia	LC	-
134	*Prinia sylvatica*	Jungle Prinia	LC	-
135	*Prinia socialis*	Ashy Prinia	LC	-
136	*Prinia inornata*	Plain Prinia	LC	-
137	*Cisticola juncidis*	Zitting Cisticola	LC	-
138	*Orthotomus sutorius*	Common Tailorbird	LC	-
139	*Dumetia hyperythra*	Tawny-bellied Babbler	LC	-
140	*Turdoides caudata*	Common Babbler	LC	IV
141	*Turdoides malcolmi*	Large Grey Babbler	LC	IV
142	*Turdoides striata*	Jungle Babbler	LC	IV
143	*Turdoides affinis*	Yellow-billed Babbler	LC	IV
144	*Chrysomma sinense*	Yellow-eyed Babbler	LC	IV
145	*Zosterops palpebrosus*	Oriental White-eye	LC	IV
146	*Acridotheres tristis*	Common Myna	LC	IV
147	*Sturnia pagodarum*	Brahminy Starling	LC	IV

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
148	*Zoothera citrina*	Orange-headed Thrush	LC	-
149	*Copsychus saularis*	Oriental Magpie Robin	LC	IV
150	***Saxicoloides fulicatus***	**Indian Robin**	LC	IV
151	*Saxicola caprata*	Pied Bushchat	LC	IV
152	*Chloropsis jerdoni*	Jerdon's Leafbird	LC	IV
153	*Dicaeum agile*	Thick-billed Flowerpecker	LC	IV
154	*Dicaeum erythrorhynchos*	Pale-billed Flowerpecker	LC	IV
155	*Leptocoma zeylonica*	Purple-rumped Sunbird	NA	IV
156	*Cinnyris asiaticus*	Purple Sunbird	LC	IV
157	*Passer domesticus*	House Sparrow	LC	-
158	*Gymnoris xanthocollis*	Chestnut-shouldered Petronia	LC	-
159	*Ploceus philippinus*	Baya Weaver	LC	IV
160	*Euodice malabarica*	Indian Silverbill	LC	IV
161	*Amandava amandava*	Red Avadavat	LC	IV
162	*Lonchura striata*	White-rumped Munia	LC	IV
163	*Lonchura punctulata*	Scaly-breasted Munia	LC	IV
164	*Lonchura malacca*	Black-headed Munia	LC	IV
165	*Motacilla maderaspatensis*	White-browed Wagtail	LC	-
166	*Anthus rufulus*	Paddyfield Pipit	LC	IV

***Status assigned by the International Union for Conservation of Nature and Natural Resources, where – CR – Critically Endangered; EN – Endangered; NT – Near Threatened; VU – Vulnerable and LC – Least Concern.*

***Schedules I to VI: Indian Wildlife (Protection) Act, 1972.*

Sources: R. Grimmett, C. Inskipp & T. Inskipp (2011). Birds of the Indian Subcontinent. Oxford University Press, pp 1-528; Salim Ali (2012) reprinted. The Book of Indian Birds. Oxford University Press, pp 1-326; IUCN (2019). The IUCN Red List of Threatened Species. Version 2019-1; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Appendix F Migratory Birds of the Study Area

S. No.	Scientific Name	Common Name	Type	IUCN Status*	WPA Schedule**
1	*Coturnix coturnix*	Common Quail	Winter	LC	IV
2	*Coturnix coromandelica*	Rain Quail	Winter	LC	IV
3	*Anser indicus*	Bar-headed Goose	Winter	LC	IV
4	*Tadorna ferruginea*	Ruddy Shelduck	Winter	LC	IV
5	*Anas strepera*	Gadwall	Winter	LC	IV
6	*Anas clypeata*	Northern Shoveler	Winter	LC	IV
7	*Anas acuta*	Northern Pintail	Winter	LC	IV
8	*Anas querquedula*	Garganey	Winter	LC	IV
9	*Anas crecca*	Common Teal	Winter	LC	IV
10	*Aythya ferina*	Common Pochard	Winter	VU	IV
11	***Plegadis falcinellus***	**Glossy Ibis**	Winter	LC	IV
12	***Ardea cinerea***	**Grey Heron**	Winter	LC	IV
13	*Anhinga melanogaster*	Darter	Winter	NT	IV
14	*Phalacrocorax fuscicollis*	Indian Cormorant	Winter	LC	IV
15	*Phalacrocorax carbo*	Great Cormorant	Passage	LC	IV
16	*Falco tinnunculus*	Common Kestrel	Winter	LC	IV
17	*Falco peregrinus*	Peregrine Falcon	Winter	LC	I
18	*Pandion haliaetus*	Osprey	Winter	LC	I
19	*Circus aeruginosus*	Eurasian Marsh Harrier	Winter	LC	IV
20	*Circus macrourus*	Pallid Harrier	Winter	NT	IV
21	*Hieraaetus pennatus*	Booted Eagle	Winter	LC	IV
22	*Porzana pusilla*	Baillon's Crake	Winter	LC	IV
23	*Turnix tanki*	Yellow-legged Buttonquail	Winter	LC	IV
24	*Himantopus himantopus*	Black-winged Stilt	Winter	LC	IV
25	*Philomachus pugnax*	Ruff	Winter	LC	IV
26	*Gallinago stenura*	Pin-tailed Snipe	Winter	LC	IV
27	*Gallinago gallinago*	Common Snipe	Winter	LC	IV
28	*Limosa limosa*	Black-tailed Godwit	Winter	NT	IV
29	*Numenius arquata*	Eurasian Curlew	Winter	NT	-
30	*Tringa erythropus*	Spotted Redshank	Winter	LC	IV
31	*Tringa totanus*	Common Redshank	Winter	LC	IV
32	*Tringa stagnatilis*	Marsh Sandpiper	Winter	LC	IV
33	*Tringa nebularia*	Common Greenshank	Winter	LC	IV
34	*Tringa ochropus*	Green Sandpiper	Winter	LC	IV

S. No.	Scientific Name	Common Name	Type	IUCN Status*	WPA Schedule**
35	*Tringa glareola*	Wood Sandpiper	Winter	LC	IV
36	*Actitis hypoleucos*	Common Sandpiper	Winter	LC	IV
37	*Calidris minuta*	Little Stint	Winter	LC	IV
38	*Calidris temminckii*	Temminck's Stint	Winter	LC	IV
39	*Chlidonias hybrida*	Whiskered Tern	Winter	LC	-
40	*Asio flammeus*	Short-eared Owl	Winter	LC	IV
41	*Merops philippinus*	Blue-tailed Bee-eater	Winter	LC	-
42	*Jynx torquilla*	Eurasian Wryneck	Winter	LC	IV
43	*Coracina melanoptera*	Black-headed Cuckooshrike	Passage	LC	IV
44	*Lanius cristatus*	Brown Shrike	Winter	LC	-
45	*Dicrurus leucophaeus*	Ashy Drongo	Winter	LC	IV
46	*Oriolus (oriolus) kundoo*	Indian Golden Oriole	Winter	LC	IV
47	*Terpsiphone paradisi*	Asian Paradise-flycatcher	Winter	LC	IV
48	*Hirundo rustica*	Barn Swallow	Winter	LC	IV
49	*Cecropis daurica*	Red-rumped Swallow	Winter	LC	IV
50	*Acrocephalus dumetorum*	Blyth's Reed Warbler	Winter	LC	-
51	*Phylloscopus humei*	Hume's Leaf Warbler	Winter	LC	-
52	*Phylloscopus trochiloides*	Greenish Warbler	Passage	LC	-
53	*Sylvia curruca*	Lesser Whitethroat	Winter	LC	-
54	*Sylvia althaea*	Hume's Whitethroat	Passage	LC	-
55	*Sturnia malabarica*	Chestnut-tailed Starling	Winter	LC	-
56	*Pastor roseus*	Rosy Starling	Winter	LC	IV
57	*Luscinia svecica*	Bluethroat	Winter	LC	IV
58	*Phoenicurus ochruros*	Black Redstart	Winter	LC	IV
59	*Monticola solitarius*	Blue Rock Thrush	Winter	LC	IV
60	*Monticola cinclorhynchus*	Blue-capped Rock Thrush	Winter	LC	IV
61	*Muscicapa dauurica*	Asian Brown Flycatcher	Winter	LC	IV
62	*Ficedula superciliaris*	Ultramarine Flycatcher	Winter	LC	IV
63	*Eumyias thalassinus*	Verditer Flycatcher	Winter	LC	IV
64	*Motacilla flava*	Yellow Wagtail	Winter	LC	-
65	*Motacilla cinerea*	Grey Wagtail	Winter	LC	-
66	*Motacilla alba*	White Wagtail	Winter	LC	-
67	*Anthus godlewskii*	Blyth's Pipit	Winter	LC	IV
68	*Anthus trivialis*	Tree Pipit	Winter	LC	IV
69	*Anthus hodgsoni*	Olive-backed Pipit	Winter	LC	IV
70	*Carpodacus erythrinus*	Common Rosefinch	Winter	LC	IV

*****Status assigned by the International Union for Conservation of Nature and Natural Resources, where – VU – Vulnerable; NT- Near Threatened and LC – Least Concern.*

***Schedules I to VI: Indian Wildlife (Protection) Act, 1972.*

Sources: R. Grimmett, C. Inskipp & T. Inskipp (2011). Birds of the Indian Subcontinent. Oxford University Press, pp 1-528; Salim Ali (2012) reprinted. The Book of Indian Birds. Oxford University Press, pp 1-326; IUCN (2019). The IUCN Red List of Threatened Species. Version 2019-1; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Appendix G Reptiles of the Study Area

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
1	*Indotyphlops braminus*	Brahminy Blindsnake	-	IV
2	*Grypotyphlops acutus*	Beaked Worm Snake	-	IV
3	*Python molurus molurus*	Indian Python	-	I
4	*Gongylophis conicus*	Common Sand Boa	-	IV
5	*Eryx johnii*	Red Sand Boa	-	IV
6	*Coelognathus helena helena*	Common Trinket Snake	-	IV
7	*Ptyas mucosa*	Indian Rat Snake	-	II
8	*Argyrogena fasciolata*	Banded Racer	-	IV
9	*Oligodon taeniolatus*	Russell Kukri Snake	LC	-
10	*Oligodon arnensis*	Common Kukri Snake	-	-
11	*Dendrelaphis tristis*	Common Bronzeback Tree Snake	-	
12	*Lycodon striatus*	Barred Wolf Snake	-	IV
13	*Lycodon aulicus*	Common Wolf Snake	LC	IV
14	*Sibynophis subpunctatus*	Dumeril's Black-headed Snake	-	-
15	*Xenochrophis piscator*	Checkered Keelback	-	II
16	*Amphiesma stolatum*	Striped Keelback	-	-
17	*Macropisthodon plumbicolor*	Green Keelback	-	-
18	*Boiga trigonata*	Common Cat Snake	LC	-
19	*Ahaetulla nasuta*	Common Vine Snake	-	IV
20	*Bungarus caeruleus*	Common Krait	-	IV
21	*Calliophis melanurus*	Indian Coral Snake	-	
22	*Naja naja*	Spectacled Cobra	-	II
23	*Daboia russelii*	Russell's Viper	LC	II
24	*Echis carinatus*	Saw-scaled Viper	-	IV

*****Status assigned by the International Union for Conservation of Nature and Natural Resources, where – LC – Least Concern; NA – Not Assessed.*

***Schedules I to VI: Indian Wildlife (Protection) Act, 1972.*

Sources: Indraneil Das (2002). Snakes & other Reptiles of India. New Holland Publishers (UK) Ltd pp. 1-144; Romulus Whitaker & Ashok Captain (2006). Snakes of India; Dreko Books, Chennai, pp 1-146; IUCN (2019). The IUCN Red List of Threatened Species. Version 2019-1; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Appendix H Amphibians of the Study Area

S. No.	*Scientific Name*	Common Name	IUCN Status *	WPA Schedule**
1	*Bufo melanostictus*	Common Indian Toad	LC	-
2	*Bufo stomaticus*	Marbled Toad	LC	-
3	*Kaloula taprobanica*	Indian Painted Frog	LC	-
4	*Ramanella variegata*	Marbled Narrow Mouth Frog	LC	-
5	*Uperodon globulosus*	Balloon Frog	LC	-
6	*Uperodon systoma*	Marbled Balloon Frog	LC	-
7	*Polypedates maculatus*	Common Tree Frog	LC	-
8	*Euphlyctis cyanophlyctis*	Skipper Frog	LC	-
9	*Haplobatrachus tigerinus*	Indian Bullfrog	LC	IV
10	*Limnonectes limnocharis*	Paddyfield Frog	-	-

*****Status assigned by the International Union for Conservation of Nature and Natural Resources, where – LC – Least Concern.*

***Schedules I to VI: Indian Wildlife (Protection) Act, 1972.*

Sources: R. J. Ranjit Daniels, (2005). Amphibians of Peninsular India. Indian Academy of Sciences, Universities Press, pp 1-258; J.C. Daniel (2002) reprinted edition (2016). The Book of Indian Reptiles and Amphibians, Bombay Natural History Society and Oxford University Press, pp.13-215; IUCN (2019). The IUCN Red List of Threatened Species. Version 2019-1; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Appendix I Details of Fishes in the Study Area

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
1	*Anguilla bengalensis*	Indian Long-fin Eel	-	-
2	*Cirrhinus reba*	Reba Carp	LC	-
3	*Labeo calbasu*	Kalbasu	LC	-
4	*Puntius carnaticus*	Carnatica Carp	LC	-
5	*Puntius conchonius*	Rosy Barb	LC	-
6	*Puntius dorsalis*	Long-snouted Barb	LC	-
7	*Puntius sarana subnasutus*	Peninsular Olive Barb	-	-
8	*Puntius sophore*	Spotfin Barb	LC	-
9	*Puntius ticto*	Ticto Barb	LC	-
10	*Puntius vittatus*	Kooli Barb	LC	-
11	*Tor khudree*	Yellow Mahseer	EN	-
12	*Tor putitora*	Golden Mahseer	EN	-
13	*Chela laubuca*	Glass Barb	-	-
14	*Barilius bendelisis*	Hamilton's Baril	-	-
15	*Danio aquipinnatus*	Blue Danio	LC	-
16	*Parluciosoma daniconius*	Blackline Rasbora	LC	-
17	*Nemacheilus denisoni*	Day's Loach	LC	-
18	*Lepidocephalus thermalis*	Malabar Loach	LC	-
19	*Aorichthys seenghala*	Giant River Catfish	-	-
20	*Mystus cavasius*	Gangetic Mystus	LC	-
21	*Mystus vittatus*	Striped Dwarf Catfish	LC	-
22	*Rita rita*	Rita	LC	-
23	*Ompok bimaculatus*	Indian Butter-Catfish	NT	-
24	*Wallago attu*	Shark Catfish	NT	-
25	*Pangasius pangasius*	Pungas	LC	-
26	*Clarias batrachus*	Magur	LC	-
27	*Heteropneustes fossilis*	Stinging Catfish	LC	-
28	*Oryzias melastigma*	Ricefish	LC	-
29	*Gambusia affinis*	Mosquito Fish	LC	-
30	*Pseudambassis ranga*	Glassfish	LC	-
31	*Nandus nandus*	Mottled Nandus	LC	-
32	*Etroplus maculatus*	Spotted Etroplus	LC	-

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
33	*Etroplus suratensis*	Banded Pearlspot	LC	-
34	*Oreochromis mossambica*	Egyptian Mouth Breeder	-	-
35	*Glossogobius giurus*	Goby	-	-
36	*Anabas testudineus*	Climbing Perch	DD	-
37	*Pseudosphromenus cupanus*	Indian Paradise Fish	LC	-
38	*Channa marulinus*	Giant Snakehead	-	-
39	*Channa punctatus*	Spotted Snakehead	-	-
40	*Channa striatus*	Striped Snakehead	-	-
41	*Mastacembelus armatus*	Tyre-track Spiny Eel	LC	-

***Status assigned by the International Union for Conservation of Nature and Natural Resources, where –EN - Endangered; NT – Near Threatened; LC – Least Concern and DD – Data Deficient.*

***Schedules I to VI: Indian Wildlife (Protection) Act, 1972.*

Sources: R. J. Ranjit Daniels, (2002). Freshwater Fishes of Peninsular India, Indian Academy of Sciences, Universities Press, pp 1-288; IUCN (2019). The IUCN Red List of Threatened Species. Version 2019-1; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Appendix J No Objection Certificate (NOC) obtained for the Project from Talekhan Gram Panchayat

ಕರ್ನಾಟಕ ಸರ್ಕಾರ

ಗ್ರಾಮ ಪಂಚಾಯತ ಕಾರ್ಯಾಲಯ ತಲೇಖಾನ

ತಾ॥ ಮಸ್ಕಿ ಜಿ॥ ರಾಯಚೂರು

ಸಂಖ್ಯೆ : ಗ್ರಾ.ಪಂ.ಸಂ/ನಿಪ್ರ/2018-19 ದಿನಾಂಕ : 04.06.2018

-:: ನಿರಾಕ್ಷೇಪಣಾ ಪ್ರಮಾಣ ಪತ್ರ ::-

ತಲೇಖಾನ ಗ್ರಾಮ ಪಂಚಾಯತ ವ್ಯಾಪ್ತಿಯಲ್ಲಿ ಬರುವ ಗ್ರಾಮಗಳ ಸ.ನಂ ಗಳಲ್ಲಿ ಶ್ರೀ **M/s Clean Solar Power (Gulbarga) Pvt Ltd** ಇವರು ಸೋಲಾರ್ ಪ್ಲಾಂಟ್ ಸ್ಥಾಪಿಸಲು ತಲೇಖಾನ ಗ್ರಾಮ ಪಂಚಾಯತ ವ್ಯಾಪ್ತಿಯಲ್ಲಿ ಬರುವ ಸಾರ್ವಜನಿಕ ರಸ್ತೆಯನ್ನು ಉಪಯೋಗಿಸಲು ಗ್ರಾಮ ಪಂಚಾಯತಯಿಂದ ಯಾವುದೇ ಆಕ್ಷೇಪಣೆ ಇರುವುದಿಲ್ಲಾ ಹಾಗೂ ಈ ಕೆಳಕಂಡ ಷರತ್ತುಗಳ ಒಳಪಟ್ಟು ನಿರಾಕ್ಷೇಪಣಾ ಪ್ರಮಾಣ ಪತ್ರ ನೀಡಿರುತ್ತೇವೆ.

ಷರತ್ತುಗಳು :-

1. ಗ್ರಾಮ ಪಂಚಾಯಿತಿಯ ಆಸ್ತಿಗಳಿಗೆ ಹಾನಿಯಾಗದಂತೆ ರಸ್ತೆಗಳು ಉಪಯೋಗಿಸಬಹುದು.
2. ಗ್ರಾಮ ಪಂಚಾಯಿತಿಯ ಕುಡಿಯುವ ನೀರಿನ ಪೈಪ್ ರಸ್ತೆ ಹಾಗೂ ಇತರೆ ಏನಾದರೂ ಹಾನಿಯಾಗಿದ್ದಲ್ಲಿ ತಾವೇ ದುರಸ್ತಿ ಮಾಡಿಕೊಡತಕ್ಕದ್ದು.

ಅಧ್ಯಕ್ಷರು
ಗ್ರಾಮ ಪಂಚಾಯತ ತಲೇಖಾನ

ಪಂಚಾಯತ ಅಭಿವೃದ್ಧಿ ಅಧಿಕಾರಿ
ಗ್ರಾಮ ಪಂಚಾಯತ ತಲೇಖಾನ

AECOM India Private Limited
19th Floor
Building No.5
Tower C
Cyber City
Gurgaon 122002
Haryana
India

CIN: U74210KA2005PTC037770

T: +91 124 4682700/800
aecom.com