ENVIRONMENT AND SOCIAL IMPACT ASSESSMENT REPORT

30 MW Solar Power Project, Sira Taluka, Tumkur District, Karnataka

February 2019

Quality Information

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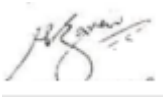
 Rajshree Das, Environmental Consultant	 Amit Goswami, Senior Environment and Social Consultant	 Chetan Zaveri Executive Director, Environment
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1. INTRODUCTION

Hero Future Energies Pvt. Ltd. (hereinafter referred as “HFE”), one of the leading Independent Power Producers, plans to integrate renewable energy in the energy mix of the country by identifying the best solutions and install renewable energy systems bench marked against the best-in-class engineering standards. HFE came into existence in the year 2012 and carries an illustrious legacy of the Hero Group. The company is focused on futuristic and clean energy. HFE has presence in nearly ten states of India with an operating asset base of ~ 500 MW across wind, solar PV (grid connected) and rooftop plants. The company plans to focus on solar – wind hybrid technology in the near future.

M/s Clean Solar Power (Gulbarga) Pvt. Ltd. (hereinafter referred as “CSPGPL”), a 100% subsidiary of HFE, is developing a 30 MW grid connected solar photovoltaic power project (hereinafter referred as “project”) in Tumkur district of Karnataka. CSPGPL has engaged AECOM India Pvt. Ltd. (hereinafter referred as “AECOM”) to undertake an Environmental and Social Impact Assessment (ESIA) study for the project.

This Environmental and Social Impact Assessment (ESIA) study report is prepared in order to ensure that the project is established in a manner that is socially responsible and reflects sound environmental management practices. The ESIA is prepared in accordance with International Finance Corporation’s (IFC) Performance Standards (PS) on Social and Environmental Sustainability, 2012 and General Environment, Health and Safety (EHS) Guidelines, 2015. The aim of the study is to assess whether the project complies with the requirements of the above mentioned guidelines as necessitated by financial investors.

This report has been prepared on the basis of a reconnaissance survey, baseline environmental monitoring, review of secondary data and consultation with relevant stakeholders. Based on the requirements of the IFC PSs, adequate management plans are also developed as part of this report.

1.1 Project Overview

The project is spread across 161 acres of private barren and uncultivable land located entirely in Bejjihalli village, Sira Taluk of Tumkur district in the southern state of Karnataka, India and will be connected to nearest 66/11kV grid substation of Karnataka Power Transmission Corporation Ltd (hereinafter referred as “KPTCL”) located at P.D Kote of Hiriyur Taluk of Chitradurga district in Karnataka.

The associated facilities for the project include the following:

- Project Switchyard – situated within the project site boundary;
- Power Evacuation System – The electrical energy generated from the 30 MW project (approximately 57 million kWh) will be transmitted to the switchyard within the project site via internal transmission line. Power from the switchyard will be evacuated by stepping-up the power from 300 V to 66 kV through transformers to the feeder bay in grid substation at P.D. Kote. The total line length of the 66 KV DC overhead external transmission line is 2.5 km;
- Internal access road - The project site can be accessed through:
  - Proposed 3.0 m wide peripheral Murram road and approximately 3575 m in length;
  - Proposed 3.5 m wide Water Bound Macadam (WBM) road (from Main gate to Control and Inverter Room) and approximately 2975 m in length.

Land parcels measuring about 161 acres have been identified and procurement process is under-process from 22 land owners residing in Bejjihalli village. The procurement process is being conducted in two (2) phases. The owners have voluntarily sold their land due to minimal rain fall received during the last five years and low productivity of the land. The purchase of right of way of land for laying the transmission line for about 2.5 km length is under process.

Few of the activities associated with the pre-construction and construction phase of the project such as, geo-technical investigation, development of access route, construction of internal access roads, internal and external transmission lines, main control room and switchyard is being carried out by M/s. Larsen & Turbo Limited (herein after referred as “L&T”). L&T has engaged sub-contractor M/s. PVR Constructions for electrical works and M/s. Vinayaka Surveyors for land survey works.

A labour camp for construction workers (unskilled labourers) hired by M/s. L&T is being set up within the project site boundary. There are few built structures within the project land which are being utilised as resting place/shelter for the construction workers currently deployed at site.

CSPGPL has entered into a service agreement with M/s. Trina Solar Limited for Supply and erection/commissioning of the project components (Solar Panels). Thereafter, a separate contract will be executed for operation and maintenance of the panels. Identification of partners of O&M of this project is under process.

1.2 Purpose and Scope

This study is being undertaken as per the requirements of the IFC Performance Standards to understand the Environmental and Social impacts associated with the proposed 30 MW solar power project. The study suggests appropriate mitigation measures and management plans to prevent and minimize all adverse impacts identified. The environmental and social assessment has been carried out against the following reference framework:

- The IFC Performance Standards for Environmental and Social Sustainability;
  - 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
  - Performance Standard 8: Cultural Heritage
- The IFC General EHS Guidelines; and
- Applicable Indian national, state and local regulatory requirements.

The scope of work for the entire ESIA study includes the following activities:

- Reconnaissance survey and primary site assessment to collect and review baseline environmental and social conditions;
- Generation of primary baseline environmental data including soil quality and water quality;
- Collection of additional secondary environmental, social and demographic information;
- Collection of information on forestry, flora and fauna, and natural habitats and species of special conservation/scientific interest through ecological assessment of the study area;
- Consultation with local community, stakeholders and review of land transfer process;
- Identification of social concerns and issues pertaining to implementation of the Project;
- Identification and review of the applicable standards and identification of key issues;
- Assessment of potential environment and social impacts of the Project and its components (including associated facilities like, transmission line, access roads etc. as applicable) and developing mitigation measures and plans to maximize project benefits to the community; and
- Preparation of an Environmental and Social Management Plan (ESMP) providing the summary of the identified impacts, appropriate mitigation measures and monitoring of environment and social impacts on an ongoing basis as well as to identify any requirements that may occur subsequent to the completion of the ESIA.

1.3 Agencies/ Persons Contacted

The following agencies/ persons were contacted during the course of the study:

- Hero Future Energies Pvt. Ltd.;
- Clean Solar Power (Gulbarga) Private Limited;
- Eco Services India Private Limited;
- PVR Constructions; and
- Vinayaka Surveyors

1.4 Limitations

The ESIA study for the project is largely based on the documents made available, discussions with community, project representatives and observations from the site survey conducted. Professional judgement and subjective interpretation of facts has been applied for this study. All information and inferences presented herein are based on the specifics currently available within the limits of the scope of work, information provided by the client or its representative, existing secondary data, budget and schedule.

1.5 Layout of the Report

The full report presents the findings, analysis and recommendations for the proposed project which have been provided by the Environmental and Social Impact Assessment (ESIA) team.

Table 1-1: Layout of the Report

Chapter	Description of the Content
Chapter 1 - Introduction	The chapter provides description of project background with objectives, purpose and scope and approach & methodology of the study.
Chapter 2 - Project Description	This chapter deals with project details such as layout, land details, site settings, project components etc. This also deals with the description of the infrastructural development as a part of project life cycle during construction and operation phase and resources required.
Chapter 3 – Environmental and Social Regulatory Framework	This chapter provides information on Policy, Legal and Administrative framework applicable to the proposed wind project. The Section defines applicability of IFC Performance Standards of the proposed project.
Chapter 4 – Environment and Socio-Economic Baseline	This chapter illustrates the baseline settings of the environmental aspects, ecological profile and socio-economic status of the project area. Results of the primary monitoring conducted is also analysed and presented under this chapter.
Chapter 5 – Stakeholder Engagement and Consultation	This chapter presents stakeholder identification process for the project, details of consultations held with key questions and responses extracted from the survey undertaken during site visit.
Chapter 6 – Analysis of Alternatives	This chapter presents the analysis of alternatives for the proposed wind project considering no project scenario, alternate methods for power generation and technology and alternate routes for transmission line.
Chapter 7 – Evaluation of Impacts	This Chapter describes the impacts associated with the construction and operation phase of the project and suggests specific mitigation measures to avoid/reduce the identified impacts.
Chapter 8 – Environmental and Social Management Plan (ESMP)	This Section provides recommendation for environmental and social management plan aimed at minimizing the negative environmental and social impacts of the project. Environmental and social monitoring requirements for effective implementation of mitigating measures during development as well as operation of the project have also been delineated along with requisite institutional arrangements for their implementation.
Chapter 9 – Conclusion and Categorization of the Project	This chapter concludes the outcomes of the study and categorises the proposed project based on IFC Categorization.

1.6 List of Annexures

Annexure 1: List of Fauna in the study area

Annexure 2: List of Participants

Annexure 3: Status of the groundwater utilisation of Chitradurga district

Annexure 4: Identified Stakeholders

Annexure 5: Summary Of Consultation Activities

Annexure 6: Grievance Record Register

Annexure 7: Information on Silicon Tetrachloride

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2. PROJECT DESCRIPTION

This chapter describes the site settings of the project, project components and its requirements such as land and other associated project facilities. It elaborates on the various project phases along with its implementation schedule and mechanism.

2.1 Site Setting

The proposed project is located entirely in Bijjihalli village, Sira Taluk of Tumkur district of Karnataka, India. It is spread across 161 acres of private barren and uncultivable land and will be connected to nearest 66/11kV grid substation KPTCL located at P.D Kote of Hiriyur Taluk of Chitradurga district in Karnataka. ***Figure 2-1*** shows the indiacative project site location geographically.

The site is accessible by Hiriyur Road to Bejjihalli village through internal village road. The site is plain with elevation in the range of 590 to 600 m above mean sea level (amsl). It is majorly covered with red soil, tree species like *Azadirachta indica* and limited/no ground vegetation since land has been cleared as part of pre-construction phase. The surrounding area comprises of pomegranate and coconut plantations and scattered villages which indicates a rural setup***. Figure 2-2*** shows the physical features of the study area. A natural depression within the project site causes storage of rain water and giving it a form of pond, though it generally remains dry all throughout the year except during the rainy season.

Photo 2-1:View of the Project site

Photo 2-2:Commencement of construction works at site

Source: Site Survey

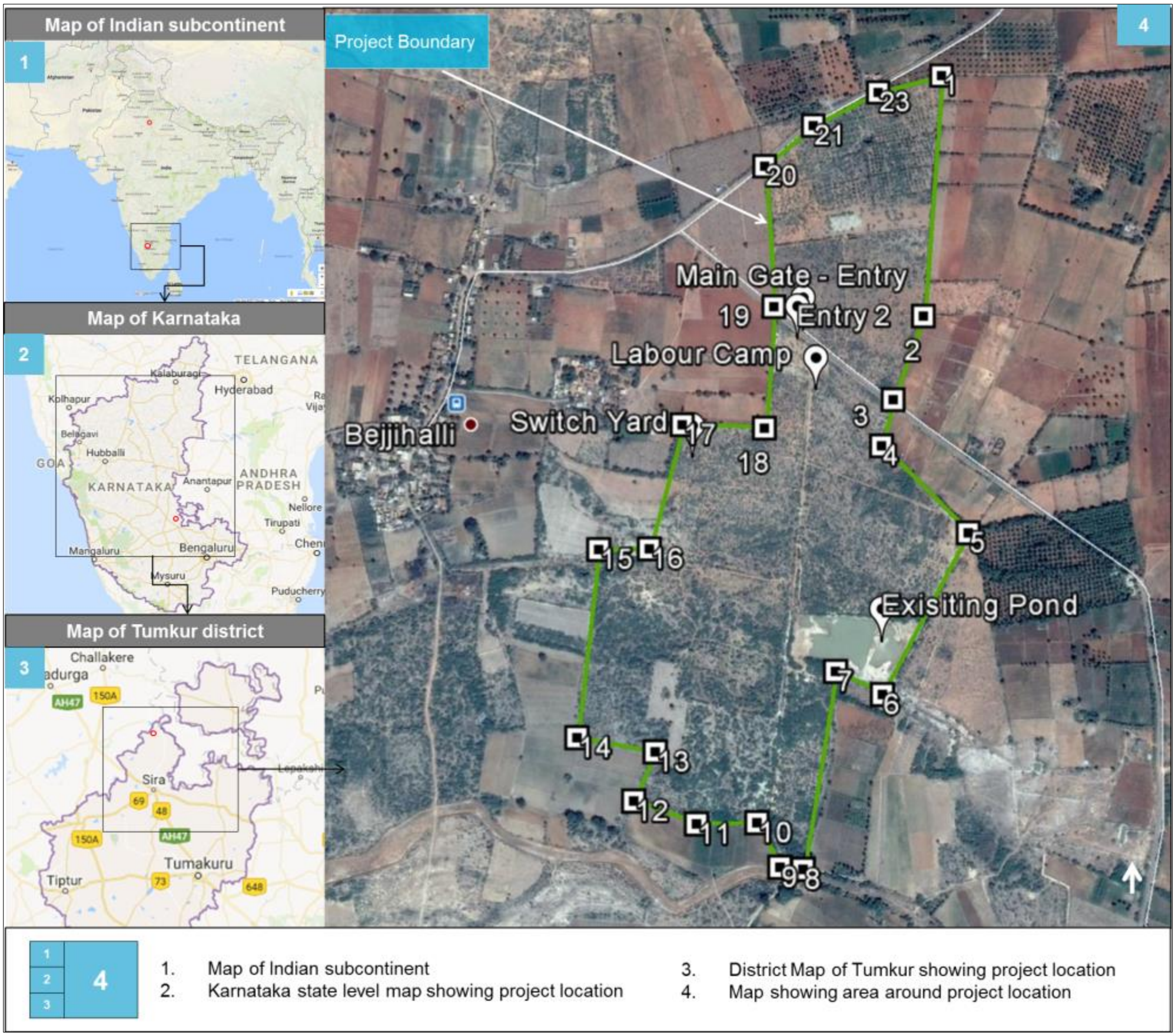


Figure 2-1: Indicative Project Location

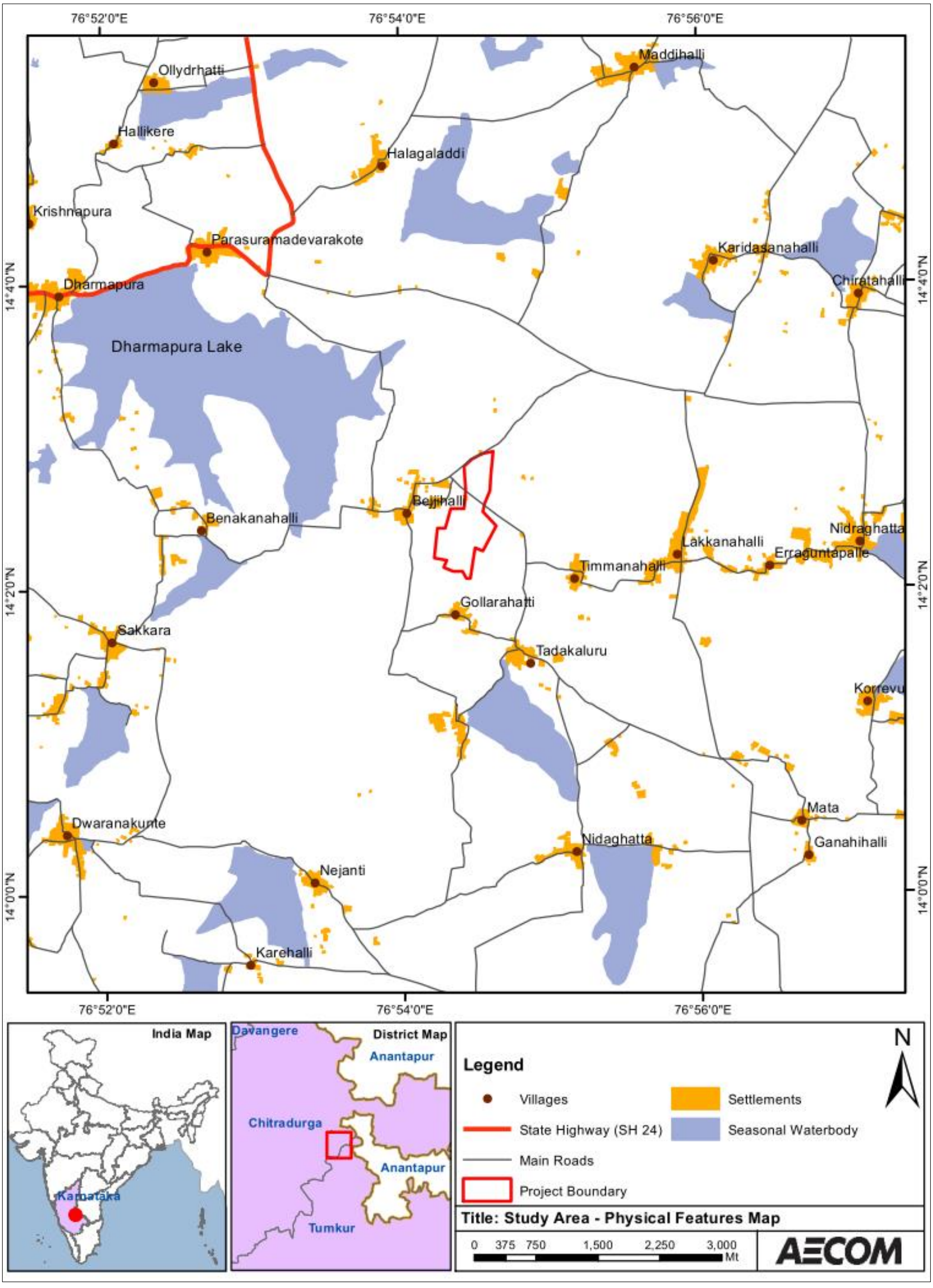


Figure 2-2: Physical Features Map

2.2 Project Layout

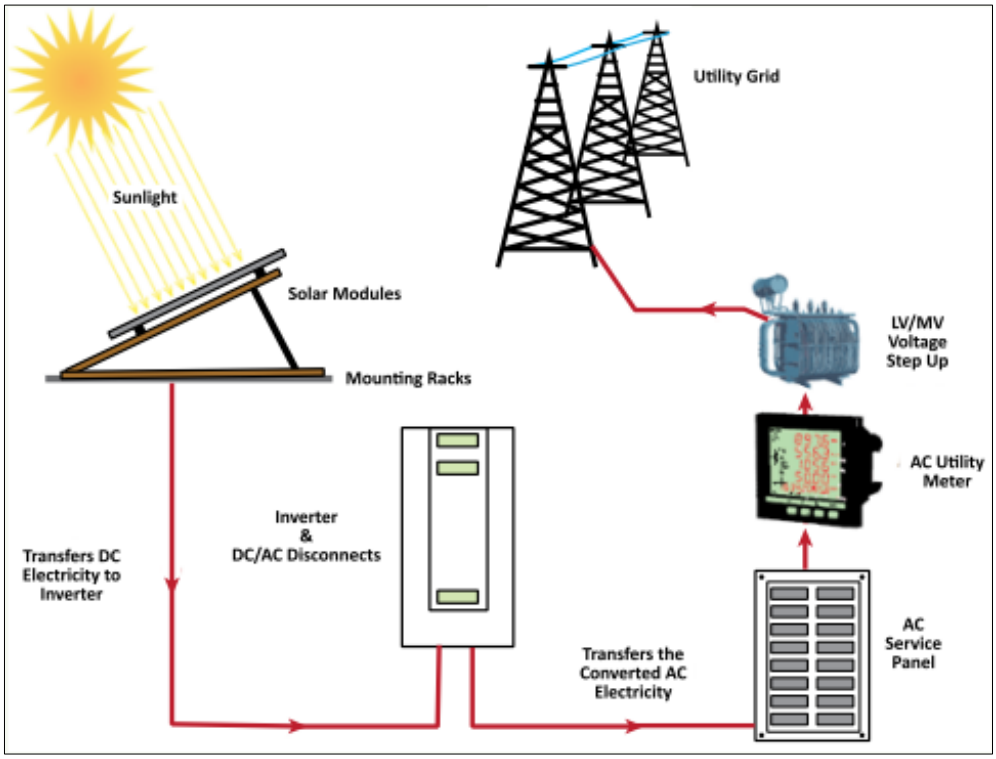
The project comprises of arrays of solar photovoltaic (PV) modules spread across 161 acres of barren and uncultivable private land. The project is expected to generate approximately 57 million kWh (30 MW) of direct current (DC) power. The DC power will transmit into a number of Power Conditioning Units (PCUs) also called as Inverters, to convert DC power to AC power at 3 phase, 300 V, 50 Hz, conforming to the grid requirements. The output from the PCUs is connected through proper isolation and circuit breaking arrangements to the transformers in order to step it up to 110 kV, 3ph AC supply. The electrical power at 66 kV level will be evacuated to the feeder bay at the sub-station.

It is proposed to use Poly-Crystalline module technology of Trina make and three (3) varieties of rated power viz., 315Wp, 320Wp and 325Wp. A total of 85722 no. of modules of all 3 types of power capacity will be arranged in 2041 rows. Each string will accommodate about 21 no. of modules and around 77 no. of L&T tracker system will be used. Pitch Distance for L&T Tracker is 4.25m with Tilt Angle of ±45°.

The project land is partitioned via the village road into two (2) land parcels. Transportation through the village road is not expected to be hindered since the panels in both the land parcels will be connected via underground cabling connections. During discussions with the project site-In charge, it was pointed out that the underground cabling works will be undertaken during night time for a very short duration and thus providing very minimal/no interruption to the local population residing in the project village. The permission for the same will be obtained in the No Objection Certificate (NOC) from the gram panchayat office.

2.3 Project Components

The 30 MW solar power project proposes to use Poly-Crystalline solar PV modules. The main components of the system are detailed and illustrated below in ***Figure 2-3***:



Source: Utility-Scale Solar Photovoltaic Power Plants by IFC (World Bank Group)

Figure 2-3: Overview of Solar PV Power Plant

Table 2-1: Components of a Solar PV Power Plant

S.No.	Component	Description
1.	Solar PV modules	These convert solar radiation directly into electricity through the photovoltaic effect in a silent and clean process that requires no moving parts. The PV effect is a semiconductor effect whereby solar radiation falling onto the semiconductor PV cells generates electron movement. The output from a solar PV cell is DC electricity. A PV power plant contains many cells connected together in modules and many modules connected together in strings[1] to produce the required DC power output.
2.	Inverters	These are required to convert the DC electricity to alternating current (AC) for connection to the utility grid. Many modules in series strings and parallel strings are connected to the inverters.
3.	Module mounting (or tracking) systems	These allow PV modules to be securely attached to the ground at a fixed tilt angle, or on sun-tracking frames.
4.	Step-up transformers	The output from the inverters generally requires a further step-up in voltage to reach the AC grid voltage level. The step-up transformer takes the output from the inverters to the required grid voltage (for example 25kV, 33kV, 38kV, or 110kV, depending on the grid connection point and country standards).
5.	The grid connection interface	This is where the electricity is exported into the grid network. The substation will also have the required grid interface switchgear such as circuit breakers (CBs) and disconnects for protection and isolation of the PV power plant, as well as metering equipment. The substation and metering point are often external to the PV power plant boundary.

Apart from the above basic components, the project system consists of a main control room (MCR), four (4) inverter control block, a met station, a switch yard and three (3) watch towers within the project boundary.

2.4 Power Evacuation System

The proposed solar power plant envisages a power export of 57 million kWh from the plant in 1st year of operation. The grid connections will be at 66 kV in P.D Kote substation which is at a distance of 2.5 km from the site. The evacuated power from the plant shall be stepped up from 300 V to 66 kV through transformers. A switchyard is proposed to be constructed with in the project site which will be in line with the Karnataka Power Transmission Corporation Limited (KPTCL)'s specifications and Grid Code. The project power evacuation system is illustrated in the ***Figure 2-4*** below:

2.5 Land Requirement

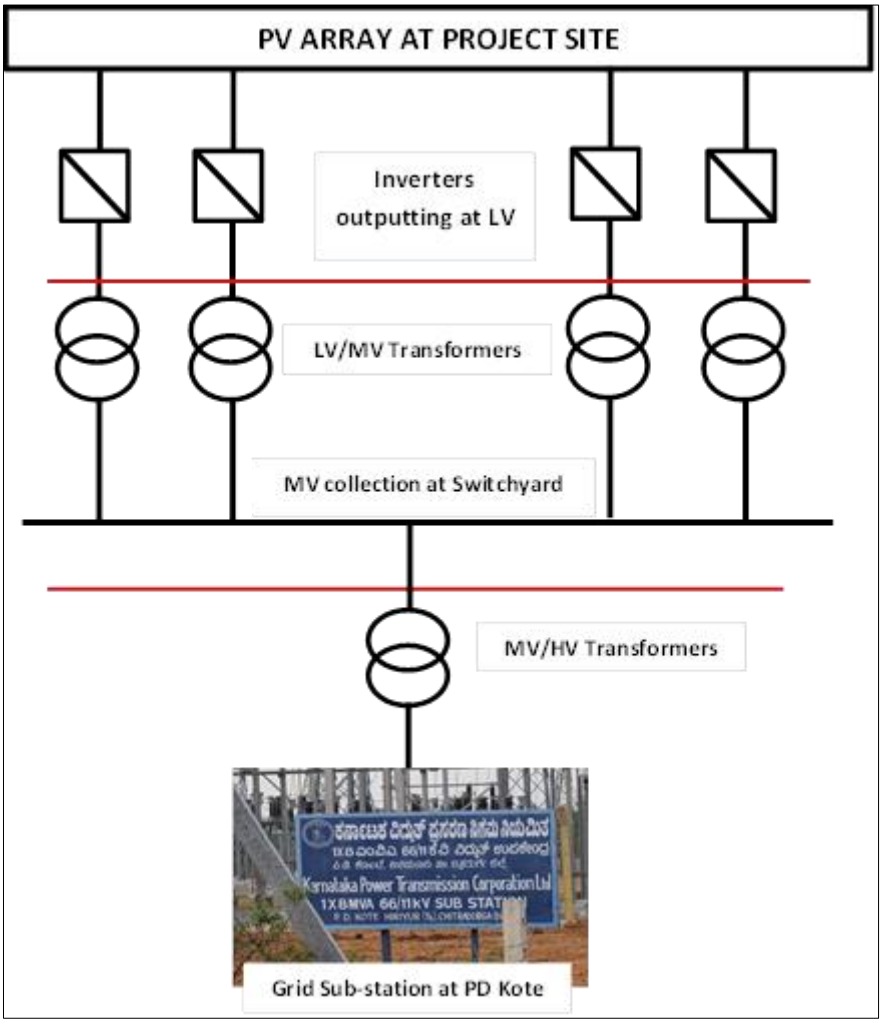
The project is spread entirely across 161 acres of private land of Bejjihalli village of Siri taluk in Tumkur district of Karnataka. These lands are classified as "Dry agricultural and Kharab land" as per the revenue records. The component wise break-up of the land required for the project components is provided in the ***Table 2-2***below:

Table 2-2: Component wise break-up of land required for the Project

S.No.	Project Component	Land Area (acre)/Length (km)	Type of Land	Land Use
1.	Solar PV Panels	161	Private	Dry agricultural and Kharab land
2.	Project's Switchyard	1000 Sq. m	Private	Dry agricultural and Kharab land
3.	Internal Access Road – Murram Road	~3575 m	Private	Dry agricultural and Kharab land
4.	Internal Access Road – WBM road	~2975 m	Private	Dry agricultural and Kharab land
5.	External Transmission Line	~2.5 km	Private	ROW is on combination of Dry agricultural and Kharab land and plantations at few stretches of the land.

Note: ROW rights are yet to be obtained at village level

[1] Modules may be connected together in a series to produce a string of modules. When connected in a series the voltage increases. Strings of modules connected in parallel increase the current output.



Source: CSPGPL

Figure 2-4: Project's Power Evacuation System

2.5.1 Land for Transmission Line

During the site visit in the month of May 2017, the purchase of right of way (ROW)for the transmission line and the rate for one- time compensation was in process. The procedure was envisaged to be completed by the month of June.

2.5.2 Access Road

An exclusive access to the construction site is usually required prior to mobilization of manpower and machinery. The construction of access road primarily involves removal of vegetation and modification of topography. With regard to this project, the access road is an existing 3 m wide village road. Right of Way and No Objection Certificate from the project's Gram Panchayat for cutting/use of the road for the project is under process.

2.5.3 Process of Land Procurement

For the purpose of land for the project, CSPGPL appointed two (02) land aggregators namely Mr. Srinivasan and Mr Harish Reddy (hereinafter referred to as "land aggregators"). The land aggregators identified barren and uncultivable land for the project. Land parcels measuring to be about 161 acres have been identified and procurement process is under-process from 22 land owners residing in Bejjihalli village. The procurement process is being conducted in two (2) phases.

These landowners had earlier executed an unregistered sale agreement with two individuals namely Mr. Nisar Khan and Mr. Gangadhar (hereinafter referred to as "party"). According to the sale agreement signed between the land owners and CSPGPL, compensation have been agreed to be given to the party in relation to the land previously purchased. The previous agreements between the landowners and party hence stand terminated/null and void and they bear witnesses to the present transaction.

It was understood during community consultations that the land owners have voluntarily sold their land for the proposed project owing to minimal rain fall received during the last five years and decrease in productivity of the land.

The following conditions were considered during the entire land procurement process:

i. The transaction took place with the seller's informed consent; and
ii. The seller was provided with compensation above the prevailing market values.

The land procurement process for the project has been divided into two phases. As on the date of site visit in May 2017, the first phase of land procurement was completed wherein 118 acres was procured and the second phase of land procurement process for the remaining 43 acres was in process. The entire land procurement process was envisaged to be completed by the end of May 2017.

2.6 Status of the Project as on date of site visit

The project was in its pre-construction stage during the site survey. The project site has been identified and land parcels are currently being transferred to the ownership of CSPGPL. The project developer, M/s. L&T has commenced works related to construction of labour camps for migrant labourers and construction works like excavation and foundation works for MCR and switchyard.

Table 2-3: Implementation Schedule (as on 17th May 2017)

S.No.	Activities	Commencement	Expected Completion	Status during site survey
1.	Land Hand Over	15th April 2017	20th July 2017	Phase I completed – 118 acres
2.	Site Survey	16th April 2017	20th April 2017	Under process
3.	Soil Testing	15th April 2017	25th April 2017	Completed
4.	Fencing	1st May 2017	15th June 2017	Under process
5.	Transmission Line & Bay	1st May 2017	30th June 2017	Not commenced
6.	Procurements and Delivery of Materials	10th May 2017	14th July 2017	Not commenced
7.	Construction and Engineering Works	15th April 2017	20th May 2017	Excavation and Foundation works for MCR and Switchyard
8.	Execution	6th May 2017	20th July 2017	Not commenced
9.	Testing	20th July 2017	23rd July 2017	Not commenced
10.	Process for Commissioning	23rd July 2017	25th July 2017	Not commenced

Source: CSPGPL

2.7 Project Development

Development of a typical solar power plant project's lifecycle can be divided into four (4) phases:

i. Pre-Construction phase;
ii. Construction phase;
iii. Operation and Maintenance phase; and
iv. Decommissioning phase

2.7.1 Pre-Construction phase

The planning phase involves the conceptualization of the project and has the following five components:

i. Site selection and resource assessment;
ii. Land purchase/allotment process;
iii. Site surveys as topographic, geo-technical investigations, soil testing, power evacuation arrangements etc.;
iv. Application for Approvals/clearances/ permits;
v. Design and finalization of contractors; and
vi. Mobilisation of contractors.

2.7.2 Construction phase

The Construction activities for development of a solar power project include the following:

i. Construction of internal access roads;
ii. Site preparation activities such as clearance, excavation, filling, levelling etc.;
iii. Construction of site office, equipment and supplies storage areas, labour camps, fuel storage areas and waste pits;
iv. Excavation, construction and reinforcement of the MCR, switchyard, inverter control blocks locations;
v. Transportation of equipments;
vi. Completing internal electrical connections at each panel rows;
vii. Erection of internal overhead electrical lines;
viii. Construction of electrical switchyard; and
ix. Commissioning of the panels

2.7.3 Operations and Maintenance

Compared to other power generating technologies, solar PV power plants have low maintenance and servicing requirements. However, proper maintenance of a PV plant is essential to maximise both energy yield and the plant's useful life.

Maintenance can be divided as follows:

i. Scheduled maintenance: Planned in advance and aimed at fault prevention, as well as ensuring that the plant is operated at its optimum level;
ii. Unscheduled maintenance: Carried out in response to failures.

Scheduled maintenance is generally carried out at intervals planned in accordance with the manufacturer's recommendations, and as required by equipment warranties. Scheduled maintenance that requires plant shutdown should be conducted where possible during non-peak production periods, such as early morning or evening. Specific scheduled maintenance tasks are:

i. Module Cleaning;
ii. Checking module connection integrity;
iii. Checking the junction boxes;
iv. Inverter servicing;
v. Tracker Servicing;
vi. Vegetation control; and
vii. Checking and Servicing of monitoring and security systems, auxiliary power supplies, and communication systems.

Unscheduled maintenance is carried out in response to failures. As such, the key parameters when considering unscheduled maintenance are diagnosis, speed of response and repair time.

Common unscheduled maintenance requirements include:

i. Tightening cable connections that have loosened;
ii. Replacing blown fuses;
iii. Repairing lightning damage;
iv. Repairing equipment damaged by intruders or during module cleaning;
v. Component failure
vi. Repairing mounting structure faults;
vii. Rectifying tracking system faults;
viii. Rectifying SCADA faults; and
ix. Internal road repairs as and when required.

2.7.4 Decommissioning phase

The project will have an operational life estimated at 20 years. The project, if it reaches a stage where no upgradation / expansion is expected, then the panels will be decommissioned and dismantled. Activities during this stage would primarily include, disembarking/ dismantling and transport of the panels and decommissioning of the electrical switchyard.

Decommissioning activities will potentially generate greater amounts of waste at the end of the project life. Project equipments including panels, inverters, transformers, racking and trackers will be disposed to authorised recyclers. Potential waste includes panels, electrical equipment, scrap metal (from racking) and wiring. The waste

generated during this phase will be separated into recyclable, non-recyclable and hazardous as per the regulations and disposed accordingly.

2.8 Resource Requirement

The project life cycle involves requirement of various resources such as manpower, water supply, materials, fuel and power supply.

2.8.1 Construction Phase

2.8.1.1 Labour

The labour requirement varies during the entire period of construction phase. A total of 300 migrant workers including skilled, semi-skilled and unskilled labourers are expected to be deployed during the construction phase.

A labour camp for construction workers (unskilled labourers) hired by M/s. L&T is being set up within the project site boundary. There are few built structures within the project land which are currently being utilised as resting place/shelter for the construction workers. Skilled workers will be accommodated in rented houses in Sira and neighbouring Hiriyur town.

2.8.1.2 Water

During construction phase, water will be required for domestic purposes as well as for construction activities. The water requirements will be met through water from private tankers and also from existing bore well located within the project site. The water requirement during the construction phase is estimated to be approximately 80-85 KL of water for all construction works[2].

Since the project site is located in “critical zone” with respect to ground water utilisation as per the Central Ground Water Authority (CGWA), any amount of groundwater extraction will require permission from CGWA.

2.8.1.3 Key material supplies

The construction material including cement, aggregates, steel, paints, solvents etc., beside other supplies required for the project such as fuels and machine oils, drilling requirements, spare parts for construction machinery and food and supplies for construction manpower will be procured locally.

2.8.1.4 Fuel and Power supply

The power requirement for construction works will be met through Diesel Generator of 2 X 30 kVA capacity. HSD will be used as fuel and will be procured on daily basis. Therefore separate storage area for fuel is not expected.

Quantity of Fuel for cooking food for the manpower residing in the campsite during construction phase depends on need basis requirement. Fuel wood, kerosene or LPG will be used for cooking. Required fuel will be sourced from local vendor. In case of bulk storage of LPG cylinders, adequate safety provisions will be made.

2.8.1.5 Waste generation

The construction activities will lead to generation of wastes such as construction debris, waste from packaging materials. The movement of heavy machinery for site clearance, earth moving, transportation and commissioning of components will generate waste oil, lubricants and paints. Used/ Spent oil is classified as a hazardous waste and its storage, transportation and disposal has to be in accordance with the Hazardous Waste Management Handling and Trans-boundary Movement Rules 2016.

2.8.2 Operation Phase

2.8.2.1 Staff

The project is expected to engage a total of 5-10 employees including operation and maintenance engineers and project management staffs.

[2] curing piling foundation and batching... 10 tankers with 6KL capacity per day

The project has engaged about 8-10 guards from local community/project village and neighbouring areas as security staffs sub-contracted through M/s. L&T. These staffs will continue to work in the project site during O&M phase also. Identification of partners of O&M of this project is under process.

2.8.2.2 Water

The quantity of water required varies according to available cleaning technologies and the local climate, however approximately 1.6 litres of water per m^2 of PV modules may be required.

Considering the project site located in a water scarce region and designated as “critical zone” with respect to ground water resources and uncertain and erratic rainfall, adequate alternative means need to be ensured including rain water harvesting / using and increasing the storage capacity of the existing water tanks/ponds, etc. to meet the O&M water demands. It is recommended to hire local contractors to supply packaged drinking water to site staffs.

2.8.2.3 Fuel and Power supply

There are no designated storage areas for lubricating and transformer oils as per the proposed layout given in *Error! Reference source not found.*. CSPGPL shall ensure the identified O&M contractor has designated an area within the project boundary for storing the oil drums as per statutory requirements. The power requirement at site office will be met through electricity connection from State electricity board.

2.8.2.4 Waste generation

There are no designated waste storage areas as per the proposed layout. The responsibility of the storage, transportation of waste from site to safe disposal site rests with the developer. CSPGPL shall ensure that the identified O&M contractor has designated an area within the project boundary for storage of waste generated and its final safe disposal.

The project during its O&M phase will generate hazardous wastes such as used or spent oil from the transformers/inverters, waste residues containing oil and discarded solar panels during regular maintenance due to component failure.

As per the Hazardous Waste Management Handling and Trans-boundary Movement Rules 2016, used or spent oil (5.1 of schedule I) and waste residues containing oil (5.2 of schedule I) and poly-crystalline PV solar panels produced from silicon tetrachloride (Class C, Schedule II, corrosive characteristics, refer ***Annexure 7***) are categorised as Hazardous waste and will handled as per the rules. CSPGPL shall obtain an authorisation for generation and storage of the Hazardous waste from Karnataka State Pollution Control Board (KSPCB) and specified measures as prescribed in the rules will be followed for its storage and handling including disposal of the wastes through a KSPCB approved recycler.

3. ENVIRONMENTAL AND SOCIAL REGULATORY FRAMEWORK

3.1 Introduction

There are certain environmental and social regulations which are applicable to Solar Power Projects. This section outlines the legal framework and highlights the environmental and social regulations applicable to the Project. It broadly focuses on the:

- Enforcement Agencies;
- Applicable Environmental and Social Laws, Regulations and Policies;
- IFC Performance Standards;
- Applicable Environmental Standards; and
- Applicable International Conventions/Protocols.

3.2 Enforcement Agencies

In India, Ministry of New and Renewable Energy (MNRE) is the nodal agency to manage renewable energy projects including solar power projects and the environmental aspects are governed by Ministry of Environment, Forests and Climate Change (MoEFCC). Karnataka State Pollution Control Board (KSPCB) is responsible for securing compliance under the Environmental Protection Act, 1986, the umbrella legislation regulating environmental issues in the country. The social governance aspects at the micro level are addressed by institutions like panchayats and municipal bodies.

A brief of the relevant enforcement agencies both at central level and state level with respect to the institutional framework is described in ***Table 3-1*** below.

Table 3-1: Relevant Enforcement Agencies

S.No.	Agency	Functions
1.	Ministry of Environment and Forests (MoEFCC)	The Ministry of Environment, Forests and Climate Change is the nodal agency in the administrative structure of the Central Government for the planning, promotion, co-ordination and overseeing the implementation of India's environmental and forestry policies and programmes. It is concerned primarily with the implementation of policies and programmes relating to conservation of the country's natural resources including its lakes and rivers, its biodiversity, forests and wildlife, ensuring the welfare of animals, and the prevention and abatement of pollution. While implementing these policies and programmes, the Ministry is guided by the principle of sustainable development and enhancement of human well-being.
2.	Central Pollution Control Board (CPCB)	The Central Pollution Control Board (CPCB) was established in September 1974, for the purpose of implementing provisions of the Water (Prevention and Control of Pollution) Act, 1974. The executive responsibilities for the industrial pollution prevention and control are primarily executed by the CPCB at the Central level, which is a statutory body, attached to the MoEFCC. CPCB works towards control of water, air and noise pollution, land degradation and hazardous substances and waste management. The specific functions of CPCB are as follows: - Prevent pollution of streams and wells; - Advise the Central Government on matters concerning prevention, control and abatement of water and air pollution; - Co-ordinate the activities of SPCB's and provide them with technical and research assistance; - Establish and keep under review quality standards for surface and groundwater and for air quality; - Planning and execution of national programme for the prevention, control and abatement of pollution through the Water and Air Acts; and - The CPCB is responsible for the overall implementation and monitoring of air and water pollution control under the Water Act, 1974, and the Air Act, 1981.
3.	Karnataka State Pollution Control Board (KSPCB)	The Karnataka State Pollution Control Board was constituted by the Government of Karnataka on 21st September 1974 for Prevention and Control of Water Pollution, in pursuance of the Water (Prevention & Control of Pollution) Act, 1974. Enforcing the Water Act, KSPCB was

S.No.	Agency	Functions
		responsible for prevention and control of water pollution and maintaining or restoring of wholesomeness of water. After the enactment of the Air (Prevention & Control of Pollution) Act, 1981 the enforcing responsibility was also entrusted to KSPCB. As such, the Board was later renamed as the Karnataka State Pollution Control Board in 1985. The Air (Prevention & Control of Pollution) Act, 1981 is an enactment to provide for prevention, control and abatement of air pollution. Apart from the above said Acts, the Board is also enforcing the following Acts & Rules: • The Water (Prevention & Control of Pollution) Cess Act, 1977, and as amended from time to time. • The Water (Prevention & Control of Pollution) Cess Rules, 1978. • The following Rules and Notifications framed under Environment (Protection) Act, 1986: – Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016. – Environmental Impact Assessment Notification, 2006. – Bio-Medical Waste Management Rules, 2016. – Plastic Waste Management Rules, 2016. – The Noise Pollution (Regulation & Control) Rules, 2000. – Construction & Demolition Waste Management Rules, 2016 – Municipal Solid Wastes (Management & Handling) Rules, 2000. – E-waste (Management and Handling) Rules 2011 – Batteries (Management and Handling) Rules, 2001 – The Public Liability Insurance Act, 1991.
4.	Department of Ecology and Environment, Karnataka 3.2.1	Department of Ecology and Environment, Karnataka is responsible to preserve and enhance the quality of the natural environment, including water, air and soil quality; conserve and protect flora, fauna and other natural resources; enforce environmental Acts and Rules made by the Central Government and Government of Karnataka; and coordinate various environmental policies and programs. The Department is under the Administrative Control of Minister of Cabinet rank for Forest, Ecology & Environment. The Department is headed by The Principal Secretary, Forest, Ecology and Environment and Secretary (Ecology & Environment). Department is responsible for 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; – 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.	Petroleum and Explosives Safety Organization (PESO) 3.2.2	The PESO is under the Department of Industrial Policy & Promotion, Ministry of Commerce and Industry, Government of India. The Chief Controller of Explosives is responsible to deal with provisions of • The Petroleum Act 1934 and the Rules 2002, • The Static and Mobile pressure vessels {Unfired} Rules, 1981 and amendment 2000, 2004; • Manufacture, Storage and Import of Hazardous Chemical Rules, 1989 and amendment 2000.
6.	Department of Factories, Boilers, Industrial Safety and Health, Government of Karnataka	The main objective of the Department of Factories, Boilers, Industrial Safety and Health is to ensure safety, health, welfare and working conditions of workers working in factories and in construction works by effectively enforcing the provisions of the Factories Act, the Building & Other Construction Workers Act and others labour legislations. It is also to ensure the protection of rights of workers and to redress their grievances.
7.	Ministry of New & Renewable Energy (MNRE)	The MNRE is the nodal ministry of Government of India for all matters related to new and renewable energy. The broad aim is to develop and deploy new and renewable energy for supplementing the energy requirements of the country as stated on its website. The role of MNRE has been assuming importance in recent times with growing concerns of energy security. Energy self-sufficiency was identified as the major driver for new and renewable

S.No.	Agency	Functions
		energy in the wake of the two oil shocks of 1970. It facilitates research, design, development, manufacture and deployment of new and renewable energy systems/devices for transportation, portable and stationary applications in rural, urban, industrial and commercial sectors.
8.	Karnataka Renewable Energy Development Limited (KREDL)	The Karnataka Renewable Energy Development Limited (KREDL) is an organization working under the purview of Energy Department, Government of Karnataka. The objectives of the KREDL are to promote renewable energy in the State and to initiate all necessary actions for Energy Conservation in the State. The KREDL works through various Governmental Agencies, Private Organizations, NGO's and Accredited Energy Auditors. The Karnataka Renewable Energy Development Ltd. (KREDL) is an organization devoted entirely to the promotion of non-conventional energy sources in Karnataka. Its aim is to promote projects for harnessing energy from wind, small-hydro, biomass, solar energy and energy recovery from wastes through private investment. The company advises the Government of Karnataka on policies to be adopted for ensuring a systematic and balanced growth of projects for harnessing renewable energy sources. KREDL create synergies between industry, finance, government, and technical experts to evaluate challenges and opportunities arising from law and policy; make politically feasible recommendations to promote clean energy. KREDL also catalogues "best practices" in renewable energy regulation at national and regional levels. Disseminate findings through renewable energy networks and global partnerships, targeted events, and at international negotiating fora; and Act as a catalyst for change to promote policy and legal instruments that will enhance the market position for renewable energy.
9.	Central Electricity Authority (CEA)	Central Electricity Authority (CEA) is a Statutory Body constituted under the erstwhile Electricity (Supply) Act, 1948, hereinafter replaced by the Electricity Act 2003, where similar provisions exist, the office of the CEA is an "Attached Office" of the Ministry of Power. The CEA is responsible for the technical coordination and supervision of programmes and is also entrusted with a number of statutory functions.
10.	Central Electricity Regulatory Commission	The Commission intends to promote competition, efficiency and economy in bulk power markets, 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. In pursuit of these objectives the Commission aims to – • Improve the operations and management of the regional transmission systems through Indian 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;
11.	Central Ground Water Authority	Central Ground Water Authority (CGWA) was 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. The authority is entrusted with powers of: • 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; • Exercise of powers under section 4 of Environment (Protection) Act, 1986 for the appointment of Officers. CGWA is regulating withdrawal of ground water by industries/ projects. CGWA has published guidelines/ criteria for evaluating proposals/ requests for ground water abstraction (with effect from 16/11/2015). As per the guidelines, for non-notified areas, NOC for ground water withdrawal will be considered for Industries as per the criteria given in the notification, presented in Table below.

Table 3-2: Criteria for granting NOC to Industries/ Infrastructure/ Mining in Non-Notified Areas

Category*	Mandatory Recycle/Reuse (for various purposes except recharge to ground water)	Withdrawal permitted (% of proposed recharge)
Safe	Major and Medium Industries to recycle and reuse at least 40% of the waste water	NOC is required for ground water withdrawal subject to adoption of artificial recharge to ground water.
Semi-critical	Major and Medium Industries to recycle and reuse at least 50%	Withdrawal may be permitted subject to undertaking of ground water recharge**

S.No.	Agency	Functions		
			of the waste water	measures. The withdrawal should not exceed 200% of the recharged quantity.
		Critical	Major and Medium industries should fully recycle and reuse the waste water	Withdrawal may be permitted subject to undertaking of ground water recharge** measures. The withdrawal should not exceed 100% of the recharged quantity
		Overexploited	All Industries to fully recycle and reuse the waste water	Withdrawal may be permitted subject to undertaking of ground water recharge** measures. The withdrawal should not exceed 50% of the recharged quantity.
		** The guidelines will follow the assessment as on Ground Water Resource Estimation (GWRE) 2011 till further revision.* ***The recharge should be implemented within the premises and/or same water shed/assessment unit. Detail project proposal shall be included along with the application for NOC.* ***The proposed project site is located in "critical zone" and is expected to utilize ground water during the construction and operation phase of the project and thus will require permission from CGWA for extraction of ground water.***		
12.	Gram Panchayat	Gram Sabha or the Panchayats are the local bodies which have been bodies defined by the 73rd Constitutional Amendment Act, 1992. Panchayats have to be consulted before making the acquisition of land in the Scheduled Areas for development projects and before re-settling or rehabilitating persons affected by such projects in the Scheduled Areas. The responsibilities that have been entrusted upon Panchayats comprises of the 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. ***The process of obtaining a Non- Objection Certificate (NOC) for the project from the Gram Panchayat of Bejjihalli village has been initiated.***		
13.	Karnataka Power Transmission Corporation Limited (KPTCL)	Karnataka Power Transmission Corporation Limited is a registered company under the Companies Act, 1956 was incorporated on 28th July 1999 and is a company wholly owned by the Government of Karnataka. KPTCL was formed on 1st August 1999 by carving out the Transmission and Distribution functions of the erstwhile Karnataka Electricity Board. KPTCL is mainly vested with the functions of Transmission of power in the entire State of Karnataka and also Construction of Stations & Transmission Lines and maintenance of 400/220/110/66 KV Sub-Stations. Many new lines and Sub-Stations were added & existing stations were modified in the Transmission network. It operates under a license issued by Karnataka Electricity Regulatory Commission.		

3.3 Applicable Environmental and Social Laws, Regulations and Policies

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 subsequent sections.

Table 3-3: Applicable Policies

S.No.	Policy	Description
1.	National Electricity Policy 2005	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.
2.	National Solar Mission 3.3.1.1	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 3 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.

S.No.	Policy	Description
		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 National Solar Mission encourages development of solar power projects in the country.
3.	National Environmental Policy, 2006	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. ***The proposed project will comply with the requirements of the National Environment Policy.***
4.	Karnataka State Solar Policy 2014-2021	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 05.09.2013 for suggesting amendments to the existing Solar Policy 2011-16. The GOK revised its Solar Policy to Karnataka Solar Policy 2014-21. Objectives of solar policy are: • 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 R&D and innovations, skill development in the sector.

Table 3-4: Applicable Environmental and Social Laws and Regulations

S.No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
1.	Environmental Protection	Construction activities will generate air and noise pollution. Scattering of debris and construction material can lead to contamination of soil and water	The Environment (Protection) Act 1986, as amended in April 2003; EPA Rules 1986, as amended in 2002.	KSPCB MoEFCC 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	Consent to Establish [3]
3.	License under Factories Act, 1948	Factory license is required as 'factory' means '*any premises having ten or more workers involved in a manufacturing process*'.	Chapter I of The Factories Act, 1948	Factories Inspectorate, Karnataka	Factory License from the State Government or Chief Inspectorate of Factories, Karnataka
4.	Water Cess Collection (a tax on water use and water pollution caused)	Water use and waste water generation	The Water (Prevention and Control of Pollution) Cess Rules 1978, as amended through 16th July 1992; and Water (Prevention and Control of Pollution) Cess Act 1977, as amended through 6th May 2003	KSPCB	Filing of monthly returns as per prescribed format (Form I under the Act), if total consumption of water exceeds 10 kilo litres per day[4].
5.	Noise Emissions	Noise generated from operation of construction machinery	The Noise (Regulation & Control) Rules, 2000 as amended in January 2010. As per the Environment (Protection) Act (EPA) 1986 the ambient noise levels are to be maintained as stipulated by CPCB for different categories of areas like, industrial, commercial, residential and silence zones etc.	KSPCB	There will be generation of Noise during construction activities. Compliance under the rules to maintain stipulated standard for silent zone since the project site is located in a rural set-up with habitation in the surrounding.
6.	Hazardous Wastes Management	The proposed project will generate waste oil from diesel generator and transformer oil from switchyard; solvents and	Hazardous Wastes (Management Handling and Trans boundary Movement) Rules, 2016	KSPCB	Authorization for handling, generation, storage and disposal of hazardous wastes.

[3] *As per latest directions of Central Pollution Control Board, dated March 07-3-16, 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."*

4 As per the MoEF's Notification dated 6th May 2003, Central Government has exempted all industries consuming water less than 10 kilo litres per day from the levy of Cess.

S.No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
		chemicals used or cleaning etc.	Environment (Protection) Act, 1986		Maintain records of Hazardous and other Wastes managed in Form 3. Hazardous waste not to be stored for a period more than ninety (90) days. Filing of annual return in Form 4 under the rules or before the 30th day of June following the financial year to which that return relates. Packaging, labelling and transportation of hazardous waste as per the guidelines issued by CPCB from time to time. Other compliance under the rules authorization by Central Pollution Control Boards to vendors accepting used or spent oil, Wastes or residues containing oil and silicon tetrachloride.
7.	Change in Land Use	A prior permission from the Government of Karnataka is required for acquiring/purchasing any agricultural land for non-agricultural purposes	Karnataka Land Reforms Act, 1961	Deputy Commissioner (on behalf of the Government of Karnataka)	CSPGPL shall ensure that Change in Land Use Certificate is obtained from Government of Karnataka for conversion of agricultural to Industrial land.
8.	Electricity Distribution License	Private sector projects to obtain distribution Licenses from the State Electricity Regulation Committee and to have open access to the transmission lines	The Electricity Act 2003	State Electricity Regulation Committee	CSPGPL shall obtain license under the Electricity Act and ensure that the Health and Safety requirements specified under the rules in compliance.
9.	Storage of Petroleum products	There will be storage of Diesel at site for operation of generators during construction phase.	The Petroleum Act 1934, as amended in August 1976 The Petroleum Rules 1976, as amended in March 2002.	PESO (Chief Controller of Explosives)	The site will store a small quantity of fuel at site. However, in case fuel storage exceeds the limit as stipulated in the Act, CSPGPL is required to obtain a license from PESO.
10.	Surface Transportation	Movement of construction vehicles and other vehicles for transportation of workers	The Motor Vehicles Act 1988, as amended by Motor Vehicles (Amendment) Act 2000, dated 14th August 2000 The Central Motor Vehicles Rules 1989, as amended.	Regional Transportation Office (RTO), Karnataka	Compliance of stipulated standards under Rule 115.
11.	Welfare and Work Environment	Engagement of workers for construction and operation of the plant	The Factories Act, 1948 and Karnataka Factories Rules, 1969	Deputy Chief Inspector of Factories	CSPGPL/ Construction contractor (L&T) shall comply with all the requirements of factories rules and participate in periodic inspection.

S.No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
					CSPGPL shall ensure that no child labour is engaged.
12.	Child Labour	Engagement of Child Labour at site	The Child Labour (Prohibition and Regulation) Act, 1986	Department of Inspectorate of Factories, Karnataka	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 will ensure compliance to Child Labour Act.
13.	Bonded Labour	Engagement of bonded Labour at site	Bonded Labour (Abolition) Act, 1976	Department of Inspectorate of Factories, Karnataka	All forms of bonded labour are abolished.
14.	Labour	Provision of wages to labour engaged at the site	Minimum Wages Act, 1948	Department of Inspectorate of Factories, Karnataka	This Act 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 of minimum wages to persons employed by him.
15.	Labour	Equal wages to male and female workers at site	Equal Remuneration Act, 1976	Department of Inspectorate of Factories, Karnataka	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.
16.	Labour	Engagement of Labour at site	Workmen's Compensation Act, 1923	Department of Inspectorate of Factories, Karnataka	Requires if personal injury is caused to a workman by accident arising out of and in the course of his employment, his employer shall be liable to pay compensation in accordance with the provisions of this Act.
17.	Labour	Engagement of Female Labour at site	Maternity Benefit Act, 1961	Department of Inspectorate of Factories, Karnataka	No employer shall knowingly employ a woman in any establishment during the six weeks immediately following the day of her delivery or her miscarriage. No pregnant woman shall, on a request being made by her in this behalf, be required by her employer to do during the period any work which is of an arduous nature or which involves long hours of standing, or which in any way is likely to interfere with her pregnancy or the normal development of the foetus, or is likely to cause her miscarriage or otherwise to adversely affect her health.
18.	No Objection Certificate from Gram Panchayat	The project is set in rural set-up of Bejjihalli Village of Tumkur district in Karnataka	Karnataka Panchayats Act 1994	Panchayat Union	Provides for application of consent from the respective panchayat body/village administrative officer etc. during the project life cycle.
19.	Possession of valid license by the engaged contractor.	Contractors or third parties to be involved in the construction works for the proposed project, if required, will also be engaged only subject to availability of	Building and Other Construction Workers (Regulation Of Employment And Conditions Of Service) Act, 1996 and Contract Labour (Regulation and	Registration Officer	CSPGPL should ensure that contractor/ third party have a valid registration under the Building and Other Construction Works Act and Contract Labour (Regulation and Abolition) Act, 1970.

S.No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
		valid registration.	Abolition) Act, 1970. Building and Other Construction Workers' (Regulation of Employment and Conditions of Service) Karnataka Rules, 2006.		
20.	Labour working at the site	Working conditions of contracted Labour working at the site	The Contract Labour (Regulation and Abolition) Karnataka Rules, 1974	The Commissioner of Labour, Karnataka	CSPGPL should ensure that all the contracted workers are provided with condition of services, rate of wages, holidays, hours of work as stipulated in the rules.

3.4 IFC Performance Standards

The Performance Standards (PS) established stipulates that the project shall meet the following 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.

As per the proposed implementation arrangements under the project, CSPGPL owns the project and will be responsible for project implementation. The IFC performance standards apply to private sector projects and provide instruments to manage the operations of projects in an environmentally and socially acceptable manner. The performance standards are designed to help avoid, mitigate, and manage risks and impacts as a way of doing business in a sustainable way, including stakeholder engagement and disclosure obligations of the client in relation to project-level activities. The following performance standards are applicable:

Table 3-5: Applicable Performance Standards

Performance Standards	Applicability
Assessment and Management of Environmental and Social Risks & Impacts / PS 1	√
Labour and Working Conditions / PS 2	√
Resource Efficiency and Pollution Prevention / PS 3	√
Community Health, Safety, and Security / PS 4	√
Land Acquisition and Involuntary Resettlement / PS 5	✖
Biodiversity Conservation and Sustainable Management of Living Natural Resources / PS 6	√
Indigenous Peoples / PS 7	✖
Cultural Heritage / PS 8	✖

Table 3-6: IFC Performance Standards – Requirements and Applicability

S.No.	Performance Standard	Description	Applicability
1.	Performance Standard 1 - Assessment and Management of Environmental and Social Risks and Impacts	PS 1 establishes that the client should establish and maintain a Social and Environmental Management System (ESMS) appropriate to the nature and scale of the project and commensurate with the level of social and environmental risks and impacts throughout the life cycle of the project. The ESMS should incorporate elements pertaining to Policy, Identification of risks and impacts, Management programs, Organizational capacity and competency, Emergency preparedness and response, Monitoring and review, Stakeholder engagement, and External Communications and Grievance Mechanisms.	The PS 1 is applicable to projects associated with environment and/or social risks and/or impacts. The proposed project will have environmental and social impacts and 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. CSPGPL also needs to develop and implement a project specific Environmental and Social Management System to manage the risks associated with its operations.
2.	PS 2: Labour and Working Conditions	Performance Standard 2 recognizes that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental5 rights of workers. Objectives of this PS include the following: - promoting fair treatment, non-discrimination and equal opportunity of workers; - Establishing, maintenance and improvement of worker-management relationship; - Promoting compliance with national employment and labour laws; - Protecting workers, including vulnerable categories of workers such as children, migrant workers engaged by third parties and workers in the client's supply chain; - Promoting safe and healthy working conditions and health of workers; and - Avoiding use of forced labour.	The applicability of PS2 is important during the construction phase as well as the operation phase. It not only covers the direct workers but all contracted workers engaged for the project as well. Migrant workers will be engaged for the project in the construction phase therefore standards pertaining to campsite management will be applicable. Skilled labour and workers will be sourced through authorised contractors. Construction contractor is liable to provide adequate provisions such as access to clean water, sanitary facilities and other necessary facilities at the construction site. CSPGPL/L&T shall take measures to prevent child labour, forced labour and discrimination. Freedom of Association and collective bargaining shall be provided to all workers. Wages, work hours and other benefits shall be as per the national labour and employment laws. CSPGPL/L&T shall provide for grievance mechanism for workers including indirect workers and in their organizations where they exist to raise workplace concerns. CSPGPL shall ensure that matters are brought to the management's attention and addressed expeditiously. CSPGL/L&T shall document all grievances and follow up on any corrective actions. CSPGPL/L&T will extend a safe and healthy work environment to contracted workers and to any other workers who provide project related work and services and should ensure that training is provided to all workers on relevant aspects of Occupational Health and Safety (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. CSPGPL should develop and implement procedures to manage and monitor performance of third parties. These procedures should be integrated in the day to

[5] As guided by ILO Conventions

S.No.	Performance Standard	Description	Applicability
			day operations of the company and requirements should be clearly communicated to third parties and if possible to workers engaged by these third parties.
3.	PS 3: Resource Efficiency and Pollution Prevention	As per PS3, the project is required to implement technically and financially feasible and cost effective measures for improving efficiency in its consumption of energy, water, as well as other resources and material inputs, with focus on areas that are considered core business activities. The client is required to avoid the release of pollutants or, when avoidance is not feasible, minimize and/or control the intensity and mass flow of their release. This applies to the release of pollutants to air, water, and land due to routine, non-routine, and accidental circumstances with the potential for local, and impacts.	The project is a clean energy and does not have major pollution sources associated with it. The construction phase would generate wastes like wastewater, waste oil and construction debris. The operation phase will lead to usage of ground water resources in the water deficient area, generation of minor quantities of waste such as used oil or residues containing oil and occasionally producing discarded solar panel during regular maintenance activity. Practices like implementing rain water harvesting structures, reduced water consumption fixtures, handling of hazardous waste, minimal release of waste, safe disposal of waste, waste water management etc. shall be done as prescribed in Hazardous and Other Wastes (Management and Transboundary Movement) Rules 2016. CSPGPL should ensure that the requirements of PS 3 are met.
4.	PS 4: Community, Health, Safety and Security 3.4.1	The applicability of Performance Standard 4 is established during the environmental and social risks and impacts identification process. The implementation of the actions necessary to meet the requirements of this Performance Standard is managed through the client's Environmental and Social Management System, the elements of which are outlined in Performance Standard 1. This Performance Standard addresses potential risks and impacts to the affected Communities from project activities. Occupational health and safety requirements for workers are included in Performance Standard 2, and environmental standards to avoid or minimize impacts on human health and the environment due to pollution are included in Performance Standard 3. The client will evaluate the risks and impacts to the health and safety of the affected Communities during the project life-cycle and will establish preventive and control measures consistent with good international industry practice (GIIP) such as in the World Bank Group Environmental, Health and Safety Guidelines (EHS Guidelines) or other internationally recognized sources. The client will identify risks and impacts and propose mitigation measures that are commensurate with their nature and magnitude.	The applicability of the Performance standard shall be established during the ESIA process and its applicability during construction period will be limited with movement of heavy machinery/vehicles with construction materials and equipments. The PS 4 is therefore applicable for the project.
5.	PS 5: Land Acquisition and Involuntary Resettlement	The client will consider feasible alternative project designs to avoid or minimize physical and/or economic displacement (*), while balancing environmental, social, and financial costs and benefits, paying particular attention to impacts on the poor and vulnerable.(*) Involuntary resettlement refers both to physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or other means of livelihood) because of project-	The required land for the project is about 161 acres of private land owned by 22 landowners. The project land primarily comprises of barren uncultivable land known as "Dry agricultural and Kharab land" as per revenue records. The land owners on their own volition decided to sell their land parcels due to low productivity of the land parcels over the past five years owing to minimal rainfall. Two land aggregators have been engaged by CSPGPL to negotiate with these landowners on an individual basis. The purchase of land was through negotiated settlement and on a

S.No.	Performance Standard	Description	Applicability
		related land acquisition and/or restrictions on land use.	willing buyer/willing seller basis. 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.	PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources 3.4.2	Performance Standard 6 recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development. The requirements of this PS are guided by the Convention on Biological Diversity, which defines biodiversity as "the variability among living organisms from all sources including inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complex of which they are a part; this includes diversity within species, between species and of ecosystems". Objectives of this PS are to address how clients can sustainably manage and mitigate impacts on biodiversity and ecosystem services throughout project's lifecycle.	PS 6 is applicable to projects located in modified, natural, and critical habitats; or projects that potentially impact or are dependent on ecosystem services or that include the production of living natural resources. The proposed project-area contains a mosaic of natural and modified habitats, which is supporting a variety of flora and fauna, and providing various ecosystem-services to the local communities. The remnant patches of natural vegetation in the area also provide habitats to a good diversity of wild fauna. These patchy natural habitats are also likely to be acting as wildlife corridors, which connect the faunal populations inhabiting the region. The proposed project-area also contains critical habitats, in the form of potential roosting, foraging and nesting sites of some globally threatened, a few endemic and many migratory species. The project installations and activities are likely to cause a moderate loss, degradation or fragmentation of these habitats and services through alteration or obstruction of natural ecological flows and the removal of natural vegetation. Thus PS 6 is applicable for the project.
7.	PS 7: Indigenous Peoples 3.4.3	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. Peoples are particularly vulnerable if their lands and resources are transformed, encroached upon, or significantly degraded. Their languages, cultures, religions, spiritual beliefs, and institutions may also come under threat. As a consequence, Indigenous Peoples may be more vulnerable to the adverse impacts associated with project development than non-indigenous communities. This vulnerability may include loss of identity, culture, and natural resource-based livelihoods, as well as exposure to impoverishment and diseases.	The state of Karnataka is not classified as a Scheduled Area although it is home to a number of tribes. The project area and is surrounding areas do not have indigenous peoples residing around it. Therefore PS7 is not applicable.
8.	PS 8: Cultural Heritage 3.4.4	Performance Standard 8 recognizes that the importance of cultural heritage for current and future generations. This performance standard aims to ensure protection of cultural heritage in the course of project activities which is consistent with the Convention Concerning the Protection of the World Cultural and Natural Heritage. In	This PS is applicable when tangible forms of cultural heritage, unique natural features or tangible objects that embody cultural values and certain intangible forms of culture are impacted or are proposed to be used for commercial purposes. No cultural heritage site of archaeological or national importance is situated within the

S.No.	Performance Standard	Description	Applicability
		addition project's use of cultural heritage is based on the standards set by the Convention on Biological Diversity.	project area or nearby surrounding areas. In addition, no intangible form of culture of the project area is expected to be used by the project proponent for commercial purposes. Hence PS8 is not applicable for this project.

3.4.5 IFC Categorization of Projects

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 categories used by the IFC are:

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

IFC therefore categorizes the project primarily according to the significance and nature of its impacts. It 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.

3.5 Applicable Environmental Standards

The applicable environmental standards for the proposed project have been discussed in the subsequent sections. The ambient air quality standards will be applicable only during the construction phase of the project and the wastewater discharges from the project during both construction and operation phases shall be as per the general discharge standards as sector specific standards are not available for solar power projects. Noise standards notified by MoEFCC for different land uses will be followed.

3.5.1 Ambient Air Quality

As per EHS guidelines of IFC of December 2008, "the ambient air quality standards are ambient air quality levels established and published through national legislative and regulatory process and ambient quality guidelines refers to ambient quality level primarily developed through clinical, toxicological and epidemiological evidences (such as those published by the World Health Organization)".

In India, the Central Pollution Control Board (CPCB) has specified National Ambient Air Quality Standards (NAAQS) for residential, commercial, industrial and sensitive zones for the country as a whole. Revised National Ambient Air Quality Standards (MoEF notification G.S.R 826(E), dated 16th November 2009) have been presented below in ***Table 3-7***.

Table 3-7: Ambient Air Quality Standards

S. No	Pollutant	Time Weighted Average	Concentration in ambient air for Industrial Area Residential, Rural & other Areas
1	Sulphur Dioxide (SO_2)	Annual Avg*	50.0 µg/m^3
		24 hours**	80.0 µg/m^3
2	Oxides of Nitrogen as NO_2	Annual Avg*	40.0 µg/m^3
		24 hours**	80.0 µg/m^3
3	Particulate matter (size less than 10µm)	Annual Avg*	60.0 µg/m^3
		24 hours**	100.0 µg/m^3
4	Particulate matter (size less than 2.5 µm)	Annual Avg*	40.0 µg/m^3
		24 hours**	60.0 µg/m^3

S. No	Pollutant	Time Weighted Average	Concentration in ambient air for Industrial Area Residential, Rural & other Areas
5	Lead (Pb)	Annual Avg*	0.5.0 µg/m^3
		24 hours**	1.0 µg/m^3
6	Carbon Monoxide (CO)	8 hours**	2.0 µg/m^3
		1 hour	4.0 µg/m^3
7	Ozone	8 hours**	100.0 µg/m^3
		1 hour	180.0 µg/m^3
		24 hours**	60.0 µg/m^3
8	Ammonia (NH3)	Annual Avg*	100.0 µg/m^3
		24 hours**	40.0 µg/m^3
9	Benzene	Annual Avg*	5.0 µg/m^3
10	Benzo(a) pyrene	Annual Avg*	1.0 ng/m^3
11	Arsenic	Annual Avg*	6.0 ng/m^3
12	Nickel		20.0 ng/m^3

Note:

**Annual Arithmetic mean of minimum 104 measurements in a year taken twice a Week 24 hourly at uniform interval*

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

3.5.2 Water Quality Standards

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

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

Designated Best Use	Class of Water	Criteria
Drinking water source without conventional treatment but after disinfections	A	1. Total coliform organisms (MPN/100 ml) shall be 50 or less 2. pH between 6.5 to 8.5 3. Dissolved Oxygen (DO) 6 mg/l or more, and 4. Biochemical Oxygen Demand (BOD) 2 mg/l or less
Outdoor bathing (Organised)	B	1. Total coliform organisms (MPN/100 ml) shall be 500 or less 2. pH between 6.8 to 8.5 3. Dissolved Oxygen 5 mg/l or more, and 4. Biochemical Oxygen Demand 3 mg/l or less
Drinking water with conventional treatment followed by disinfections	C	1. Total coliform organisms (MPN/100 ml) shall be 5000 or less 2. pH between 6 and 9 3. Dissolved Oxygen 4 mg/l or more, and 4. Biochemical Oxygen Demand 3 mg/l or less
Propagation of wild life and fisheries	D	1. pH between 6.5 to 8.5 2. Dissolved Oxygen 4 mg/l or more, and 3. Free ammonia (as N) 1.2 mg/l or less
Irrigation, industrial cooling, controlled waste disposal	E	1. pH between 6.0 and 8.5 2. Electrical conductivity less than 2250 micro mhos/cm, 3. Sodium Absorption Ratio (SAR) less than 26, and Boron less than 2 mg/l.
	Below E	Not meeting A, B, C, D & E Criteria

Note: MPN= Most Probable Number
Source: Central Pollution Control Board

Drinking water quality standards as per IS 10500, 2012 by Bureau of Indian Standards (BIS) is presented in ***Table 3-9*** below.

Table 3-9: Drinking Water Standards as per IS 10500:2012

S. No	Parameters	Measurement Unit	IS 10500* specification for drinking water Desirable limit (Permissible limit)

S. No	Parameters	Measurement Unit	IS 10500* specification for drinking water Desirable limit (Permissible limit)
1	pH Value	Unit	6.5-8.5 (No relaxation)
2	Turbidity	NTU	1 (5)
3	Colour	Hazen units	5 (15)
4	Total Dissolved Solids	mg/L	500 (2000)
5	Total Alkalinity (as $CaCO_3$)	mg/L	200 (600)
6	Nitrate	mg/L	45 (No relaxation)
7	Chlorides (as Cl)	mg/L	250 (1000)
8	Sulphate	mg/L	200(400)
9	Calcium (as Ca)	mg/L	75 (200)
10	Magnesium (as Mg)	mg/L	30 (100)
11	Fluorides (as F)	mg/L	1.0 (1.5)
12	Total Hardness (as $CaCO_3$)	mg/L	200 (600)
13	Arsenic (as As)	mg/L	0.01 (0.05)
14	Iron (as Fe)	mg/L	0.3 (No relaxation)
15	Copper (as Cu)	mg/L	0.05 (1.5)
16	Mercury (as Hg)	mg/L	0.001 (No relaxation)
17	Zinc (as Zn)	mg/L	5 (15)
18	Total Chromium (as Cr)	mg/L	0.05 (No relaxation)
19	Barium (as Ba)	mg/L	0.7 (No relaxation)
20	Cadmium (as Cd)	mg/L	0.003 (No relaxation)
21	Conductivity	mS/cm	---
22	Total Suspended Solids (TSS)	mg/L	---
23	Salinity	mg/L	---
24	Oil & Grease	mg/L	---
25	Dissolved Oxygen (DO)	mg/L	---
26	COD	mg/L	---
27	BOD	mg/L	---
28	Phosphate	mg/L	---
29	Lead	mg/L	0.01 (No relaxation)
30	Total Coliform	MPN/100mg	10 (No relaxation)
31	Faecal Coliform	---	---

**The figures in the brackets indicated permissible limit in absence of alternate source*

As per IFC EHS guidelines, the treated sewage discharge shall meet the following guidelines:

Table 3-10: Treated Sewage Discharge

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

Note: MPN= Most Probable Number
Source: General EHS Guidelines prescribed by IFC

3.5.3 Ambient Noise Standards

As per EHS guidelines of IFC, for residential, institutional and educational area, the one hourly equivalent noise level (Leq hourly) for day time is 55 dB (A) while the Leq hourly for night time is prescribed as 45 dB (A).Noise standards notified by the MoEFCC vide gazette notification dated 14 February 2000 based on the A- weighted equivalent noise level (Leq) are as presented in ***Table 3-11.***

Table 3-11: 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

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

3.5.4 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 3-12: Standards for Occupational Noise Exposure

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

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

3.6 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 below.

Table 3-13: 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 September 17, 1992 and also ratified the Copenhagen, Montreal and Beijing Amendments on March 3, 2003.
2.	UN (Rio) Convention on Biological Diversity	India is a party since February 18, 1994 by Ratification; Protocol - Party since September 11, 2003.
3.	Conventions on the Conservation of Migratory species of wild animals and migratory species	India is a 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

S. No.	International Conventions	Salient Features
		(CDM) as a new concept for voluntary greenhouse-gas emission reduction agreements between industrialized and developing countries on the project level. The 1st period of the protocol implementation terminated in 2012. The 2nd period (2012-2017) is currently under operation. In the Doha Climate Change Conference in November 2012, nitrogen tri-fluoride (NF_3) was added to the list of greenhouse gases (GHGs) as identified under the protocol.
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; • C111 discrimination (Employment and Occupation) Convention, 1958 (03:06:1960, ratified).

4. ENVIRONMENT AND SOCIO-ECONOMIC BASELINE

4.1 Introduction

This chapter of the ESIA report presents information on the baseline condition of the physical, chemical, biological and social environment within the proposed project area.

Key existing sources of information used for this section comprises of information published in the web portals of government departments, analysis of available research papers and secondary data review from established sources such as Indian Meteorological Department, etc. Reconnaissance visits, environmental monitoring of water and soil quality of the area, physical and biological field surveys were carried out in the month of May and June 2017 to supplement the existing baseline data.

The proposed project land is located in Siri Taluk of Tumkur district in Karnataka. ***A study area of 5 km (for Environmental aspects) and 1 km (for Socio-Economic aspect) from the boundary of the project site was considered for the evaluation of environmental and social existing status and potential impacts.***

This section covers the following topics:

- Physiography
- Soil and Geology
- Drainage
- Hydrogeology
- Ground Water Resources
- Climate and Meteorology
- Natural Hazards
- Ambient Air Quality
- Ecology
- Socio-Economic Setting
- Land Use/Land Cover
- Existing Traffic Conditions

4.2 Physiography

The project district, Tumkur is a part of the southern Karnataka plateau and located in the eastern belt of the state. It is a land locked district with no or limited natural features like rivers or mountains. The landscape consists mainly of undulating plains interspersed with few hills sprouting all over the place.

There are two parallel ranges of narrow granitic hills running north to south of the district of which one range mainly comprising of schistose rocks, passes through the project taluk viz., Sira and others including Chiknayakanahalli and Gubbi taluks.

The project site and its adjoining area have nearly flat to gently slope terrain with elevation ranging from 590 to 600 m above mean sea level (amsl).

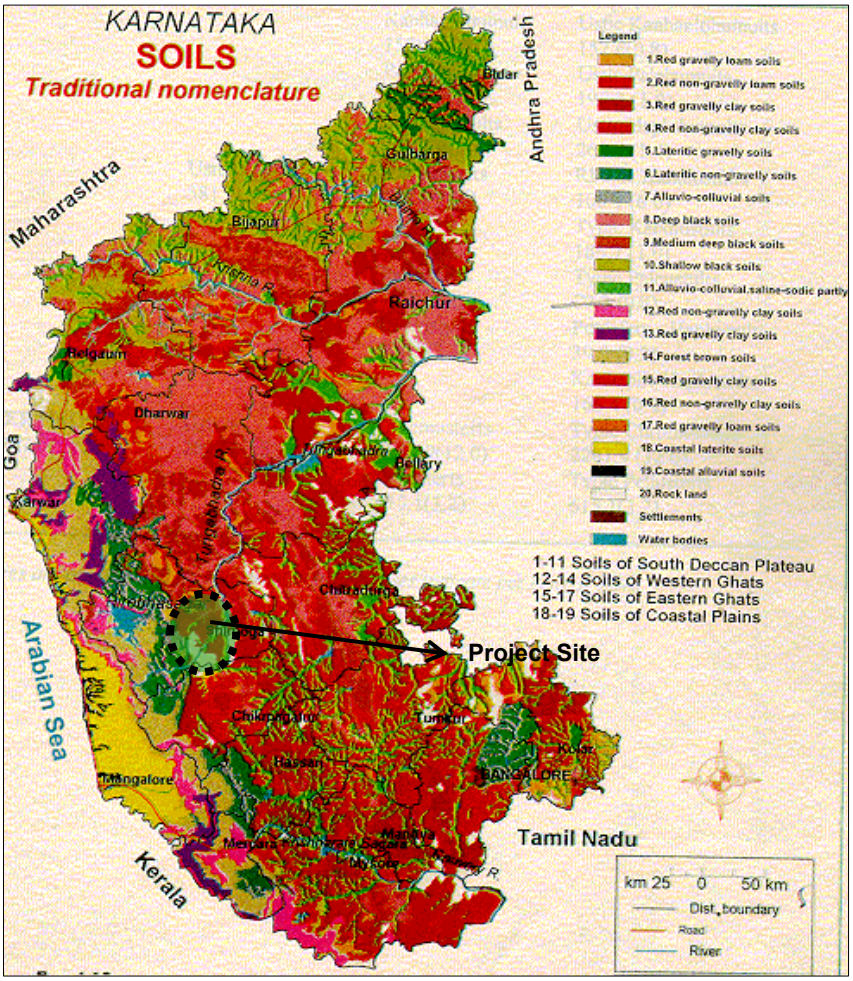
4.3 Geology and Soil

Geologically, project district, Tumkur is situated right on the archaeon complex. The rock formations are represented by the crystalline schists, the granitic gneisses and the newer granites.

As per the definition of National Soil survey Organization & Land Use Planning, the soils in the district can be classified as Ustalfs and Ustalfs-Tropepts which is generally hard and less fertile. More commonly seen in the district are red soil, black soil and sandy type of soil. The project taluka i.e., Sira shows presence of both red loamy and black soils. Red loamy soils are well drained but poor in lime and bases whereas black soils are rich in bases and have a high water holding capacity. Since rainfall in these areas is generally lower than the

surrounding areas, these soils due to prevailing arid conditions are appropriate for red-fed agricultural crops like groundnut, jowar and toor.

Soils in the project site and adjacent area were observed to be "red gravelly loam soil" type.



Source: NBSS & LUP, R.C, Bangalore / KSDA

Figure 4-1: Soil Map of Karnataka indicating the Project Site

Photo 4-1:Red soils within the project site

Photo 4-2:Red gravelly soils in the surrounding area

Source: Site Survey

4.3.1 Baseline Monitoring

Soil samples from two locations were collected and analysed to evaluate the soil quality in the project site. The details of the soil quality monitoring locations are given in ***Table 4-1*** below:

Table 4-1: Details of Soil Quality Monitoring Locations

S.No.	Sampling Locations	Location Code	Geographical Location
1.	North Side of the Project Site	SQ1	14°02'43.4"N 76°54'31.5"E
2.	Near DG Set Location	SQ2	14°02'27.2"N 76°54'26.6"E

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).

Table 4-2: 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	
	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

4.3.2 Results

The results of soil sampling have been presented below in ***Table 4-3*** and inferences have been described in the section below.

Table 4-3: Soil quality results of the sampling locations

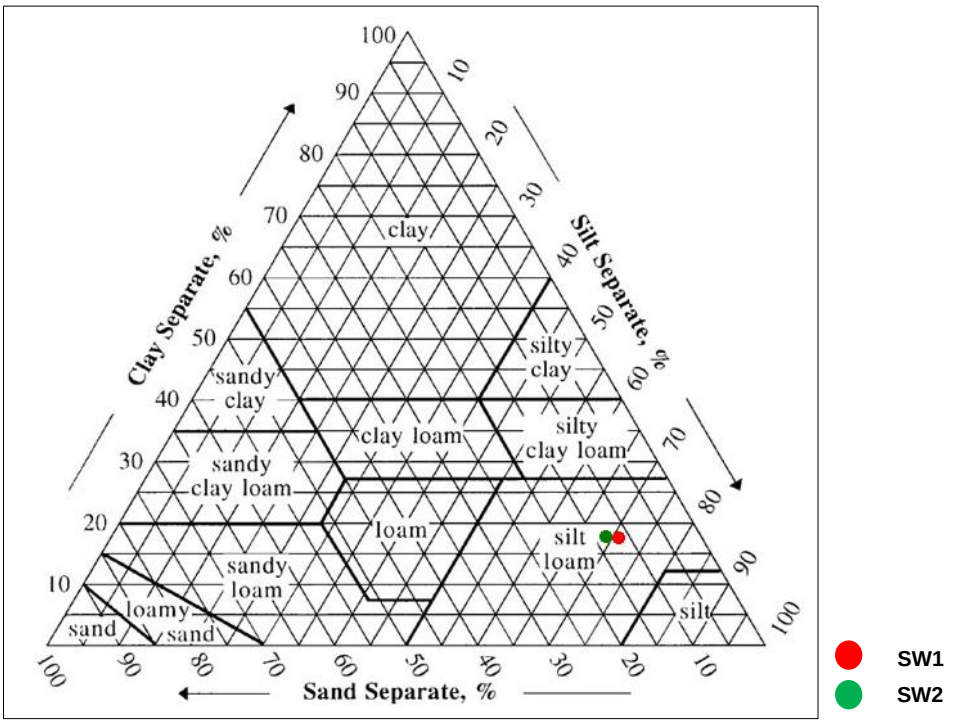
S.No.	Parameters	Unit	Soil Sampling locations	
			SQ1	SQ2
1.	Texture			
	Sand	%	12.7	14.2
	Clay	%	17.0	17.3
	Slit	%	70.3	68.5
2.	pH @ 25° C	-	5.85	7.72
3.	Electrical Conductivity	mmhos/cm	0.16	0.21
4.	Total Nitrogen (as N)	ppm	480	490
5.	Phosphorous (as P)	ppm	11.0	5.8
6.	Potassium (as K)	ppm	702	835
7.	Sodium (as Na)	ppm	851	828
8.	Cation Exchange Capacity (CEC)	meq/l	15.2	14.7
9.	Oil and Grease	mg/kg	Not Detected	Not Detected
10.	Permeability	%	27.0	26.0
11.	Porosity	%	17.0	18.0

4.3.3 Inference

The soil samples analysed show more or less similar characteristics. The pH and EC values of SW1 show normal characteristics whereas SW 2 indicate normal to saline conditions. Total Nitrogen content in the soil sample ranges from 480 to 490 ppm, Phosphorus content ranges from 5.8 to 11.0 ppm and Potassium value ranges from 702 to 835 ppm.

CEC is a measure of a soil's capacity to retain and release elements such as K and Na. Soils with high clay and/or organic matter content have high CEC. Sandy, low organic matter soils have low CEC. CEC of the soil samples range from 14.7-15.2 meq/l. The soil texture triangle of both the samples illustrates "Silt Loam soils".

Sodium value in the samples ranges from 828-851 ppm indicating soils quality to be marginally suitable for crop production which along with uneven and scanty rainfall has restricted agricultural activity in the project site. Oil and Grease parameter is not detected in both the samples indicating no baseline oil contamination within the project site.



Source: http://www.nrcs.usda.gov/

Figure 4-2: Soil Texture Triangle

4.4 Drainage

There are no perennial rivers in the project district, Tumkur. Few rivers and a number of big streams flow during the rainy seasons and dry up during summer. Of the few rivers that flow in the district, the most important are River Shimsha and Jayamangali. None of the important river streams flowing in the project district flows through the project taluk, Sira.

The study area shows presence of several seasonal streams, nallas and water bodies and the drainage pattern of the area can be described as semi dendritic to dendritic in nature. ***Figure 4-3*** shows the drainage pattern of the study area.

One of the major seasonal rain-fed water body "Dharmapura Lake" was observed to be situated within the study area, it is located at a distance of 2 km from the western boundary of the site. The project site also includes a rain-fed seasonal water body /pond due to natural depression within the site. This water body is intended to be retained in its original form by CSPGPL.

4.5 Ground Water Resources

The water occurring below the saturated zone in the sub-surface (beneath the ground) is generally defined as groundwater. Groundwater occurs in permeable geologic formations known as 'Aquifers', i.e., formations having open spaces either cracks, fractures or intergranular spaces, which permit appreciable amount of water to move through them under ordinary field conditions.

Groundwater development status is normally determined by the extent of Dynamic Resources. Dynamic Resource is a variable and replenish-able part of groundwater resource added yearly to groundwater system, which can be obtained without disturbing the sub surface storage of groundwater. It is the upper limit of safe yield / exploitation.

As per the estimated Dynamic Ground water resource of the project district as reported in Ground Water Information Booklet (Sep 2012) published by CGWB, the stage of ground water development is

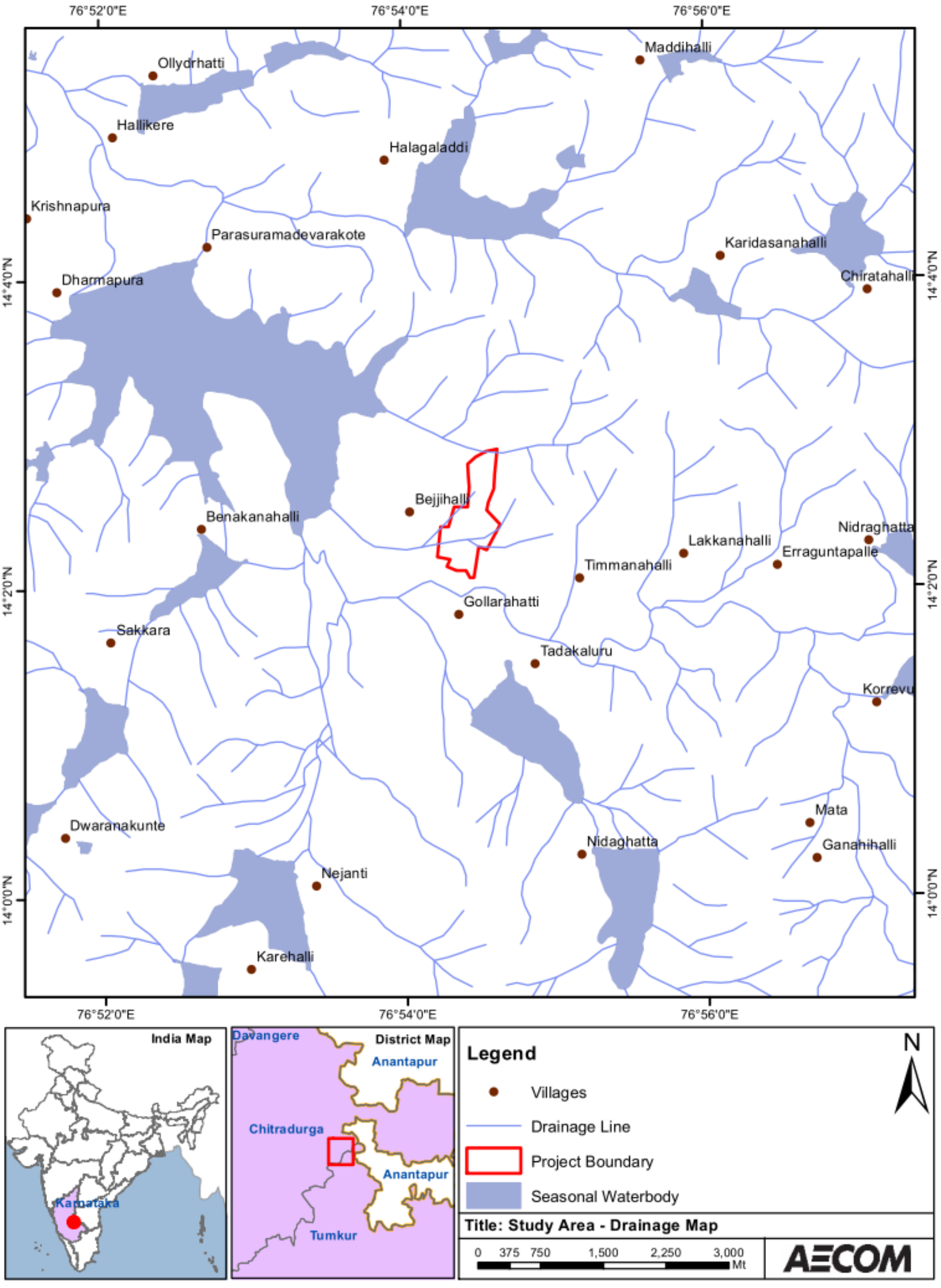
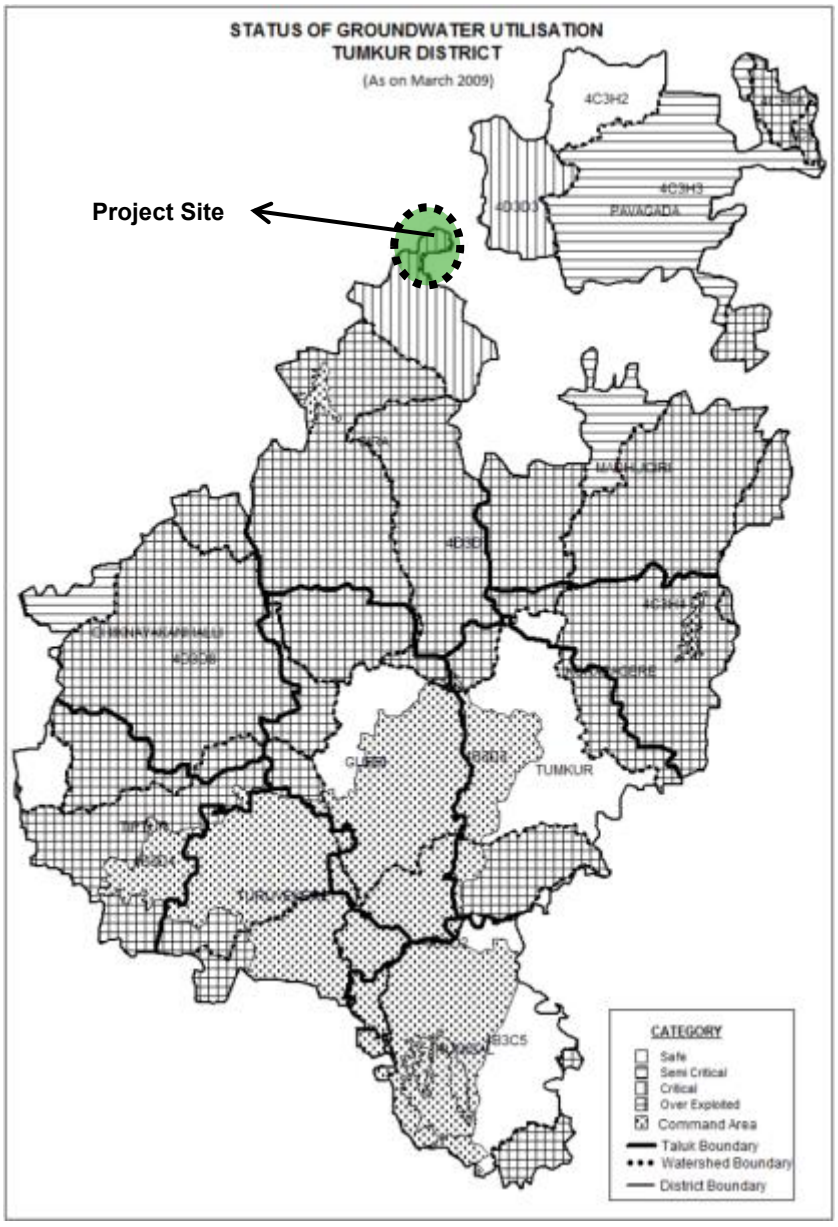


Figure 4-3: Drainage Map of the study area

93.68%. 54.2% area of the project district is overexploited, 3.5% critical, 10.3% semi critical and only 32% of the area is safe.

The ground water development in the project taluk i.e. Sira shows that 5% of the total area is safe, 15% is critical and 80% is semi critical.

*The project site as illustrated in the **Figure 4-4** below is located in the Critical Zone of the taluk. Critical zone[6] is designated when the percentage of utilization of available groundwater resource is between 90-100% and either pre-monsoon or post monsoon groundwater trend shows significant decline.*



Source: Ground water Information Booklet of Tumkur district, CGWB

Figure 4-4: Categorisation of GW in Tumkur district indicating the Project Site

4.6 Water Quality

The inhabitants of the project village i.e, Bejjihalli village source their drinking and domestic use water from common bore-well in the village which is 2000 ft deep. They are also provided with untreated tap water supplied by the Panchayat. It is supplemented with uncovered wells and hand-pumps. Apart from that there are few man-made tanks/ponds in the village which serve as natural rain water harvesting structures.

[6] http://www.karnataka.gov.in/Parisaramahiti/Pages/Groundwater.aspx

4.6.1 Baseline Monitoring

Two (2) ground water samples from taps located in Bejihalli and PD Kote were collected to assess the water quality of the study area. Surface water sample from the pond like natural depression within the project site could not be analysed since it didn't contain any water during the sampling collection period.

4.6.2 Results

The details of the water quality sampling locations are given in ***Table 4-4***.

Table 4-4: Details of Water Quality Monitoring Locations

S. No.	Sampling Locations	Location Code	Geographical Location	Sample
1.	Bore well water from Bejihalli	GWQ 1	14° 02' 28.5" N 76° 54' 00.8" E	Ground Water
2.	Bore well water from PD Kote	GWQ 2	14° 02' 42.2" N 76° 54' 11.5" E	Ground Water

The water samples were analysed for various physical, chemical and biological parameters as per drinking water standard IS 10500:2012. The results of the surface water samples are compared with the CPCB classification of quality for the inland surface water. The results of the analysis have been presented and inferences have been described in the ***Table 4-5*** below.

Table 4-5: Results of Water Quality Analysis

Sr. No.	Parameters	IS 10500:2012 AL (PL)	Unit	Water Quality Sampling Locations	
				GWQ1	GWQ2
PHYSICAL PARAMETERS					
1.	Color	*5 (15)*	Hazen	<5	<5
2.	Temperature	–	°	26.2	26.2
3.	pH Value	*6.5-8.5*	–	7.65	7.81
4.	Electrical Conductivity	–	µmhos/cm	2149	2540
5.	Turbidity	*1 (5)*	NTU	1.2	1.9
6.	Alkalinity (as $CaCO_3$)	*200 (600)*	mg/l	360	436
7.	Total Dissolved Solids	*500 (2000)*	mg/l	1261	1488
CHEMICAL PARAMETERS					
8.	Nitrate	*45 (-)*	mg/l	10.4	17.5
9.	Chloride (as Cl)	*250 (1000)*	mg/l	254.48	254.48
10.	Sulphate (as SO_4)	*200 (400)*	mg/l	29.0	53.0
11.	Fluoride (as F)	*1 (1.5)*	mg/l	1.2	1.3
12.	Total Hardness (as $CaCO_3$)	*300 (600)*	mg/l	392	332
13.	Calcium (as $CaCO_3$)	*75 (200)*	mg/l	73.74	48.09
14.	Magnesium (as Mg)	*30 (100)*	mg/l	50.64	51.62
15.	Arsenic (as As)	*0.01(0.05)*	mg/l	BDL (DL:0.005)	BDL (DL:0.005)
16.	Iron (as Fe)	*0.3 (-)*	mg/l	0.15	0.7
17.	Copper (as Cu)	*0.05 (1.5)*	mg/l	BDL(DL:0.03)	BDL(DL:0.03)
18.	Lead (as Pb)	*0.01(-)*	mg/l	BDL (DL:0.005)	BDL (DL:0.005)
19.	Mercury (as Hg)	*0.001(-)*	mg/l	BDL(DL:0.0005)	BDL(DL:0.0005)
20.	Mangenese (as Mn)	*0.1 (0.3)*	mg/l	BDL(DL:0.5)	BDL(DL:0.5)
21.	Zinc (as Zn)	*5 (15)*	mg/l	BDL (DL:0.02)	BDL(0.02)
22.	Chromium (as Cr^{+6})	*0.05 (-)*	mg/l	BDL(DL:0.1)	BDL(DL:0.1)
23.	Barium (as Ba)	*0.7 (-)*	mg/l	BDL(DL:0.1)	BDL(DL:0.1)
24.	Cadmium (as Cd)	*0.003 (-)*	mg/l	BDL (DL:0.005)	BDL (DL:0.005)
25.	Phosphate	–	mg/l	BDL(DL:0.1)	BDL(DL:0.1)
26.	Salinity	–	g/l	0.46	0.44
27.	Mineral Oil	*0.5 (-)*	mg/l	BDL(DL:2)	BDL(DL:2)
BIOLOGICAL PARAMETERS					
28.	Total Coliforms	*Nil*	Nos./100ml	220	280
29.	Faecal Coliforms	*Nil*	Nos./100ml	26	33

4.6.3 Inference

The pH values in both water samples indicate basic characteristics. Other physical parameters like Turbidity, Alkalinity and TDS values in the water samples were observed to be more than the permissible limits prescribed in the standard.

The water samples were observed to be Turbid in nature indicating presence of suspended solids that are usually invisible to the naked eye. This can be linked to high value of TDS and Alkalinity in these samples. Alkalinity of water may be due to the presence of one or more of a number of ions. Possible effects of prolonged exposure to alkaline water may result in gastrointestinal issues and other skin irritations.

High TDS water can be due to presence of inorganic salts (principally calcium, magnesium, potassium, sodium, bicarbonates, chlorides, and sulphates) and some small amounts of organic matter that are dissolved in water. High total dissolved solids may affect the aesthetic quality of the water; interfere with washing clothes and corroding plumbing fixtures.

Chemical parameters such as Nitrate, Sulphate and Calcium are within the acceptable limits as prescribed in the standard. Iron content in water sample from Bejihalli is within the limit; however sample from PD Kote shows Iron content exceeding the limit. Natural Iron dissolved in groundwater is found found naturally as divalent iron which can be associated with presence of organic matter in the sample. High Iron in drinking water causes reddish-brown stains on laundry, dishes, utensils, sinks and concrete. The water may also have a metallic taste and an offensive odour.

Parameters such as Chloride, Fluoride, Total Hardness and Magnesium were observed to be exceeding the acceptable limits in samples from both the locations. Chloride although harmless at low levels can give drinking water an unpleasant taste and odour since it combines with other parameters to form various salts. High value of Magnesium in these water samples from Bejihalli and PD Kote can be linked to the hardness value in the sample, since Magnesium is the major contributing ion to water hardness.

The health effects of hard water are mainly due to the effects of the salts of calcium and magnesium dissolved in it, in these samples case it is primarily Magnesium since calcium content were observed to be within the acceptable limits in both the samples. The major impact of hyper-magnesemia is renal insufficiency associated with change in bowel habits such as Diarrhoea.

The elevated level of Fluoride in both the samples contributes to the detrimental impact on the teeth and bones of humans. Prolonged exposure to high dosage of Fluoride may lead to crippling skeletal fluorosis, which is associated with osteoporosis in females and bone deformities in children along with loss of enamel in teeth making them broken and appear brownish. As reported in the Ground Water Information Booklet of Tumkur district dated September 2012 high fluoride content is a major ground water quality issue in the project district. It is due to presence of recent granites which is naturally occurring in the geology of the area and its content increases with depth in the ground water.

One of the major concerns associated with these ground water samples is presence of Bacteriological parameters (both Total and Faecal Coliforms) content which is in the range of 220-280 Nos/100 ml and 26-33 Nos/100 ml respectively. Presence of these indicates that the water has been contaminated with the faecal material of man or other animals.

The presence of faecal contamination is an indicator that a potential health risk of nausea, vomiting, fever, and Diarrhoea for individuals exposed to this water. Faecal coliform bacteria may occur in these samples as a result of the leaching of domestic sewage or human and animal waste into soil and ground water.

Other metal and heavy metal parameters such as Arsenic, Copper and Lead, Mercury, Barium Manganese, Zinc, Chromium, Cadmium and phosphate were not detected in both the water samples. The samples also did not show presence of Mineral oil.

Therefore, it can be concluded that ground water samples collected from tube-wells located at project village (Bejihalli) and project area (PD Kote) are not suitable to be consumed directly as drinking water. Conventional treatment methods such as only boiling and chlorination will not suffice and help meet the criteria of safe drinking water since levels of Chloride, Magnesium, Fluoride, Iron (in PD Kote), TDS and Alkalinity exceeds the acceptable limits of drinking water standards Therefore, a reverse osmosis (RO) treatment is highly recommended before consuming water from these sources.

4.7 Climate and Meteorology

The district experiences continuous rise in temperature during the months of March to May and April is usually considered as hottest month. Maximum temperature may reach 40°or 41°C during the hot season. Southwest monsoon sets in during the period of June to September. In this season, the temperature drops appreciably and the weather is pleasant throughout the season. October and November may be termed as post- monsoon season and during the period temperature decreases steadily and remains cool till February. Winter sets in December and prolongs up to February. December is generally the coolest month of the year and the daily minimum temperature in this season sometimes reaches 9° to 10°C. The annual potential Evapotranspiration is over 1800 mm with monthly rates less than 100 mm during December and January and over 250 mm during May.

The winds are predominantly south-westerly during the summer monsoon and north-easterly during the winter monsoon.

The normal rainfall in the district is 780 mm and the isohyets drawn from normal rainfall indicates that the amount of rainfall is maximum in eastern part and sharply reduces towards northern part of the district. The annual average rainfall in the project taluk, Sira is 632 mm. It also experiences a high variability of rainfall in the entire district i.e., about 46% (SW Monsoon period), 60% (NE Monsoon period) and 34% (annual rainfall).

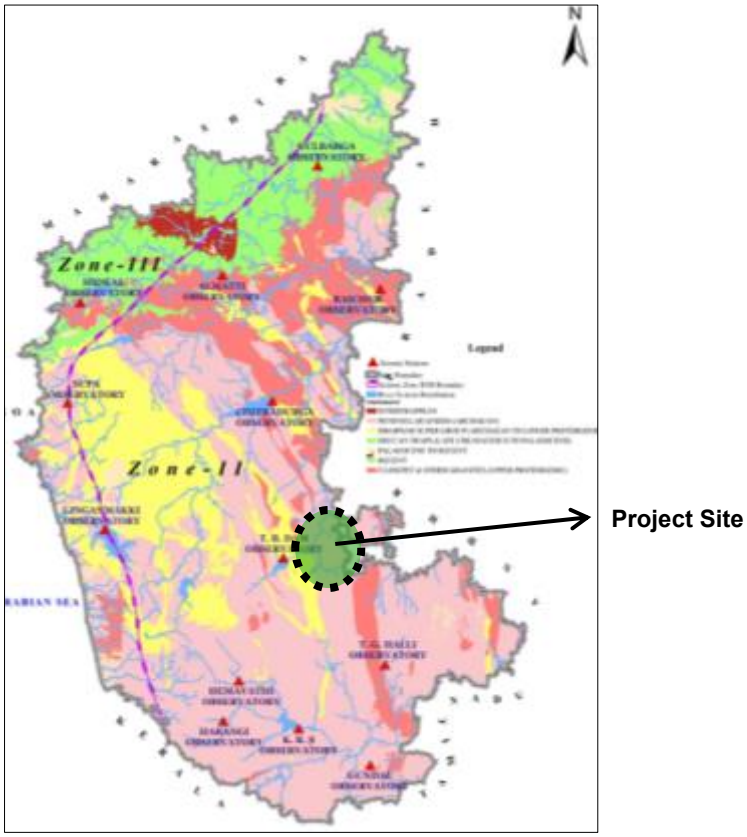
Table 4-6: Rainfall Pattern in Project Taluk

Taluk	Parameters	Pre-Monsoon	SW Monsoon	NE Monsoon	Annual Rainfall
Sira	Average Rainfall (mm)	116	343	173	632
	Minimum Rainfall (mm)	10	114	0	295
	Maximum Rainfall (mm)	265	678	547	1254
	Standard Deviation (mm)	64	158	104	217
	Coefficient of Variance (%)	55	46	60	34

Source: District Census Handbook Tumkur, Directorate of Census Operations, Karnataka

4.8 Natural Hazards

As per the Revised Earthquake Hazard Mapping, 22.13% of the total geographical area of Karnataka state is under ‘moderate’ earthquake damage risk zone and remaining area of the state is under ‘low’ damage risk zone. The project site located in Tumkur District of Karnataka lie in seismic zone II with Low Damage Risk Zone (MSK VI) as shown in ***Figure 4-5*** below.



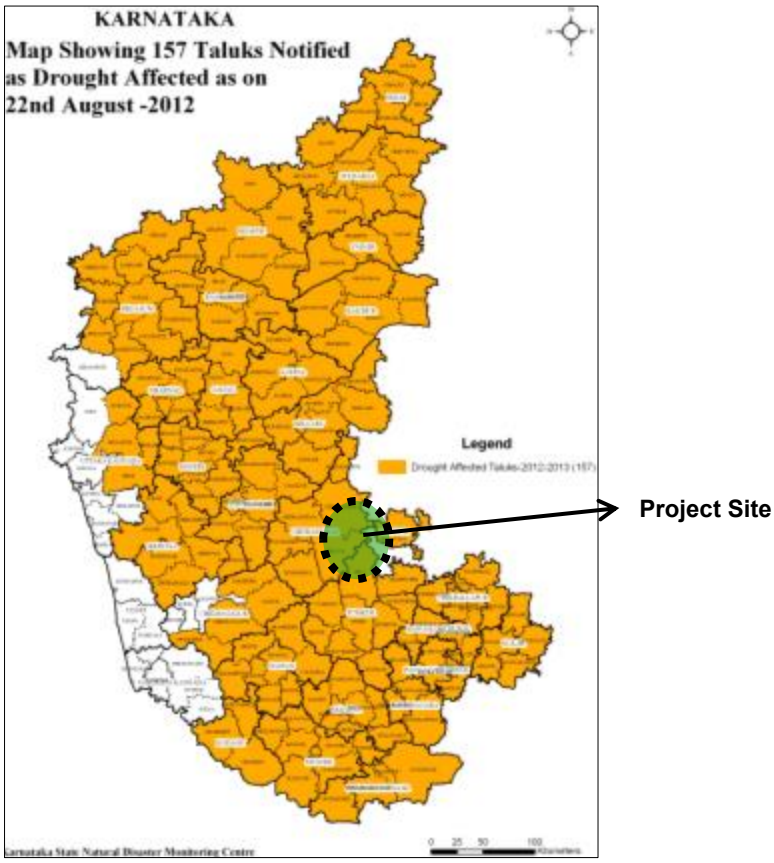
Source: Karnataka State Natural Disaster Monitoring Centre

Figure 4-5: Geological Map of Karnataka State with Seismic Zonation indicating the Project Site

The project district, Tumkur falls in drought prone area as per Karnataka State Natural Disaster Management Centre (KSDMC) and Central Research Institute for Dryland Agriculture (CRIDA). The studies conducted by CRIDA further reveals that the district falls under Central Dry Zone (KA-4) as per Agro-climatic zonation.

During consultation with the local inhabitants, it was understood that there have been no instances of flooding in the area near the project site. The natural depression within the project site causes storage of rain water and giving it a form of pond generally remains dry all throughout the year except during the rainy season from September to December. Uneven and scanty rainfall has restricted agricultural activities in the area.

As per the map of drought affected Talukas of Karnataka given ***Figure 4-6*** the entire Sira taluk is a drought affected area.



Source: Karnataka State Natural Disaster Monitoring Centre

Figure 4-6: Map of Drought affected Taluks of Karnataka indicating the Project Site

4.9 Archaeological Sites

As per the Archaeological Survey of India, there are around five (5) archeologically important monuments/sites[7] in the project district, Tumkur as listed below:

- Channigaraya Temple in Aralaguppe;
- Fort in Madhugiri;
- Onnakesava Temple in Nagalapura; and
- Juma Masjid and Malik Rihan Darga in Sira.

Out of these two (2) monuments/sites is located in the project taluka i.e, Sira. However, the monuments are at a distance of 35 km from the southern boundary of the project site.

There is a "Samadhi" located at around 100 m outside the western boundary of the project site. The access to this place is not affected since it does not pass through the site. This was confirmed during the consultation with the locals residing in the neighbouring plot of the site.

[7] http://asi.nic.in/asi_monu_alphalist_karnataka_bangalore.asp

Photo 4-3: A "Samadhi" of local importance outside the project boundary around 100 m from western boundary

4.10 Ambient Air Quality

Solar power projects in particular do not cause any emissions during its operation phase and fugitive dust emissions are witnessed during construction phase of the project. Therefore, carrying out ambient air quality of the project area was not included in the scope of ESIA study.

The project is set up in a predominantly rural residential area with no identified sources of air pollution in the vicinity. Also, the traffic movement in the area was also observed to be relatively low therefore indicating an overall "Low" pollution level in the area.

4.11 Ecology

4.11.1 Introduction

The area covered by the project site, along with the area falling within 5 km of the boundary of the project site, was subjected to an ecological assessment. This area is collectively referred to as 'Study Area' hereinafter. The fieldwork towards this assessment was conducted on May 17 and 18, 2017. The ecological assessment was focused on identifying ecological receptors in the study area, predicting the potential ecological impacts of the proposed project and recommending practicable mitigation measures.

4.11.2 Description of the Study Area

Geographically, the study area is a part of the Deccan Plateau region of Karnataka. Ecologically, the study area mainly represents a large tract of modified habitats, such as agricultural lands, roads and habitations, interspersed with sparsely distributed patches of natural vegetation. Major water sources in the study area include seasonal natural water-flows, artificial tanks and bore wells.

This section of the report describes the methodology adopted for primary and secondary data collection, the diversity of higher flora and fauna recorded at, or reported from, the study area, the habitat and ecosystem services-profile of the study area and the designated areas in the vicinity of the study area.

4.11.3 Methodology

This sub-section describes the methodology adopted for the ecological assessment of the study area.

Primary Data

Primary data for ecological assessment was collected through quadrat-studies at six (6) sites distributed across the study area. These sites were selected to represent the range of habitats and microhabitats observed in the study area.

The standard quadrat study methodology was adopted for the assessment of the floristic diversity in the study area. The quadrats laid were of size 20 m x 20 m 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 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, observed during a brief walk-over of the site. While recording primary data on fauna, only occurrence of a species at a given site was noted, without enumerating the individuals sighted.

The timings of the quadrat-studies covered most of the diurnal faunal activity-period, from mid-morning till early evening. Given the preliminary nature of this survey, the emphasis of the studies was kept limited to only the higher flora, and amongst the fauna, to only the higher and diurnal fauna.

The percentage-frequency, abundance and density per hectare of each plant-species were calculated on the basis of quantitative floristic data recorded through the quadrat studies. The quantitative avifaunal data recorded during the walk-over of the quadrat-sites was processed to get the percentage frequency of each bird-species recorded.

The following formulae were used for calculating the values for % frequency, abundance and density of the plant species encountered in the quadrat-studies:

$$\%\ \text{Frequency of species A} = \frac{\text{Number of quadrats of occurrence of species A}}{\text{Total number of quadrats studied}}\ \text{x } 100$$

$$\text{Abundance of species A} = \frac{\text{Number of individuals of species A in total quadrats studied}}{\text{Number of quadrats of occurrence of species A}}$$

$$\text{Density of species A} = \frac{\text{Number of individuals of species A in total quadrats studied}}{\text{Total area studied}}$$

The following formula is used for calculating % frequency of the bird species encountered in the quadrat-studies:

$$\%\ \text{Frequency of species A} = \frac{\text{Number of quadrats of occurrence of species A}}{\text{Total number of quadrats studied}}\ \text{x } 100$$

The species richness, of the woody and non-woody florae as well as the avifauna, is calculated merely as the total number of species of the concerned biotic group encountered during the quadrat-studies.

Table below that follows presents the quadrat location co-ordinates, elevation from mean sea level and nearest villages or landmark of the six-(6) quadrat sites at which primary data regarding flora and fauna was recorded.

Table 4-7: Details of the Quadrat Sites

S.No.	Location Co-ordinates	Elevation (m)	Nearest Village/Landmark
1	14° 02' 33.01" N, 76°54' 21.07" E	596	Within site, Near Labour camp
2	14° 02' 28.12" N, 76°54' 18.63" E	593	Within site, Near Pomegranate orchard
3	14° 02' 03.92" N, 76°54' 27.80" E	590	Within site, Near Seasonal stream
4	14° 02' 36.08" N, 76°54' 05.02" E	597	Bijjihalli Village, Near Anganwari
5	14° 02' 42.87" N, 76°54' 13.17" E	596	Bijjihalli Village, Near School
6	14° 02' 37.29" N, 76°54' 27.35" E	596	On road, near site entry

Source: AECOM Primary Survey

Secondary Data

The relevant scientific data was sourced from available published literature. Additional information on ecological services and biological profile of the study area was gathered through informal communication with the local

residents. The information sources quoted in this section of the report are mentioned at the pertinent places in the sub-sections.

4.11.4 Floristic Profile of the Study Area

Forest Types

According to the Champion and Seth Classification of Indian Forests, the natural vegetation of the survey area represents the following forest-types:

Type 6A/C1 Southern Thorn Forests [Sub-type C1- Southern Thorn Forests of Sub-group 6A – Southern Tropical Scrub Forests]

The natural vegetation of the study area is scattered, bushy in appearance, stunted and forming thickets. Formation of this type of forest is usually resulted from degradation of Southern Tropical Thorn Forests. These forests are mainly comprising scattered shrubs intermixed with grasses and other herbaceous species, dotted with trees in between.

The forests are mixed, with low species richness and usually do not form marked plant communities.

The tree vegetation in this forest type is composed of tree species such as *Acacia nilotica, Melia azadarach, Borassus flabilifer, Euphorbia tirucalli, Prosopis cineraria, Prosopis juliflora, Phoenix sylvestris, Tamarindus indica etc. Shrubs such as Abutilon indicum, Agave americana, Senna auriculata, Lantana camara, Calotropis gigantea, Calotropis procera* and *Opuntia elatior* are dominant components of the vegetation. Ground flora is represented by species such as *Argemone Mexicana, Barleria buxifolia, Cyperus sp., Eragrostis sp. and Croton bonplandianus*.

Type 6/DS2 (Group 6 – Southern Tropical Thorn Forest, Degradation Stage DS2 – Southern Euphorbia Scrub)

This type of forest may represent either the ultimate stage in degradation of the previous forest type or extremely poor soil conditions. Though the Acacias and their associates continue to occur even in this stage, the trees are very stunted and take on a bush-like form. It is a very open form of forest in which the presence of fleshy Euphorbias is characteristic. Most of the soil is bare, with only a thin cover of wiry grasses.

Species associated with this type include[8]:

- **Large shrubs** such as Calotropis gigantea, Capparis decidua, Euphorbia antiquorum and Euphorbia tirucalli;
- **Small shrubs** such as Barleria buxifolia, Cassia auriculata, Dodonaea viscosa and Opuntia elatior; and;
- **Grasses** such as Aristida spp. and Cymbopogon spp.

Flora Recorded in the Quadrats

Table 4-8 below that follows presents the quantitative floristic data recorded during the quadrat-studies carried out at the six (6) aforementioned locations. The woody and non-woody floristic species are listed in separate sections, along with the percentage frequency, abundance and density of each species. Photographs of few significant plant species recorded in the study area are provided in ***Plate 4-1***.

Table 4-8: Floristic Species Recorded in the Quadrats

Sr. No.	Scientific Name of Species	Family	Habit	IUCN Status	% Frequency	Abundance	Density
Woody Species: Vegetation profile representing the perennial flora of the study area							
1.	*Abutilon indicum*	Malvaceae	Shrub	NA	17	3	200
2.	*Azadirachta indica*	Meliaceae	Tree	NA	33	2	13
3.	*Acacia nilotica*	Leguminosae	Tree	NA	17	1	4
4.	*Acacia leucophloea*	Leguminosae	Tree	NA	17	1	4

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

Sr. No.	Scientific Name of Species	Family	Habit	IUCN Status	% Frequency	Abundance	Density
5.	*Prosopis cineraria*	Leguminosae	Tree	NA	17	1	4
6.	*Tamarindus indica*	Leguminosae	Tree	NA	33	1	8
7.	*Balanites aegyptiaca*	Zygophyllaceae	Shrub	NA	17	3	13
8.	*Calotropis procera*	Apocynaceae	Shrub	NA	17	1	67
9.	*Calotropis gigantea*	Apocynaceae	Shrub	NA	17	1	67
10.	*Dodonaea viscosa*	Sapindaceae	Shrub	NA	17	3	200
11.	*Eucalyptus sp.*	Myrtaceae	Tree	NA	17	1	4
12.	*Albizia lebbeck*	Leguminosae	Tree	NA	33	2	13
13.	*Lantana camara*	Verbenaceae	Shrub	NA	17	2	133
14.	*Cocos nucifera*	Arecaceae	Tree	NA	17	2	8
15.	*Ficus religiosa*	Moraceae	Tree	NA	17	1	4
16.	*Melia azedarach*	Meliaceae	Tree	NA	33	1	8
17.	*Senna sp.*	Leguminosae	Shrub	-	17	1	67
18.	*Prosopis juliflora*	Leguminosae	Tree	NA	67	2	25
19.	*Senna italica*	Leguminosae	Shrub	NA	17	1	67
20.	*Senna auriculata*	Leguminosae	Shrub	NA	50	1	200
21.	*Ziziphus nummularia*	Rhamnaceae	Shrub	NA	17	1	4
	***Non-woody Species:* Vegetation profile representing the annual flora of the study area**						
22.	*Croton bonplandianus*	Euphorbiaceae	Herb	NA	50	2	11667
23.	*Merremia tridentata*	Convolvulaceae	Herb	NA	17	2	3333
24.	*Cassia tora*	Leguminosae	Herb	NA	50	2	11667
25.	*Hyptis suaveolens*	Lamiaceae	Herb	NA	50	1	6667
26.	*Indigofera sp*	Leguminosae	Herb	-	17	1	1667
27.	*Parthenium hysterophorus*	Asteraceae	Herb	NA	67	2	13333
28.	*Tridax procumbens*	Asteraceae	Herb	NA	33	2	5000

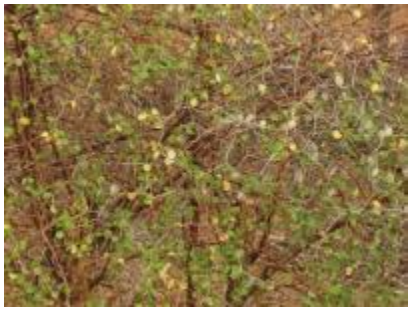
Source: AECOM Primary Survey

Plate 4-1: A few significant plant species recorded in the study area

Azadirachta indica

Senna auriculata

Calotropis gigantea



Ziziphus nummularia

Parthenium hysterophorus

Calotropis procera

Balanites aegyptiaca

Senna sp.

Hyptis suaveolens

4.11.5 Faunal Profile of the Study Area

This sub-section presents the details of the higher faunal species having recorded ranges that include the study area and/or recorded during the field survey.

4.11.5.1 Avifauna

The avifaunal profile of the study area gives details of resident and migratory bird species having recorded ranges that include the study area.

Resident Avifauna

The study area has habitat range of 173 residential birds out of which four (4) are of critically endangered, two (2) are of endangered, four (4) are of near threatened and two (2) are of vulnerable status assigned by the International Union for Conservation of Nature and Natural Resources (IUCN). ***Table 1*** of ***Annexure 1*** presents the details of resident birds having recorded ranges that include the study area. The conservation status as per the IUCN Red Data List of Threatened Species and the Schedule under which the Wildlife (Protection) Act (WPA), 1972, of India, protects the species is mentioned against each species. Of these, the names of the species sighted during the site visit are presented in ***Table 4-9*** below. Photographs of few significant bird species recorded in the study area are provided in ***Plate 4-2***.

Table 4-9: Resident Birds Sighted in the Study Area

Sr. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
1.	*Pseudibis papillosa*	Red-naped Ibis	LC	IV
2.	*Bubulcus ibis*	Cattle Egret	LC	IV
3.	*Elanus caeruleus*	Black-winged Kite	LC	IV
4.	*Haliastur indus*	Brahminy Kite	LC	IV
5.	*Merops orientalis*	Green Bee-eater	LC	-
6.	*Ocyceros birostris*	Indian Grey Hornbill	LC	-
7.	*Dinopium benghalense*	Lesser Goldenback	LC	IV
8.	*Sturnia pagodarum*	Brahminy Starling	LC	IV
9.	*Passer domesticus*	House Sparrow	LC	-
10.	*Saxicoloides fulicatus*	Indian Robin	LC	IV

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.
Source: R. Grimmett, C. Inskipp & T. Inskipp (2011). Birds of the Indian Subcontinent. Oxford University Press, pp 1-528; IUCN (2015). The IUCN Red List of Threatened Species. Version 2015-4; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Plate 4-2: A few significant Bird species sighted in the study area

Dinopium benghalense (Lesser Goldenback)

Sturnia pagodarum (Brahminy Starling)

Merops orientalis (Green Bee-eater)

Saxicoloides fulicatus (Indian Robin)

Passer domesticus (House Sparrow)

Bird Nest sighted within the project site

Ocyceros birostris (Indian Grey Hornbill)

Pseudibis papillosa (Red-naped Ibis)

Bird Nest sighted within the project site

Migratory Avifauna

The entire Indian subcontinent, including the study area, falls within the limits of the Central Asian Flyway (CAF), one of the eight (8) globally identified flyways. 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-path of the various winter, summer and passage visitor-birds migrating either to or through the region in which it is situated.

Table 2 of ***Annexure 1***, of lists the 72 migratory avifaunal species having recorded ranges that include the study area or waterbodies in the catchments of which the study area is situated. The season of migration, the conservation status as per the IUCN Red Data List of Threatened Species and the Schedule under which the species is protected by the Wildlife (Protection) Act (WPA), 1972, of India is mentioned against each species. Out of 72, four (4) near threatened and one (1) species is of vulnerable status assigned by the IUCN

4.11.5.2 Other Higher Fauna

This section presents the details of mammals, amphibians, reptiles and fishes having recorded ranges that include the study area.

Mammals

Table 3 of ***Annexure 1*** lists the mammalian species having recorded ranges that include the study area. The conservation status as per the IUCN Red Data List of Threatened Species and the Schedule under which the species is protected by the Wildlife (Protection) Act (WPA), 1972, of India is mentioned against each species. Total 45 mammal species are recorded in study area out of which four (4) are near threatened and five (5) are of vulnerable status assigned by the IUCN.

Reptiles

Table 4 of ***Annexure 1*** lists the 25 reptilian species having recorded ranges that include the study area. The conservation status as per the IUCN Red Data List of Threatened Species and the Schedule under which the species is protected by the Wildlife (Protection) Act (WPA), 1972, of India is mentioned against each species.

4.11.5.3 Invasive Alien Species

Table that follows lists the invasive alien floristic and faunal species recorded in the study area.

Table 4-10: Invasive Alien Species of the Study Area

Sr. No.	Scientific Name	Common Name	Habit / Class
Floristic Species			
1	*Lantana camara*	Wild Sage	Shrub
2	*Prosopis juliflora*	Mesquite	Tree
3	*Senna auriculata*	Matura Tea Tree	Shrub
Faunal Species			
1	*Columba livia*	Common Pigeon	Aves (Birds)

Source: www.issg.org (IUCN Global Invasive Species Database)

4.11.6 Habitat Profile of the Study Area

4.11.6.1 Natural Habitats

The natural habitats in the study-area comprise small patches of dry deciduous scrub forest, seasonal and perennial wetlands such as streams and lakes. Though these natural habitats are not in a pristine state, owing to their limited presence, they are likely to be crucial to the survival of some specialist species recorded from the region.

4.11.6.2 Modified Habitats

A major part of the study area is modified for agricultural purposes. Other modified habitats in the study area comprise habitations, fallow lands, bunds, ponds, and tar or dirt roads.

4.11.6.3 Critical Habitats

Habitats critical to the survival of IUCN-designated Critically Endangered or Endangered species, migratory species, congregatory species and endemic or restricted range species are considered to be critical habitats.

Critically Endangered or Endangered Species

Table that follows lists the species designated by the IUCN as either Critically Endangered or Endangered and having recorded ranges that include the study area.

Table 4-11: Critically Endangered/ Endangered Species of the Study Area

Sr. No.	Scientific Name	Common Name	IUCN Status
Birds			
1	*Neophron percnopterus*	Egyptian Vulture	EN
2	*Gyps bengalensis*	White-rumped Vulture	CR
3	*Gyps indicus*	Indian Vulture	CR
4	*Ardeotis nigriceps*	Great Indian Bustard	CR

5	*Sarcogyps calvus*	Red-headed Vulture	CR
6	*Sypheotides indicus*	Lesser Florican	EN

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

Congregatory Species

Table that follows lists the Congregatory species having recorded ranges that include the study area.

Table 4-12: Congregatory Species of the Study Area

Sr. 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; 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 (2015). *The IUCN Red List of Threatened Species.* Version 2015-4; *Schedules I to VI: Indian Wildlife (Protection) Act, 1972.*

Endemic / Restricted Range Species

Table that follows presents the details of the Endemic or Restricted Range species having recorded ranges that include the study area.

Table 4-13: Endemic / Restricted Range Species

Sr. No.	Scientific Name	Common Name	Range
Birds			
1	*Perdicula argoondah*	Rock Bush Quail	Peninsular India
2	*Galloperdix spadicea*	Red Spurfowl	Peninsular India
3	*Galloperdix lunulata*	Painted Spurfowl	Peninsular India
4	*Gallus sonneratii*	Grey Junglefowl	Southern Peninsula
6	*Strix ocellata*	Mottled Wood Owl	Peninsular India
7	*Rhipidura (albicollis) albogularis*	White-spotted Fantail	Peninsular India
Mammals			
8	*Anathana ellioto*	Southern Tree Shrew	Peninsular India
9	*Macaca radiata*	Bonnet Macaque	Indian Subcontinent
10	*Hipposideros fulvus*	Fulvous Leaf-nosed Bat	Indian Subcontinent

As per the data available, though the study area is likely to be providing habitats to the IUCN-designated Critically Endangered/Endangered, migratory, congregatory and endemic/restricted range species listed in the preceding tables, it is unlikely to be containing any Critical Habitat, as defined by IFC PS6.

4.11.7 Ecosystem Services

This sub-section gives details of the ecosystem services, that is, the provisioning, regulating, supporting and cultural services being provided by the study area to the local community.

4.11.7.1 Provisioning Services

Crops

Table that follows lists the crops cultivated in the study area.

Table 4-14: Crops cultivated in the Study Area

Sr. No.	Scientific Name of the Species	Common Name	Type of Crop
1.	*Arachis hypogea*	Groundnut	*Nut*
2.	*Punica granatum*	Pomegranate	*Fruit*
3.	*Cocos nucifera*	Coconut	*Oil, fruit*
4.	*Cajanus cajan*	Pigeon Pea	*Pulse*
5.	*Capsicum annum*	Chili	*Spice*
6.	*Carica papaya*	Papaya	*Fruit*
7.	*Cicer arietinum*	Chick Pea, Bengal Gram	*Pulse*
8.	*Citrullus lanatus*	Watermelon	*Fruit*
9.	*Cucumis melo*	Muskmelon	*Fruit*
10.	*Gossypium spp.*	Cotton	*Fibre*
11.	*Helianthus annus*	Sunflower	*Seed*
12.	*Oryza sativa*	Rice	*Grain*
13.	*Ricinus communis*	Castorbean	Seed
14.	*Solanum melogena*	Brinjal	Vegetable
15.	*Tamarindus indica*	Tamarind	Fruit

Fodder

The natural vegetation of the study area, including the plant cover of fallow lands and a few grass patches on project site provides fodder sources to the livestock in the area.

Fuelwood and Timber

The trees and shrubs growing naturally in the study area provide fuel-wood and timber to the local communities.

4.11.7.2 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 bore-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 plants and soil organisms of the study area absorb and process a number of chemical compounds dissolved in local water-flows, effectively recycling wastes and purifying the water. The vegetation cover of the study area, especially its collective root systems, also acts as a physical filtration system, filtering out particulate matter as the water flows towards the area's ponds, lakes, streams and rivers. Thus, the study area contributes to the regulation of the water-quality of the area by purifying surface water.

Soil Erosion Control

The vegetation cover of the study area anchors soil-particles and binds them together, lowering the rate of soil erosion by water and wind. Thus, the study area contributes to control of soil erosion in the area.

Pollination and Pest Control

The vegetation cover of the study area provides habitats to a range of faunal species that include 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.

4.11.7.3 Supporting Services

The natural functioning of the ecosystems of the study area lead 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 grazing of livestock.

Nutrient Capture and Recycling

The food-chains constituted by the organisms of the study area are continuously involved in the capture and transfer of the macro and micro nutrients in the soil, water and air, effectively recycling nutrients and making them available in the nutrient-sinks of the local ecosystems. The biomass generated by the study-area, and transferred physically by water and wind, helps recharge the soil-fertility in the surrounding area. Thus, the natural vegetation and topography of the study-area contribute to the natural productivity of the area.

Primary Production

The photosynthetic organisms of the study-area act as primary producers, creating food-reserves that directly or indirectly support the consumers of the area, including the local communities. This primary production includes, besides a number of resources utilized directly by local communities (and covered under Provisioning Services), the grass blades and leaves consumed by grazing and browsing animals like grasshoppers, bugs, beetles, snails, goats and sheep, the flowers, pollen and flower-nectar consumed by a variety of insects and birds, the seeds consumed by seed and grain-eaters like ants, sparrows, larks, pipits and mice, and the fruits consumed by birds and bats.

4.11.7.4 Cultural Services

A few temples situated in the villages falling under study area provide cultural services to the local communities. Besides these, it was noted that at a distance of one hundred (100) metres from the western side of the project site boundary a private Samadhi is located. It is located on private land and there is no restriction of access to the Samadhi due to the project.

4.11.8 Designated Areas

Designated areas include Legally Protected Areas and Internationally Recognized Areas. Protected Forests, Reserve Forests, Wildlife Sanctuaries, National Parks and Biosphere Reserves, notified by the State under the law of the land are categorised as Legally Protected Areas. Internationally Recognized Areas include areas such as World Natural Heritage Sites, Important Bird Areas and Ramsar Sites, designated through international conventions to which the State is signatory.

The Gundumala Reserved forest, spreading over 2,406.79 Ha area and Madakasira North Reserved forest spreading over 1,876.56 Ha are the nearest legally protected areas, situated about 28 km and 32 km respectively southeast of the project site. The nearest Important Bird Area is the Jogimatti State Forest, situated about 55 km west of the project site.

4.11.9 Conclusion

Geographically, the study area is a part of the Deccan Plateau region of Karnataka whereas ecologically, the study area mainly represents a large tract of modified habitats, such as agricultural lands, roads and habitations, interspersed with sparsely distributed patches of natural vegetation.

Both, the natural, as well as, the modified habitats of the area are under considerable pressure from activities such as farming, extraction of fuel in the form of timber and water, application of fertilizer, grazing of livestock, and landscape alteration by building homes and roads.

The study area seems to be providing habitats to a fairly good diversity of wild fauna typical to the prevailing ecosystem-types. The few natural habitats remaining in the area show a good representative profile of native vegetation and are likely to be acting as wildlife corridors which connect the faunal populations inhabiting the area.

4.12 Socio-economic Environment

A study of the socio- economic environment of an area is essential as people are the prime recipients of developmental projects around them. An understanding of the livelihood activities, social relations and institutions

around the area is thereby important to understand the social and economic aspects of the concerned area. This section of the report summarises the socio-economic characteristics of the study area.

Primary research in the form of stake-holder consultations was conducted to understand the perception and degree of engagement with the project. It was followed by secondary research primarily from the following government publications such as:

i. Primary Census Abstract 2001 and 2011;
ii. Village Directory Data, 2011;
iii. District Census Handbook (Tumkur),2011;
iv. Agricultural Census of 2010-11;
v. Brief Industrial Profile of Tumkur District; Ministry of MSME; Govt. of India; 2012.
vi. Relevant national/state/district level government websites.

4.12.1 District Profile

The total area of Tumkur district is 10597 sq. km. and it is the third largest district in the state of Karnataka. It has a total population of 26, 78,980 with 2,079,902 (77.6%) rural population and 599,078 (22.3%) urban population. It accounts for 4.4% of the total population of the state and stands at 4th place in the state. There are 1,350,594 (50.4%) males and 1,328,386(49.5%) females in Tumkur district. Tumkur with a sex ratio of 984 females to every 1000 males and holds the 14th rank in the State. The Scheduled Caste population contributes 18.9% to the total population of the district. The Scheduled Tribe population contributes 7.8 % to the total population of the district.

The literacy rate of Tumkur stands at 1,813,391 (75.1%). There are 1,006,024 (55.4%) male literates and 807,367(44.5%) female literates in the District.

The district has registered a work participation rate of 50.6 % with 62.0% male work participation rate and 38.9 % female work participation rate. The majority of the workers in the district are main workers comprising 79.6% and marginal workers at 20.4% of the total working population. Major work force of 63.3% is engaged in Agricultural sector i.e., Cultivators (37.3%) and Agricultural Labourers (26%). Other occupations are other workers (32.6%) and household industry (4.0%)[9].

4.12.2 Administrative Structure

For the purpose of administration Tumkur district is divided into three (03) sub-divisions and ten (10) taluks. According to the District Census Handbook 2011, there are twelve (12) towns and 2,715 villages which fall under ten (10) taluks.

4.12.3 Study Area

The study area for the project falls in Bejjihalli village in Sira Taluk of Tumkur District. According to the Tumkur District Census Handbook, Sira Taluk has two hundred and forty-nine (249) villages and one (01) statutory town under its jurisdiction. The population of the taluk comprises of 158,978 (50.6%) males and 154,780 (49.3%) females. The sex ratio of the taluk is 973 which is lower than the sex ratio at the district level which stands at 984. The population of Scheduled Castes is 69,930 (22.2%) and Scheduled Tribes 28,770 (9.1%). Literacy rate of the Taluk stands at 71.8%. The workforce population of Sira Taluk is 167,269 (59.6%) with the male participation at 58.4% and female participation at 41.5%. Similar to the trend in the district level, the majority of the workers are engaged as main workforce population at 131,445 (78.5%) and marginal workforce population at 35,824 (21.4%). Majority of the main workforce population is engaged as cultivators at 52, 335 (39.8%) followed by 37,342 (28.4%) in other industries, 32,181 (24.4%) as agricultural labourers and 9,587 (7.2%) in household industries.

The socio-economic characteristics of Bejjihalli Village has been elaborated and discussed upon in the following sections:

[9] The type of workers that come under this category of 'OW' 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. Household Industry is defined as an industry conducted by one or more members of the household at home or within the village in rural areas and only within the precincts of the house where the household lives in urban areas. It relates to production, processing, servicing, repairing or making and selling (but not merely selling) of goods

4.12.4 Demographic Profile

This section intends to present an understanding of the prevalent demography in the study area. It presents the size and composition of the population in the project village.

4.12.4.1 Population

Details of the population of Bejjihalli village have been provided below:

Table 4-15: Bejjihalli Village Population

Village	Population (2001)			Population (2011)			Decadal Growth %	Sex Ratio
	Total	Male	Female	Total	Male	Female		
Bejjihalli	1079	553 (51.2%)	526 (48.7%)	1003	528 (52.6%)	475 (47.3%)	-7%	899

Source: Census Data 2001 and 2011

It can be inferred from the table above that there has been decadal decrease in the population of Bejjihalli village. Sira Taluk has been identified as a drought-hit taluk since 2003[10] therefore the decrease in population of Bejjihalli village can be attributed to the distress migration taking place of employable men and youth from the village to cities of Bangalore and Mumbai for job opportunities.

4.12.5 Literacy

Literacy indicates the ability of a person to read and write. For the purpose of identifying literate persons for the Census in India, an individual above the age of seven years who can both read and write in any Indian language is considered literate.

Details of literacy level of Bejjihalli village have been provided below:

Table 4-16: Bejjihalli Village Literacy Rate

Village	Literate Population (2001)			Literacy Rate (2001)	Literate Population (2011)			Literacy Rate (2011)
	Total	Male	Female		Total	Male	Female	
Bejjihalli	581	352 (60.5%)	229 (39.4%)	61.4%	602	376 (62.4%)	226 (37.5%)	65.9%

Source: Census Data 2001 and 2011

The table above reflects that the female literacy level has reduced from 229 (39.4%) to 226(37.5%) over the decade. However, the literacy rate of Bejjihalli village has increased from 61.4% (2001) to 65.9% (2011).

4.12.6 Presence of Vulnerable Communities

Vulnerable communities would comprise of those communities who have a distinct culture and lifestyle which are different from that of the mainstream society. Scheduled Castes and Scheduled Tribes communities being on the periphery of mainstream society have little or limited access to modern development initiatives. This section elaborates on their presence in the village.

4.12.6.1 Scheduled Castes and Scheduled Tribes Presence

For the purpose of protection of their indigenous rights and unique culture, certain areas in the country have been classified as a Scheduled Area (i.e. if fifty percent (50%) of its population have been identified and listed as Scheduled Tribes). Karnataka does not fall under the classification of Scheduled Area.

SC/ST Presence in Bejjihalli Village

[10] https://www.ksndmc.org/Drought.aspx

According to the Census Data Abstract 2011, Bejjihalli village has a population of 1003 persons. There are 351 (34.9%) Scheduled Castes population amongst which there are 182 (51.8%) males and 169 (48.1%) females. There are 04(0.39%) Scheduled Tribes population amongst which there are 03(75%) males and 01(25%) female.

4.12.7 Existing Land Use Pattern

The existing land use pattern enables one to understand the current use of land and subsequently the livelihood patterns of the area.

The land use pattern of Bejjihalli village has been provided in the table below:

Table 4-17: Land Use pattern of Bejjihalli Village

Village	Total Geo. Area (in ha)	Net Area Sown (in ha)	Non-agricultural use (n ha)	Barren & cultivable land area	Permanent Pastures and Land area	Cultivable waste land	Current fallows
Bejjihalli	819.82	492.9	5.02	73.06	173.46	10.43	64.95
		(60.1%)	(0.61%)	(8.9%)	(21.1%)	(1.27%)	(7.92%)

Source: Village Data 2011

It can be inferred from the table above that the net area sown (60.1%) is the highest land use in the village and it is followed by Permanent Pastures and Land area (21.1%). According to stakeholder consultations the major crops that are grown in the village are groundnut and Ragi. Figure below shows the present land-use of the study area which majorly comprises of Fallow land (52%), agricultural land (23.7%), followed by barren land (12%), water body and settlements of 10% and 3% respectively.

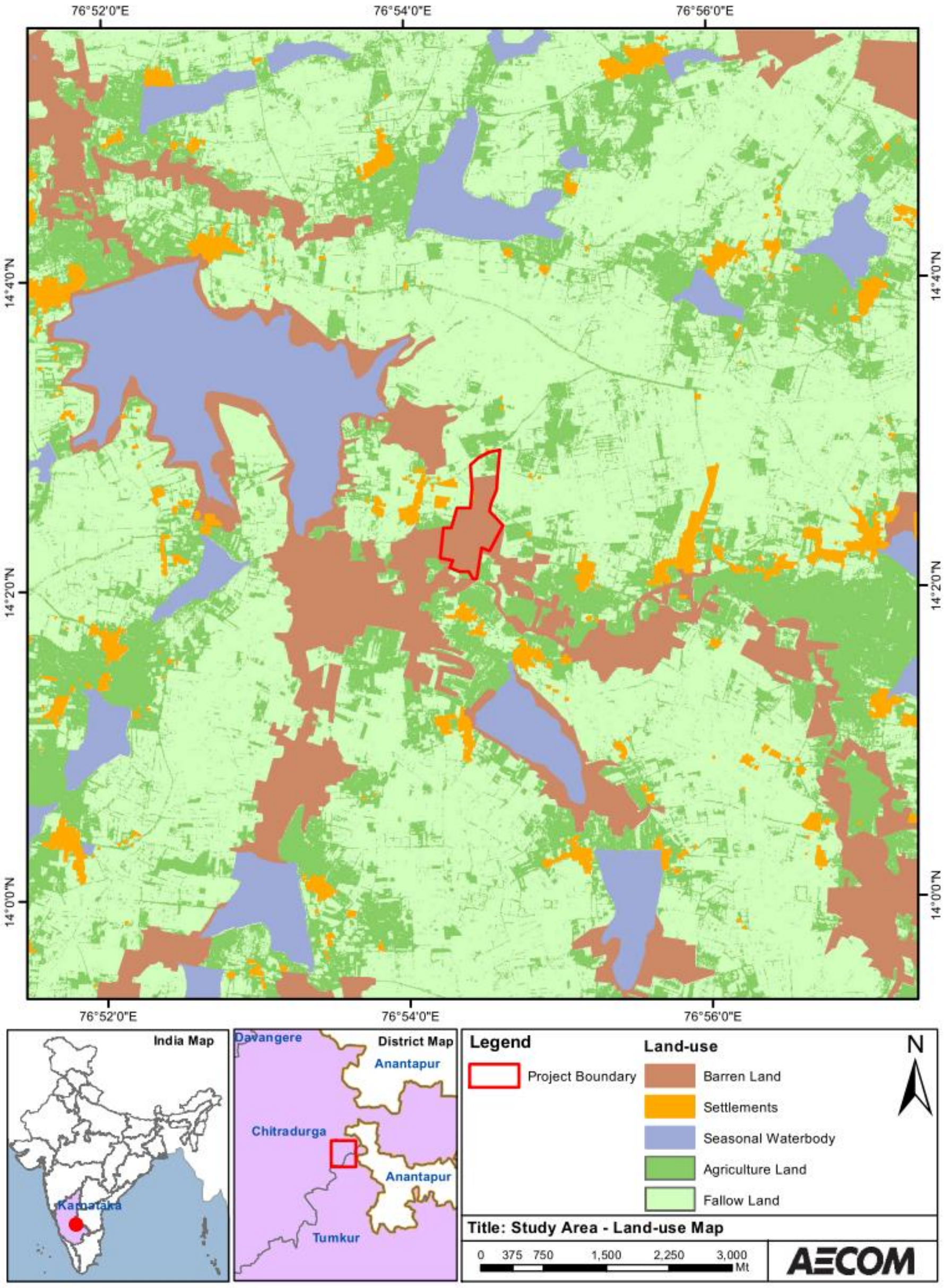


Figure 4-7: Land Use Map of the study area

4.12.8 Common Property Resource

Common Property Resource refers to resources such as grazing land, community forest, water body, irrigation system etc. that the local population uses for a purpose either for sustenance or livelihood. These properties are natural resources owned and managed collectively by a community or society rather than by individuals.

A paved 3m wide village access road passes between the two land parcels wherein the project is located. It was stated during the site visit by the HFE site representative that the Right of Way (ROW) and the Non Objection Certificate from the Gram Panchayat was under process and was envisaged to be completed by the month of June. It was also mentioned that there would be no restriction on the utilisation of the road for the community members of Bejjihalli village.

4.12.9 Workforce Participation

The working population of an area refers to the population who are engaged in productive activities and contributes towards the economic and social growth of the area. 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.

Details of the workforce population of Bejjihalli village have been provided below:

Table 4-18: Village Workforce Population

Village	**Total Workforce Population (2011)**			**Main Workforce Population (2011)**			**`Marginal Workforce Population (2011)**		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
Bejjihalli	615	328	287	349	251	98	266	77	189
		(53.3%)	(46.6%)	(56.7%)	(71.9%)	(28%)	(43.2%)	(28.9%)	(71%)

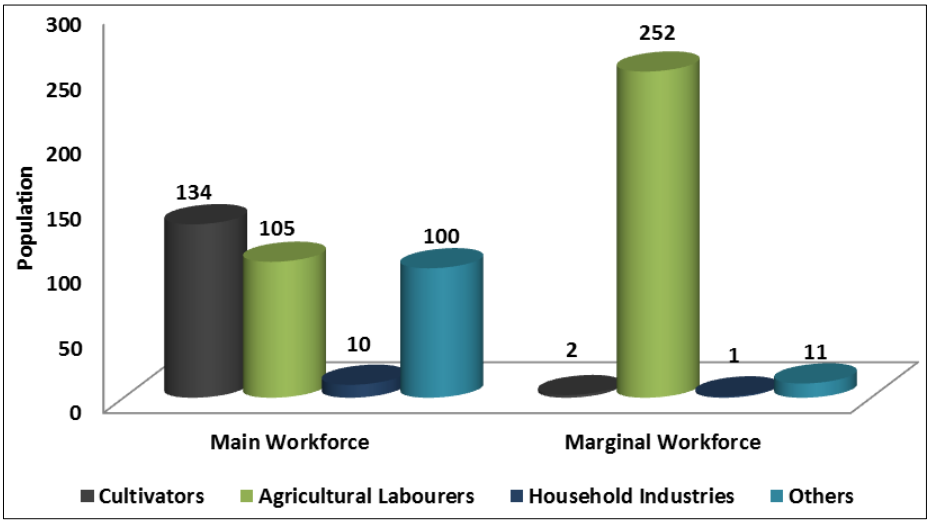
Source: Census Data 2011

The table above reflects that in Bejjihalli village main workers make up 56.7% of the total workforce population. The majority of the marginal workforce comprises of female workers 71% while in the main workforce population female workers comprise of only 28%.

4.12.10 Occupational Pattern of the Area

Livelihood patterns diversify in accordance with the availability of resources and infrastructure in the area. The patterns also depend on the presence of skilled workforce adept in performing the required tasks and responsibilities. The following section elaborates on the existing occupational pattern in the study village.

Details of the occupational pattern in Bejjihalli village have been provided in the figure below:



Source-Census Data 2011

Figure 4-8: Occupational Pattern

It can be inferred from the chart above that the majority of the workforce population are engaged in agricultural related industries. In the main workforce population 134(38.3%) people are engaged as cultivators and 105 (30%) people are engaged as agricultural labourers. In the marginal workforce the highest numbers of people are engaged as agricultural labourers which are 252 (94.7%) followed by others at 11 (4.1%).

4.12.11 Role of Women

The development of a society is evaluated on the basis of how its women are represented and integrated in the mainstream society. Financial independence and monetary contribution to the household income increases the sense of self-esteem and respect amongst the female members.

During stakeholder consultations, it was mentioned that women of the village participated in the workforce primarily as agricultural labourers and that the girl child on completing school (Class VII) from the village attends the secondary school in Tudakulur village which is located at a distance of three (03) kilometres away and senior secondary school in Dwaranakunte village which is located at a distance of nineteen (19) kilometres. For higher studies girls attend the science and engineering institutes in Tumkur located at one sixty one (161) kilometres and degree colleges in Sira located at a distance of forty five (45) kilometres. It was also mentioned that there were two self-help groups which were functional in the area.

Amongst various parameters literacy level, financial independence and accessibility to basic health facilities assist in determining the status of women in a society. These aspects have been analysed and represented in the following section.

Women Workforce Participation

With reference to the ***Table 4-18*** above, it can be inferred that women of the village make up a significant part of the total workforce population which stands at 46.6%. Their participation in the marginal workforce (71%) is significantly higher than their participation in the main workforce (28%).

Occupational Pattern of Women

Details of occupational pattern of women of Bejjihalli village have been provided in the table below:

Table 4-19: Occupational Pattern of Women

Type of Workforce Population	Total Women Workforce	Cultivators	Agricultural Labourers	Household Industries	Others
Main Workforce Population (2011)	98	31	39	4	24
		(31.6%)	(39.7%)	(4%)	(24.4%)
Marginal Workforce Population (2011)	189	0	184	0	5
			(97.3%)		(2.64%)

Source: Census Data 2011

It can be inferred from the table above that the women in Bejjihalli village are primarily engaged in the agricultural sector. As shown in the table, 71.3% of the women in the main workforce population work as cultivators (31.6%) and agricultural labourers (39.7%). Similarly, in the marginal workforce population 97.3% are engaged as agricultural labourers.

Health Schemes and Facilities

Primary research which was further substantiated by the Village Data 2011 indicated that there is no presence of health care facilities in Bejjihalli village. The village has one (01) Accredited Social Health Activist (ASHA) which caters to the health concerns of the women in the village. According to stakeholder consultations, two health camps are conducted annually in the village.

4.12.12 Existing Infrastructure Facilities

The existence and accessibility to certain basic infrastructure facilities and amenities is a critical index of an area's economic and social growth. The absence of basic amenities such as educational and health facilities as well as reliable transportation and communication facilities act as a major obstacle to growth and economic vitality. The section below will elaborate on the presence of such amenities and facilities in Bejjihalli village on the basis of the Village Data Abstract 2011 and from stakeholder consultations conducted on site.

Educational facilities

Bejjihalli village has one (01) middle school in its premises. The students attend secondary school in Tudakulur village which is located three (03) kilometres away and senior secondary school in Dwaranakunte village which is located at a distance of nineteen (19) kilometres. For higher studies students attend science and engineering institutes in Tumkur located at one sixty-one (161) kilometres and degree colleges in Sira located at distance of forty (40) kilometres.

Photo 4-4: Anganwadi Centre in Bejihali Village

Photo 4-5: Sanitation facility in the village school

Health Facilities

In the village there are no health facilities. For access to basic health facilities, the community members of Bejjihalli village have to travel to Dwaranakunte village located at a distance of nineteen (19) kilometres. Dwaranakunte village has a Primary Health Sub Centre (PHSC) and a Primary Health Centre (PHC).The nearest major hospital is at Sira which is located at around forty (40) kilometres away from the village. To cater to the nutritional needs there is one (01) Integrated Child Development Services and one (01) Anganwadi Centre in the village premises. Two (02) Health camps are conducted annually within the village premises.

Water and Sanitation Facilities

Bejjihalli village is provided with untreated tap water supplied by the Panchayat. It is supplemented with uncovered wells and hand-pumps. According to stakeholder consultations, there is one (01) Borewell with around 2000 ft depth. Bejjihalli was not covered under the Total Sanitation Campaign which has started under the aegis of the Ministry of Rural Development, Government of India. However according to stakeholder consultations, Swaach Bharat (Gramin) Mission has been implemented in the village since the year 2015 and the majority of the households in the village at present have toilet facilities within their house compounds There is no provision for house to house collection of waste and community disposal of waste.

Banking and Communication Facilities

There is no presence of commercial banks in Bejjihalli village. During the stakeholder consultations it was reported that there were two (02) Self-Help Groups in the village. Government postal and private courier services are not available in the village. The nearest available postal facility is present in Tudakulur village which is located three (03) kilometres away. Mobile phone connectivity and telephone services are available.

Road and Transportation Facilities

The main roads of Bejjihalli village are paved (Pucca) roads and the interior roads are unpaved (kuccha).It is connected through a major district road. Government-run bus and private bus services are available in Bejjihalli village. Other means of transportation are privately owned taxis, vans and tractors.

4.12.13 Existing Traffic Conditions

The project site is accessible by a minor district road from Hiriyur to Bejjihalli village through an internal village road. Also, one of the village roads partitions the entire project land into two (2) land parcels. The Village road is not unlike of any village roads, which are usually quiet and deserted with limited traffic activity.

During site visit, it was learnt that, the minor district road from Hiriyur to reach the project village and the village road passing through the project land are single way paved motor-able roads with limited traffic. Consultation with the local village residents approved to the fact that major mode of transportation in the area is through Government-run and few private buses. Apart from that, handful of people also owned personal mode of transportation like cycles, two wheelers and vans.

Therefore, it can be concluded that existing traffic activity in the project area is low and development of the project in the area will lead to increase in traffic activity of heavy vehicles carrying the project components and construction materials. However, this will be limited only for few months during the construction phase of the project.

5. STAKEHOLDER ENGAGEMENT AND CONSULTATION

5.1 Introduction

The importance of stakeholder consultations and engagement cannot be undermined for the success of projects. Successful involvement of a broad range of stakeholders delivers a holistic impact assessment consequently ensuring development of environmental and social benefits. The World Bank has reiterated that public participation in Environmental Impact Assessment tends to improve project design, environmental soundness and social acceptability.

The AECOM team visited the project site on 17th and 18th May 2017 and were able to consult with the community members of Bejjihalli village and the HFE Site representative.

5.2 Objective and Scope

The purpose of the stakeholder engagement process was to understand and assess the perception of the direct stakeholders towards the project. Simultaneously it was desired to understand the requirements and needs of the village. The process of consultation was facilitated by the Site representatives of HFE. It was undertaken with the help of informal interviews and a formal structured questionnaire which were related to socio-economic activities of the village, concerns/issues of the local population and benefits/expectations from the project. It also involved questions regarding the awareness and perception regarding solar projects in the area as many solar projects were operational and upcoming in the area.

5.3 Engagement Mapping and Analysis

The total land area procured for the project is one sixty-one (161) acres. The entire land parcel falls under private land. The land parcels were previously owned by twenty-two (22) landowners. These land parcels were barren and unproductive for the past five years due to lack of rainfall and irrigation facilities. The procured land was being utilized for sporadic grazing activities.

The stakeholders engaged in the consultations were:

i. Previous land owners of the procured land for the project.
ii. Community Members of Bejjihalli village.
iii. HFE Site Representative and Land Aggregators.

The stakeholder consultations were held at a community member's house in the village. There were twenty people in attendance at the consultations. The participant list has been attached as ***Annexure 2***.

According to the stakeholder consultations Bejjihalli village population of approximately 1500 people comprises a mix of scheduled caste (35%) scheduled tribes (30%) and general population (35%) and an equal male –female distribution. The dominant religion in the village is Hinduism as it was stated that 100 percent of the village population practised it. It was also mentioned that 60% of the females in the village were attending school and higher educational institutions.

On enquiring of the livelihood activities prevalent in the village it was stated that the majority of the families had marginal landholdings and the primary livelihood generation activity was that of cultivators and agricultural labourers. It was also stated that the majority of the youth in the village worked in Bangalore city as skilled and unskilled workers as for the past five years the agricultural productivity and its returns have been minimal.

The main crops cultivated in the area are groundnut and Ragi. These agricultural products are sold at the Sira and Hiriyur market located at a distance of 40 km and 43 km respectively. The main source of irrigation in the village is a public borewell measuring around 500-2000ft depth. As the water from the Borewell is insufficient to irrigate all agricultural land due to which most of the land parcels have become barren with little or no agricultural activities taking place in the recent years the village is highly dependent on rainfall and the local population's yearly income is dependent on it. The average monthly income was stated to be between INR 5000-10000/-. Livestock such as sheep, goats are reared primarily for personal consumption of milk and milk products.

Government Schemes in the Village

Prevalent government schemes in the area are Swaach Bharat Mission (Gramin) which aims to accelerate the efforts to achieve universal sanitation coverage and to put focus on sanitation.[11] Niranthara Jyothi Project of the Government of Karnataka which intends to provide 24 hrs 3 phase power supply to non-agricultural loads .Other scheme includes Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS).

Given below are the key responses gathered during the consultation process pertaining to the awareness of the project:

Table 5-1: Key Responses of Land sellers on Project Awareness.

S. No.	Questions	Responses
1.	What do you know about Solar Power Projects?	All members were aware that solar power projects generate electricity.
2.	Has there been any drastic change in the environment/area/region due to development of project? How has the change influenced them?	All members stated that there had been no drastic change in the environment or area with the commencement of solar power projects in the area.
3.	There are migrant workers residing in your village for the construction purposes? What are your views/opinions on it?	All members were aware of the presence of migrant workers in the area. They also stated that since the local workforce was not skilled for the project they did not have any problems with the presence of migrant workers.
4.	What have they utilised the money received from the sale of their lands?	Majority of them stated that they had purchased fertile land in other villages. They also mentioned that they had utilised the money for further education of their children.
5.	Benefits/Concerns of the Project	They stated that with the commencement of the project they anticipated that the youth of the village could be provided with employment opportunities.

Source: Information collected during Site Visit

Consultations with the Community Members of Bejjihalli Village

Consultations were held with two families residing near the project area boundary. One family consulted were the land owners and had pomegranate cultivation in the adjacent plot about 60 m from the project boundary. The second family were tenants residing there for past few years.

Given below are the key responses gathered from the community members on project awareness and perception:

Table 5-2: Key Responses from Community Members on Project Awareness

S.No	Questions	Responses
1.	Are you aware of the project coming up in the area?	They were aware of the upcoming solar power project.
2.	Do you know any project representative?	They did not know any project representative and also did not have the contact number.
3.	What are your reactions towards the project?	They were of the view that with the operation and upcoming of the solar projects in the village the ground water availability in the village had reduced in turn causing reduction in the agricultural productivity.
4.	There are migrant workers residing in your village for the construction purposes? What are your views/opinions on it?	They said that they were aware of it and did not anticipate or have any problems with it.

Source: Information collected during site visit

During the consultations, the AECOM team sensitized the community members that the solar farm projects were not water intensive projects and that the ground water availability would not be affected by it. It was suggested to the HFE representative that the project proponent should have an information disclosure meeting and increase interaction with the community members of Bejjihalli and adjoining residence/villages in order to increase public awareness about solar projects.

Presence of Samadhi Site

On reconnaissance survey of the project area, it was noted that at a distance of one hundred (100) metres from the western side of the project site boundary a private Samadhi is located. It is located on private land and there

[11] http://sbm.gov.in/sbm/Default.aspx

is no restriction of access to the Samadhi due to the project. It was also reported by HFE that there was no intention of purchasing the said land for the project.

Need Assessment

During the consultations, the existent local infrastructure was also discussed and noted. This exercise was primarily done to take cognizance of the existing infrastructure and consequently derive a Needs/Requirement Table for future community welfare activities that can be initiated by HFE as part of their Corporate Social Responsibility (CSR) initiatives. The following facilities were discussed:

i. **Educational Facilities**: On discussion with the community members, the area of educational facilities required utmost attention. Bejjihalli village has one (01) middle school in its vicinity. In order to pursue higher studies, the youth travel to Tudakulur village which is located three kilometres away and senior secondary school in Dwaranakunte village which is located at a distance of nineteen kilometres. For higher studies students attend science and engineering institutes in Tumkur located at one sixty one (161) kilometres and degree colleges in Sira located at distance of forty five kilometres;

ii. **Health Care Facilities**: There is no Public Health Sub Centres (PHSC) or Public Health Centres (PHC) in the village premises. For access to basic health facilities, the community members of Bejjihalli village have to travel to Dwaranakunte village located at a distance of nineteen (19) kilometres. Dwaranakunte village has a Primary Health Sub Centre (PHSC) and a Primary Health Centre (PHC).The nearest major hospital is at Sira which is located at around forty (40) kilometres away from the village. Two (02) health camps are organised in a year within the school compound;

iii. **Water Supply**: It was mentioned that there was one (01) Borewell measuring 500-2000 ft depth in the village for irrigation purposes. There was no provision of safe drinking water and it was stated that a Reverse Osmosis (RO) system was a prerequisite in the village;

iv. **Electricity Supply**: It was stated that the electricity supply in the village was timed and that they were provided with electricity for six (06) hours daily. They stated that although the Niranthara Jyothi Project is implemented, the situation of the electricity in the village has not improved;

v. **Road Facilities**: The village is connected through a district road which is a paved (pucca) road and the roads in the interiors of the village are unpaved (kuccha) road;

vi. **Transportation Facilities**: Private and government buses ply from the village to the towns of Sira and Tumkur;

vii. **Sanitation Facilities**: According to stakeholder consultations, Swaach Bharat Abhiyan (Gramin) Scheme is being implemented in the area and majority of the households have toilet facilities in their houses;

viii. **Employment Opportunities**: It was mentioned that the majority of the population were engaged as agricultural farm labourers and cultivators in the village. The youth of the village on completion of their higher studies in Sira and Tumkur gain employment in these places.

On discussion with the community members on the improvement of various infrastructural facilities such as Educational, Health, Road, Water Supply, Electricity, Transportation, Sanitation, Employment, Recreational and Other requirements, it was discussed that the utmost priority in the area is the provision of safe drinking water in the village. A Reverse Osmosis (RO) system to provide safe drinking water for the community was stated to be imperative. The second priority area was that of the upgradation of the existing middle school to a secondary school. Community development programs focussing on technical skill development, livelihood opportunities diversification especially for women and youth was stated to be a need as well.

HFEs Site Representative at Site Level and Land Aggregators

The land aggregators and site representative for HFE were also contacted and an interview to gather their viewpoints and clarity on land acquisition process was undertaken. The discussion points have been highlighted in the table below:

Table 5-3: Key Questions and Responses from HFE Site Representative and Land Aggregators

S.No.	Questions	Responses

S.No.	Questions	Responses
1.	**Land Procurement Process**	
	What type of land has been procured for the purpose of the project?	Private agricultural lands have been identified and procured for the project. At present the land use comprises of barren land as for the past five years there has been minimal rainfall due to which cultivation of crops on the land parcels was also not possible to be undertaken.
	How many acres have been procured for the project?	The total project area is 161 acres. The procurement of land has been divided into two phases. In Phase I -118 acres have been purchased. In Phase II- Remaining 43 acres is in the process of being purchased. .
	How was the land procurement process?	The land procurement process was initiated through two (02) land aggregators who identified barren and uncultivable land for the project. Good faith negotiations and 'willing seller-willing buyer' were the conditions adopted for the land procurement process between the twenty-two (22) land sellers and CSPGPL.
	Were all land sellers provided payments equivalent to the prevailing market value?	All land sellers have been provided payments higher than that of the market value.
	Has the No Objection Certificate (NOC) Tudakulur Panchayat been obtained?	No Objection Certificate from the Tudakulur Gram Panchayat is in the process of being obtained for the project activities.
2.	**Migrant Labour**	
	How many migrant workers were anticipated in the construction phase?	Around 300 migrant workers during the construction phase.
	Are there plans for setting up labour camps during construction phase?	The EPC contractor (L&T) has intentions of setting up labour camps for the duration of the construction phase.
3.	**Community Engagement**	
	Have there been any meetings with the community members of the village?	Till date there has not been any meeting with the community members of Bejjihalli village.
4.	**Corporate Social Responsibility (CSR)/Community Development Programme**	
	Activities undertaken (if any)	No CSR or Community development programmes have been initiated till date by HFE in the village.
	CSR Plan for future Documented Records (if any)	On the initiation of the project and its operation, CSR plans would be developed, and activities would be initiated accordingly.
5.	**Grievance Redressal Procedure**	
	Has any formal grievance redressal mechanism been set up by HFE for the community?	Till date no formal grievance redressal mechanism has been set up for the project. However, there are plans on setting a mechanism
	Has CSPL identified persons responsible as contact person for handling grievances?	Formal decisions have not been taken on the identification of a contact person. However tentative contact person will be the site representative from the project proponent side and the "Adhyaksha" of the Gram Panchayat from the community will be considered.

Source: Information collected during Site visit

6. ANALYSIS OF ALTERNATIVES

6.1 Introduction

The assessment of alternatives for location and technology has been carried out in the present study as per IFC Performance Standards which necessitate a full and detailed justification for any proposed alternatives as part of the site-specific environmental assessment. An analysis of alternative options that were considered during project conception and planning phase is discussed in the following section. The options that are analysed include:

i. No project scenario;
ii. Alternate methods of power generation;
iii. Alternate location for the project site; and
iv. Alternate routes for transmission line

6.2 No Project Scenario

As per the Load Generation Report 2016-2017, Ministry of Power, Government of India, peak power demand for the state of Karnataka for year 2015-2016, was 10,202 MW against the availability of 9,508 MW and hence experienced power deficit of 6.8%. The anticipated peak power requirement for the state of Karnataka for the year 2016-2017 is 11,152 MW against the availability of 9,905 MW. Hence, indicating a power deficit of 1247 MW (11.2%) during 2016-2017. The forecasts for the power requirement for the state of Karnataka as per Central Electricity Authority (CEA)[12] have been presented in ***Table 6-1*** below.

Table 6-1: Power Forecasts for Karnataka (2016-2017)

Parameter	Requirement	Availability	Surplus (+)/Deficit (-)	%
Peak Electric Load (MW)	11,152	9,905	-1,247	-11.2%

Source: 17th Electric Power Survey

As on 31st March 2016 Karnataka state has a total power generation capacity of 17324.06 MW from all the sources. Out of which, 8142.88 MW is contributed by thermal and 475.86 MW is contributed by nuclear. Hydro (renewable) and RES (MNRE) contribute 3599.80 MW and 5105.52 MW respectively[13]. Details are presented in ***Table 6-2*** below.

Table 6-2: Installed Capacity (in MW) of power utilities in Karnataka State (as on 31st March, 2016)

Ownership/ Sector	Model wise break up							Grand Total
	Thermal				Nuclear	Hydro (Renewable)	RES* (MNRE)	
	Coal	Gas	Diesel	Total				
State	4220.00	0.00	127.92	4347.92	0.00	3599.80	155.33	8103.05
Private	2060.00	0.00	106.50	2166.50	0.00	0.00	4950.19	7116.69
Central	1628.46	0.00	0.00	1628.46	475.86	0.00	0.00	2104.32
Sub-total	**7908.46**	**0.00**	**234.42**	**8142.88**	**475.86**	**3599.80**	**5105.52**	**17324.06**

** RES includes SHP, BP, U&I, Solar and Wind Energy;*

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

Table below gives the details of allotted and commissioned renewable energy sources in Karnataka State till March 31st, 2016.

Table 6-3: Allotted and Commissioned Renewable Energy Sources

S. No	RE Source	Potential	Allotted	Commissioned
1	Wind	13983	13928.87	2916.34
2	Hydro	3000	3014.86	835.46
3	Solar	10000	1994.00	134.00

[12] *17th Electric Power Survey*

[13] *www.cea.nic.in/reports/monthly/installedcapacity/2016/installed_capacity-03.pdf*

4	Co-Gen	1500	1846.85	1252.05
5	Bio Mass	1000	369.98	134.03
6	Municipal Solid Waste	135	25.50	0.00
Total		**29618**	**21180.05**	**5271.88**

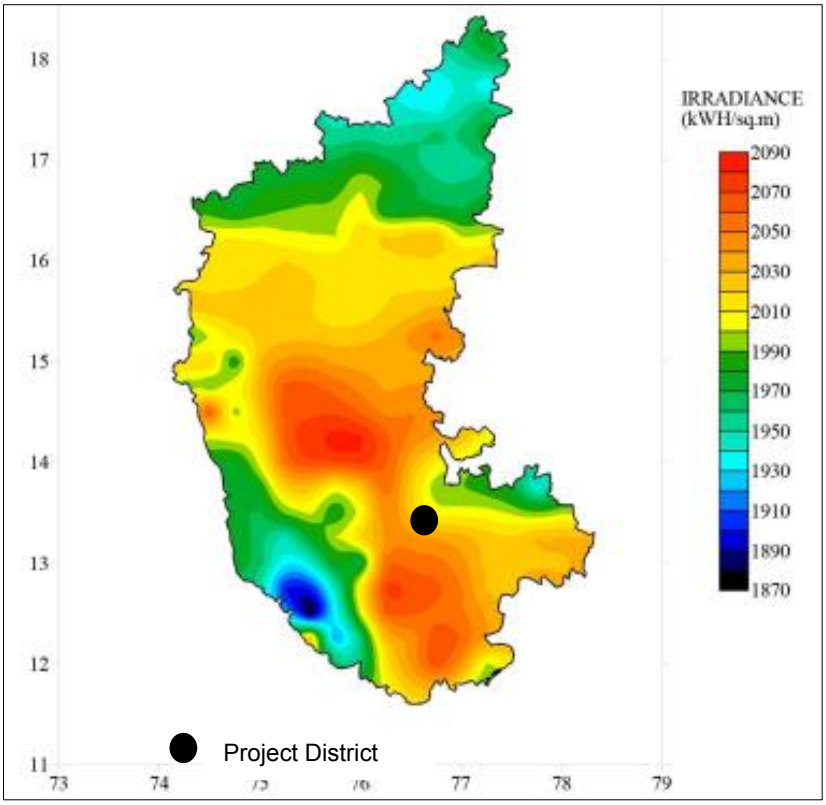
Source: Karnataka Renewable Energy Development Limited (KREDL)

The project shall harness the solar power potential of the state and hence an alternative without the project is undesirable, as the project will encourage solar power generation in the state which will improve power demand-supply scenario of the state.

6.3 Alternative site location

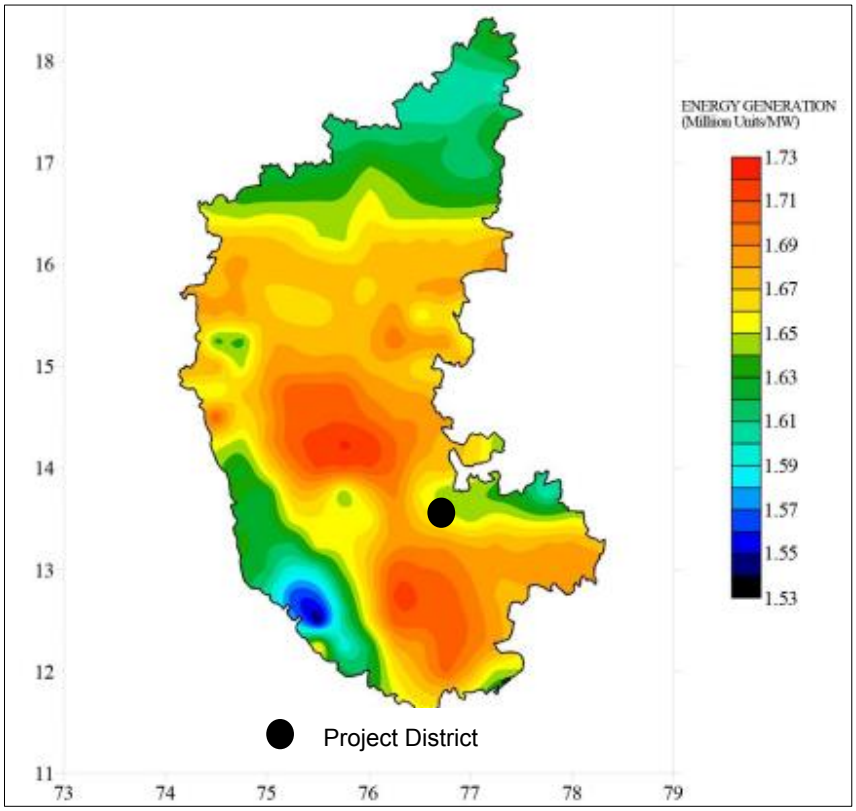
Karnataka is rich in solar radiation which will complement the conventional sources of energy in a large way. The state of Karnataka is blessed with about 240 to 300 sunny days with good solar radiation. Karnataka was the first southern state to notify its solar policy in 2011 and the first state to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

It is observed that majority of Karnataka state has very high solar PV energy potential except small area in Kodagu district located in SW part of the state. As shown in ***Figure 6-1***, the annual solar PV energy generation in the district is computed to be in the range of 1.65 to 1.67 million unit/MW.



Source: Gajjar, J., Agravat, S. and Harinarayana, T. (2015) Solar PV Energy Generation Map of Karnataka, In-dia. Smart Grid and Renewable Energy, 6, 333-343. http://dx.doi.org/10.4236/sgre.2015.612027

Figure 6-1: Annual average Irradiation map for Karnataka state



Source: Gajjar, J., Agravat, S. and Harinarayana, T. (2015) Solar PV Energy Generation Map of Karnataka, In-dia. Smart Grid and Renewable Energy, 6, 333-343. http://dx.doi.org/10.4236/sgre.2015.612027

Figure 6-2: Annual solar PV energy generation potential for Karnataka state based on the irradiation and weather parameters.

As per Taluka wise Solar Radiation Values published in Karnataka Renewable Energy Development Ltd. (KREDL)'s website; Siri taluka of Tumkur district (the project site) has an annual average Direct Normal Irradiance (DNI) of 5.60 kWh/m^2, therefore making it suitable for solar thermal power projects, since 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.

It is therefore apparent that practically the site selected is suitable for development of solar power project in terms of energy production.

6.4 Alternate Sources of Power Generation

India is a large and fast growing economy, and according to Planning Commission of India, the country's primary energy use is expected to increase by four to five times by 2031-32. Even though India's energy basket has a mix of all resources such as coal, lignite, oil, natural gas, LNG, nuclear, hydro, and wind power, the dominance of coal is conspicuous with a prominent share of approximately 50%.

The efficiency of fuels is compared on the basis of their energy content and oil is considered as the standard for this comparison. One tonne of oil can generate 42 billion Joules or 10 Billion calories of energy whereas one tonne of Indian thermal coal can generate only 4.1 Billion calories. Thus 1 Mt of Indian coal is 0.41 Mtoe (Million tonnes of oil equivalent). Taking the thermal efficiency of the power plant and other losses in the system into consideration, in the case of coal-fired boilers, the equivalence between electricity and fossil fuels is 1 Billion kWh = 0.28 Mtoe. Electrical energy in kWh can be converted to kJ or kcal and can be expressed as Mtoe. One billion KWh of energy generated from wind power is equivalent to 0.086 Mtoe, since the intermediate stages of energy production don't generate any heat.

Table 6-4: Life-cycle Emissions from Power Sources

LCA Emissions (g CO_2 equivalent/kWh)	Wind	Solar	Nuclear	Coal

LCA Emissions (g CO_2 equivalent/kWh)	Wind	Solar	Nuclear	Coal
Implementation	13.7	37.5	1.2	3.6
Operation	4.7	12.0	12.4	918.8
Decommissioning	0.6	0.5	0.4	52.2
Total	19	50	14	975.3

Source: Report on developmental impacts and sustainable governance aspects of renewable energy projects, Ministry of New and Renewable Energy

As evident from the Table above, the emission of CO_2 per kWh of energy generated from a Coal based power plant is more than 20 times that of the emission from a solar based power plant. The only emissions from the Renewable energy technologies are the emissions from fossil sources used in the production and manufacturing of equipment, waste disposal during construction, recycling etc. These life-cycle emissions are significantly lower as indicated in the table above.

Solar power projects do not produce any emissions that pollute the environment during its operation, unlike other power generating processes like burning of fossil fuels such as coal or natural gas; it is a clean fuel source and a power solution for rural and pristine locations like Bejjihalli. Solar power projects generates negligible amount of waste, i.e only during the construction period. A recent International Renewable Energy Association (IRENA) study found that countries like India would be able to greatly reduce water withdrawals and use in the electricity sector by increasing the share of renewables.

As per the prevailing Ministry of Environment and Forest laws, (the Schedule 1 of Ministry of Environment and Forests (Government of India) notification dated January 19, 2009), 38 activities are required to undertake environmental impact assessment studies. Since solar is one of the cleanest sources of energy, Environmental Impact Assessment study is not required for these projects as there is no negative environmental impact due to the project activity. The 2010 MNRE– Confederation of Indian Industry (CII) report estimates that the PV grid-connected sector will employ 152,000 people by 2020 indicating that solar projects will meet the social objective of creating new job opportunities in India.

Considering all the above mentioned positive scenarios for solar power generation, there is no requirement of an alternative method. Solar power is one of the most suitable and environment friendly option for power generation.

6.5 Alternate routes of transmission lines

Even though the construction of transmission lines has very less impact on environment and socio-cultural resources, this can be reduced by careful selection of route. Power from the solar PV plant is proposed to be evacuated to the nearest 66/11kV grid substation of KPTCL located at P.D Kote of Hiriyur Taluk of Chitradurga district in Karnataka. The substation is approximately 2.5 km from the north boundary of the project site.

The multiple components that are interlinked with the selection of route for transmission lines include landowners' concerns, micro-habitats of species, airports, military bases, rivers, water bodies or any other topographical or cultural features that could pose conflict. A careful multifarious approach is taken to reach a consensus on the routes that will do least damage and contain costs.

The transmission line route is concluded taking account of the following factors:

- There are no habitations or community structures along the route of the transmission line;
- Right of way and access roads are shared with local residents of the area;
- Areas with dense vegetation, or places requiring extensive clearing of vegetation are avoided while selecting route;
- Selection of the transmission route avoids any identified environmental sensitive site; and
- The shortest possible route after considering the above factors has been selected for the transmission line in order to reduce the environmental and social footprint of the transmission line.

CSPGPL has finalised the route for transmission of external line through a survey. Most of the transmission line route is laid out through private waste land. In case any private agricultural land is involved, CSPGPL through its land aggregator have initiated the procedure to obtain the right of way by providing a one-time payment to the rightful identified owner.

Also, CSPGPL has instigated the process of obtaining a no objection certificate (NOC) from the project village (Bejjihalli) panchayat office in order to comply with Karnataka Panchayats Act 1994 which will further indicate the assurance of peaceful right of way for transmission lines from the villagers.

6.6 Conclusion

As discussed in the previous sections, the project shall be developed in line with the objectives of national Environmental Policy, 2006, National Solar Mission, Karnataka State Solar Policy 2014-2021 and KPTCL. It will improve the power demand-supply scenario which would otherwise be a constraint on economic growth of the state.

Considering all the factors mentioned in the sections above, such as proven solar resource potential in the area; favourable environmental and social settings; low GHG emissions during the entire project life cycle; local community's acceptance of solar power projects in the region and availability of waste barren land in the selected site, solar energy based power generation is the most appropriate alternative in the area.

7. EVALUATION OF IMPACTS

7.1 Introduction

This chapter describes various environmental and social impacts identified and assessed for the construction and operation phases of the proposed solar power project and associated facilities. The specific objective of this section is to:

- Identify and assess the range of potential impacts and the extent of their severity;
- Explain the ways in which the project might affect environmental aspects such as water and soil quality, ecology, socio-economic resources, livelihoods, cultural patterns, as well as access and infrastructure issues;
- Suggest viable mitigation measures for the identified impacts;
- Provide inputs to develop a management plan based on the proposed mitigation measures.

The impacts have been identified through available project documents; discussions with the local community; the project proponents and AECOM's previous project experience in handling assignments of similar nature. An impact evaluation and significance matrix has been developed for the qualitative assessment of impacts. Mitigation measures are identified for residual or minimised impacts which cannot be avoided as part of the project development and operations. The section also identifies cumulative impacts which act along with other impacts to affect the same receptor. The significance and magnitude of such impacts will be much greater in that case.

7.2 Summary of Project activities

Pre-construction phase

Prior to construction, a detailed land survey would be performed to establish project site boundaries. Activities would include surface hydrology and floodplain mapping. Additionally, a topographic survey would be performed in order to establish site grading and drainage plans and to determine the placement of solar panels, access roads, rights-of-way (ROWs), and other project components.

A geotechnical survey would evaluate general surface conditions, subsurface conditions, seismicity, and other geological information required to develop recommendations for the design and construction of project components (e.g., type of foundations required to support the solar panels).

Before a solar power plant can be planned and built, the solar potential at the site must be precisely characterized. Solar monitoring equipment, including solar sensors and a meteorological tower, should be installed to collect data on direct normal insolation and weather conditions such as dust and haze, temperature, humidity, precipitation, clouds and fog.

Construction Phase

The entire solar project area could be impacted by site preparation activities such as clearing and grading; construction of access and on-site roads; preparation and use of material and equipment laydown areas; placement of solar panels; construction of the switchyard, central control facility and ancillary facilities; and installation of power and signal cables (typically buried or vaulted).

Concrete ingredients (sand, aggregate) may need to be extracted and hauled to the site. Construction of a transmission line would also be required.

Operation and Maintenance Phase

Minimal land-disturbing activities and associated impacts are anticipated during the operation phase. Routine activities would include operation of the solar facility to produce power, and regular monitoring and maintenance activities to ensure safe and consistent operation. Mirror washing would be required routinely (e.g., every few weeks). Both on- and off-site maintenance of access roads may require sediment removal from culverts.

Vegetation maintenance would be required within the solar panels, transmission line ROWs and internal access road ROWs.

Decommissioning and Reclamation Phase

Decommissioning of a solar power project will lead to full removal of equipment and facilities. A decommissioning plan would need to be prepared and approved prior to the actual decommissioning of the project. Underground components would be removed to a depth of at least three (3) feet to ensure an unobstructed root zone for revegetation. More deeply buried components might be abandoned in place.

Following removal of site components, site reclamation and revegetation would mitigate some impacts, such as soil erosion and habitat fragmentation.

7.3 Impact Evaluation Criteria

The criterion which has been used to appraise impacts on various environmental and social aspects is presented in the ***Table 7-1*** below:

Table 7-1: Impact Evaluation 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. For transmission line when the impact is restricted within the right of way (RoW).	except for ecology (which is defined as loss of vegetation only at site) or within the base of pylon and under the conductors
	Medium Spread	Impact is spread up to 2 km from the boundary of the Project area or within 500 m on either side of transmission line	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 up to 2 km to 5 km from boundary of the Project area or beyond 500m on either side of transmission line	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 the time taken by an environmental component to recover back to current state	Insignificant / Short Duration	when impact is likely to be restricted for duration of less than 1 year;	the anticipated recovery of the effected environmental component is within 2 years
	Medium Duration	when impact extends up to 3 years;	With an anticipated recovery of the effected environmental component is within 6 years
	Long Duration	when impact extends beyond 3 years;	with anticipated recovery of prevailing condition to happen within 6 years or beyond or upon completion of the project life
Intensity: defines the magnitude of Impact	Insignificant intensity	when resulting in minimal changes in the environmental baseline conditions;	However, it shall be reconsidered where the baseline values are already high.
	Low intensity	when resulting in changes in the baseline conditions in the immediate surroundings	for ecology it refers to minimal changes in the existing ecology in terms of their reproductive capacity, survival or habitat change
	Moderate intensity	when resulting in changes in the baseline conditions alter the baseline conditions in the	for ecology, it refers to changes that are expected to be recoverable

Criteria	Sub-Classification	Defining Limit	Remarks
		surrounding area	
	High intensity	when change resulting in the baseline conditions are significantly modified	While for ecology, high intensity refers to changes that result in serious destruction to species, productivity or their habitat.
Nature: refers to whether the effect is considered beneficial or adverse	Beneficial	-	Useful to Environment and Community
	Adverse	-	Harmful to Environment and Community

7.4 Impact Significance Criteria

A significance assessment matrix was developed to assess the impact based on the appraisal criteria developed above which is as given in the ***Table 7-2*** below:

Table 7-2: Impact Significance Criteria

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

7.5 Impact Assessment

7.5.1 Pre-Construction and Construction Phase

The impacts during the constructions stage of the project would be inherently temporary in nature but may have long lasting impacts. Construction stage impacts would potentially include:

- Impacts on surface water resources
- Impacts on ground water resources
- Windblown dust / exhaust emissions
- Increase in Noise
- Impact on Soil quality
- Disturbance of flora and fauna
- Loss of Land
- Increased Community Expectation
- Influx of migrant man-power
- Increase in traffic volume in the vicinity of the construction site
- Impact on Occupational Health and Safety
- Impact on Archeologically important site in case of chance find

7.5.1.1 Impacts on surface water resource

The surface water sources in the project area occur in the form of seasonal streams, nallas and water bodies which are either man-made or natural depression formed in the surface. These water bodies are rain-fed and remain during the other seasons. The rain-fed pond within the project boundary is observed to in dry out state during site visit and also during collection of water sample. Hence, baseline of surface water quality in the study area could not be ascertained.

Although the pond/surface water body within the boundary is intended to be retained in its original form by CSPGPL, drainage channels feeding the water body could be altered during clearing and excavating of the site. The topographic alterations near the water body could impact the surface run-off.

Mitigation

- Although surface water will not be utilised during the construction phase, it is recommended that surface water quality of the water in the man-made pond within the project site is checked for basic drinking water parameters to ensure it is not contaminated due to surface run-off or other construction debris;
- It is to be ensured that adequate number, type and location of needed culverts are constructed for storm water management to avoid run-off and wastes into the natural drainage within the project site;
- The baseline water testing results of bore-well water from Bejihalli village and PD Kote indicate ground water is contaminated and not suitable for drinking hence, it is to be ensured that RO treated water is used for drinking by the construction staffs at site.

Impact Value

Aspect	Scenario	Spread	Duration	Intensity	Overall
Surface Water Quality	Without Mitigation	Medium	Short	Moderate	**Moderate**
	With Mitigation	Medium	Short	Low	**Minor**

7.5.1.2 Impacts on ground water resource

Waste water from portable toilets constructed for construction workers and in the labour camps, if not properly channelized or if stagnated can lead to contamination of ground water. As discussed in ***Section 4.6.3***, the baseline results indicate that the ground water quality of project village and neighbouring area is already contaminated due to many chemical and bacteriological parameters exceeding the acceptable limits of drinking water standards.

The lack of provision of adequate sanitary facilities may lead to increase in faecal pollution of surface and ground water resources in the area through surface run-off and leaching respectively.

The project site is identified to be located in the Critical Zone of the taluk. The water requirement during construction phase shall be mainly for civil works and domestic purpose at the labour camp. It is estimated that approximately 80-85 KL of water will be required for construction and the requirements will be met through water from private tankers and also from existing bore well located within the project site. However, ground water utilisation for the project will thus require permission from CGWA for extraction of ground water.

Owing to the uncertain and erratic rainfall in the area along with critical status of ground water resource, further dependence on the ground water will have impact on the ground water level of the area.

Mitigation

- Portable toilets provided shall be self-contained and cleaned and disinfected on weekly basis by cleaners hired by construction contractor;
- Labourers and their family member residing in the campsites should be educated on environment and health drawbacks of involving in open defection (if practiced);
- If CSPGPL opts to use ground water and obtains the necessary permits from the authority, it is recommended that other alternative measures such as rain water harvesting and increasing the storage capacity of the existing water tanks/ponds, etc to meet the water demands shall be integrated;
- The baseline water testing results of bore-well water from Bejihalli village and PD Kote indicate ground water is contaminated water and not suitable for drinking hence, it is to be ensured that treated water is used for drinking by the construction staffs at site.

Impact Value

Aspect	Scenario	Spread	Duration	Intensity	Overall
Ground Water Quality	Without Mitigation	Medium	Short	Moderate	**Moderate**
	With Mitigation	Medium	Short	Low	**Minor**

7.5.1.3 Windblown dust / exhaust emissions

The construction stage activities, mainly movement of heavy machinery across dirt / unpaved roads and site clearing & grubbing activities (excavation works, grading) will lead to increased level of dust. Exhaust emissions of SOx, NOx, CO, CO_2 and particulate matter will be mainly contributed during the construction stage due to operation of construction machinery and road vehicles. These impacts are temporary in nature will be limited to the project area and dispersed rapidly.

Mitigation Measures

- Localized sprinkling of water at areas where vegetation is removed shall be undertaken for the entire duration of construction;
- Loose excavated soils shall be kept covered or kept wet in designated storage areas to prevent dust generation and dispersal;
- Regular maintenance of vehicles shall be carried out and valid Pollution under Control (PuC) certificates issued by registered authority shall be maintained;
- Idling time of vehicles shall be reduced the extent possible to minimize air pollutant emissions.

Impact Value

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

7.5.1.4 Increase in Noise

The construction activities i.e. earthworks – site clearance, levelling, excavations; construction of access roads; construction of site office; construction camps; are likely to increase the noise levels in the project site and its vicinity.

The closest village to the project site would be the residents of the village “Bejjihalli” which is located around 400 m from the western boundary of the project site. In addition to these two (2) families residing in the adjacent plot about 60 m from the project boundary and staff working on the site would be prone to increased noise levels.

Mitigation Measures

- Construction activities shall be planned in consultation with local communities (if required);
- Construction equipment will be maintained in good working order and properly muffled;
- Integral noise shielding to be used where practicable and fixed noise sources to be acoustically treated, for example with silencers, acoustic louvers and enclosures;
- Provision of rubber paddings/noise isolators at equipment/machinery used for construction;
- Construction vehicles shall be well maintained, and idling time will be minimized for vehicles when not in use;
- Community residing in the adjoining plot of the project boundary shall be consulted from time to time and in case of any noise related grievances must be addressed on priority, if required the community shall also be provided with PPEs to minimize their exposure to noise during construction period;
- Site workers working near high noise areas shall use personal protective equipment (PPEs) like ear plugs and earmuffs to minimize their exposure to noise.

Impact Value

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

7.5.1.5 Impact on Soil quality

The construction stage activities will involve movement of materials / goods and machinery. The storage of construction materials / PV panels / and machinery on-site will also generate waste in terms of damages in transit, spills and maintenance of machinery including minor on-site repairs. The excavated soil and construction debris can randomly be disposed in nearby fields and private land.

The labour camps constructed at site will also have municipal waste being generated which will require separate disposal practices. Labour camps are provided with portable toilets which are self-contained and cleaned and disinfected on weekly basis by cleaners hired by construction contractor. Solid wastes from the camps and kitchen area shall be disposed to the common trash area of the village.

Improper management of waste (both hazardous and non-hazardous) during construction stage may lead to impacts on soil, surface water body, visual environment in addition to the health and safety of workers. Non-hazardous waste will include wood chips, metal scrap, packaging materials etc. Hazardous waste will include metal drums, chemical containers, residual paints, waste oil from machinery lubricants etc. Oil leaks/spillages from vehicles and machinery operating on site/campsite can also result in soil contamination due to the project. The baseline soil conditions of project site indicate no baseline oil contamination with the site.

Mitigation Measures

- Activities related to the construction phase of the project shall be limited to the dry months of the year and thereby excluding the months of heavy rainfall;
- The area in the project site shall be re-vegetated with local species as early as possible;
- All construction material stored at a designated area for storage within the site shall be covered with tarpaulin sheets to avoid dispersal;
- All vehicles carrying construction material shall be covered;
- Construction debris and excavated material shall be used for filling up of low lying areas;
- Temporary paved areas shall be constructed to be used while refuelling the machineries. In case of any accidental spill, the affected soil shall be cut out and stored securely for disposal with hazardous waste.

Impact Value

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

7.5.1.6 Disturbance of Flora and Fauna

The natural and agricultural vegetation of project site will be cleared for construction and installation of the solar panels and its ancillary structures. Removal of natural vegetation will lead to complete loss or degradation of the habitat features currently being provided by the area in terms of feeding grounds, roosts, hunting perches, nesting sites, nesting materials, etc.

Site preparation for solar-panel installations involves earthworks like grubbing and levelling. Any such topographic modifications are likely to disrupt the drainage pattern of the area and the seasonal water-channels feeding surface waterbodies could be altered.

The laying of new access roads leads to fragmentation of hitherto contiguous stretches of natural habitats and disruption of faunal access to feeding, roosting and nesting sites.

The movement of vehicles and operation of construction machinery over the land surface exposes the natural environment to vehicular emissions and unnatural levels of noise, light and vibrations, soil contamination in case of fuel spillage and also dislodges fine soil particles creating dust. The regular movement of heavy vehicles causes compaction of the soil substrates. All these activities individually and collectively lead to loss or degradation of habitats and ecosystem services through pollution of natural resources, injury or death of soil organisms, reduced rate of water percolation and increased surface run-off.

Installation 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 provided by the area.

Installation of over-ground transmission systems disrupts the aerial habitat space of the area, leading to death or damage to avifauna through accidental collision with cables. Under-ground transmission systems are likely to disturb the natural soil-profile, leading to degradation of the sub-soil ecosystems and death or damage to soil organisms.

Mitigation Measures

- Conservation of the existing ground cover of as much of the area as possible and plantation of native plant species in all suitable parts of the project site;
- Topographic alteration in the project area should be kept to the minimal and natural drainage pattern of the project site should be maintained;
- Limit the extent of roads, keeping width of the road as narrow as possible and maintaining any existing natural vegetation along the road alignments as far as possible;

- Restrict the movement of vehicles to the pre-designated routes to prevent the disturbance to the ecosystems;
- Activities that require high levels of illumination to be restricted to daylight hours to prevent disruption of the natural night period by artificial lighting;
- Use of visual markers on cables to render them relatively more visible to aerially moving organisms.

Impact Value

Aspect	Scenario	Spread	Duration	Intensity	Overall
Flora and Fauna	Without Mitigation	Local	Medium	High	**Moderate**
	With Mitigation	Local	Short	Moderate	**Minor**

7.5.1.7 Loss of Land

One hundred and sixty one (161) acres of private land has been identified. In Phase I -118 acres have been purchased .In Phase II- remaining 43 acres is in the process of being purchased or the project. During stakeholder consultations with the previous land owners, it was stated that the land procured was barren land as for the past five years there had been minimal rainfall and except for the public borewell as the only other source of irrigation for minimal agricultural activities in some land parcels they had not been able to cultivate any crops on the land parcels.

7.5.1.8 Increased Community Expectation

Bejjihalli village has limited infrastructure facilities and with the advent of the project it has created several expectations amongst the local population. Expectations are primarily related with increased employment opportunities and improvement of existing infrastructure facilities. Consultations with the community members indicated that the community expected employment of youth as security personnel and unskilled workers.

Mitigation Measures

- CSPGPL shall endeavour to procure land on a willing-buyer willing seller basis and shall provide suitable remuneration;
- It is recommended that CSPGPL shall endeavour to provide suitable fertile agricultural land in the surrounding areas wherever available;
- CSPGPL shall endeavour to provide employment to the local workforce and on absence of required skill set could employ migrant workers;
- CSPGPL shall endeavour to primarily engage local contractors and vendors.

Impact Value

Aspect	Scenario	Spread	Duration	Intensity	Overall
Loss of Land	Without Mitigation	Local	Medium	High	**Moderate**
	With Mitigation	Local	Short	Moderate	**Minor**
Increased Community Expectations	Without Mitigation	Local	Medium	Moderate	**Minor**
	With Mitigation	Local	Medium	Low	**Minor**

7.5.1.9 Migrant Labour related Issues

As stated by the site representative, the construction phase of the project will extend to a total of three months. It was also stated that they anticipated around 200-250 migrant workers comprising of skilled, semi-skilled and unskilled construction workers. Accommodation for the construction workers (unskilled labourers) would be provided within the project site boundary while the skilled and semi-skilled workers will be accommodated in rented houses within the nearest town of PD Kote. With the influx of a high number of workers from outside might bring about certain concerns related to:

- Economic opportunities of the local population;
- Impact on existing resources;

- Impact on local customs and tradition;
- Community Health Impacts of Migrant Workers.

a) ***Economic Opportunities of Local population:*** The project proponent intends to engage 200-250 migrant workers for the proposed project as there is unavailability of workforce in the village. However it was mentioned that some of the unskilled workforce would also be sourced from the local population (as and when required).

b) ***Impact on Existing Resources:*** As there will be migrant workforce population who will be living in the village for the construction phase, it is anticipated that they will be using the existing resources of the village such as water supply, electricity etc. This may create a strain on the existing resources and create discord between the local population and the migrant worker population.

c) ***Impact on Local Customs and Tradition:*** It is anticipated that there could be cultural differences between the migrant workers population and the local population. Unawareness of the existing local customs and traditions and actions contradictory to it may create discord between the local and migrant worker population.

d) ***Community Health Impacts of Migrant Workers:*** With the inflow of migrant workers and their interaction with the local population may lead to emergence of health issues. Diseases such as HIV/AIDS, Tuberculosis may have tendency to spread because of the floating population.

Mitigation Measures

- The CSPGPL shall endeavour to provide employment to the local workforce and on absence of required skill set could employ migrant workers;
- The construction contractor shall ensure that the labour campsite is well managed. Adequate sanitation and waste disposal facilities are to be arranged;
- An orientation programme for the migrant worker population on the local customs and traditions should be conducted;
- The construction contractors are to intimate the security agency engaged by them to monitor the entry and exit of labour workforce from the campsite area;
- The construction contractor should conduct a medical check-up camp on the arrival of the migrant workforce to identify and mitigate communicable diseases;
- Regular medical camps and check-ups should be conducted to create awareness and investigations on communicable diseases.

Impact Value

Aspect	Scenario	Spread	Duration	Intensity	Overall
Migrant Labour Related Issues	Without Mitigation	Local	Short	Moderate	**Minor**
	With Mitigation	Local	Short	Low	**Insignificant**

7.5.1.10 Increase in traffic activity in the vicinity of the construction site

Traffic is expected to increase to a certain degree due to the nature of activities that will take place such as the transport of equipment and materials to and from the site through the surrounding road network. Additional traffic load will be evident at certain times during the day, especially if there are slow moving heavy vehicles transporting material to and from the site.

Increase vehicle activity road networks around and within the site can lead to adverse impacts such as accidents.

Mitigation Measures

- It is recommended to construct the proposed access road prior to site clearance activities;
- Prior sharing of information with the local residents restricting access to the construction phase of stretch of road during the movement of heavy machinery and equipment;
- Only trained drivers with valid license shall be hired by the construction contractor;

- Training programs shall be conducted at regular intervals for all the drivers for raising awareness about road safety and adopting best transport and traffic safety procedures once in every six months;
- Emphasis shall be given on safety amongst drivers, adopting limits for trip duration and arranging driver roster to avoid overtiredness and avoiding dangerous routes and times of day to reduce risk of accident shall also be implemented;
- Regular maintenance of vehicles and use of manufacturer approved parts should be adopted to minimize potentially serious accidents caused by equipment malfunction or premature failure.

Impact Value

Aspect	Scenario	Spread	Duration	Intensity	Overall
Increase in Traffic Activity	Without Mitigation	Medium	Short	Moderate	**Moderate**
	With Mitigation	Medium	Short	Low	**Minor**

7.5.1.11 Impact on Occupational Health and Safety

The construction activities include site preparation, infrastructure utilities installation, building structures. Therefore, there will be potential impacts on workers' health and safety due to exposure to risks through construction activities that lead to accidents causing injuries and death. The most frequent risks causes of accidental death and injury are:

- Tripping due to uneven surfaces, obstacles, trailing cables;
- Falling during working at height due to fall from fragile surfaces, roof edges and ladders;
- Fire due to hot works, smoking, failure in electrical installations;
- Mobile plant and vehicles;
- Electrical shocks;
- Manual handling and musculoskeletal disorders: typical construction activities that can cause injury such as lifting, lowering, pushing, pulling and carrying;
- Hand-arm vibration: people work with hand-held or hand-guided power-tools and machines, such as: concrete breakers, pokers and compactors, sanders, grinders and disc cutters, hammer drills, chipping hammers, chainsaws, scrabbles and needle guns;
- Temporary or permanent hearing loss which usually comes from noise generated from machinery used for excavation or piling work and from compressors and concrete mixers etc;
- Heat stress and working during high temperatures.

Mitigation Measures

- CSPGPL shall ensure that the construction contractor follows the site specific Emergency Preparedness and Response Procedure. The On-Site emergency procedure shall provide details of the anticipated emergencies, the emergency organization, facilities, emergency procedures and roles and responsibilities;
- CSPGPL shall ensure that adequate training is provided to workers and staffs hired by construction contractor about awareness on use of Personal Protection Equipment (PPE) and emergency response measures;
- CSPGPL shall introduce administrative controls into work processes such as job rotation, rest and stretch breaks etc to reduce overexertion;
- Work site layout will be well planned to avoid manual transfer of heavy loads. It shall also ensure good housekeeping at the construction site to avoid slips and falls;
- Excessive waste debris and liquid spills will be cleaned up regularly, while electrical cords and ropes will be placed along identified corridors marked for attention of everyone at site;
- Use of personal fall arrest system, such as full body harnesses as well as fall rescue procedures to deal with workers whose fall has been successfully arrested shall also been carried out;

- Dropping/lowering of construction material or tool will be restricted and undertaken only under strict supervision, if required;
- PPEs such as safety glasses with side shields, face shields, hard hats and safety shoes shall be mandatory at construction site. Ear plugs shall be provided for workers placed at high noise areas.

Impact Value

Aspect	Scenario	Spread	Duration	Intensity	Overall
Occupational Health and Safety	Without Mitigation	Local	Short	High	**Moderate**
	With Mitigation	Local	Short	Moderate	**Minor**

7.5.1.12 Impact on Archaeological important and Cultural Heritage site

Study area does not show presence of any of the ASI identified archaeologically important monuments/sites or cultural heritage site. Only a “Samadhi” is located at around 100 m outside the western boundary of the project site.

During site preparation activities like trenching and excavating required for drainage and cable routes and the installation of array structures into the ground can lead to possible chance find of any archaeological and cultural heritage important sites/articles.

Mitigation Measures

- Should any archaeological materials (artefacts; cultural material such as historic glass, ceramics, etc; sub-surface structures, etc) or cultural heritage site be uncovered or exposed during earthworks or excavations, they will immediately be reported to the project in-charge who will in turn report to the Director General of National Monuments Authority;
- Training session on health and safety should include sensitizing the contractor and site staffs about culturally heritage sites and action points in case of encounter with a previously unknown cultural heritage site.

Impact Value

Aspect	Scenario	Spread	Duration	Intensity	Overall
Archaeological important and Cultural Heritage site	Without Mitigation	Local	Short	Moderate	**Minor**
	With Mitigation	Local	Short	Low	**Insignificant**

7.5.2 Impacts during construction of Transmission Line

A total of 14 no of transmission poles are planned to be erected to evacuate the power generated from the switchyard to the 66/11kV sub-station at PD Kote. During the site visit it mentioned that the Right of Way (RoW) for the land to erect the transmission line towers will be taken by paying a one-time compensation to the identified land owners.

Possible aspects of activity with potential to cause environmental impacts include but are not limited to:

- Getting RoW permit;
- Consumption of water, generation of garbage, storage of fuel and lighting in the base camp;
- Clearing of ground vegetation;
- Transportation of equipment and workforce to site will lead to vehicular emission and noise pollution;
- Excavation and digging of pits will cause soil movement, air emissions and noise pollution;
- Use of water resources (nominal quantity) for construction activities;
- Storage, handling and transportation of construction material will lead to air pollution and noise pollution.

Mitigation Measures

- Follow standard norms and practices in acquiring RoW;
- Adequate compensation will be provided as per norms;
- Drinking water for the workers will be procured to the site from outside;
- Occupational Health and Safety practices to be implemented at site;
- Existing roads/ infrastructure to be used to the extent possible;
- Minimum trips for transportation of material/workforce to be worked out;
- Proper maintenance of transportation vehicles to be undertaken;
- Water sprinkling will be restored to in case of excessive dust emission;
- Care to be taken to bring the land to the near original condition so that, soil erosion is avoided;
- PPEs is to be used by operators of heavy machinery and also by workers and staffs;
- Effective water, wastewater and solid waste management at site;
- Transportation of hazardous waste to be as per hazardous waste management rules.

The preliminary responsibility for implementation of mitigation measure lies with Transmission line contractor.

Impact Value

Aspect	Scenario	Spread	Duration	Intensity	Overall
Construction of Transmission Line for power evacuation	Without Mitigation	Local	Short	High	**Moderate**
	With Mitigation	Local	Short	Moderate	**Minor**

7.5.3 Operation Phase

Given the long term nature, operation phase impacts would require adequate mitigation measures to minimize predicted impacts. In general, solar power generating facilities need to occupy a very large area in comparison to other types of power generation facilities relative to the level of power output generated.

7.5.3.1 Impact on ground water resources

The water requirements during the operation phase would be limited to cleaning operations for PV panels, other office building and drinking water for the project staffs. The quantity of water required varies according to available cleaning technologies and the local climate, however approximately 1.6 litres of water per m^2 of PV modules may be required.

The study area is identified to be located in the Critical Zone of the taluk showing significant decline in the pre-monsoon or post monsoon groundwater trend. Owing to the uncertain and erratic rainfall in the area along with stressed water resource further dependence on the ground water will impact the ground water levels.

Mitigation Measures

- CSPGPL shall seek permission from the concerned authority to extract ground water for usage during operation phase;
- After due approval for ground water extraction, CSPGPL to ensure instalment of water meters at the bore-well to monitor ground water abstraction;
- Wastage of water during cleaning of panels shall be avoided;
- Other alternative measures such as rain water harvesting and increasing the storage capacity of the existing water tanks/ponds, etc to meet the O&M water demands need to be integrated;

Impact Value

Aspect	Scenario	Spread	Duration	Intensity	Overall
Ground water resources	Without Mitigation	Local	Long	High	**Major**

	With Mitigation	Local	Short	Moderate	**Moderate**

7.5.3.2 Impact on Soil Quality

The impacts on the soil are limited to accidental spillage of lubricants / fuel and other chemicals that may potentially cause soil contamination. The repair works of underground cable network may lead to increased soil erosion in that localized pocket.

Hazardous wastes typically generated during O&M phase of a solar farm include used or spent oil (5.1 of schedule I) and waste residues containing oil (5.2 of schedule I) and poly-crystalline PV solar panels produced from silicon tetrachloride (Class C, Schedule II, corrosive characteristics). These solar panels are discarded panels during regular maintenance works due to component failure Improper management of the Hazardous wastes generated can impact the soil and nearby surface water body, visual environment and Health and safety of O&M staffs.

Any unforeseen impacts due to modification of the slope and existing drainage channels may lead to increased runoff or waterlogging is some sections of the proposed solar farm. Such unforeseen impacts could be significant in nature leading to permanent adverse impacts. The impacts could lead to lesser inflow of water to the natural surface water body within the site.

The impacts during the operation stage would be limited to waste water generation from maintenance and cleaning activities in addition to the domestic waste being generated from the workers domestic activities and administrative building.

Mitigation Measures

- Temporary paved areas shall be constructed to be used while refuelling the machineries. In case of any accidental spill, the affected soil shall be cut out and stored securely for disposal with hazardous waste;
- A separate designated area shall be demarcated within the project boundary to store the Hazardous waste generated, procedures to store, handle and dispose these wastes will be as per the Hazardous Waste Management Handling and Trans-boundary Movement Rules 2016.

Impact Value

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

7.5.3.3 Visual Impacts

There will be a change of landscape of the area due to installation of solar panels and project related structures. Therefore, visual impact due to glare generated from the solar panel is also anticipated. The change in landscape and glare from the panels can affect the habitation as well as fauna of the area. Hence, to assess the impact solar glare assessment study is carried out.

A Desktop based glare assessment study has been carried out utilizing the Solar Glare Hazard Analysis Tool (SGHAT) developed by Sandi National Laboratory14 to assess potential glare utilizing latitude and longitudinal coordinates, elevation, sun position, and vector calculations. The PV module orientation, reflectance environment and ocular factors are also considered by the software. If potential glare is identified by the model, the tool calculates the retinal irradiance and subtended angle (size/distance) of the glare source to predict potential ocular hazards according to the glare intensity categories.

Glare Intensity Categories

Glare refers to the human experience of reflected light. The potential hazard from solar glare is a function of retinal irradiance (power of electromagnetic radiation per unit area produced by the sun) and the subtended angle (size and distance) of the glare source.

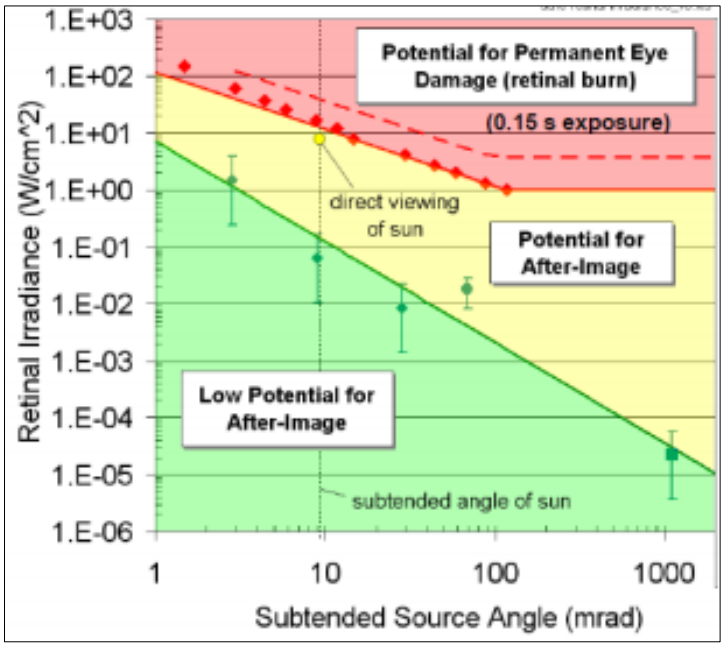
[14] https://share.sandia.gov/phlux/sghat/

Glare can be broadly classified into three categories: low potential for after-image, potential for after-image, and potential for permanent eye damage, ***Figure 7-1*** below illustrates the glare intensity categories.

The amount of light reflected from a PV panel depends on the amount of sunlight hitting the surface, as well as the surface reflectivity. The amount of sunlight interacting with the solar panel will vary based on geographic location, time of year, cloud cover, and solar panel orientation.

The SGHAT does not take into consideration the following factors:

- Backtracking or the effect of shading in relation to the PV array tracking system;
- Gaps between PV modules;
- Topography and vegetation between the solar panels and the viewer (sensitive receptor);
- Atmospheric conditions.



Source: Solar Glare Hazard Analysis Tool (SGHAT) Presentation (2013)

Figure 7-1: Glare Categories

SGHAT has been used extensively in the United States to assess the potential impact of solar arrays located in close proximity to airports. A limited analysis has been undertaken for the proposed project which can provide an overview of potential of glare effect caused, if any.

The baseline glare condition assessment takes into consideration the following:

- The terrain of the area is assumed to be flat;
- There are no obstructions between the PV (solar panels) and the Observation Points (OPs) considered.

The main elements of the Solar Farm with the potential to influence glare are the tilt, orientation, and optical properties of the PV modules in the solar array, and the rotational capabilities of the tracking system.

The proposed 30MW solar power project will be based on crystalline silicon (c-Si) Solar Photo Voltaic technology using Module Make Trina Solar, Model nos TSM-310PD14 & TSM-315PD14 which is Poly Crystalline Silicon Module for power generation. The optimum tilt angle of tracking axis for proposed solar plant has been computed to be 45 degrees and modules facing towards south i.e. the orientation of tracking axis would be 180 degrees, with maximum tracking angle to be 60 degrees. The panels are proposed to be installed at a height of 5.5 ft.

There is an adjacent solar project of 8MW based on the crystalline silicon (c-Si) Solar Photo Voltaic technology using 3 different kinds of module; (1) Talesun Solar – 310W/315 W (2) JA Solar -310 W/315 W and (3) Astronergy -310W/315W.

Table 7-3: Extreme Latitude and Longitude for the Proposed Solar Site

S.No	Latitude	Longitude	Ground Elevation (ft)	Height above ground (ft)	Total Elevation (ft)
PV-1 (30 MW)					
1	14.03451	76.90718	1935.54	5.5	1940.54
2	14.03982	76.90386	1935.63	5.5	1940.63
3	14.04829	76.91023	1953.66	5.5	1958.66
4	14.04019	76.91064	1953.66	5.5	1958.66
PV-2 (8 MW)					
1	14.05812	76.9199	1992.71	5.5	1997.71
2	14.06307	76.91724	1986.02	5.5	1991.02
3	14.06773	76.91981	1958.72	5.5	1963.72
4	14.06149	76.92161	1979.19	5.5	1984.19

Table 7-4: SGHAT Modelling Parameters for both the Solar Plants considered

Modelling Parameters	Values	
	30 MW Plant	**8 MW Plant**
Time Zone	UTC+5	UTC+5
Axis Tracking	Single	Single
Tilt of Tracking Axis	45	45
Orientation of tracking Axis	180	180
Offset Angle of Module	0	-
Module Surface Area	Smooth glass with Anti Reflective coating (ARC)	Smooth glass with Anti Reflective coating (ARC)
Maximum Tracking Angle	60	60
Height of panels above ground	5.5 ft	5.5 ft
Slope Error	--	--
Reflectivity Varies with Incidence angle	Yes	Yes

Source: SGHAT

Solar Glare Analysis has been considered for an area of 161 acres (30MW) and roughly 50 acre for the adjacent solar power plant, the ***Table 7-3*** gives the ground elevation with extreme longitude and latitude of both the Photovoltaic Arrays.

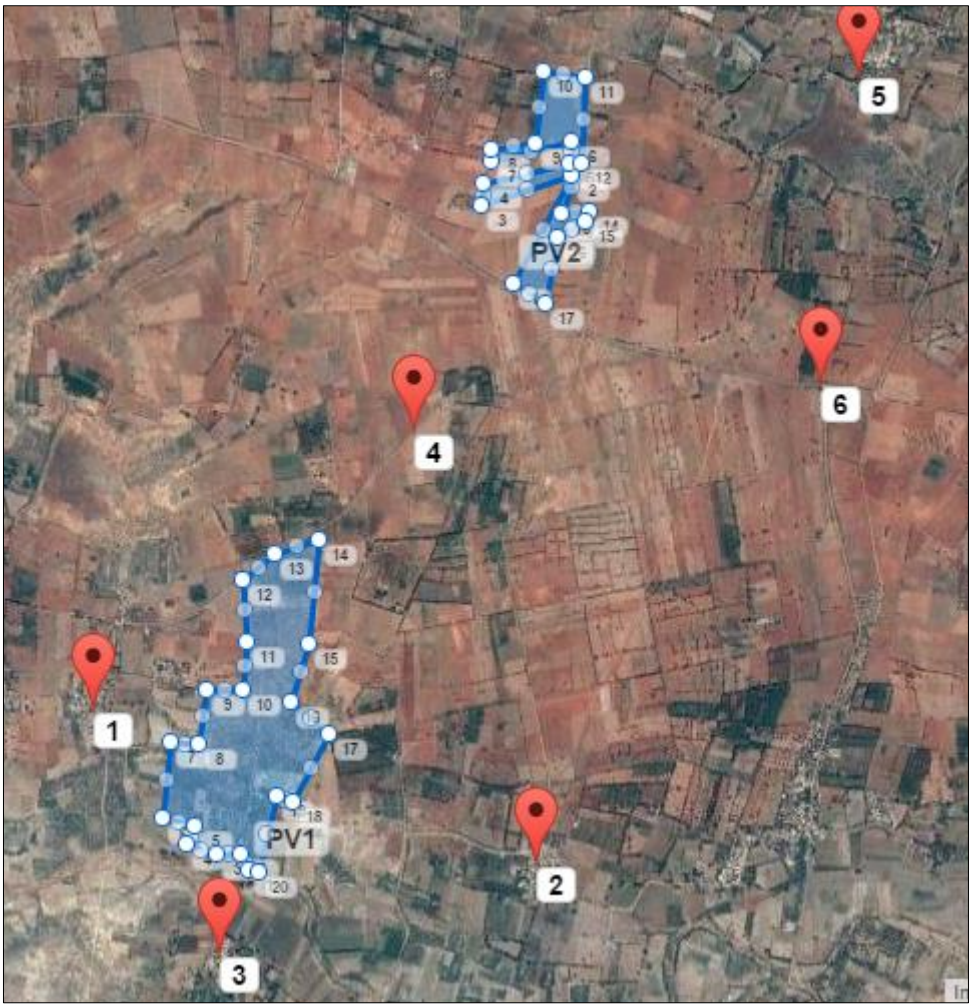


Figure 7-2: Solar Sites with Indicative Observation points

Total of (06) observation points (OP) have been considered around the sites. The observation points have been considered in a radius of 4 km from both the sites. Three (03) points are in the range of 1kms from the site boundary of 30 MW solar plant and rest 3 (three) fall in the radius of 4 km from the site, Whereas talking in terms of 8 MW Solar Plant, 3 (three) points fall in the radius of 2 km and the rest 3 (three) falls in the radius of 4 km. 4 villages are covered in the 4 km radius. The Sira-Amrapuram Road and the Village road have also been considered among the observation points.

Table 7-5: Observation Points Details with Glare Gauge Results

S.No	Description	Distance from the Nearest Boundary of PV1	Distance from the Nearest Boundary of PV 2	Latitude (Degrees)	Longitude (Degrees)	Ground Elevation (ft)	Eye Level height above ground elevation (ft)	Glare Potential from PV 1	Glare Potential from PV-2
1	OP-1: Bejjihalli Village	0.5 km	2.70 km	14.04111	76.90051	1949.52	5.5	No Glare	Green Glare Potential. No potential for Red or Yellow Glare.
2	OP-2: Thimmanahalli Village	1.22 km	2.64 km	14.03466	76.91951	1955.38	5.5	Green Glare Potential. No potential for Red or Yellow Glare.	Green Glare Potential. No potential for Red or Yellow Glare.
3	OP-3: Palya Village	0.45 km	3.35 km	14.03093	76.90593	1950.14	5.5	Green Glare Potential. No potential for Red or Yellow Glare.	Green Glare Potential. No potential for Red or Yellow Glare.
4	OP-4: A point on the Road Connecting the Two farms	0.8 km	0.7km	14.0527	76.91423	1971.78	4.5	No Glare	Green Glare Potential. No potential for Red or Yellow Glare.
5	OP-5: Karidasarahalli Village	3.39 km	1.47 km	14.06746	76.93334	1977.51	5.5	No Glare	No Glare
6	OP-6: Sira Amrapuram Cross Road	2.46 km	1.42 km	14.0547	76.9317	2023.89	4.5	No Glare	Green Glare Potential. No potential for Red or Yellow Glare.

Source: Solar Glare Hazard Analysis Software

Table 7-6: Findings for the Glare Assessment

Observation Points	Glare Occurrence from 30 MW Solar Farm				Glare Occurrence from 8 MW Solar Farm			
	Potential	Intensity	Timings (24 hr Clock)	Months of the Year	Potential	Intensity	Timings (24 hour Clock)	Months of the Year
OP-1: Bejjihalli Village	No Potential	--	--	--	Low Potential for temporary after image	Continuous	14:00-16:00 hrs	April to September
OP-2: Thimmanahalli Village	Low Potential for temporary after image	Scattered	07:45-10:00hrs	April, May, July and August.	Low Potential for temporary after image	Continuous	11:30-12:30 hrs	Last 15 days in April and first 15 days in August
OP-3: Palya Village	Low Potential for temporary after image	Continuous	10:00-14:00 hrs	April and August	Low Potential for temporary after image	Continuous	13:00-14:00 hrs	Last 15 days in April and first 15 days in August
OP-4:A point on the Road	No Potential	--	--	--	Low Potential for	Continuous	13:00-16:00 hrs	April to September

Connecting the Two farms					temporary after image			
OP-5: Karidasarahalli Village	No Potential	--	--	--	No Potential	--	--	--
OP-6: Sira Amrapuram Cross Road	No Potential	--	--	--	Low Potential for temporary after image	Scattered	08:00-09:00 hrs	April, May, July & August

Source: Solar Glare Hazard Analysis Report.

The graphs below in **Figure 7-3** to **7-6** represent the annual occurrence of glare Potential.

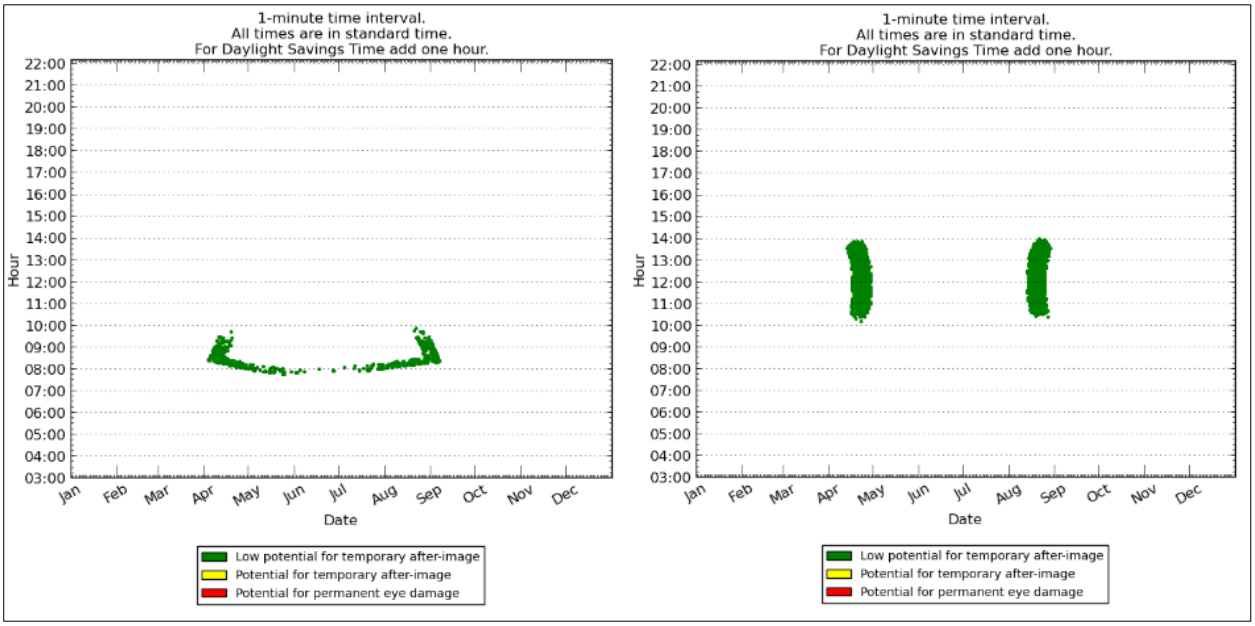


Figure 7-3: Glare Potential Plot for OP-2 and OP-3 from 30 MW Solar Plant

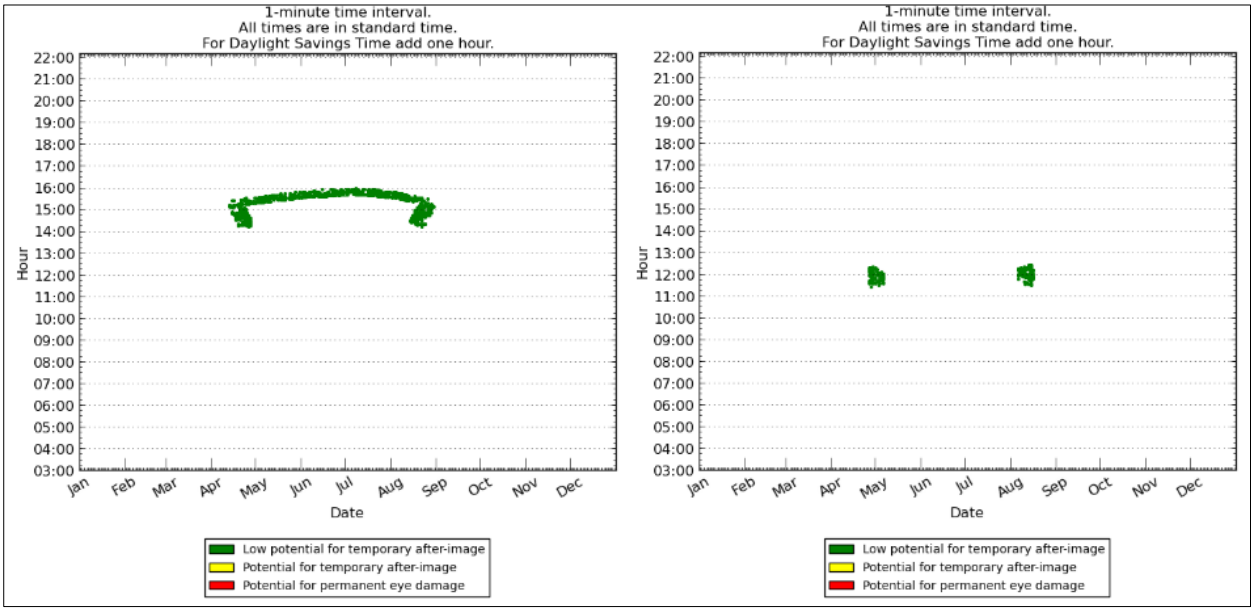


Figure 7-4: Glare Potential for OP-1 and OP-2 from 8 MW Solar Plant

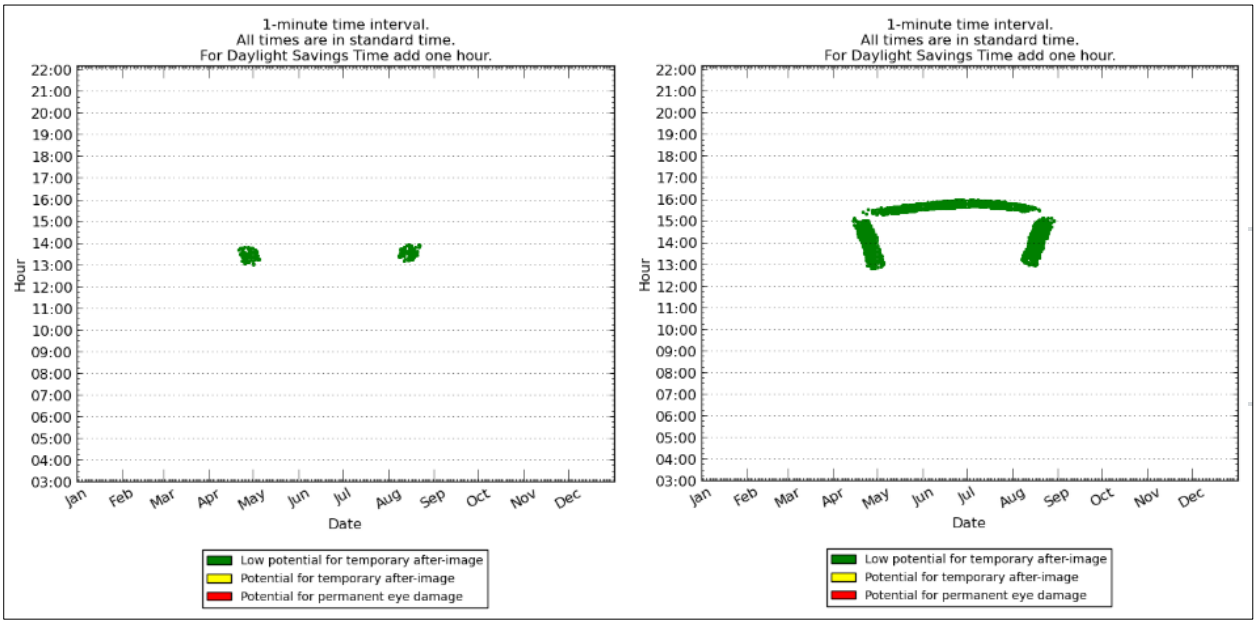


Figure 7-5: Glare Potential for OP-3 and OP-4 from 8MW Plant

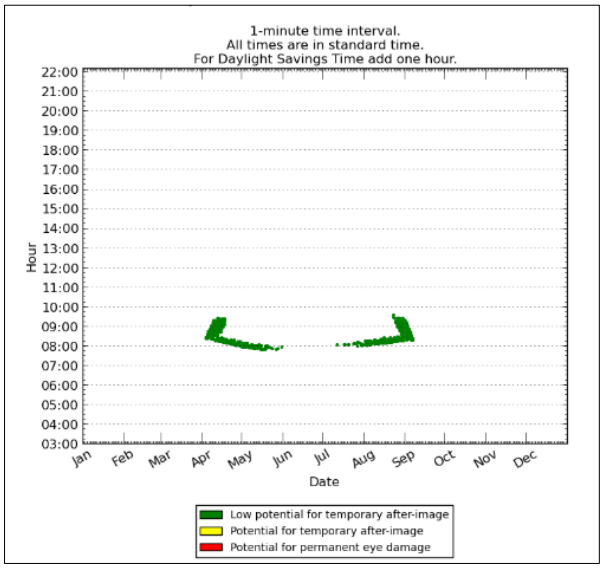


Figure 7-6: Glare Potential for OP-6 from 8MW Plant

Findings

Based on the assumptions and parameters of the desktop assessment carried out, the following results can be inferred:

From the proposed 30 MW Solar Power Plant:

- There is no glare potential identified for the Bejjihalli Village (500m, North West Direction), Karidasarahalli Village (3.39 km in the north Direction), A point on the Road Connecting the Two farms(0.8 km in the north direction) and Sira Amrapuram Cross Road (2.46 km in the north east direction). The absence of glare at OP-1 is due to the anti-glare reflective coating;
- The potential glare hazard was identified for OP-2 which is Thimmanahalli Village was in the 'Low Potential for temporary After-Image' category, ranging from 1 hrs 45 mins to 10 mins per day (7:00 to 9:30) for the summer months of April, May, July and August. The pattern of the glare observed is Continuous to Scattered (in month of June and July);
- The potential glare hazard identified for OP-3 located on Palya Village was in the 'Low Potential for temporary After-Image' category. The glare occurrence was from 10:00-14:00 continuously for the last 15 days of April and August only. The pattern for the glare during the day time is continuous.

From the existing 8 MW Solar Power Plant:

- There is no glare potential identified for the OP-5 Karidasarahalli Village located in the north west of the site;
- The potential glare hazard was identified for OP-1 which is Bejjihalli Village; it was in the 'Low Potential for temporary After-Image' category, for only an hour per day between 14:00-16:00 hrs for the summer months of May, June, July and August. The pattern of the glare observed is continuous. However, the glare is only for one hour during summer months;
- The potential Glare hazard was identified for OP-2 which is Thimmanahalli Village; it was in the 'Low Potential for temporary After-Image' category, for an hour per day during 11:30-12:30 hrs for few days in the months of April and August. The pattern of the glare observed is scattered;
- The potential Glare hazard was identified for OP-3 which is Palya Village; it was in the 'Low Potential for temporary After-Image' category, for only an hour per day between 13:00-14:00 hrs for few days in the months of April and August. The pattern of the glare observed is scattered;
- The potential Glare hazard identified for OP-4 which was in the 'Low Potential for temporary After-Image' category, for an hour or half per day between 12:30-16:00 hrs for the summer months of April, May, June, July and August. The pattern of the glare observed is continuous;
- The potential Glare hazard identified for OP-6 which is Sira Amrapuram Cross Road was in the 'Low Potential for temporary After-Image' category, for 20 mins to half an hour per day between 07:45-09:30hrs for the summer months of April, May, July and August. The pattern of the glare observed is continuous.

None of the observation points falls in yellow or red Glare Potential zone due to proposed solar power project and existing 8 MW solar Plant. Solar glare in green zone is limited to only maximum 2 hours in day during summer months (May to August). There is no glare observed in north direction (OP1 and OP4) due to proposed solar plant. 8MW solar plant will cause some glare on OP 6 and OP4 since both observation points are located in south of the power plant. Considering the assumptions applied in the assessment and scale of both the plants, the impact of glare is assessed to be minor.

Mitigation Measures

It is recommended to arrange the panels in a systematic manner which will give an aesthetic sense to it. The proposed project would include a boundary wall around the perimeter of the project to further obscure the peripheral view of the project and any indirect reflection. The project site is not located in any view sheds. Also, the roads in the immediate project area are very lightly travelled and most do not have picturesque designations.

Impact Value

Aspect	Scenario	Spread	Duration	Intensity	Overall
Visual Impacts	Without Mitigation	Local	Long	Low	**Minor**
	With Mitigation	Local	Short	Low	**Insignificant**

7.5.3.4 Impact on 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;
- Using ground water from tube-well directly for consumption; 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

- Regular training on electrical safety module to staffs and 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;
- An accident reporting, and monitoring record shall be maintained; and
- It is recommended to hire local contractors to supply packed drinking water for the staffs since ground water of the project area is contaminated and requires RO treatment prior to its use as drinking water.

Impact Value

Aspect	Scenario	Spread	Duration	Intensity	Overall
Occupational Health and Safety	Without Mitigation	Medium	Short	Moderate	**Moderate**
	With Mitigation	Medium	Short	Low	**Minor**

7.5.3.5 Ecological Impacts

a) ***Impact due to physical presence of Installations:*** The physical presence of the solar panels and related 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.

b) ***Impact due to Illumination at project site:*** 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.

c) ***Impact due to increase in 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.

d) ***Impact due to use of Herbicides:*** Herbicides are usually used throughout the operation phase to control the growth of plants which may cut off sunlight from the solar panelling. These herbicidal chemicals are toxic to most organisms and tend to accumulate in the subsoil layers. The toxic components are likely to enter into the operating food chains within the area through surface and ground water sources.

e) ***Impact due to use of Dust Settling Chemicals:*** In general practice, the dust-settling chemicals tend to be employed throughout the operation phase to prevent the dust and dirt accumulated on the coating surface of the solar panels. These dust settling chemicals may have toxic effects on organisms and may have tendency to bio-accumulate and could eventually contaminate the soil, surface and ground water and food chains in the area.

f) ***Impact due to spillage of materials:*** Solar power generation projects often employ in their systems the chemicals such as heat transfer fluids belonging to chemical groups of nitrates, nitrites, sulphates and sulphites. Many of these chemicals are toxic to organisms involved in the respective ecosystem. Accidental or as a part of routine operations the spillage of these chemicals will likely to degrade the food chains and could result into the contamination of the natural resources in the area.

Mitigation Measures

- Installing the solar panels in small, discrete clusters, rather than installing them in one continuous swathe;
- Ensure that all electrical components are adequately insulated;

- Restrict project- operation activities to the daytime and avoiding use of artificial lighting in and around the project site as far as possible;
- Ensure that vehicles and machinery used in the project activities comply with the prescribed emission standards and their movement is strictly restricted to pre-designated routes;
- Strictly prohibiting the use of herbicides in the facility and opting for manual weeding to control plant growth in the solar panel area;
- The use of dust-settling chemicals in the facility should be avoided and instead, manual sprinkling of water could be opted for to control dust in and around the solar panel area;
- Implement good operational practices and training to the staff and site workers to ensure prevention of spillages and installation of effective containment systems to prevent any accidental spillage from leaching into the local environment.

Impact Value

Aspect	Scenario	Spread	Duration	Intensity	Overall
Flora & Fauna	Without Mitigation	Local	Short	Moderate	**Minor**
	With Mitigation	Local	Short	Low	**Insignificant**

7.5.3.6 Socio-Economic Impacts

a) ***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 the operation of the project. There is a likelihood of increase in employment opportunities of the local people as security personnel and housekeeping workforce. Revenue generation possibilities such as opening of shops by the local people are also a possibility.

b) ***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 upgradation of school compound, health camps etc. as part of their CSR activities.

Mitigation Measures

- CSPGPL shall ensure engagement of local workforce population for unskilled jobs like grass cutting, cleaning, housekeeping staffs at the site office and security personnel wherever possible;
- It shall ensure that while engaging contractors and sub-contractors during the operation phase agreements on priority basis shall be made with local contractors and vendors;
- While developing the CSR activities it shall ensure communication and consultation with the community members of Bejjihalli village and develop required infrastructure for the village.

Impact Value

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact on Local economy	Without Mitigation	Local	Long	High	Major
	With Mitigation	-	-	-	-
Upgradation of Local Infrastructure	Without Mitigation	Local	Long	High	Major
	With Mitigation	-	-	-	-

7.5.4 Decommissioning Phase

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, re-contouring 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 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:

Impacts

a) Improper disposal of discarded wastes in the area may cause visual discontentment amongst local residents;
b) Generation of hazardous wastes such as discarded solar panel wastes (silicon tetrachloride – A Class C, Schedule II, corrosive characteristics) along with transformers/inverters containing spent/used oil which if in contact can cause contamination with the physical environmental aspects such as soil and water resource quality;
c) Reduction of Workforce;
d) Demolition activity would lead to generation of dust and increased noise activity which would be carried downward to the habitations in the surrounding areas.

Mitigation Measures

- Designated waste disposal sites should be marked for disposal of all redundant and discarded solar panels until disposed-off to KSPCB authorised hazardous waste handlers;
- All waste generated from decommissioning shall be collected and disposed of at the nearest municipal disposal site. Structures that can be reused should 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 increase noise levels;
- The contractor shall inform workers and local community about the duration of work.

Impact Value

Aspect	Scenario	Spread	Duration	Intensity	Overall Significance
Improper Waste Disposal	Without Mitigation	Local	Short	High	Moderate
	With Mitigation	Local	Short	Moderate	Minor
Generation of dusts and increased noise levels	Without Mitigation	Local	Short	High	Moderate
	With Mitigation	Local	Short	Moderate	Minor
Reduction of Workforce	Without Mitigation	Local	Short	Moderate	Minor
	With Mitigation	Local	Short	Low	Insignificant

7.6 Cumulative Impact Assessment

The proposed solar power project is of 30 MW located in Bejjihalli village. An operational 8 MW solar power project of Azure Power is located around two (2) kilometres away from the proposed solar power project. Operation of these solar power projects is anticipated to bring about changes in the area with respect aspects like ground water resources, waste management, glare (covered in Section 7.5.3) and socio-economic status of the area. The section below discusses the cumulative impacts of these solar power projects on the study area.

1. Impact on ground water resources

The existing 8 MW operational solar project is located in PD Kote falling in Hiriyur taluka of Chitradurga district. According to the CGWB district brochure, 82% of the taluk is under over-exploited zone with 5% being in safe zone and 6-7% of the area within semi-critical to critical zone.

The Map illustrating the status of the groundwater utilisation of Chitradurga district (refer ***Annexure III***) shows that the operational 8 MW solar project is located in the ***"Critical zone"*** which is same as the proposed project's location ground water status.

Therefore, it can be inferred that dependence on the ground water resources for utilizing water for cleaning of solar panels and other domestic usage during operation phase of both the projects will impact the ground water status of the overall area. Although, ground water can be utilised after obtaining due approval from the concerned authority, it is recommended to integrate other alternative water conservation measures such as rain water harvesting, treating and recycling of domestic waste water and increasing the storage capacity of the existing water tanks/ponds to hold rain water.

2. Impact due to improper waste management

Improper disposal of discarded wastes in the area may cause visual discontentment amongst local residents. Hazardous wastes such as discarded solar panel wastes (silicon tetrachloride – A Class C, Schedule II, corrosive characteristics) along with transformers/inverters containing spent/used oil will be generated which if in contact can leach into the physical environmental aspects such as soil and water resource quality and cause severe hazardous impacts which are non-reversible.

It is essential that both the operational projects obtain Hazardous waste authorisation from KSPCB for generation of hazardous waste at within site. Therefore, the projects shall comply with all the storage, transportation and disposal rules as specified in the Hazardous Waste Management Handling and Trans-boundary Movement Rules 2016 in order to mitigate the cumulative impacts.

3. Impact on Socio-Economic status of the area

Change in Land Use Pattern

The land use of Bejjihalli village is primarily barren agricultural land. With the existing and the upcoming solar power projects in the area, the land use pattern of the village would convert from barren agricultural land to Industrial land.

Change in Livelihood Opportunities

With the existing and proposed solar farm projects in the area, the land-use pattern of the area will change from agricultural to industrial area thereby bringing about a change in the livelihood patterns in the area. There would be a diversification in the livelihood opportunities from primarily agriculturists and cultivators there could be a shift towards unskilled and skilled work as these solar projects would require workforce during the construction, operation and decommissioning phases.

Upgradation of Local Infrastructure

The existing and proposed solar farm projects would most likely prepare Community Social Responsibility (CSR) activities for the benefit of the community members of Bejjihalli village. This would lead to the development of existing infrastructure and possibilities of development of new infrastructure facilities in the area.

Operation of solar power projects in the area where land is barren and not fit for agriculture will bring in prosperity in terms of provision of jobs for both skilled and unskilled labour like housekeeping and cleaning staffs, security guards and minor electrical and civil works. Also, the projects will also engage local contractors and vendors for food for staffs and drinking water supplies etc.

8. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

8.1 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 this 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 construction, operation and closure of the proposed Project. The ESMP specifies the mitigation and management measures to which CSPGPL 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 construction, operation and maintenance 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 activities for the 30 MW Solar Power Project. This ESMP is applicable to all the employees of CSPGPL and its sub-contractors, engaged during the project lifetime. The CSPGPL shall ensure adherence to the mitigation measures and ESMP by its sub-contractors.

8.2 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 O&M.

Head of Projects and O&M will overview monitor and control the activities of HSE Manager who in-turn is the reporting manager 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 Manager.

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. It is proposed that the 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.

It is proposed to appoint a social officer at project level, who will work in coordination with the contractors and stakeholders for managing the social (including 3rd party workers, staffs and neighbouring community) issues.

The proposed organizational structure for project has been presented in ***Figure 8-1***below.

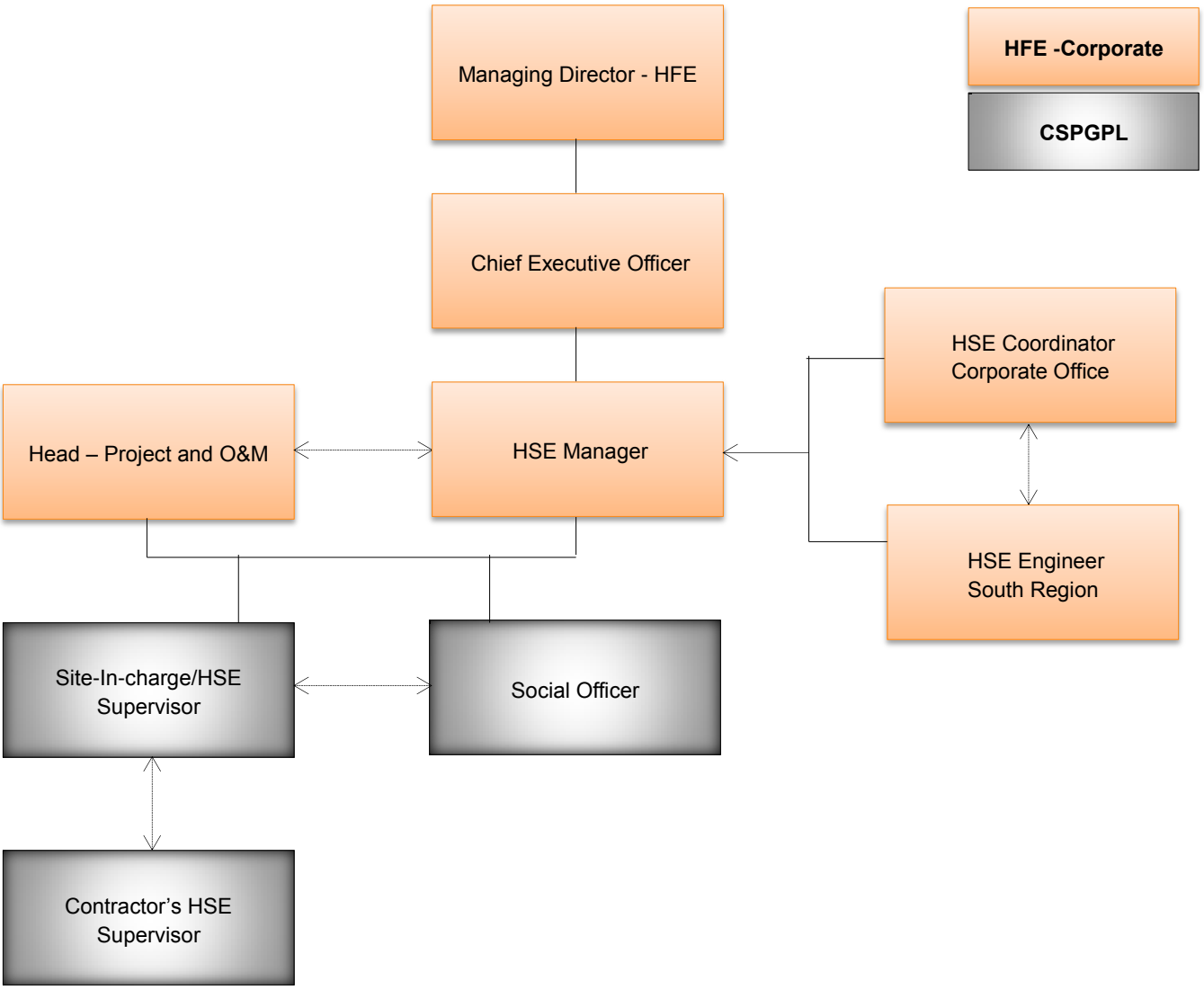


Figure 8-1: Proposed Project Organisation Structure

8.3 Roles and Responsibilities

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

Site-In-Charge/HSE Supervisor
The Site-In-Charge is responsible for overall management of the project, ESMP implementation and supervising the HSE aspects related to the project. He/she shall report to the HSE Manager. The following tasks will fall within his/her responsibilities:

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

- Conduct training programs and awareness activities on health and safety for site staff and community;
- Preparation of necessary documents and record keeping system;
- Review and updating of ESMP for its effective implementation;
- He will have the authority to issue the work permit system for working at heights during O&M phase of the project;
- The person will be responsible for arrangement of first aid and firefighting equipments at the site office;
- The person will maintain the records of near miss and incidents that can happen at site, if any; and
- The person will be responsible for maintaining records of hazardous waste generated on site on monthly basis and ensure its proper disposal to authorized vendors of KSPCB only.

Social Officer
The Social Officer will have the following responsibilities:

- Undertaking community development initiatives in the Project villages;
- Planning, implementing and recording all the CSR activities being undertaken for the Project;
- Managing all grievances of the Project and recording the actions taken;
- Acting as a point of contact for local residents and community members;
- Providing training and guidance to the employees and workers on how to behave with the community to avoid conflicts;
- Develop a Grievance Redressal Mechanism in lines with informing the local community about the Grievance Redressal Mechanism and ensuring effective implementation; and
- Conducting periodic meetings with local community for understanding their grievances and outcomes of the CSR activities;

8.4 Monitoring and Audit

The ESMP will have to be monitored on a regular basis in order to ensure effective implementation. The HSE team of the CSPGPL will undertake inspection and monitoring of the environmental and social impacts of construction and operation phase activities in order to ensure the effectiveness of suggested mitigation measures.

- CSPGPL will ensure that all their contractors comply 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 HSE commitments of the 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 the CSPGPL;
- The inspection and audit findings will be implemented by contractor management in the areas of concern; and
- The entire process of inspections and audits will be documented.

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).

8.5 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 that document control is ensured. The following records shall be maintained at site:

- Documented Environment and Social Management System;
- Legal Register;
- Operation control procedures;
- Work instructions;
- Incident reports;
- Emergency preparedness and response procedures;
- Training records;
- Monitoring reports;
- Auditing reports; and
- Complaints register, and issues attended/closed.

8.6 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, CSPGPL shall ensure that the job specific training and HSE 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. L&T is responsible for ensuring that their workers are provided HSE training as stipulated. A training register should be kept on site for all training conducted onsite.

An environmental and social management training programme shall be conducted to ensure effective implementation of the management and control measures during construction and operation of the project. The training programme shall ensure that all concerned members of the team understand the environmental and social risks associated with 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 sub-contracted labour, are trained adequately before assignments begin.

Table 8-1: Training Requirements for the project

Topic	Training Content	Targeted Audience
General Project Awareness	• Benefits of the Project; • Type of land required for the project; and • Possible Employment Opportunities.	Local Communities
Environmental and Social Management training	• Purpose of action plan for the project activities; • Requirements of the specific Action Plans; • Understanding of the sensitive environmental and social features within and surrounding the project areas; • Understanding of the potential risks from the project activities; and • Action items to be taken in case of “chance find” during excavation works.	Site-In-Charge and Sub-Contracted Workers
Occupational Health & Safety Training	• The importance of conforming with all HSE policies; • The HSE impacts of the proposed activities; • HSE benefits of improved personal performance; • Worker roles and responsibilities in achieving conformance with the client’s HSE policy, procedures and this ESMP including associated procedures and emergency preparedness and response requirements; • Mitigation measures required to be implemented when carrying out their work activities; • Use of PPE; • Job Safety Analysis;	Site-In-Charge and Sub-Contracted Workers First Aiders and Fire Fighters

Topic	Training Content	Targeted Audience
	• First aid trainings and awareness regarding medicines; • Fire drills and usage of fire extinguishers at the time of emergency; and • Maintaining accident and incident investigation reports.	

8.7 Management Plans

8.7.1 Introduction

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.

8.7.2 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.[15] 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.

Stakeholder Engagement

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 can 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.

[15] IFC's Stakeholder Engagement- A Good Practice Handbook for Companies doing Business in Emerging Markets

- *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

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 in ***Annexure IV*** to identify and classify the stakeholders.

Stakeholders 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 ***Annexure V.*** 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:

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 Management Plan, Stakeholder Engagement Plan and Social Management Plan shall be made available for the stakeholders if asked for. The hard copies of the same should be placed at the project site office.

Table 8-2: 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	• Relevant when the majority of the affected communities' population comprises of minorities or marginalized groups.

Communicative Methods	Objective	Relevance
	nature.	• 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.

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.

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:

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

8.7.3 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.

Importance of Grievance Redressal Mechanism

For successful construction and operation of developmental projects, Grievance redressal mechanism is an important tool. The primary objective of a Grievance redressal mechanism is to develop and promote practices which would ensure creation and sustenance of healthy stakeholder relationships and redressal and expeditious settlement of genuine grievances of the workers and the management staff. Its aim is to be gender inclusive, social class inclusive and a continuous and transparent stakeholder engagement process. Grievance redressal mechanism is developed with the prime intention of being a primary apparatus for identification of complaints, its subsequent assessment and thereafter the resolution of the complaints.

Stages of Grievance Redressal Mechanism

As the Grievance Redressal Mechanism for is currently not in place the following section will provide certain recommendations which should be considered while developing a Grievance Redressal Mechanism:

i. **Development of Procedures**: HFE/CSPGPL should ensure that there is a procedure in place at the site level to lodge and register complaints. Identification of a community liaison officer is the foremost step to develop a grievance redressal mechanism. It should be followed by the procedure of receiving complaints, assessment of complaints, procedure to identify the appropriate resolution path and decision making on the final resolution process. These procedures are to be given appropriate time frames to ensure effective and suitable redressal.

ii. **Development of Responses and Suitable Options**: The second step would be to develop appropriate responses for the received/anticipated grievances. Procedures to reach an appropriate resolution should be in place. It could include formal or informal procedures to reach a resolution such as discussions and negotiations. Resolutions can be reached through mediation with the intervention of a third-party generally a community leader or prominent member of the community.

iii. **Publicise the Grievance Redressal Mechanism**: There is a requirement to publicise the grievance redressal mechanism as when there is awareness creation of the mechanism there will be increased involvement of the stakeholders. Information dissemination to the local community comprises of the next step. The publicising of the GRM can be done through stakeholder engagement activities such as focus group discussions, local community meetings, and development of communicative methods such as printing of pamphlets with the telephone number of the Grievance officer, installation of grievance boxes at suitable locations, updating of websites etc. The GRM should be documented both in the native language (Kannada) and English for wider outreach.

iv. **Training on Grievance Redressal Mechanism**: As the GRM is now in place, it is a prerequisite that the community members and the workers are informed on the procedures involved in the mechanism. For the workers, at the time of recruitment and formal induction programme they can also be trained on the workings of the GRM. During these trainings the whole process of the GRM should be discussed. It includes the identification and appointment of a local point of contact, process of registering a grievance, timelines for redressal of the complaints and information on the personnel involved in the redressal process.

v. **Recording of Grievances**: After the dissemination of the provision of the Grievance redressal Mechanism, it is a prerequisite that HFE/CSPGPL should start receiving and addressing the grievances. Required grievances boxes, record books and tracking form should be in order to address and record the grievances.

vi. **Resolution and Follow up Action**: On receiving the complaints and grievances, the corrective action to be taken should be discussed and implemented within stipulated time frames in each level. Record of follow up action in the form of photographs, agreements between the project proponent and the complainant should be documented for reference purposes.

vii. **Appeals**: On account of the complainant not being satisfied with the follow up action, the individual should be offered an appeal process. Involvement of the HFE in the appeal process is encouraged to maintain transparency and accountability.

Proposed Grievance Redressal Mechanism

i. **Formation of a Grievance Redressal Committee**: For the purpose of the successful implementation of the GRM, it is a prerequisite that a Grievance Redressal Committee is formed. The formation of the GRC would provide a stipulated framework for the receipt and redressal of grievances. Representatives in the Grievance Redressal Committee should comprise of:

Figure 8-2: Grievance Redressal Committee

ii. Community Liaison Officer can be designated as the point of contact at the site level. The functions of the Grievance Redressal Committee are:

- To record grievances brought up by the community members and the workers/management staff.
- To assess and prioritize the grievances and redressal of the grievances within a stipulated time-frame.
- To inform the aggrieved community members and workers/management staff on the progress of the grievance redressal and the outcome or decisions taken by the committee.
- Grievance Redressal Committee at the site level should inform the concerned at the corporate level at the event of escalation.
- Grievance Redressal Committee should proactively analyse the received grievance and accordingly act towards redressing it.
- To continually review the existent Grievance Redressal Mechanism and its applicability on the basis of local customary tradition and culture. Thereafter should initiate systemic reforms/modifications if required for better connectivity and implementation of the GRM.

iii. **Formation of Criteria for Classification of Grievances**: HFE can formulate a table for classification of the grievances. A sample of which can be found below:

Table 8-3: Classification of Grievances

Code No	Criteria
01	Human Resources Related
02	Community Related Grievances

Stages of Grievance Redressal Mechanism

As Grievance Redressal would involve a multitude of individuals, information and action responses, it is imperative to develop a structure which would assist in effective information gathering, recording and Addressal of the grievances received. The steps for developing a Grievance Redressal process have been provided below:

Receive and Register a Complaint

i. Installation of secured Grievance boxes at relevant sites (such as site office, substation) within the project area.
ii. Dissemination of the mobile-phone number of the Community Liaison Officer as a point of contact for grievances to community members/workers through display at strategic locations in the site.
iii. A stakeholder with a concern/grievance regarding the onsite safety, community health and safety, compensation related grievance may register a written complaint to the appointed grievance officer and drop the written complaint at the grievance boxes installed at different locations.
iv. The complainant may have the option of lodging complaints verbally as many may not have the ability to write.

v. The complainant should have the option to remain anonymous while registering the complaint.
vi. Once received, a database in the form of a Grievance Register or computerised database should be maintained.

Assessment and Addressal of the Complaint

i. The Community Liaison Officer is advised to check and open the grievance boxes every fifteen (15) days.
ii. The grievances will be assessed by the grievance officer in a stipulated time frame of two (02) working days to determine if the issues raised by the complainant falls within the mandate of the grievance mechanism or not.
iii. During the assessment phase, the Grievance Redressal Committee (Level I) team will assess the complaints and discuss the key issues and methods to address the issue. The complainant should be made aware of the results within fifteen (15) working days.
iv. If the grievance of cannot be resolved at Site (Level I), then the case will be referred/forwarded to the (Level II) for redressal.
v. The solution for the grievance shall be devised in five (05) working days by the committee at Level II.
vi. On the event of no resolution at Level II, the complainant will have the option to approach the appropriate court of law for redressal.
vii. The complainant will have the opportunity to present and discuss the grievance at all levels of the GRC.

Documentation and Reporting

Documentation and Reporting are important components of Grievance Redressal Mechanism. They help to keep track of the grievances and can be used as a databank for future responses/mitigation measures to similar grievances.

i. **Grievance Tracking Form**: A Grievance Tracking Form should be prepared. It will enable the GRC to trace the grievances and present similar responses.

ii. **Grievances Record Book**: GRC will maintain a record book containing all the received complaints and the actions taken. The record book should include the following details:

   a. The Name of Complainant (optional in case anonymity is asked to be maintained);
   b. Date of the complaint;
   c. Nature of the complaint;
   d. Follow-up Action/Redressal of the complaint;
   e. Date of communication to the complainant of the final result;
   f. Implementation of the decision;
   g. Appeals to higher levels (if any).

iii. **Maintenance of Minutes of Meetings**: The Community Liaison Officer shall be responsible for maintaining the minutes of Meetings with stakeholders, complainants and grievance redressal committee.

Engagement of Third Party

To maintain ultimate transparency and accountability for the grievance mechanism process third parties such as NGOS, local community etc. can at times be involved in the grievance redressal process. These parties can serve as process organisers, mediums through which a complaint can be passed on to the company or they can act as facilitators, witnesses, advisors or mediators. Third parties can assist in enhancing trust level amongst communities as well as assist in overcoming limitation of project level mechanism. The engagement of the third party can thereby be contemplated upon by the company.

Monitoring and Reporting

Monitoring and Reporting are requisite tools for measuring the effectiveness of the grievance mechanism. The implementation and execution of the grievance mechanism is to be regularly monitored and reviewed in order to increase its effectiveness. The efficient use of resources, determining broad trends and acknowledging recurring problems before they reach a higher level of contention. They also create a base level of information that can be used by the project proponent to report back to the stakeholders.

Monitoring: Depending on the extent of project impacts and the volume of grievances, monitoring measures like internal (identified corporate level staff) and external audits (third party consultants) based on the complexity of the grievances received can be adopted by HFE. The frequency of the audits can be decided upon by the corporate level. Through the review and analysis of each grievance and its analysis of its effectiveness and efficiency HFE can draw on the complaints to evaluate systemic deficiencies. In addition monitoring of the grievance mechanism helps ensure that the design and implementation of the mechanism in adequately responding to stakeholders grievances in a cost effective manner.

Reporting: The grievances that have been received and registered are required to be recorded and regularly updated. A sample of grievance record register has been provided as ***Annexure VI*** .The Community Liaison officer at the site level is responsible for discharging his responsibility of recording and updating the grievances and at the time of their audit should be able to present these documents on account of an audit. Minutes of meetings with all stakeholders, complainants and the Grievance Redressal Committee should be documented for reference purposes. In addition to the monitoring and the reporting thereafter it ensures continual improvement on the company's operation is guaranteed. The monitoring reports are also used as a system to report back to the community members on the action/resolution taken in relation to the grievances and the modification/changes proposed to make it more user-friendly.

8.7.4 Environmental Monitoring Programme

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 the following Table 8-4.

Table 8-4: Environmental Performance Monitoring

S. No	Environment Performance Indicator (EPI)	Monitoring Parameter	Period & Frequency
A	**Construction Phase**		
1	Dust generated from site clearance/ levelling	• Visual observation of dust generation	Daily during site preparation
2	Noise emissions from vehicles and machineries	• Noise pressure level in dB(A) • Compliance with CPCB noise limits specified for DG sets • Check for valid certificates of Type Approval and also valid certificates of Conformity of Production for equipment particularly DG sets • Volume of water sourced and consumed	Quarterly during site Preparation Daily during construction phase
3	Fugitive emissions from handling and storage of raw materials	• Visual observation	Daily during construction phase
4	Community health and safety	• Complaints registered by the local communities • No. of. Accidents	Monthly during Construction phase
5	Occupational health and safety	• Health surveillance of workers • Sanitation status of labor camps and canteen • Potable nature of drinking water viz. coliform, pH, TSS, Residual chlorine • Usage of proper PPEs • Safety performance indicators viz. LTIs. Near misses, fatalities etc.	Monthly during construction phase Daily during construction phase
6	Disposal of sewage	• Visual observation of leaks, Overflows etc. • Odour	Daily during construction phase
7	Surface run-off Discharge Domestic waste generation, storage, handling and disposal	• Visual observation of water logging due to drainage disruption • CPCB Inland Water Discharge Parameters • Quantity of waste generated and recycled • Visual observation of waste segregation and storage conditions viz. usage of labelled and covered bins, insect repellents etc. • Awareness level of onsite workers	One representative storm event every year Weekly during construction phase
8	Hazardous chemicals and waste storage, handling and disposal	• Visual observation of chemical storage conditions viz. presence of spill kits, drip trays, fire extinguisher and display of MSDS etc.	Weekly during construction phase

S. No	Environment Performance Indicator (EPI)	Monitoring Parameter	Period & Frequency
		• Quantity of waste oil and other hazardous waste generated and recycled to registered recyclers • Awareness level of onsite workers	
B	**Operation Phase**		
1	Fugitive emissions	• Visual observation of dust generated • Water sprinkling details viz. frequency and quantity	Daily during operational phase
2	Community health and safety	• Complaints registered by the local communities • No. of. Accidents	Monthly during operational phase
3	Occupational health and safety	• Health surveillance of staffs and other workers • Sanitation status of onsite office building and canteen • Potable nature of drinking water viz. coliform, pH, TSS, residual chlorine • Usage of proper PPEs • Safety performance indicators viz. Near misses, fatalities etc.	Monthly during operational phase Daily during operational phase

8.8 Environment and Social Management Plan

The ESMP aims at ensuring the implementation of proposed mitigation and monitoring measures along with the responsible entity for implementation. Although the ESIA process does not reveal any significantly high adverse impacts due to the project, the following Table provides mitigation measures that further reduce the severity of identified adverse impacts on land and environment due to the project activities.

S.No.	Potential Impact/Activity	Mitigation Measures	Monitoring/Training Requirement	Responsibility
Pre-Construction and Construction Phase				
1.	Impact on surface water resources	• Check water quality of surface water sample from the natural pond within the site; • Adequate number, type and location of needed culverts to be constructed; • RO Treated water should be used for drinking by the construction staffs at site.	Testing of surface water quality for drinking water standards	CSPGPL to ensure compliance by construction contractors and sub-contractors
2.	Impact on ground water resources	• Portable toilets provided shall be self-contained and cleaned and disinfected; • Labourers should be educated on environment and health drawbacks of involving in open defection; • Rain water harvesting and increasing the storage capacity of the existing water tanks/ponds, etc to meet the water demands shall be integrated; • RO Treated water is to be used for drinking by the construction staffs at site.	Testing of ground water quality for drinking water standards	CSPGPL to ensure compliance by construction contractors and sub-contractors
3.	Impact on ambient air quality	• Localized sprinkling of water at areas where vegetation is removed; • Loose excavated soils shall be kept covered or kept wet in designated storage areas; • Regular maintenance of vehicles shall be carried out; • Idling time of vehicles shall be reduced.	Undertake ambient air quality monitoring at construction locations and at labour camp when work is ongoing.	CSPGPL to ensure compliance by construction contractors and sub-contractors
4.	Impact on ambient noise quality	• Construction activities shall be planned in consultation with local communities; • Construction equipment will be maintained in good working order and properly muffled; • Construction vehicles shall be well maintained and idling time will be minimized; • Community residing in the adjoining plot of the project boundary shall be consulted from time to time and in case of any noise related grievances must be addressed on priority, if required the community shall also be provided with PPEs to minimize their exposure to noise during construction period; • Site workers working near high noise areas shall	Undertake ambient noise quality monitoring at construction location, at labour camp and at nearest residential location when work is ongoing.	CSPGPL to ensure compliance by construction contractors and sub-contractors

S.No.	Potential Impact/Activity	Mitigation Measures	Monitoring/Training Requirement	Responsibility
		use personal protective equipment (PPEs) like ear plugs and earmuffs to minimize their exposure to noise.		
5.	Impact on Soil Quality	• The area in the project site shall be re-vegetated with local species; • All construction material stored within the site shall be covered; • All vehicles carrying construction material shall be covered; • Construction debris and excavated material shall be used for filling up of low lying areas; • Temporary paved areas shall be constructed to be used while refuelling the machineries. In case of any accidental spill, the affected soil shall be cut out and stored securely for disposal with hazardous waste.	Inspection of storage of areas where construction material is stored;	CSPGPL to ensure compliance by construction contractors and sub-contractors
6.	Impact on Ecology	• Plantation of native plant species in all suitable parts of the project site; • Topographic alteration in the project area should be kept to the minimal and natural drainage pattern of the project site should be maintained; • Maintain any existing natural vegetation along the road alignments; • Activities that require high levels of illumination to be restricted to daylight hours to prevent disruption of the natural night period by artificial lighting; • Use of visual markers on cables to render them relatively more visible to aerially moving organisms.	The entire workforce shall be sensitized (by the construction contractor) to possible adverse ecological impacts during the construction phase by conducting awareness programs.	CSPGPL to ensure compliance by construction contractors and sub-contractors
7.	Impact on Socio-Economic Aspect	• Endeavour to procure land on a willing-buyer willing seller basis and provide suitable remuneration; • Provide suitable fertile agricultural land in the surrounding areas wherever available; • Provision of employment to the local workforce and on absence of required skill set could employ migrant workers; • Primarily engage local contractors and vendors.	Monitor the land procurement process and compensation paid on time; Maintain a record of all sale deeds executed; Monitor the site preparation activities.	CSPGPL
8.	Impact due to Migrant Labour	• Provide employment to the local workforce also; • Labour campsite is well managed with adequate sanitation and waste disposal facilities are to be arranged; • An orientation programme for the migrant worker population on the local customs and traditions should be conducted; • Conduct a medical check-up camp on the arrival of the migrant workforce to identify and mitigate communicable diseases.	Records related to wages, age, leave etc to be maintained; HSE training sessions for all workmen/staffs	CSPGPL to ensure compliance by construction contractors and sub-contractors
9.	Impact on Traffic activity	• Prior sharing of information with the local residents restricting access during the movement of heavy machinery and equipment; • Only trained drivers with valid license shall be hired; • Training programs shall be conducted at regular intervals for all the drivers; • Regular maintenance of vehicles and use of manufacturer approved parts should be adopted.	Monitor Vehicles PUC certificates; Training Records of Drivers Engaged to be maintained	CSPGPL to ensure compliance by construction contractors and sub-contractors
10.	Impact on Occupational Health and Safety	• Construction contractor follows the site specific Emergency Preparedness and Response Procedure. The On-Site emergency procedure shall provide details of the anticipated emergencies, the emergency organization, facilities, emergency procedures and roles and responsibilities; • CSPGPL shall ensure that adequate training is provided to workers and staffs hired by construction contractor about awareness on use	Records and details of PPE usage, Work permits, First Aid and regulatory compliances should be maintained.	CSPGPL to ensure compliance by construction contractors and sub-contractors

S.No.	Potential Impact/Activity	Mitigation Measures	Monitoring/Training Requirement	Responsibility
		of Personal Protection Equipment (PPE) and emergency response measures; • CSPGPL shall introduce administrative controls into work processes such as job rotation, rest and stretch breaks etc to reduce overexertion; • Work site layout will be well planned to avoid manual transfer of heavy loads. It shall also ensure good housekeeping at the construction site to avoid slips and falls; • Excessive waste debris and liquid spills will be cleaned up regularly, while electrical cords and ropes will be placed along identified corridors marked for attention of everyone at site; • Use of personal fall arrest system, such as full body harnesses as well as fall rescue procedures to deal with workers whose fall has been successfully arrested shall also been carried out; • Dropping/lowering of construction material or tool will be restricted and undertaken only under strict supervision, if required; • PPEs such as safety glasses with side shields, face shields, hard hats and safety shoes shall be mandatory at construction site. Ear plugs shall be provided for workers placed at high noise areas.		
11.	Impact on Archaeological important and Cultural Heritage sites	• Should any archaeological materials or cultural heritage site be uncovered or exposed during earthworks or excavations, they will immediately be reported to the project in-charge who will in turn report to the Director General of National Monuments Authority; • Training session on health and safety should include sensitizing the contractor and site staffs about culturally heritage sites and action points in case of encounter with a previously unknown cultural heritage site.	Training on action to be taken in case of encounter with previously unknown cultural heritage site.	CSPGPL to ensure compliance by construction contractors and sub-contractors
Operation Phase				
12.	Impact on ground water resources	• Wastage of water during cleaning of panels shall be avoided; • Other alternative measures such as rain water harvesting and increasing the storage capacity of the existing water tanks/ponds, etc to meet the O&M water demands need to be integrated; • Hire local contractors to supply packed drinking water for the staffs.	Ground water sample testing at the project site location.	CSPGPL
13.	Impact on soil quality	• Temporary paved areas shall be constructed to be used while refuelling the machineries; • A separate designated area shall be demarcated within the project boundary to store the Hazardous waste generated, procedures to store, handle and dispose these wastes will be as per the Hazardous Waste Management Handling and Trans-boundary Movement Rules 2016.	Site engineers and maintenance staff need to be aware and trained about the procedure for proper storage and disposal waste oil and how to act in case of accidental oil spillage; Ground water sample and soil sample testing needs to be undertaken at the waste oil handling and storage location.	CSPGPL
14.	Impact on Occupational Health and Safety	• 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 at all strategic locations to deal with any incident of fire.	All safety related incidents will be recorded and monitored, in order to ultimately achieve “zero incidences” level. Training to be provided to the workers regarding health and safety procedures. Workers to be trained for use of Personal Protection Equipment and its importance.	CSPGPL

S.No.	Potential Impact/Activity	Mitigation Measures	Monitoring/Training Requirement	Responsibility
15.	Impact on Ecology	• Installing the solar panels in small, discrete clusters, rather than installing them in one continuous swathe; • Ensure that all electrical components are adequately insulated; • Restrict project- operation activities to the daytime and avoiding use of artificial lighting in and around the project site as far as possible; • Strictly prohibiting the use of herbicides in the facility and opting for manual weeding to control plant growth in the solar panel area; • The use of dust-settling chemicals in the facility should be avoided; • Implement good operational practices and training to the staff and site workers to ensure prevention of spillages.	Training the vegetation controlling and cleaning manpower on long term issues of herbicide usage.	CSPGPL
16.	Visual Impact/Glaring	• Arrange the panels in a systematic manner which will give an aesthetic sense; • Include boundary wall around the perimeter of the project	Internal audits and community meetings	CSPGPL
17.	Impact on Socio-Economic Aspect	• Engage local workforce population for unskilled jobs like grass cutting, cleaning, housekeeping staffs at the site office and security personnel wherever possible; • Communicate and consult with the community members of Bejjihalli village and develop required infrastructure for the village.	Any community development activities will be guided and implemented in accordance with the community development policy of CSPGPL.	CSPGPL
Decommissioning Phase				
18.	Impact on Air, Soil, Noise, Ecology and Socio-Economic Aspects	• Designated waste disposal sites should be marked for disposal of all redundant and discarded solar panels until disposed-off to KSPCB authorised hazardous waste handlers; • All waste generated from decommissioning shall be collected and disposed of at the nearest municipal disposal site; • 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 increase noise levels; • Inform workers and local community about the duration of work.	Information to workers/staffs of close down; Training on safe handling of bulk hazardous wastes generated at site	CSPGPL
Cumulative Impacts				
19.	Impact on ground water resource, waste management and socio-economic status	• The proposed project location and the existing project location is classified as “critical zone” with respect to its ground water resources, although ground water can be used with due approval it is recommended to integrate other alternative water conservation measures such as rain water harvesting, treating and recycling of domestic waste water and increasing the storage capacity of the existing water tanks/ponds to hold rain water; • Obtain Hazardous waste authorisation for generation of Hazardous waste and comply with the Hazardous waste rules 2016; • Operation of solar power projects in the area where land is barren and not fit for agriculture, will bring in prosperity in terms of provision of jobs for both skilled and unskilled labour like housekeeping and cleaning staffs, security guards and minor electrical and civil works; • The projects will also engage local contractors and vendors for food for staffs and drinking water supplies etc.	Testing of groundwater and soil of the area; Any community development activities will be guided and implemented in accordance with the community development policy of CSPGPL.	CSPGPL along with project proponent of adjoining solar project in the vicinity.

9. CONCLUSION

The Environmental and Social Assessment study for the proposed 30 MW solar power project in Tumkur District of Karnataka has been undertaken in accordance with IFC's Performance Standards.

The ESIA study aimed to identify and evaluate potential environmental impacts associated with all aspects of the proposed project. The conclusion and recommendations of this study are result of on-site inspections, the evaluation of impacts identified, and the process of stakeholder consultation. The impacts due to the project are site specific and reversible and availability of land with is suitable for establishing the proposed project.

Therefore, the solar power project can be categorized as ***Category B***, viz., projects with potential limited adverse environmental and social risks and/or impacts that are few in number, generally site-specific, largely reversible and can readily addressed through corrective action plan.

The rationale for categorization is provided below:

- Private land required for the project has been procured on willing seller/willing buyer basis with individual negotiation with the land owners through a land aggregator and outcome of the stakeholder consultations held with the owners does not identify any discontentment amongst the sellers;
- No issues pertaining to resettlement and rehabilitation;
- No baseline soil contamination within the project site;
- The site is not located in an ecologically sensitive area or forest land;
- The site is not located in the immediate vicinity of any archeologically important or culturally heritage site;
- Development of the proposed solar project will have social and environmental impacts like dependence on area's water resources, occupational health & safety hazards, ecological impacts like site specific habitat loss and fragmentation, generation of hazardous wastes (in the form of the discarded solar panels) which can be readily addressed with implementation of the suggested mitigation measures;
- Solar Power projects would eventually reduce Greenhouse emissions that would have occurred for generation of same amount of energy from Fossil fuel powered plants; and
- The project will bring positive impacts through the creation of direct and indirect employment and business opportunities which will increase the socio-economic status of the area.

Annexure 1: List of Fauna in the study area

List of Fauna having recorded ranges that include the study area:

Table 5: Resident Birds of the Study Area

Sr. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
1.	*Francolinus pictus*	Painted Frankolin	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	II
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	-
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
34.	*Pernis ptilorhynchus*	Oriental Honey Buzzard	LC	IV
35.	*Neophron percnopterus*	Egyptian Vulture	EN	IV
36.	*Gyps bengalensis*	White-rumped Vulture	CR	I

Sr. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
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.	*Clanga hastata*	Indian Spotted Eagle	VU	IV
44.	*Aquila rapax*	Tawny Eagle	LC	IV
45.	*Aquila fasciata*	Bonelli's Eagle	LC	IV
46.	*Nisaetus cirrhatus*	Crested Hawk Eagle	LC	IV
47.	*Ardeotis nigriceps*	Great Indian Bustard	CR	I
48.	*Sypheotides indicus*	Lesser Florican	EN	I
49.	*Amaurornis phoenicurus*	White-breasted Waterhen	LC	IV
50.	*Amaurornis akool*	Brown Crake	LC	IV
51.	*Turnix sylvaticus*	Small Buttonquail	LC	IV
52.	*Turnix suscitator*	Barred Buttonquail	LC	IV
53.	*Porphyrio porphyrio*	Purple Swamphen	LC	IV
54.	*Gallinula chloropus*	Common Moorhen	LC	IV
55.	*Fulica atra*	Eurasian Coot	LC	IV
56.	*Burhinus (oedicnemus) indicus*	Indian Thick-knee	LC	-
57.	*Esacus recurvirostris*	Great Thick-knee	NT	-
58.	*Hydrophasianus chirurgus*	Pheasant-tailed Jacana	LC	IV
59.	*Metopidius indicus*	Bronze-winged Jacana	LC	IV
60.	*Vanellus malabaricus*	Yellow-wattled Lapwing	LC	IV
61.	*Vanellus indicus*	Red-wattled Lapwing	LC	IV
62.	*Charadris dubius*	Little Ringed Plover	LC	IV
63.	*Rostratula bengalensis*	Greater Painted-snipe	NA	IV
64.	*Cursorius coromandelicus*	Indian Courser	LC	-
65.	*Glareola lactea*	Small Pratincole	LC	-
66.	*Sterna aurantia*	River Tern	NT	-
67.	*Pterocles exustus*	Chestnut-bellied Sandgrouse	LC	IV
68.	*Pterocles indicus*	Painted Sandgrouse	LC	IV
69.	*Columba livia*	Common Pigeon	LC	-
70.	*Streptopelia orientalis*	Oriental Turtle Dove	LC	IV
71.	*Streptopelia decaocto*	Eurasian Collared Dove	LC	IV
72.	*Streptopelia tranquebarica*	Red Collared Dove	LC	IV
73.	*Stigmatopelia chinensis*	Spotted Dove	LC	IV
74.	*Stigmatopelia senegalensis*	Laughing Dove	LC	IV
75.	*Treron phoenicopterus*	Yellow-footed Green Pigeon	LC	IV
76.	*Psittacula krameri*	Rose-ringed Parakeet	LC	IV
77.	*Psittacula cyanocephala*	Plum-headed Parakeet	LC	IV

Sr. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
78.	*Clamator jacobinus*	Jacobin Cuckoo	LC	IV
79.	*Hierococcyx varius*	Common Hawk Cuckoo	LC	IV
80.	*Cacomantis sonneratii*	Banded Bay Cuckoo	LC	IV
81.	*Cacomantis passerinus*	Grey-bellied Cuckoo	LC	IV
82.	*Eudynamis scolopaceus*	Asian Koel	LC	IV
83.	*Rhopodytes viridirostris*	Blue-faced Malkoha	LC	IV
84.	*Taccocua leschenaultii*	Sirkeer Malkoha	LC	IV
85.	*Centropus (sinensis) parroti*	Southern Coucal	LC	IV
86.	*Tyto alba*	Barn Owl	LC	IV
87.	*Otus bakkamoena*	Indian Scops Owl	LC	IV
88.	*Glaucidium radiatum*	Jungle Owlet	LC	IV
89.	*Athene brama*	Spotted Owlet	LC	IV
90.	*Bubo bubo*	Eurasian Eagle Owl	LC	IV
91.	*Ketupa zeylonensis*	Brown Fish Owl	LC	IV
92.	*Strix ocellata*	Mottled Wood Owl	LC	IV
93.	*Caprimulgus atripennis*	Jerdon's Nightjar	LC	IV
94.	*Caprimulgus asiaticus*	Indian Nightjar	LC	IV
95.	*Caprimulgus affinis*	Savanna Nightjar	LC	IV
96.	*Cypsiurus balasiensis*	Asian Palm Swift	LC	-
97.	*Hemiprocne coronata*	Crested Tree Swift	LC	-
98.	*Apus affinis*	Little Swift	LC	-
99.	*Upupa epops*	Common Hoopoe	LC	IV
100.	*Coracias benghalensis*	Indian Roller	LC	IV
101.	*Halcyon smyrnensis*	White-throated Kingfisher	LC	IV
102.	*Alcedo atthis*	Common Kingfisher	LC	IV
103.	*Ceryle rudis*	Pied Kingfisher	LC	IV
104.	*Merops orientalis*	Green Bee-eater	LC	-
105.	*Ocyceros birostris*	Indian Grey Hornbill	LC	-
106.	*Megalaima zeylanica*	Brown-headed Barbet	LC	IV
107.	*Megalaima haemacaphala*	Coppersmith Barbet	LC	IV
108.	*Dendrocopos nanus*	Brown-capped Pygmy Woodpecker	LC	IV
109.	*Dendrocopos mahrattensis*	Yellow-crowned Woodpecker	LC	IV
110.	*Dinopium benghalense*	Lesser Goldenback	LC	IV
111.	*Chrysocolaptes festivus*	White-naped Woodpecker	LC	IV
112.	*Tephrodornis pondicerianus*	Common Woodshrike	LC	IV
113.	*Artamus fuscus*	Ashy Woodswallow	LC	-
114.	*Coracina macei*	Large Cuckooshrike	LC	IV
115.	*Aegithina tiphia*	Common Iora	LC	IV
116.	*Pericrocotus cinnamomeus*	Small Minivet	LC	IV
117.	*Lanius vittatus*	Bay-backed Shrike	LC	-
118.	*Lanius meridionalis*	Southern Grey Shrike	NA	-

Sr. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
119.	*Dicrurus macrocercus*	Black Drongo	LC	IV
120.	*Dicrurus caerulescens*	White-bellied Drongo	LC	IV
121.	*Oriolus xanthornus*	Black-hooded Oriole	LC	-
122.	*Rhipidura (albicollis) albogularis*	White-spotted Fantail	NA	-
123.	*Rhipidura aureola*	White-browed Fantail	LC	-
124.	*Dendrocitta vagabunda*	Rufous Treepie	LC	IV
125.	*Corvus (macrorhynchos) culminatus*	Indian Jungle Crow	LC	IV
126.	*Corvus splendens*	House Crow	LC	V
127.	*Parus major*	Great Tit	LC	IV
128.	*Ptyonoprogne concolor*	Dusky Crag Martin	LC	-
129.	*Petrochelidon fluvicola*	Streak-throated Swallow	LC	-
130.	*Hirundo smithii*	Wire-tailed Swallow	LC	-
131.	*Mirafra cantillans*	Singing Bushlark	LC	IV
132.	*Mirafra affinis*	Jerdon's Bushlark	LC	IV
133.	*Ammomanes phoenicura*	Rufous-tailed Lark	LC	IV
134.	*Eremopteryx griseus*	Ashy-crowned Sparrow Lark	LC	IV
135.	*Alauda gulgula*	Oriental Skylark	LC	IV
136.	*Pycnonotus jacosus*	Red-whiskered Bulbul	NA	IV
137.	*Pycnonotus cafer*	Red-vented Bulbul	LC	IV
138.	*Pycnonotus luteolus*	White-browed Bulbul	LC	IV
139.	*Prinia hodgsonii*	Grey-breasted Prinia	LC	-
140.	*Prinia sylvatica*	Jungle Prinia	LC	-
141.	*Prinia socialis*	Ashy Prinia	LC	-
142.	*Prinia inornata*	Plain Prinia	LC	-
143.	*Cisticola juncidis*	Zitting Cisticola	LC	-
144.	*Orthotomus sutorius*	Common Tailorbird	LC	-
145.	*Dumetia hyperythra*	Twany-bellied Babbler	LC	IV
146.	*Turdoides caudata*	Common Babbler	LC	IV
147.	*Turdoides malcolmi*	Large Grey Babbler	LC	IV
148.	*Turdoides striata*	Jungle Babbler	LC	IV
149.	*Turdoides affinis*	Yellow-billed Babbler	LC	IV
150.	*Chrysomma sinense*	Yellow-eyed Babbler	LC	IV
151.	*Zosterops palpebrosus*	Oriental White-eye	LC	IV
152.	*Acridotheres tristis*	Common Myna	LC	IV
153.	*Sturnia pagodarum*	Brahminy Starling	LC	IV
154.	*Zoothera citrina*	Orange-headed Thrush	LC	-
155.	*Copsychus saularis*	Oriental Magpie Robin	LC	IV
156.	*Saxicoloides fulicatus*	Indian Robin	LC	IV
157.	*Saxicola caprata*	Pied Bushchat	LC	IV
158.	*Cyornis tickelliae*	Tickell's Blue Flycatcher	LC	IV
159.	*Chloropsis jerdoni*	Jerdon's Leafbird	LC	IV

Sr. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
160.	*Dicaeum agile*	Thick-billed Flowerpecker	LC	IV
161.	*Dicaeum erythrorhynchos*	Pale-billed Flowerpecker	LC	IV
162.	*Leptocoma zeylonica*	Purple-rumped Sunbird	NA	IV
163.	*Cinnyris asiaticus*	Purple Sunbird	LC	IV
164.	*Passer domesticus*	House Sparrow	LC	-
165.	*Gymnoris xanthicollis*	Chestnut-shouldered Petronia	LC	-
166.	*Ploceus philippinus*	Baya Weaver	LC	IV
167.	*Euodice malabarica*	Indian Silverbill	LC	IV
168.	*Amandava amandava*	Red Avadavat	LC	IV
169.	*Lonchura striata*	White-rumped Munia	LC	IV
170.	*Lonchura punctulata*	Scaly-breasted Munia	LC	IV
171.	*Lonchura malacca*	Black-headed Munia	LC	IV
172.	*Motacilla maderaspatensis*	White-browed Wagtail	LC	IV
173.	*Anthus rufulus*	Paddyfield Pipit	LC	IV

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

Source: R. Grimmett, C. Inskipp & T. Inskipp (2011). Birds of the Indian Subcontinent. Oxford University Press, pp 1-528; IUCN (2015). The IUCN Red List of Threatened Species. Version 2015-4; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Table 6: Migratory Birds of the Study Area

Sr. No.	Scientific Name	Common Name	Season of migration	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	Winter	LC	IV
16.	*Falco tinnunculus*	Common Kestrel	Winter	LC	IV
17.	*Falco peregrinus*	Peregrine Falcon	Winter	LC	IV
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	-
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	IV
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
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

Sr. No.	Scientific Name	Common Name	Season of migration	IUCN Status*	WPA Schedule**
43.	*Coracina melanoptera*	Black-headed Cuckooshrike	Passage Migrant	LC	IV
44.	*Lanius cristatus*	Brown Shrike	Winter	LC	-
45.	*Lanius schach*	Long-tailed Shrike	Winter	LC	-
46.	*Dicrurus leucophaeus*	Ashy Drongo	Winter	LC	IV
47.	*Oriolus (oriolus) kundoo*	Indian Golden Oriole	Winter	LC	IV
48.	*Terpsiphone paradisi*	Asian Paradise-flycatcher	Winter	LC	IV
49.	*Hirundo rustica*	Barn Swallow	Winter	LC	IV
50.	*Cecropis daurica*	Red-rumped Swallow	Winter	NA	IV
51.	*Acrocephalus dumetorum*	Blyth's Reed Warbler	Winter	LC	-
52.	*Phylloscopus humei*	Hume's Leaf Warbler	Winter	LC	-
53.	*Phylloscopus trochiloides*	Greenish Warbler	Passage Migrant	LC	-
54.	*Sylvia curruca*	Lesser Whitethroat	Winter	LC	-
55.	*Sylvia althaea*	Hume's Whitethroat	Passage	LC	-
56.	*Sylvia hortensis*	Orphean Warbler	Winter	LC	-
57.	*Sturnia malabarica*	Chestnut-tailed Starling	Winter	NA	IV
58.	*Pastor roseus*	Rosy Starling	Winter	NA	IV
59.	*Luscinia svecica*	Bluethroat	Winter	LC	IV
60.	*Phoenicurus ochruros*	Black Redstart	Winter	LC	IV
61.	*Saxicola torquatus*	Common Stonechat	Winter	LC	IV
62.	*Monticola solitarius*	Blue Rock Thrush	Winter	LC	IV
63.	*Muscicapa dauurica*	Asian Brown Flycatcher	Winter	LC	IV
64.	*Ficedula superciliaris*	Ultramarine Flycatcher	Winter	LC	IV
65.	*Eumyias thalassinus*	Verditer Flycatcher	Winter	LC	IV
66.	*Motacilla flava*	Yellow Wagtail	Winter	LC	IV
67.	*Motacilla cinerea*	Grey Wagtail	Winter	LC	IV
68.	*Motacilla alba*	White Wagtail	Winter	LC	IV
69.	*Anthus godlewskii*	Blyth's Pipit	Winter	LC	IV
70.	*Anthus trivialis*	Tree Pipit	Winter	LC	IV
71.	*Anthus hodgsoni*	Olive-backed Pipit	Winter	LC	IV
72.	*Carpodacus erythrinus*	Common Rosefinch	Winter	LC	IV

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Table 7: Mammals of the Study Area

Sr. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
1	*Macaca radiata*	Bonnet Macaque	LC	II
2	*Semnopithecus hypoleucos*	Southern Plains 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	NT	I
10	*Sus scrofa*	Indian Wild Pig	LC	III
11	*Panthera pardus*	Common Leopard	NT	I
12	*Felis chaus*	Jungle Cat	LC	II
13	*Prionailurus bengalensis*	Leopard Cat	LC	I
14	*Prionailurus viverrinus*	Fishing Cat	LC	I
15	*Prionailurus rubiginosus*	Rusty Spotted Cat	VU	I
16	*Paradoxurus hemaphroditus*	Common Palm Civet	LC	II
17	*Viverricula indica*	Small Indian Civet	LC	II
18	*Herpetes edwardsii*	Grey Mongoose	LC	II
19	*Herpetes smithii*	Ruddy Mongoose	LC	IV
20	*Hyaena hyaena*	Striped Hyaena	NT	III
21	*Canis lupus*	Grey Wolf	LC	I
22	*Canis aureus*	Golden Jackal	LC	II
23	*Vulpes bengalensis*	Indian Fox	LC	II
24	*Mellivora capensis*	Honey Badger	LC	I
25	*Lutrogale perspicillata*	Smooth-coated Otter	VU	I
26	*Lepus nigricollis*	Indian Hare	LC	IV
27	*Manis crassicaudata*	Indian Pangolin	NT	I
28	*Anathana ellioto*	Southern Tree Shrew	LC	II
29	*Suncus murinus*	House Shrew	LC	II
30	*Suncus etruscus*	Pygmy White-toothed Shrew	LC	-
31	*Hystrix indica*	Indian Crested Porcupine	LC	IV
32	*Funambulus palmarum*	Three-striped Palm Squirrel	LC	-
33	*Tatera indica*	Indian Gerbil	LC	-
34	*Vandeleuria oleracea*	Indian Long-tailed Tree Mouse	LC	V
35	*Mus musculus*	House Mouse	LC	V
36	*Mus booduga*	Little Indian Field Mouse	LC	V
37	*Millardia meltada*	Soft-furred Field Rat	LC	V
38	*Madromys blanfordi*	White-tailed Wood Rat	LC	V
39	*Golunda ellioti*	Indian Bush Rat	LC	V
40	*Bandicota indica*	Large Bandicoot Rat	LC	V

Sr. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
41	*Bandicota bengalensis*	Indian Mole Rat	LC	V
42	*Rattus rattus*	House Rat	LC	V
43	*Megaderma lyra*	Greater False Vampire	LC	-
44	*Hipposideros fulvus*	Fulvous Leaf-nosed Bat	LC	-
45	*Pipistrellus ceylonicus*	Kelaart's Pipistrelle	LC	-

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

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

Source: Vivek Menon (2014), *Indian Mammals: A Field Guide.* Hachette Book Publishing India Pvt. Ltd., Gurgaon, India, pp 1-522; IUCN (2016). *The IUCN Red List of Threatened Species.* Version 2016-3.

Table 8: Reptiles of the Study Area

Sr. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
1	*Ramphotyphlops braminus*	Brahminy Worm Snake	NA	IV
2	*Grypotyphlops acutus*	Beaked Worm Snake	NA	IV
3	*Python molurus molurus*	Indian Python	NA	I
4	*Gongylophis conicus*	Common Sand Boa	NA	IV
5	*Eryx johnii*	Red Sand Boa	NA	IV
6	*Coelognathus helena Helena*	Common Trinket Snake	NA	IV
7	*Ptyas mucosa*	Indian Rat Snake	NA	II
8	*Argyrogena fasciolata*	Banded Racer	NA	IV
9	*Oligodon taeniolatus*	Russell's Kukari Snake	LC	-
10	*Oligodon arnensis*	Common Kukri Snake	NA	-
11	*Dendrelaphis tristis*	Common Bronzeback Tree Snake	NA	-
12	*Lycodon striatus*	Barred Wolf Snake	NA	IV
13	*Lycodon aulicus*	Common Wolf Snake	LC	IV
14	*Dryocalamus nympha*	Bridal Snake	NA	IV
15	*Sibynophis subpunctatus*	Dumeril's Black-headed Snake	NA	-
16	*Xenochrophis piscator*	Checkered Keelback	NA	II
17	*Amphiesma stolatum*	Striped Keelback	NA	-
18	*Macropisthodon plumbicolor*	Green Keelback	NA	-
19	*Boiga trigonata*	Common Cat Snake	LC	-
20	*Ahaetulla nasuta*	Common Vine Snake	NA	IV
21	*Bungarus caeruleus*	Common Krait	NA	IV
22	*Calliophis melanurus*	Slender Coral Snake	NA	-
23	*Naja naja*	Spectacled Cobra	NA	II
24	*Daboia russelii*	Russell's Viper	LC	II
25	*Echis carinatus*	Saw-scaled Viper	NA	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 (2016). *The IUCN Red List of Threatened Species.* Version 2016-3; *Schedules I to VI: Indian Wildlife (Protection) Act, 1972*

Annexure 2: List of Participants

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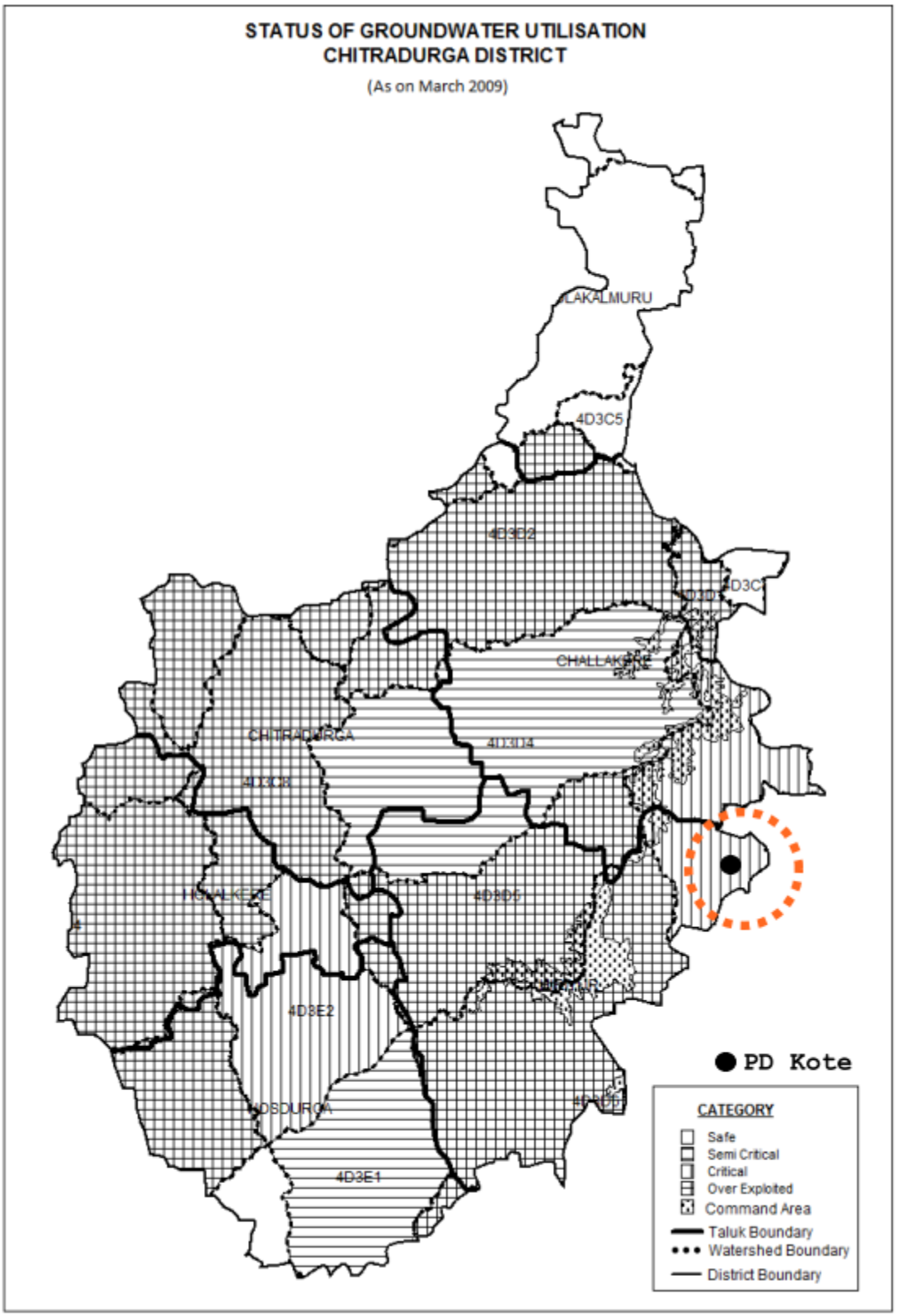
Participant List

S.No.	Name	Address	Signature
1	Srinivasan	Bejihalli	D. Srinivas
2	Manjunath	Bejihalli	
3	T.V. CHANDRASHEKAR	—	[illegible]
4	THRIMURTHY. BV	Bejjihally	Thrimurthy BV
5	B.T. Nagaraja	—	B.T. Nagaraja
6	D Ramesh	—	[illegible]
7	[illegible]	—	[illegible]
8	Thippamma. D	—	Thippamma D.
9	Krishnappa BR	—	Krishna
10	B.T. Thuppamma	—	B.T. Thuppamma
11	G.B. Basavaraj	—//—	Basavaraj
12	Sadashivaiah. B-G	—"—	Sadashivaiah BG
13	Thimma Reddy KR		Bejjihally
14	Jagadish B.R		Bessihally
15	[illegible]		Bessihally
16	[illegible]	—"—	[illegible]
17	Kamala	—"—	Kamala
18	[illegible]	—"—	[illegible]
19	Paramesh. B.E	—"—	[illegible] B E
20	Hemjanappa	—"—	Hemjanappa

Date: 18/05/17
30 MW, Solar Project, Bejihalli

Annexure 3: Status of the groundwater utilisation of Chitradurga district



Source: Ground Water Information Booklet Chitradurga District, Karnataka State, February 2013

Annexure 4: Identified Stakeholders

IDENTIFIED STAKEHOLDERS

Name of the Project: _____ Date: _____

S. No.	**Types of Stakeholders**	**Description**	**Groups/Individuals**
1.	Direct Stakeholders		
2.	Indirect Stakeholders		

_____

Signature of Community Liaison Officer

Annexure 5: Summary Of Consultation Activities

SUMMARY OF CONSULTATION ACTIVITIES

Name of project: _____ Date: _____

Identified Stakeholder	Objective	Communicative method Utilised	Proposed Timeline	Responsibility

_____

Signature of Community Liaison Officer

Annexure 6: Grievance Record Register

GRIEVANCE RECORD REGISTER

Name of project: _____ Date: _____

S.No	Date of Receipt	Particulars of the Complainant				Particulars of the Grievance			
		Name	Address	Contact no.	Whether acknowledgement given at the time of receipt	Subject of the Grievance	Description of Grievance	Date of acknowledgement	Date of redress

_____

Signature of the Community Liaison Officer

Annexure 7: Information on Silicon Tetrachloride

SILICON TETRACHLORIDE

STC

CAUTIONARY RESPONSE INFORMATION

Common Synonyms
Silicon chloride

Liquid Colorless to light yellow Suffocating odor

Reacts violently with water. Irritating gas is produced on contact with water.

Evacuate.
KEEP PEOPLE AWAY.
AVOID CONTACT WITH LIQUID AND VAPOR.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Notify local health and pollution control agencies.
Protect water intakes.

Fire

Not flammable.
DO NOT USE WATER OR FOAM ON ADJACENT FIRES.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled will cause difficult breathing.
Move victim to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
POISONOUS IF SWALLOWED.
Will burn skin and eyes.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. CORRECTIVE RESPONSE ACTIONS

Dilute and disperse
Stop discharge
Chemical and Physical Treatment:
Neutralize
Do not add water to undissolved material
Pump or dredge contaminated sediment

2. CHEMICAL DESIGNATIONS

2.1 CG Compatibility Group: Not listed.
2.2 Formula: $SiCl_4$
2.3 IMO/UN Designation: 8/1818
2.4 DOT ID No.: 1818
2.5 CAS Registry No.: 10026-04-7
2.6 NAERG Guide No.: 156
2.7 Standard Industrial Trade Classification: 52241

3. HEALTH HAZARDS

3.1 Personal Protective Equipment: Acid-canister-type gas mask or self-contained breathing apparatus; goggles or face shield; rubber gloves; other protective clothing to prevent contact with skin.

3.2 Symptoms Following Exposure: Inhalation causes severe irritation of upper respiratory tract resulting in coughing, choking, and a feeling of suffocation; continued inhalation may produce ulceration of the nose, throat, and larynx; if inhaled deeply, edema of the lungs may occur. Contact of liquid with eyes causes severe irritation and painful burns; may cause permanent visual impairment. Liquid may cause severe burns of skin. Repeated skin contact with dilute solutions or exposure to concentrated vapors may cause dermatitis. Ingestion causes severe internal injury with pain in the throat and stomach, intense thirst, difficulty in swallowing, nausea, vomiting, and diarrhea; in severe cases, collapse and unconsciousness may result.

3.3 Treatment of Exposure: Get medical attention at once following any exposure to this compound. INHALATION: remove victim from contaminated atmosphere; if breathing has ceased, start mouth-to-mouth resuscitation; oxygen should only be administered by an experienced person when authorized by a physician; keep patient warm and comfortable. EYES: immediately flush with large quantities of running water for a minimum of 15 min.; continue irrigation for an additional 15 min. if physician is not available. SKIN: immediately flush affected area with water; severe or extensive burns may be caused by silicon tetrachloride, producing shock symptoms (rapid pulse, sweating and collapse); keep patient comfortably warm. INGESTION: if patient is conscious give large amounts of lime water or milk of magnesia; plain water should be given if neither of these is available; do NOT give sodium bicarbonate or make any attempt to induce vomiting; if patient is unconscious, do not give anything but ensure there is no obstruction to breathing (tongue should be kept forward and false teeth removed); he will be less likely to aspirate vomitus if placed in a face-downward position.

3.4 TLV-TWA: Not listed.
3.5 TLV-STEL: Not listed.
3.6 TLV-Ceiling: Not listed.
3.7 Toxicity by Ingestion: Grade 4; LD_{50} <50 mg/kg
3.8 Toxicity by Inhalation: Currently not available.
3.9 Chronic Toxicity: Currently not available
3.10 Vapor (Gas) Irritant Characteristics: Vapors cause severe irritation of eyes and throat and can cause eye and lung injury. They cannot be tolerated even at low concentrations.
3.11 Liquid or Solid Characteristics: Currently not available
3.12 Odor Threshold: Currently not available
3.13 IDLH Value: Not listed.
3.14 OSHA PEL-TWA: Not listed.
3.15 OSHA PEL-STEL: Not listed.
3.16 OSHA PEL-Ceiling: Not listed.
3.17 EPA AEGL: Not listed

4. FIRE HAZARDS

4.1 Flash Point: Not flammable
4.2 Flammable Limits in Air: Not flammable
4.3 Fire Extinguishing Agents: Not pertinent
4.4 Fire Extinguishing Agents Not to Be Used: Water or foam on adjacent fires
4.5 Special Hazards of Combustion Products: Not pertinent
4.6 Behavior in Fire: Contact with water in foam applied to adjacent fires will produce irritating fumes of hydrogen chloride.
4.7 Auto Ignition Temperature: Not pertinent
4.8 Electrical Hazards: Not pertinent
4.9 Burning Rate: Not pertinent
4.10 Adiabatic Flame Temperature: Currently not available
4.11 Stoichometric Air to Fuel Ratio: Not pertinent.
4.12 Flame Temperature: Currently not available
4.13 Combustion Molar Ratio (Reactant to Product): Not pertinent.
4.14 Minimum Oxygen Concentration for Combustion (MOCC): Not listed

5. CHEMICAL REACTIVITY

5.1 Reactivity with Water: Reacts vigorously with water to evolve hydrogen chloride (hydrochloric acid)
5.2 Reactivity with Common Materials: In presence of moisture will corrode metals; the reaction is not violent.
5.3 Stability During Transport: Stable
5.4 Neutralizing Agents for Acids and Caustics: Flood with water, rinse with sodium bicarbonate or lime solution.
5.5 Polymerization: Not pertinent
5.6 Inhibitor of Polymerization: Not pertinent

6. WATER POLLUTION

6.1 Aquatic Toxicity: Currently not available
6.2 Waterfowl Toxicity: Currently not available
6.3 Biological Oxygen Demand (BOD): None
6.4 Food Chain Concentration Potential: None
6.5 GESAMP Hazard Profile:
Bioaccumulation: 0
Damage to living resources: 1
Human Oral hazard: 1
Human Contact hazard: II
Reduction of amenities: XX

7. SHIPPING INFORMATION

7.1 Grades of Purity: Technical: 99.7+%; C.P.: 99.9+%
7.2 Storage Temperature: Ambient
7.3 Inert Atmosphere: Dry air
7.4 Venting: Pressure-vacuum
7.5 IMO Pollution Category: Currently not available
7.6 Ship Type: Currently not available
7.7 Barge Hull Type: Currently not available

8. HAZARD CLASSIFICATIONS

8.1 49 CFR Category: Corrosive material
8.2 49 CFR Class: 8
8.3 49 CFR Package Group: II
8.4 Marine Pollutant: No
8.5 NFPA Hazard Classification: Not listed
8.6 EPA Reportable Quantity: Not listed.
8.7 EPA Pollution Category: Not listed.
8.8 RCRA Waste Number: Not listed
8.9 EPA FWPCA List: Not listed

9. PHYSICAL & CHEMICAL PROPERTIES

9.1 Physical State at 15° C and 1 atm: Liquid
9.2 Molecular Weight: 169.9
9.3 Boiling Point at 1 atm: 135.7°F = 57.6°C = 330.8°K
9.4 Freezing Point: –94°F = –70°C = 203°K
9.5 Critical Temperature: 452.5°F = 233.6°C = 506.8°K
9.6 Critical Pressure: 542 psia = 36.8 atm = 3.74 MN/m^2
9.7 Specific Gravity: 1.48 at 20°C (liquid)
9.8 Liquid Surface Tension: 19.6 dynes/cm = 0.0196 N/m at 20°C
9.9 Liquid Water Interfacial Tension: Not pertinent
9.10 Vapor (Gas) Specific Gravity: 5.86
9.11 Ratio of Specific Heats of Vapor (Gas): Currently not available
9.12 Latent Heat of Vaporization: 74.2 Btu/lb = 41.2 cal/g = 1.73 X 10^5 J/kg
9.13 Heat of Combustion: Not pertinent
9.14 Heat of Decomposition: Not pertinent
9.15 Heat of Solution: –742 Btu/lb = –412 cal/g = –17.3 X 10^5 J/kg
9.16 Heat of Polymerization: Not pertinent
9.17 Heat of Fusion: Currently not available
9.18 Limiting Value: Currently not available
9.19 Reid Vapor Pressure: Currently not available

NOTES

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