Initial Environment Examination

Project Number: 56116-001
Draft
September 2022

India: FPL Tamil Nadu Open Access Solar Project

Prepared by AECOM India Private Limited for the Fourth Partner Energy Private Limited and Asian Development Bank.

Environment and Social Impact Assessment

50 MW (AC) Solar Power Project, Sivaganga, Tamil Nadu, India

Fourth Partner Energy Private Limited

15 September 2022

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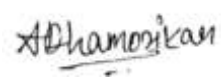			
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Revision History

Revision	Revision date	Details	Authorized	Name	Position
00	26 July 2022	Draft ESIA	Yes	Chetan Zaveri	Vice President Environment
01	30 July 2022	Draft ESIA	Yes	Chetan Zaveri	Vice President Environment
02	16 Aug 2022	Final ESIA	Yes	Chetan Zaveri	Vice President Environment
03	15 September 2022	Final ESIA	Yes	Chetan Zaveri	Vice President Environment

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No	Yes	Fourth Partner Energy Private Limited

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List of Abbreviations

SNo.	Abbreviation	Extension
1.	AC	Alternate Current
2.	AAQ	Ambient Air Quality
3.	AoI	Area of Influence
4.	CGWA	Central Ground Water Authority
5.	CPCB	Central Pollution Control Board
6.	CPR	Common Property Resource
7.	CTE	Consent to Establish
8.	CTO	Consent to Operate
9.	CSR	Corporate Social Responsibility
10.	CR	Critically Endangered
11.	DPR	Detailed Project Report
12.	DG	Diesel Generator
13.	DC	Direct Current
14.	FPEPL	Fourth Partner Energy Private Limited
15.	ERT	Emergency Response Team
16.	EN	Endangered
17.	EPC	Engineering, Procurement and Construction
18.	EPA	Environment (Protection) Act, 1986
19.	EAP	Environment Action Plan
20.	ESIA	Environment and Social Impact Assessment
21.	ESMP	Environment and Social Management Plan
22.	ESMS	Environment and Social Management System
23.	EMS	Environment Management System
24.	EHS	Environment, Health and Safety
25.	FGD	Focus Group Discussions
26.	GOM	Government of Tamil Nadu
27.	GP	Gram Panchayat
28.	GHG	Green House Gases
29.	GSS	Grid Sub -Station
30.	GRM	Grievance Redress Mechanism
31.	TNPCB	Tamil Nadu Pollution Control Board
32.	TNPCL	Tamil Nadu Power Corporation Limited
33.	TNUVNL	Tamil Nadu Urja Vikas Nigam Limited
34.	HSE	Health, Safety and Environment
35.	ISA	Implementation and Support Agreement
36.	IMD	Indian Meteorological Department
37.	IP	Indigenous People

SNo.	Abbreviation	Extension
38.	IFC	International Finance Corporation
39.	IUCN	International Union for Nature and Natural Resources
40.	MW	Mega Watt
41.	MoEF&CC	Ministry of Environment, Forest and Climate Change
42.	MNRE	Ministry of New and Renewable Energy
43.	NOC	No Objection Certificate
44.	O&M	Operations and Maintenance
45.	PRI	Panchayati Raj Institution
46.	PPE	Personal Protective Equipment
47.	PV	Photo Voltaic
48.	PUC	Pollution Under Control
49.	PSS	Pooling Sub-station
50.	PPA	Power Purchase Agreement
51.	PIC	Prior Informed Consent
52.	SC	Scheduled Caste
53.	ST	Scheduled Tribe
54.	SPV	Special Purpose Vehicle
55.	TL	Transmission Line
56.	VU	Vulnerable
57.	WMP	Waste Management Plan
58.	WPA	Wildlife Protection Act

1. Introduction

Fourth Partner Energy Pvt. Ltd. (hereinafter referred to as FPEPL or client is India's leading solar energy company. FPEPL are committed to helping businesses switch to cleaner, cheaper solar power. Since inception in 2010, they have leveraged technology and innovation to become a one-stop renewable energy solutions platform for India's commercial and industrial sectors. Fourth Partner Energy offers onsite & offsite solar, energy trading, battery storage and electric vehicle infrastructure solutions. In the past decade, have progressed from being a leader in Solar EPC to having developed in-house, end-to-end services across evaluation, design, financing, procurement, construction, operation and maintenance of solar infrastructure, helping the company deliver the lowest total cost of ownership to the client. FPEPL gives a very wide range of solar solutions which includes on-site solar facilities (rooftop solar, ground mounted solar), off-site open access solar (group captive solar, captive solar and third party) and innovative solar solutions. FPEPL has 3 SPVs as FPEL Mitra Pvt. Ltd., FP Suntastic Pvt. Ltd. and FP Orion Pvt. Ltd.

50 MW (AC) solar power plant (also referred to as the Project or Solar Park) in Tamil Nadu is proposed to be set up by FPEPL. AECOM India Private Limited (hereinafter referred to as 'AECOM') has been appointed by FPEPL to undertake the Environment and Social Impact Assessment (ESIA) study to evaluate environment and social risks and impacts associated with the Project. The ESIA study comprised of a reconnaissance survey, baseline environmental monitoring, primary ecological survey, data analysis and consultations and discussions with relevant stakeholders.

Key project features of the project are as follows:

Table 1-1: Key Project Features of The Project

Sr. No.	Description	Details
Site Details		
1.	Plant Location	Pulavanvayal Village, Siramam (Branch - PO), Kalayarkoil Taluk, Sivaganga District, Tamil Nadu 630554
2.	Latitude and Longitude	9°45'32.99"N 78°35'56.64"E
Power plant details		
3.	Power plant capacity	50 MW AC (75 MW DC)
4.	Type of system	Grid connected
5.	Rooftop/ground mounted	Ground mounted
6.	Module mounting structure	Fix
7.	PV Technology	Mono perc
8.	Inverter capacity	200 kW/250 kW string inverter
9.	Remote monitoring system	Yes
10.	Project life	25 years
11.	Expected duration of execution	15 months

1.1 Project Background

The proposed ground mounted solar photovoltaic power plant (SPP) is of 50 MW AC (75 MW DC) capacity to be located at Pulavanvayal Village, Siramam (Branch - PO), Kalayarkoil Taluk, Sivaganga District in the state of Tamil Nadu. The said SPP would be connected to 110/22 kV bay Maravamangalam Substation. No energy storage in the form of batteries has been envisaged. The plant capacity will be sufficient to meet the load of the plant for the entire day. The site location is easily accessible from air, road or railways.

The said project will be built with latest cutting-edge technology products consisting above 540Wp Mono Perc solar panels, 200kW/250kW string solar inverters, AC/DC LT cables, step-up transformer, auxiliary transformers, HT cables, HT panels, LT panels, lightening arrestors, earthing, etc

The intent of the project is to utilize the available solar energy to produce electrical energy through Ground Mounted Grid-tied Solar PV power plant. This power plant will be connected at 110 kV bay at 110/22KV Maravamangalam substation. A 110 kV transmission line will connect the solar power plant to substation.

1.2 Purpose and Scope of Work

The main purpose of the ESIA study is to identify, evaluate and manage environmental and social impacts that may arise during the development and operation of the project. The objectives of the ESIA study have been detailed below:

- Reconnaissance survey and primary site assessment to collect and review baseline environmental and social conditions;
- Collection of secondary environmental, social and demographic information;
- Identification and review of the applicable environment and social standards and identification of key issues;
- Assessment of potential environment and social impacts of the project and its components;
- Identifying key stakeholders and undertaking stakeholder consultations to assess the influence and impact of the proposed project on them;
- Preparing an ESIA Report encompassing all components of the baseline study, impacts assessed, documented consultations undertaken and management plans to mitigate the impacts assessed; and
- Developing an Environmental and Social Management Plan (ESMP) based on the impacts identified

1.3 Applicable Reference Framework

The following reference framework is referred to while developing the ESIA Report for the project:

- Applicable Indian EHS and Social regulations (including relevant approvals, permits and consents obtained);
- IFC Performance Standards Framework 2012;
- World Bank Group (WBG) Environment, Health and Safety (EHS) General Guidelines, 2007;
- IFC/World Bank EHS Guidelines for Electric Power Transmission and Distribution (2007).
- ADB Safeguard Policy Statement (SPS) (2009);
- ADB Social Protection Strategy (2001);
- ADB Gender and Development Policy (1998);
- ADB Access to Information Policy (2019).

1.4 Approach and Methodology

The approach and methodology applied for the execution of the impact assessment study is as provided:

- The relevant project documents and detailed project report were reviewed to understand the project requirements;
- Regulatory review was undertaken to understand the applicable, local and national legislation and regulatory frameworks;

- A detailed social and environmental assessment of the site and surrounding areas was undertaken through the following:
  - Reconnaissance surveys to understand site specific issues;
  - Discussions with the local community;
  - Collation of secondary information on social aspects of the site, supplemented by consultations with the local communities to understand community perception with regard to the project and its activities;
  - Stakeholder mapping and Identification;
  - Focused group consultations;
  - Field surveys and data compilation;
  - Group/Community Consultations: Group meetings and consultations with local and community representatives; and
- Assessment of impacts based on understanding of the project activities as told during site visit and documents;
- Preparation of an Environment and Social Management Plan (ESMP).

1.4.1 Delineation of the Study Area/Area of Influence

A case study approach was adopted to understand the various criteria for delineation of the study area or area of influence. IFC categorises the project primarily according to the significance and nature of its impacts. IFC defines the project's area of influence as the primary project site(s) and related facilities that the client (including its contractors) develops or controls; shared 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 independent of the project.

IFC Sustainability Framework and Performance Standards (PS), World Bank EHS Guidelines and sector-specific (as applicable) environmental, health and safety guidelines as well as national regulatory requirements suggest that primary baseline data is to be collected so that it reflects the pollutants of concern associated with project processes. Since the proposed project is a renewable energy project and is located in the barren region and is devoid of much habitation, industrial activity or other pollution sources, hence, primary impacts from the proposed solar power project have been assessed in and around a radius of 2 kilometres (km) around the Project Site and secondary impacts have been assessed in and around a radius of 5 km around the Project Site.

Therefore, for the purpose of the ESIA study, an area of 5 km (aerial distance) radius has been considered as the Area of Influence (AoI) for identification and assessment of potential environmental and social impacts around the proposed project.

- **Direct Impact Zone (Core Components):** The area covering the Project Site, internal transmission line corridor and direct access road to the project is designated as the area under the direct influence of the project for environmental, ecological and social impacts.
- **Indirect Impact Zone (Shared Facilities):** Area outside the direct impact zone of the project, up to a radius of 5 km, is considered as the indirect influence zone for the project for environmental, ecological and social impacts.

All the baseline environmental profiling, including environmental monitoring, socio-economic studies and public consultations, have been carried out within the AoI of 5 km.

In order to include the farthest anticipated direct receptors of biodiversity-related impacts, AoI for the biodiversity studies was delineated as the proposed Project Site, along with the area extending outward up to a radius of 5 km from the Project Site boundary.

1.4.2 Desktop Review

AECOM carried out a desk-based review of the information shared by the client prior to mobilizing for the site visit for undertaking the Impact assessment. As part of the review, the proposed project area was screened using Google Earth. Based on the review of Google Earth imagery, the environmental and social settings to be covered as part of the site visit were assessed and subsequently scoped in.

The desk-based review was primarily focussed on but was not limited to the following documents:

- Detailed project report (DPR);
- PVsyst simulation report;
- Various land related documents;
- Organizational chart; and
- Other Project related documents.

1.4.3 Screening and Scoping

At the initial stage of the impact assessment, a preliminary level screening and scoping assessment of the project and its components, including an appraisal of the higher-level environment and social (E&S) risks, screening of the project site and shared facilities (including the access roads, transmission lines, substation, sources of raw material etc.) was undertaken. The screening and scoping study was conducted to identify the likely impacts that the development of the project will have on environment, biodiversity and social conditions in the AoI, to establish an understanding of the various linkages between the lifecycle phases of the project and the associated environmental, social and ecological aspects and development of the activity-impact matrix for the project, to identify the various stakeholders to be consulted for the ESIA study and develop a forward-going approach and methodology to be adopted including E&S baseline development, stakeholder engagement, impact assessment and development of the Environment and Social Management Plan (ESMP).

The screening and scoping assessment was undertaken based on the understanding of the objective and scope of work and AECOM's experience of working on renewable energy projects, especially the solar energy sector.

The AECOM team, comprising of one (1) EHS expert, one (1) Social expert and one (1) bio-diversity expert undertook a site visit to the project location between 27th June to 30th June 2022. One (1) social expert from AECOM visited the site between 22nd to 24th June 2022.

As part of the site visit, the following key activities were undertaken:

- Meeting with the on-site project team;
- Site walk along the land parcel earmarked for the project;
- Site walk through the proposed site for the Pooling Substation (PSS) of the solar power park and the Tamil Nadu corporation substation;
- Consultations with members of local communities nearby villages;
- Preliminary biodiversity observations on habitats types.

1.4.4 Site Survey

AECOM team conducted a site survey between 22nd to 24th June 2022 and 27th to 30th June 2022. The following activities were undertaken during this visit:

- Undertake environmental assessments to gain an understanding of the following and consultations with site representatives:
  - Site setting assessment of 5 km study area for the project site;
  - Study of key environmental receptors such as large water bodies, forest area, man-made sensitivities such as schools, colleges, hospitals etc.
- Undertake environmental monitoring and collection of baseline environmental data; however due to unfavourable conditions at site it was decided to shift the monitoring at the later stage
- Undertake social assessments and consultations in the form of individual interviews and focused group discussions (FGDs) with the following key stakeholder groups:
  - Local stakeholders; and
  - Institutional stakeholders/government departments.
- Collection of biodiversity baseline data and key stakeholder consultations (Forest department, local community, etc.).

1.4.5 Baseline Data collection

Environmental baseline data was collected through primary monitoring and reconnaissance surveys of the study area (5 km distance around the project site). Secondary information through literature surveys was also collected for the study area. The baseline study included the following:

- Primary environmental baseline data collection within the study area - The primary environmental was not collected due to ongoing land purchase activities. Social baseline data was collected for socio-economics profile. The ecology and biodiversity data were also collected as part of the primary data collection;
- The GIS mapping of the study area was done to present details on land use pattern, forest/ vegetation cover, settlements, water bodies, drainage pattern, spot heights and contours; and
- Information on geology, meteorological conditions, water and ecological resources, socio-economic status etc. was collected from secondary sources.

1.4.6 Stakeholder Consultation

During the site visit for ESIA, following groups of stakeholders were consulted with the objective of collecting baseline data/information:

- **Institutional Stakeholders:** Consultations with Panchayat Representatives, Sub-Registrar, Medical Officers, Forest officials, etc.
- **Local communities**: Consultations with landowners, women groups, farmers, shepherds, etc., were conducted; and
- **FPEPL site representative**: Consultations were undertaken with the FPEPL site team along with land aggregator during visit.

1.4.7 Impact Assessment

Impact identification and prediction were undertaken on the basis of documents provided for review and site visits conducted. The major processes involved are:

- Identification – to define the impacts associated with different phases of the project and the activities undertaken;
- Prediction – to forecast the nature, magnitude, type, duration, extent, scale, frequency likelihood and sensitivity of the major impacts identified; and

- Evaluation – to determine the significance of residual impacts i.e. taking into account how mitigation will reduce a predicted impact.

Professional judgement, experience and knowledge of similar projects were used for impact analysis. The extent and potential consequences of the impacts have been compared against applicable reference framework. Mitigation measures have been suggested for each of the identified adverse impacts.

1.4.8 Environment and Social Management Plan

This section delineates the roles and responsibility and timeline for implementing mitigation measures to prevent the significant impacts arising from activities during different phases of the project.

1.5 Layout of Report

The current ESIA Report has been arranged under the following chapters:

1. **Chapter One: Introduction** (This chapter provides a background of the project and the current Report, the objectives with which the study has been undertaken, the scope of work, etc.)
2. **Chapter Two: Project description** (This chapter provides details of the project location, key project components and utilities, land requirements, power purchase agreement, current project status, etc.)
3. **Chapter Three: Environment and Social Regulatory Framework** (This chapter encompasses the national administrative requirements, applicable permits, licences, approvals and consents and project categorisation as per Reference Framework)
4. **Chapter Four: Environmental and Socio-economic Baseline** (This chapter illustrates the environmental baseline, socio-economic baseline and Ecology baseline)
5. **Chapter Five: Stakeholder Engagement and Consultation** (This section presents the key stakeholders consulted during this study)
6. **Chapter Six: Analysis of Alternatives** (This section presents the analysis of alternatives for the proposed solar project)
7. **Chapter Seven: Impact Assessment** (This chapter highlights the impact assessment criteria, key environmental risks and key social risks)
8. **Chapter Eight: Environment and Social Management Plan** (This chapter highlights the organization structure, training, Inspection monitoring and audit and Documents and record keeping)
9. **Chapter Nine Conclusion and Recommendations**

1.6 Limitations

This report presents the observations made by AECOM's professionals based on the scope of work and agreed approach and methodology with client. The present report has been developed to identify the potential E&S issues and conditions associated with the activities of the project for which the assessment has been carried out. During the course of this assessment, AECOM has attempted to independently assess the potential presence of E&S issues or conditions within the limits of the established scope of work as described in the contract between client and AECOM.

The assessments is based on the information and documents received by AECOM, and the site conditions as witnessed by the AECOM team during the time of the inspection. As with any assessment exercise, there is a certain degree of dependence upon verbal information provided by the point of contact for assessment, limited number of documents available for review and information available in the public domain, which is not readily verifiable through visual observations or supported by any available written documentation. During the course of the site assessment, AECOM has attempted to independently assess the potential presence of such conditions within the limits of the established scope of work as described in the proposal. However, verification of potentially important

facts is not always possible. AECOM shall not be held responsible for conditions or consequences arising from relevant facts that were concealed, withheld, or not fully disclosed by site representative at the time this assessment was performed. The assessment is based on sample site visits carried out by AECOM. This report is to be used to understand the overall E&S requirements of the project covered under this study rather than performance of overall entity. The report is based on inputs received during stakeholder consultations and details shared by client. The outcome of this report can change in case these information is changed at any stage.

This report has been prepared by AECOM for the benefit of its client. AECOM's client may release the information to third parties, who may use and rely upon the information at their discretion. However, any use of or reliance upon the information by any party shall be solely at the risk of such party and without legal recourse against AECOM, its parent, its subsidiaries and affiliates; or their respective employees, officers, or directors; regardless of whether the action in which recovery of damages is sought is based upon contract, tort (including the sole, concurrent, or other negligence and strict liability of AECOM), statute, or otherwise. This information shall not be used or relied upon by a party that does not agree to be bound by the above statement.

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The environmental and social assessment for client is based on the documents made available for review, discussions with site personnel and observations from the site walkthrough of the sample project sites as well as the potential project sites (where investment is probable) undertaken by AECOM professionals at the site during the assessment process. Wherever documentation, policies and procedures for evaluation were not available for review, it has been presented in the report at relevant sections. In addition, wherever AECOM has not been able to make a judgment or assess any process, it has been presented as an information gap and a way forward has been suggested.

2. Project Description

2.1 Project Location

The project is proposed on approximately 225.98 Acres of land in Pulavanvayal Village in Sivaganga district. Transmission line will be traversed from project site till substation to Marvamangalam which is 5.54 kms in length. The site location is easily accessible from air, road or railways.

The project site location has been depicted in the ***Figure 2-1*** below.

2.2 Site Settings

No physical structures were noted on the site during the site visit. The selected site is a relatively flat terrain. The access road running parallel to the site is an existing paved road (~3.5 m wide) and is well connected to nearby villages.

2.2.1 Access

The project site can be accessed through NH 36 which starts at Vikravandi and ends at Manamadurai is total 334 kms of length. This NH is connected with the State Highway numbered 34 which further leads to the project site after taking a turn to the village road. Parallel to SH 34 is SH 29 and the project site can be accessed from here as well. Transmission line from the project area stretches to the substation at Marvamangalam which lies at SH 29.

The nearest Airport is Madurai Airport and is 52 kms away from Sivaganaga. The airport is well connected to many major cities like Bangalore, Chennai, Tirupati, Hyderabad and Mumbai. Airport being an international one is well connected with Colombo and Dubai.

2.3 Status of the Project

For the purpose of the assessment, a site visit was undertaken between 22nd to 24th June 2022 and 27th to 30th June 2022. As on the day of site visit, the project was noted to be in pre-construction phase, and it was noticed that land procurement was under process. As per the information provided on land procurement, 100% of the land is a privately owned land. As on the date of site visit (23rd June 2022), of total 225.98 acres sale deeds were executed for about 82 acres and Power of attorney from the landowners were obtained for 109 acres.

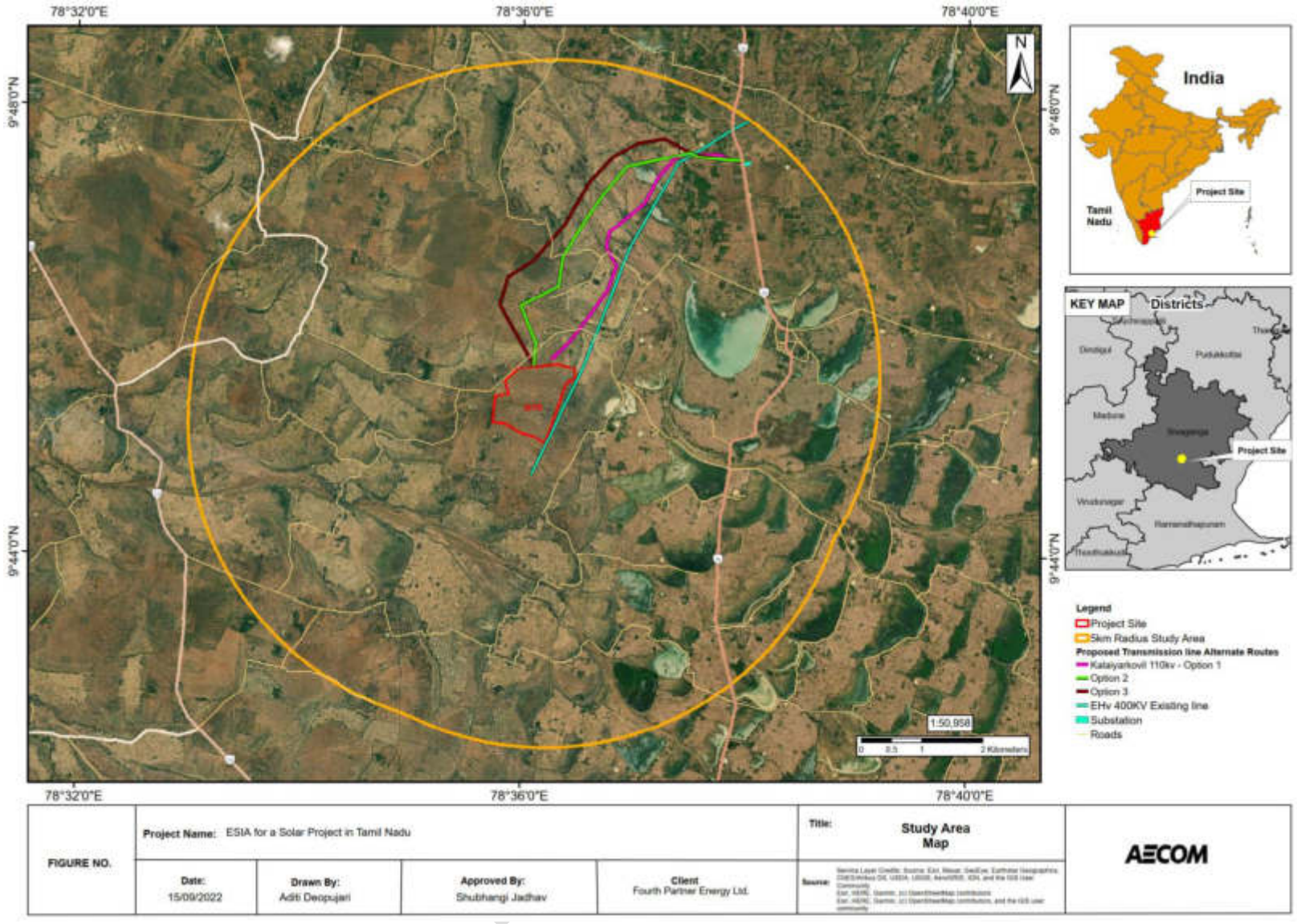

Figure 2-1: Map showing Project Location and Study Area

2.4 Project Overview

2.4.1 Project Components

The project components for a solar power plant include solar PV array, transformer, inverter, transmission line and shared infrastructures (office building, control room, guard room, etc.).

Solar power is trapped through the PV cells in the modules, which are connected to form an array to produce higher voltage. Since the power generated through the solar panels is a Direct Current (DC) and electrical appliances use the Alternating Current (AC), inverters are used to convert DC to AC generated in the solar farms. The power conditioner unit string inverter shall be provided to convert DC power produced by SPV modules, into AC power. The power conditioning unit/inverter shall be grid interactive and also DG set interactive if necessary. Inverter output shall be compatible with the grid frequency.

Details on components of PV solar plant are presented in ***Table 2-1***.

Table 2-1: Components of Solar PV 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 direct current (DC) electricity. A PV power plant contains many cells connected in modules and many modules connected 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 33kV and 230 kV depending on the grid connection point and country standards).
5.	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.

Source: Detailed Project Report (DPR)

2.4.2 PV Plant overview

As light hits the solar panels, the solar radiation is converted into direct current electricity (DC). The direct current flows from the panels and is converted into alternating current (AC) by PCU and then used by local electric utilities.

PV MODULES:

- Solar photo voltaic module array consists of high efficiency above 540Wp solar modules utilizing Mono crystalline high-power Silicon Solar Photovoltaic cells.
- Solar module shall be laminated using lamination technology using established polymer (EVA) and Tedlar / Polyester laminate. Anti-reflection coating to be applied on to cells improve light absorption and to increase cell performance.

[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.

- Modules are made of high transmissivity>4mm tempered glass, front surface giving high encapsulation gain and hot butyl rubber edge sealant for module protection and mechanical support.
- Offered modules are in accordance with the requirements of IEC 61215, IEC 61730 Part 1 & 2 and IEC 61701/IS61701.
- Module Junction box is IP65 has been designed for long life outdoor operation in harsh environment.
- Efficiency of solar PV Module is guaranteed to 90% for up to 10 years & 80% for up to 25 years. Fill factor of modules are greater than 0.70.
- PV modules are equipped with bypass diode to minimize power drop caused by shades.
- PV modules have been designed with suitable encapsulation and sealing arrangements to protect the silicon cells from the environment. The arrangement and the material of encapsulation are compatible with the thermal expansion properties of the Silicon cells and the module framing arrangement/material. It has low iron tempered glass front for strength and superior light transmission. The back sheet has been suitably designed for environment protection against moisture and high voltage electrical insulation. ix. All nuts and bolts shall be made of very good quality stainless steel.
- PV modules have been designed for maximum system voltage of 1500-V DC and have positive output power tolerance.

IDENTIFICATION & TRACEABILITY

- Each PV module is provided with RF identification tag (RFID) which contains the following information:
- Name of manufacturer of PV Module
- Name of manufacturer of Solar cell
- Month & Year of Manufacture (separately for solar cells & module)
- Country of origin (separately for solar cells & module)
- I-V curve for the module
- Peak wattage, Im, Vm & FF for the module
- Unique serial No. & Model No. of the module
- Date & Year of obtaining IEC PV module qualification certificate
- Name of the test lab issuing IEC certificates
- Other relevant information on traceability of Solar cells & module as per ISO 9000 series

MODULE MOUNTING STRUCTURE

- The structure shall be designed to allow easy replacement of any module and shall be in line with the site requirements.
- The support structure design & foundation shall be designed with reference to the existing soil conditions in order to withstand wind speed applicable for the zone (Site Location) or 180kmph, whichever is higher, using relevant Indian wind load codes. The structures and foundations shall also conform to the seismic conditions pertaining to the zone using relevant Standards and codes.
- The structure must be designed with considering appropriate factor of safety.
- The structure shall be designed for simple mechanical and electrical installation. It shall support SPV modules at a given orientation & tilt, absorb and transfer the mechanical loads to the ground properly. Welding of structure at site shall not be allowed.

- The array structure shall be made of mild steel members of suitable sizes with weather protection coating. The coating shall be as per ASTM A792/ A792M-10 standard Al – Zn alloy with hot dip process and thickness of 150GSM or galvanization of 80 microns on both sides to suit the 25 years requirement. It is to ensure that before application of this coating, the steel surface shall be thoroughly cleaned of any paint, grease, rust, scale, acid or alkali or such foreign material as are likely to interfere with the coating process. The bidder should ensure that inner side should also be coated.
- The array structure shall be so designed that it will occupy minimum space without sacrificing the output from SPV panels at the same time.
- Nut & bolts, washers (packing and spring) supporting structures including Module Mounting Structures shall have to be adequately protected from atmosphere and weather prevailing in the area.
- All fasteners shall be of stainless steel of grade SS 316 and must sustain the adverse climatic conditions and long life. Two numbers of anti-theft fasteners of stainless steel on two diagonally opposite corners for each solar module shall also be provided. If any lower grade stainless steel (SS 304, UNS S 20430 or equivalent) fasteners are used, they must have protective corrosion resistance coating.
- Modules shall be clamped & bolted with the structure properly. The material of clamps shall be Al / Steel having weather resistant properties. Clamp – bolt shall use EPDM rubber and shall be designed in such a way so as not to cast any shadow on the active part of a module Developer may use EPDM rubber washers as per the tracker manufacturer recommendation.
- The array structure shall be grounded properly using maintenance free earthing kit.
- Design the structure height considering highest flood level at the site. The minimum clearance between the lower edge of the module and the ground shall be the higher of (i) accessed highest flood level at the site and (ii) 500 mm.
- For multiple module mounting structures located in a single row, the alignment of all modules shall be within an error limit of maximum 10mm.
- Civil foundation design for Module Mounting Structures (MMS) as well as control room, equipment room and power equipment shall be made in accordance with the Indian Standard Codes and prevailing soil conditions. The Successful Bidder shall submit the detailed foundation & structural design analysis along with calculations and basis/ standards in the Bid duly certified by a Chartered Structural Engineer having substantial experience in similar work.
- Cable should pass from Pipes and Cable-ties shall be used to hold and guide the Pipes (cables/wires) from the modules to junction boxes or inverters. All the cables were aesthetically tied to module mounting structure.
- In case the string monitoring unit (SMU or JB) is mounted on the module mounting structure, bidder to take into consideration of the load thus added on the MMS. Accordingly, suitable supporting members for mounting the SMU/ JB must be designed and supplied. Separate structure for mounting of SMU can also be proposed.
- We must submit the complete quality documents i.e. test certificates for all tests conducted starting from raw material stage, in process, final testing w.r.t structure.
- Every major Component of the Plant should be suitably named/ numbered & marked for ease of traceability, identification, and maintenance.

POWER CONDITIONING UNIT (PCU):

The power conditioner unit string inverter shall be provided to convert DC power produced by SPV modules, into AC power. The power conditioning unit/inverter shall be grid interactive and also DG set interactive if necessary. Inverter output shall be compatible with the grid frequency. The salient features of the inverters have been presented in ***Table 2-2*** below and the details have been provided in subsequent sections.

Table 2-2: Typical Technical Feature Of The Inverter

Technical Specification	Value
Nominal AC output voltage and frequency	800V, 3 phase, 50 HZ
Accuracy of AC voltage control	± 0.1%
Output frequency	50 Hz
Accuracy of frequency control	± 0.1%
Grid frequency synchronization range	± 3 Hz
Maximum input DC voltage	Depending on the inverter used
Ambient temperature considered	40 C
Humidity	95% non-condensing
Protection of enclosure	IP-65 (minimum) for outdoor
Grid frequency tolerance range	± 3%
Grid voltage tolerance	-20% & +15%
No-load losses	Less than 1% of rated power
Inverter efficiency (minimum)	>95%
Total harmonic distortion	<3%

Source: Detailed Project Report (DPR)

As per the PVsyst – simulation report on grid connected systems for 50 (AC) MW, some of the key information is mentioned in below.

Table 2-3: PV Array Characteristics Details

PV array characteristics

PV Module		Inverter	
Manufacturer	Renewsys India Pvt Ltd.	Manufacturer	Sungrow
Model	DESERV SGALACTIC 144-540	Module	SG320HX-20A
Unit Nom. Power	540 Wp	Unit Nom. Power	295 KWac
Number of PV Modules	138881 units	Number of inverters	169 units
Nominal (STC)	75.0 MWp	Total power	49855 kWac
Modules	4789 strings X 29 in series	Operating voltage	500-1500 V
Total PV Power		Total Inverter power	

PV array characteristics

Nominal (STC)	74996 kWp	Total Power	49855 kWac
Module area	360661 m2	No. of Inverters	169 units
Cell area	331181 m2		

Source: PVsyst Simulation report (June 2022)

2.4.3 Power Evacuation—Substation and Transmission Line

The PV crystalline silicon technologies have been a proven technology nationally and globally for the past 20+ years in solar market. Various aspects of these technologies have been practically analysed, like generation, requirement of O&M, probability of operational failure etc. by FPEPL. Out of the various factors considered before finalizing this technology for current solar park, practical functionality of the technology was one of the major ones.

Power from the proposed plant will be evacuated to the nearest already existing 110/22kV Substation of Tamil Nadu Transmission Corporation situated at Marvamangalam and can be accessed through at the SH 34. Total length of the transmission line will be ~5 kms and it was known that there is an existing 400 kV line and the proposed 110kV line will run parallel with it. Based on the route alignment survey report by Tamil Nadu transmission corporation ltd. for joining 110 kV line from FPEL Mithra pvt ltd 50 MW AC project to Marvamangalam 110 kV substation, salient features of the TL are listed below in the table 2.4 and figure 2.2 marks the proposed route and the 2 alternate routes marked in the topographical map of the region:

Table 2-4: salient features of the line

S. No	Feature	Details
1	Proposed route length	5.54km
2	Name of the conductor	PANTHER
3	Size of the conductor	30/3.00+7/3.00 MM
4	Size of the earth wire	7/3.55 mm
5	Type of supports	GCR, HCR, KCR
6	Wind pressure	76kg/sqms
7	LT & HT line crossing	7 No’s
8	66 kV line crossing	Nil
9	110 kV line crossing	Nil
10	230 kV line crossing	Nil
11	400 kV line crossing	1 No
12	Minor road crossing	2 No’s
13	Metal road crossing	Nil
14	SH/NH major road crossing	1 No

15	River crossing	Nil
16	Railway crossing	Nil

Client has selected 3 options for Transmission line:

- Option-1: Porasadappu, Pottalkudi, Udarappuli, Kadiyavayal Vilaage - (There is an existing 400KV line and the proposed TL will be laid parallel to this one).
- Option-2: Porasadappu, Udukkulam, Mudikkarai, Kadiyavayal Village
- Option-3: Porasadappu, Udukkulam, Mudikkarai, Kadiyavayal Village

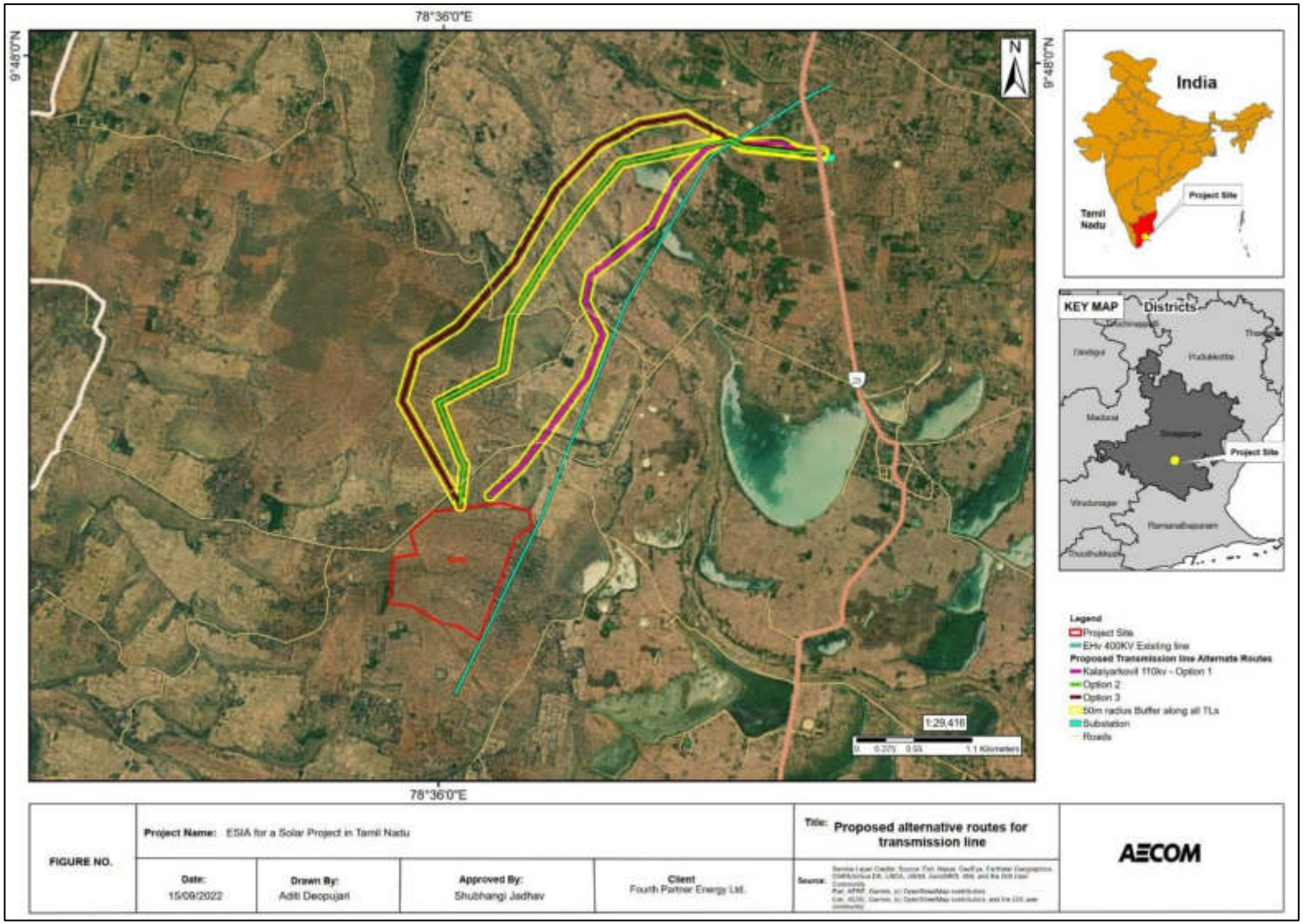

Figure 2-2: Transmission line routes connecting solar plant and substation

2.5 Resource Requirement and Procurement

2.5.1 Land requirement and Procurement process

The following project components were identified for which land will be required during the construction and/ or operation phase;

- Installation of solar modules;
- Site office;
- Invertor room;
- Stock yard; and
- Transmission line

The above information on the project components has been drawn based on discussions with the site representatives of FPEPL, consultations with the land aggregator, landowners, panchayat representatives and review of land-related documents shared by FPEPL.

2.5.1.1 Project-related land procurement and existing land procurement status

The proposed 50 MW Solar power project is proposed to be developed in Pulavanvayal Village, Kalayarkoil Taluk, Sivaganga District. The total land requirement for the proposed project would be around 225.98 acres which includes installation of Solar modules along with site office, inverter room, and other associated facilities. For the proposed project, private land are given preference and does not involve any Tribal / land owned by Scheduled Tribe population.

- **Extent of land:** The Project Site comprises of single parcel at Pulavanvayal Village, Sivaganga District, measuring 225.98 acres (91.451 hectares).
- **Mode of procurement:**
    - **Solar Plant Site:** The required land is being procured through a land aggregator (Aditya Energy) on a Willing Buyer and Willing Seller basis.
    - **Transmission Line:** Three alternatives are considered and feasible alternatives are being studied by FPEPL and feasible route selected will be indicated in the Land Access and LRP report being developed for the project. As reported by FPEPL, the land falling within tower footprint area and RoW are proposed to be sourced through private negotiation on payment of one-time compensation. Any change in route alignment or failure of negotiated settlements (Willing Lessor Willing Lessee) government compulsory procedures as per the provisions of Indian Telegraph Act, 1885 will be followed.
- **Current procurement status:** As on the date of site visit (22nd to 24th June 2022), of total 225.98 acres sale deeds were executed for about 82 acres and Power Of Attorney (POA)[2] from the landowners were obtained for 109 acres and are in process of being transferred to client. The delay in transferring the land is due to obtaining Adangal document from the local Registrar (administrative process). Land procurement for main project site and route finalization for the TL is expected to be completed by 30th October 2022.
- **Farming and irrigation:** The entire project land sites were observed to be barren and soil type seems to gravel in nature. Due to poor soil quality & lack of irrigation facilities the land is unfit for cultivation. During site visit, it was observed that the land parcels were kept barren and as reported during the consultation with landowners and revenue officials since 30+ years no crops were cultivated on the proposed project site land. Though the proposed transmission line traverse through private agriculture land, the predominant crops cultivated

[2] POA was done for the landowners who reside outside the country. POA is a document in which the owner assigns the signing authority to someone else, so the landowners are no required to be physically present at the time of sale deed execution.

are Paddy (rice). Post project implementation the landowners will not be having any restriction to use the land falling within the RoW and Tower footprint area.

- **Access road:** The solar site can be accessed through State Highway (SH)29 connecting nearest towns Kalayarkoil and Maravamangalam at 5.3km. The project site is connected through the exiting government village roads and the same will be utilized for the project use. Hence, no additional land is proposed for widening of the access road or no modification or alteration of existing road is envisaged and use of access road will be as per the applicable regulations and in compliance to ADB SPS.
- **Transmission line:** Power generated from the project will be fed to the common Pooling Substation (PSS), which is to be constructed within the proposed project site and power will be further evacuated through a 110-kV transmission line measuring ~5.54 km involving installation of about 22-25 towers connecting to the existing GSS (Maravamangalam) 110/22 kV Substation). The 110kv transmission line PSS and GSS are mostly passing through agricultural land parcels and does not have any railway or NH crossing. As reported by the FPEPL and based on the site observations the right of way (RoW) of the transmission line does not include any residential structures or community structures. As on date route survey by FPEPL is progress and the final route alignment and exact number of towers to be placed and land use of tower footprint area will be described in the final Land Access and LRP report developed for the project.
- **Grazing within and around the project site:** Grazing activities were observed within the vicinity of the project village, and it was reported that most of the households are holding 1-2 cows each and nearly about 4-5 houses in each village in the vicinity are reported to be having 50-70 Goats / Sheeps in each household. The milk produced are mostly self-consumed and goat/sheep are sold to the nearby market / to the local traders. Based on the consultation with shepherds/grazers, revealed that the project site land is not a designated grazing field and the proposed project does not affect / create hindrance to their grazing activity.
- **No appropriation through the tools of acquisition:**
    - **Solar Plant Site:** It is to be noted that no appropriation of land using the tools of acquisition have been involved in procuring the solar site land, as the land is sourced by executing sale deed on the basis of willing buyer and willing seller.
    - **Transmission Line:** The compensation for the tower footprint along with RoW will be based on the private negotiations and in line with the requirements of the Guidelines issued on “Payments of Compensation towards damages in regard to Right of Way of Transmission line” dated 15th October 2015 by Ministry of Power, GOI. Since the route alignment is in progress and any failure in negotiated, settlement may lead to IR. The compensation will be based on the Land access and LRP report as prepared for the project and status of the land procurement and trigger of IR will be reported by FPEPL in Closeout Report to ADB.
- **Project Induced Vulnerability:** The proposed project does not source the required land from the vulnerable population like SC/ST. As mentioned in the earlier sections, no livelihood dependency is reported on the said project site land and for the transmission line one-off compensation for the tower footprint area and RoW use are to be paid at replacement cost and no restriction in movement of men and cattle below the RoW is envisaged. The area is mostly rainfed and majority of population are dependent on agriculture and allied activities, the proposed project does not result in induced vulnerability among the population instead create economic benefit by way of employment and minor business opportunities in the study area and region.

2.5.1.2 Key Issues Aspects of Land Procurement

As indicated earlier, land required for the proposed project development is being procured through private landowners on a Willing Buyer and Willing Seller Basis. The position of the project/ land procurement vis-à-vis key socio-economic issues are as follows:

- **Schedule V Area and Tribal Land:** The Project area including the proposed transmission line route does not fall under Schedule-V areas as defined in the Indian Constitution under Article 342. The land identified for the project does not comprise of any tribal land/ land parcels owned by members belonging to the Indigenous Peoples (IP). Moreover, the project does not have any impacts on IPs. It is to be noted that there are no Scheduled Tribe population residing within the study area villages and no land belonging to tribes were involved in the project.
- **Forest land:** The project will be developed on private rainfed barren land, and the proposed TL route reported to be mostly traverse through private land. As reported, no forest land will be used for the project as well as for the proposed transmission line corridor.
- **Common Property Resources (CPR):** No CPRs were reported on the project land parcels and no existing community access to CPRs are being blocked or restricted for the local community. Based on review of the proposed transmission line route there are no structures are falling within the RoW and reported to have no hindrance on the CPR due to the TL route.
- **No Objection Certificate (NOC) from Panchayat:** Gram Panchayat NOC from Siramam village is yet to be obtained, application for the same was made by respective SPVs on 26th July 2022.
- **Landlessness:** Based on the consultation with the sample landowners as part of study and the profile of landowners shared by FPEPL (Appendix-G), it was reported that the none of the landowners were made landless and most of them reinvested the compensation money by purchasing alternative land, invested in business, etc. Any case of landlessness or vulnerability reported during the future land transactions shall be reported to the lender through Closeout report.
- **Encumbrance on Land/ Economic Impact:**
  - **Solar Site:** No encumbrance or encroachment on the project land could be observed at site or reported during stakeholder consultations. Similarly, the land was not used for agricultural activities as the soil quality and lack of irrigation facility makes the land unsuitable for cultivation. The compensation for the land is determined based on mutual understanding between land aggregator and landowners, which is generally two to three times the government circle rate and above the prevailing market rate.
  - **Transmission Line:** The compensation value for RoW use of the proposed transmission line is to be determined based on negotiations and through willing buyer and willing seller basis. However, in case of failure in negotiated settlements may result in use of government procedures in RoW clearance. However, the one-off compensation towards tower footprint area, RoW use at the replacement cost as per the Guidelines issued by Ministry of Power dated 15th Oct 2015, crop loss during stringing will be issued based on the yield loss as per the guidelines issued by the local horticulture / agriculture department and loss of any physical structures if any to be compensated at replacement cost.
- **Cultural Heritage sites:** Within the project site and the proposed TL ROW, there are no cultural or religious important place.

2.5.2 Land Procurement Process

Land required for the proposed project development is being procured through private landowners on a Willing Buyer and Willing Seller Basis and does not envisage any physical or economic displacement with respect to the project site land. The route alignment for the proposed TL is to be selected based on the negotiations with the landowners, based on acceptance level of the landowners, the suitable route will be finalized. Failure of negotiated settlements among the RoW landowners will Trigger SPS-2. The said land does not include any Notified tribal /land belonging to tribal/ Nomadic tribes or forest land. The procedure used for procurement of the said land has been highlighted in figure below.

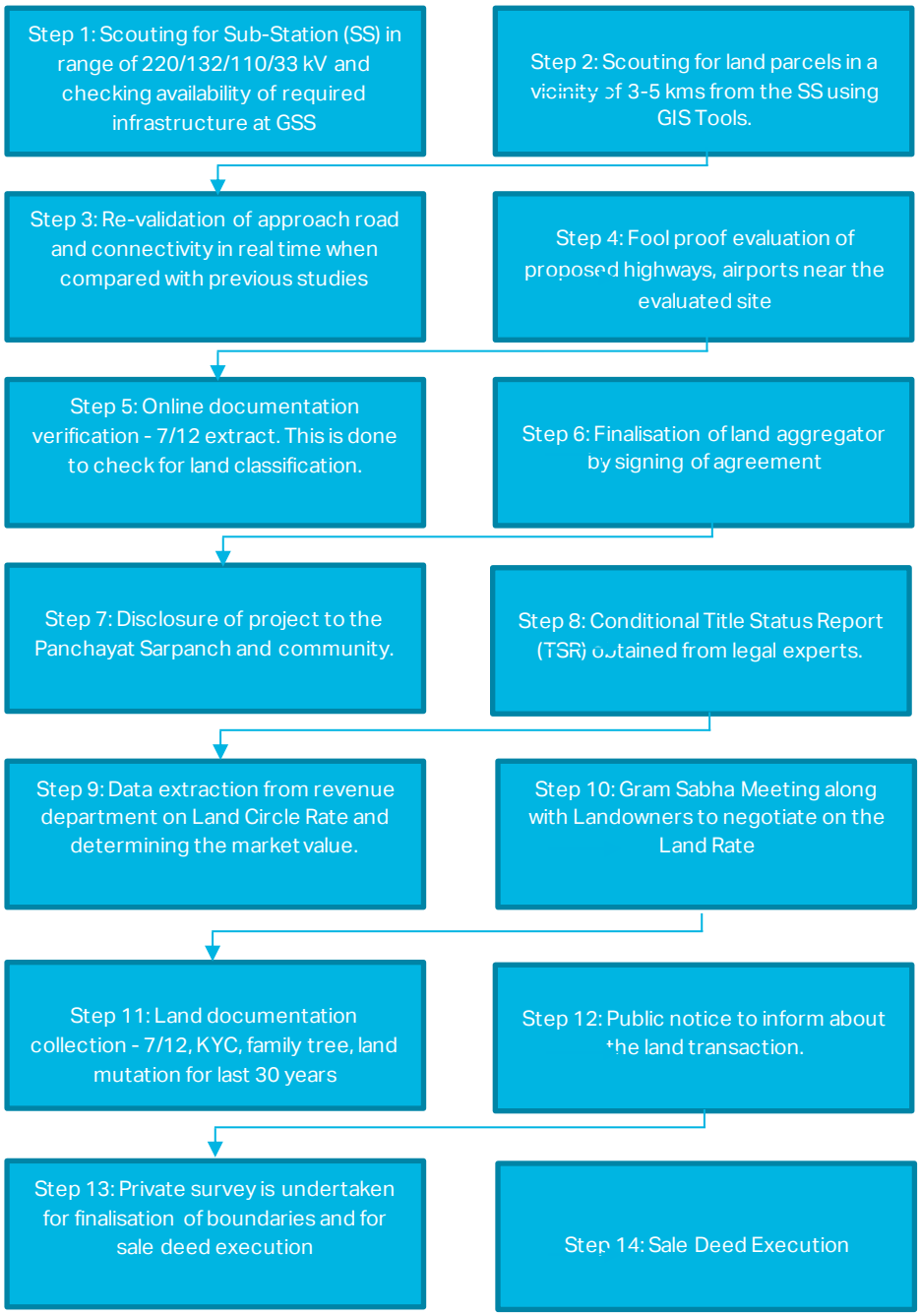

Figure 2-3: Land Procurement Process for Solar Project

Figure 2-4: Selection Criteria and Process Involved in Sourcing land for Transmission Line

2.5.2.1 Role of Land Aggregator

FPEPL had appointed M/s. Aditya Energy as a land aggregator for the proposed project to support in land procurement process and liasoning with various government departments. Some of the key roles of the Land Aggregator in Land Procurement Process for the proposed project are highlighted below.

- Identify and aggregate the project land suitable for the Project
- Conduct the survey of the project land through a Government surveyor and submit soft copy of finalised boundary co-ordinates for engineering purposes (including sub-survey no wise marking)
- Procure and provide documents related to the title, survey, revenue, marketability in connection with the Project Land and right of way land.
- Obtain the right of way ('ROW') for the properties leading to the substations if applicable
- Co-Ordinate in the execution and registration of the conveyance/ transfer deed in connection with the Project Land and ROW.
- Obtain No Objection Certificate (NOC) from the respective village panchayats / gram panchayats for the Land Aggregation.
- Liaison with the Government Authorities for obtaining such approvals/ permissions required for setting up of the Project on the Project Land and also for transfer of ownership of the Project Land on to the name of the SPVs.
- Mutation of the revenue records in the name of the Owner I it's SPVs.
- Construction of the approach road in connection the Project Land after obtaining all the necessary Approvals and ensuring all ROW issues / definitive pathway rights in favour of SPVs, if applicable

2.5.3 Manpower requirement

As on date of site visit, procurement of land for the project was in process and no project-related construction activities had started. The EPC contractor for the project was yet to be appointed at the time of site visit. It was estimated that during the peak construction phase, approximately 200-230 workers will be employed for a duration of 6 months of which about 100 unskilled workers will be sourced from local workforce and around 130 workers would be migrant. The technical staffs to be employed during the construction and operation phase would be around 11(5 from FPEPL and 6 from sub-cons) and 2(FPEPL) respectively. Some of the key activities to be undertaken at site during the construction phase includes foundation work, civil construction work, electrical and structural work, etc. While most of the workers in the unskilled and semi-skilled categories will be hired from the neighbouring villages and from within the Sivaganga district, the manpower requirement in the skilled and highly skilled categories will be sourced by contractors. It was revealed by the site representative of FPEPL that migrant workers will be provided accommodation in the one labour camp which will be constructed near the project site during the construction phase. The location of the same was not finalised. As reported no migrant women workers or family members are to be involved for the project and labour camp would be provided for only men. However, facilities including separate toilets, restrooms, would be provided for local women workers being employed

The manpower requirement during the operations phase was reportedly around 30 (10 skilled and 20 unskilled) people who will be engaged through contractors mostly for module cleaning, tilting, housekeeping, security, gardening etc.

2.5.4 Water Requirement

Construction Phase

As per the information shared by the Client, water requirements were calculated for the work in phased manner and will be calculated for total 50 MWp accordingly. Water requirements will defer with each passing phase of the constructions and the requirement is thus segregated accordingly - 7000 litres per day for the initial 4 months and then 2500 litres for the next 2 months.

During consultations it was identified that tanker water will be used for construction phase. Agreement for the water procurement is yet to be obtained. RO plant for drinking water in the labour camps will be at provided. Considering around 120 labours around 14.4 KL /day water will be required for domestic use[3]. As required, packaged drinking water will be sourced from local vendors.

As per the current information regarding water source for concrete batching, water resource assessment will be under EPC scope, if groundwater is decided to be abstracted. Though, Sivgangai project falls under "Safe Category" as per CGWB, source of water would be decided basis the availability of groundwater & surface water. Whenever borewells would get constructed, NOC will be obtained from CGWA and whilst they do that, the water will be sourced from outside the plant through water tankers basis the needs & requirement. Nevertheless, who-so-ever the water supplier is, FPEPL will ensure that the respective supplier has obtained necessary approvals from applicable government body and is authorized to supply the water for commercial & industrial use.

Operation Phase

The water requirements for the plant in operation phase will be predominantly for washing of solar PV modules periodically to remove dust and other dirt and for domestic use. Water required for module cleaning is approximately 3 litres/module, and it was known that borewell and water tankers will be used as and when required. However, approval for the borewell water extraction needs to be obtained. In total 450 kilo litres of water will be used per cleaning cycles.

Except for cleaning of the solar PV panels, there is very limited water requirement in solar PV power Projects. Underground water through bore holes shall be used during construction and O&M stage. Considering around 10 labours around 0.45 KL /day water will be required for domestic use[4]. Packaged drinking water will be sourced from local vendors. Water usage and resource-based study is not in place currently with FPEPL but in-order to obtain NOC for groundwater, similar studies will be required, as applicable, as mentioned under section 3.1 National and regional enforcement authorities

2.6 Waste Generation

2.6.1 Wastewater

During construction phase, adequate number of portable toilets will be provided by the EPC contractor at site and a septic tank with soak pit will be provided for disposal of domestic wastewater generated. Wastewater from construction activity will be limited to cleaning and washing activities.

During the operation phase, domestic wastewater will be limited to domestic wastewater discharged from the site office. Toilets with a septic tank and soak pit will be provided for disposal of domestic wastewater generated at the site office.

2.6.2 Hazardous Waste

During construction phase, hazardous waste such as used oil from diesel generator (DG) sets, oil-soaked cotton, oil lined containers, construction machinery, paints, etc. will be generated at the site. The hazardous waste will be disposed through a State Pollution Control Board (SPCB) authorized hazardous waste recycler within 90 days of generation.

[3] 120 liter/day/worker
[4] 45 liter/day/worker

During operation phase, no DG set is proposed to be installed at the site and thus the hazardous waste generation will be limited to used oil from transformer. The oil will be reused after filtration and the waste oil will be disposed through SPCB approved hazardous waste recycler. Discarding of broken solar panels will be done through approved vendors in accordance with The Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016. FPEPL's usually set up a "Return Back/Buy Back" arrangement with solar module supplier at least for the period of construction phase. Once the construction gets completed, all discarded or damaged solar modules will be managed by authorized CPCB/TNPCB approved recycler.

2.6.3 Solid Waste

Solid waste generation during the construction phase will consist primarily of scrapped building materials, excess concrete and cement, rejected components and materials, packing and shipping materials (pallets, crates, styrofoam, plastics, etc.). The municipal waste will be disposed by the EPC contractor through local vendors / local bodies and recyclables will be sold off to vendors.

During operation phase, the waste generated will be limited to paper, plastic waste and food waste from the site offices and through labour activities in labour camps. The waste shall be collected in designated bins at site and disposed at a regular interval by the O&M contractor through local vendors / local bodies and recyclables will be sold off to vendors.

2.7 Implementation Schedule

FPEPL will engage an EPC contractor on turnkey basis for undertaking construction works. The construction works will comprise of carrying out geotechnical investigations, foundation works, installation of switch yard, array yard installation, SCADA system, inverters modules and equipment installation including the transmission line connecting the PSS and GSS. As per the execution schedule, it will take approximately 18 months since the application and approval when the commissioning/power supply will start which includes all the SPVs Figure 2-5 and 2-6 mentions the implementation schedule in detail. TL route is supposed to be finalized by end of October 2022. TL Completion (including RoW Execution & related statutory approvals) would take 5 Months post finalisation of TL Route.

Once construction of the project is over, the project will be handed over to an Operation and Maintenance Contractor (O&M) which is yet to be finalised by FPEPL. The O&M contract will be for a period of twenty-five (25) years. As part of the O&M, the O&M contractor will be the in-charge of project management which includes financial and administrative control, overall project co-ordination, manpower selection for operation and maintenance etc.

2.7.1 Construction Activities

The site development activities for the proposed project will entail the following:

- soil investigations;
- site clearing;
- site levelling;
- Transmission line foundations and stringing;
- construction of access roads;
- fencing of site; and
- laying of foundations.

All construction activities shall occur within the site boundary limits except for those activities related to the interconnections between the site and the common infrastructures, which will be performed by the FPEPL outside the boundary wall of the site.

2.7.2 Operation and Maintenance

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

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

Maintenance Requirement:

The main objective of the plant maintenance will be to keep the project running reliably and efficiently as long as possible. Efficient operation implies close control not only over the cost of production but also over the cost of maintenance.

Routine Maintenance:

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

1) ***General maintenance***: Vegetation will need to be cut back if it starts to cause a fire risk or introduce shading, which based on the site visit can be seen that the no vegetation was grown as of now when the construction is yet to be started;
2) ***Modules***: Visual inspection and replacement of damaged modules will be required. Cleaning of the module glass surface during long dry periods may be considered. Module cleaning needs to be carried out periodically to remove dust, bird dropping, etc.;
3) ***Wiring and junction box***: Visual inspection for corrosion, damage such as chafing and damage by rodents and birds and for overheating of cables and connections;
4) ***Inverter Servicing***: Inverter faults are the most common cause of system downtime in PV power plants and therefore, the scheduled maintenance of inverters should be treated as a centrally important part of the O&M strategy. The preventive maintenance of inverters will include visual inspection, cleaning/replacing cooling fan filters, removal of dust from electronic components, tightening of any loose connections, etc.

Breakdown Maintenance

Breakdowns can occur due to lack of routine or preventive maintenance, bad climatic conditions, disturbance in utility grid, etc. As breakdowns affect energy generation and hence revenue generation, these kinds of faults will be immediately corrected.

Tentative execution schedule for SPV 1 & 2 and SPV 3 are attached in the below figure 2-5 and 2-6 respectively.

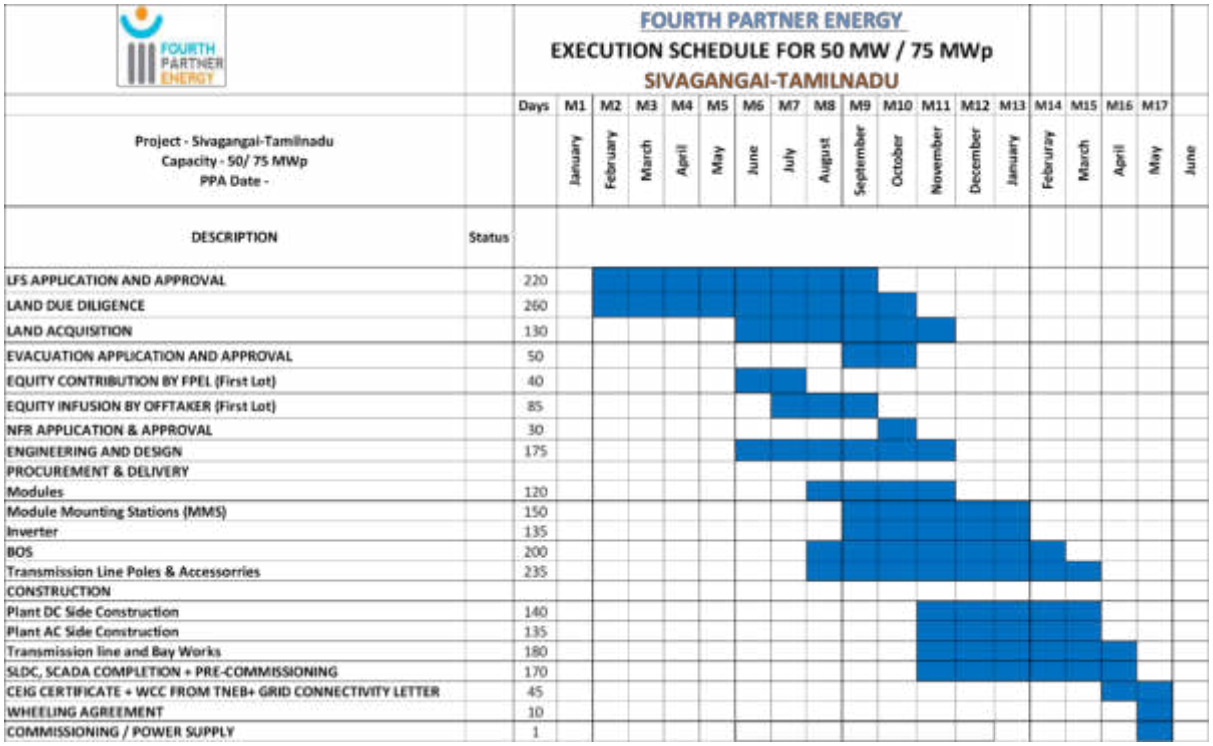

Figure 2-5: Tentative Execution Schedule for SPV 1 & 2

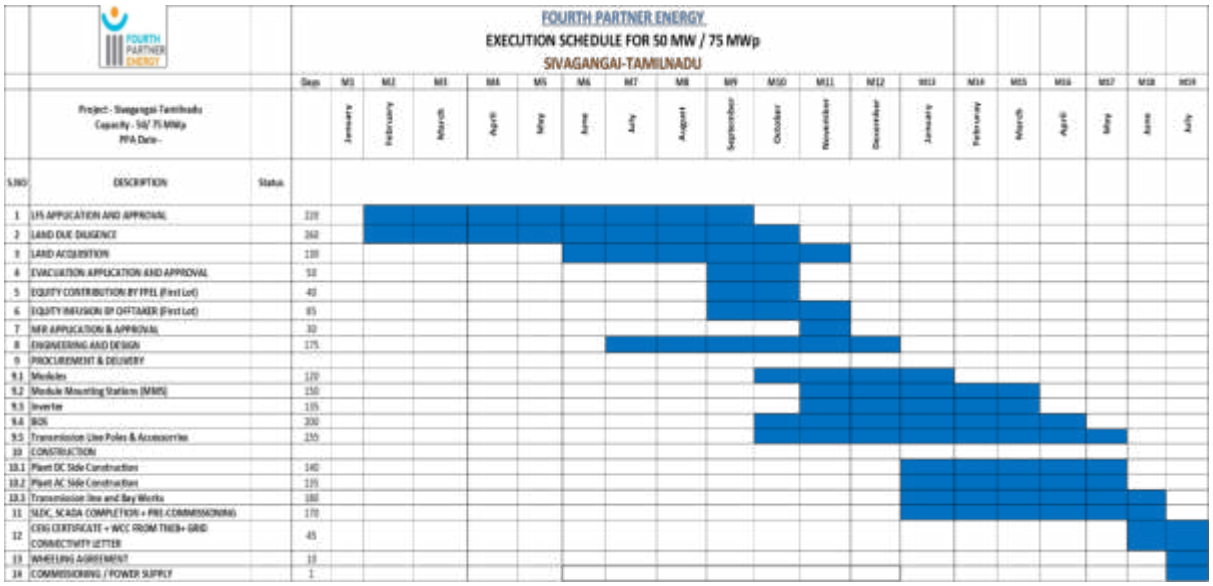

Figure 2-6: Tentative Execution Schedule for SPV3

3. Environment and Social Regulatory Framework

This section highlights the environmental and social regulations applicable to the proposed solar power project. The section broadly focuses on the institutional framework, national administrative/ regulatory requirements, applicable environment, health and safety and social legislative requirements, IFC Performance Standards, relevant to the proposed project.

3.1 National and Regional Enforcement Authorities

In India, Ministry of New and Renewable Energy (MNRE) is the nodal agency to manage the upcoming solar power projects and the environmental aspects are governed by Ministry of Environment, Forests and Climate Change (MoEF&CC), Central Pollution Control Board (CPCB), Central Electricity Authority (CEA) and Central Electricity Regulatory Commission (CERC). The social governance aspects at the micro level are addressed by institutions like *panchayats* and municipal bodies.

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

- Regulatory and implementing entities;
- Legal framework including policies, acts and laws; and
- Permitting system.

A brief description of the relevant enforcement agencies with respect to the institutional framework is described in ***Table 3-1*** below:

Table 3-1: Enforcement Agencies Relevant To The Project

S. N.	Name of Agency	Description
1.	MoEF&CC	MoEF&CC is the apex body in India which has been formulated to plan, promote, co-ordinate and oversee the implementation of India's environmental and forestry policies and programmes. Various acts like The Environment (Protection) Act 1986, as amended in April 2003, The Air (Prevention and Control of Pollution) Act, 1981, amended in 1987 and The Water (Prevention and Control of Pollution) Act, 1974, amended in 1988 have been developed. It is the responsibility of the apex body to ensure the compliance under the acts to maintain stipulated standards and environmental management through various supporting rules promulgated under the Acts. As per F. No. 320/14/2017-NSM office memorandum, MoEF&CC has clarified that the provisions of the EIA notification 2006 is not applicable to solar PV power projects, solar thermal power projects and development of solar parks subject to such projects following the statutory stipulations made in its office memorandum.
2.	Central Pollution Control Board (CPCB)	The 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 MoEF&CC. CPCB works towards control of water, air and noise pollution, land degradation and hazardous substances and waste management. CPCB will direct TNPCB in case any violation is undertaken in complying with the conditions of Hazardous Waste Authorization.

S. N.	Name of Agency	Description
		Central Pollution Control Board issued direction dated 07.03.2016 to all SPCBs /PCCs under Section 18(1)(b) of the Water (Prevention and Control of Pollution) Act, 1974, to maintain uniformity in categorization of industries as red, orange, green and white for grant of consent, inventorization of industries and other related activities.
3.	Tamil Nadu Pollution Control Board (TNPCB)	The Tamil Nadu Prevention and Control of Water Pollution Board was constituted by the Government of Tamil Nadu on twenty seventh day of February, Nineteen eighty-two (27-2-1982) in pursuance of the Water (Prevention and Control of Pollution) Act, 1974 (Central Act 6 of 1974). The Board was later renamed as Tamil Nadu Pollution Control Board (TNPCB) in the year 1983. It enforces the provisions of the Water (Prevention and Control of Pollution) Act, 1974, the Air (Prevention and Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986. Solar Farms fall under 'White Category' as per Final Document on Revised Classification of Industrial Sectors Under Red, Orange, Green and White Categories (February 29, 2016) issued by CPCB. There shall be no necessity of obtaining the Consent to Operate for White category of industries under the Water (Prevention and Control of Pollution) Act, 1974 and the Air (Prevention and control of pollution) Act, 1981. Intimation to concerned SPCB / PCC shall suffice. As per the CPCB direction, there shall be no necessity of obtaining the Consent to Operate for white category of industries and an intimation to concerned SPCB shall suffice[5] For hazardous and other wastes generated by such industries shall be handed over to the authorised actual users, waste collectors or disposal facilities.
4.	Petroleum and Explosives Safety Organisation (PESO)	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 Explosive Act, 1884* and *Rules, 2008, The Petroleum Act, 1934* and the *Rules 2002, The Static and Mobile pressure vessels (Unfired) Rules, 2016* and amended 2018, and *Manufacture, Storage and Import of Hazardous Chemical Rules, 1989* and *amendment 2000*. A petroleum license is required for possession of Petroleum Class B if the total quantity in possession exceeds 2500 litres and for any receptacle exceeding 1000L capacity. The site will store a small quantity of fuel during construction phase. However, in case fuel storage exceeds the above limit as stipulated in the Act, the project is required to obtain a license from PESO.
5.	Director Industrial Safety and Health (DISH)	The main objective of the DISH 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, 1948* the *Building & Other Construction Workers Act 1996* and other labour legislations. It is also to ensure the protection of rights of workers and to redress their grievances. Factory license is required as 'factory' means 'any premises having ten or more workers involved in a manufacturing process'. Factory License from the State Government or Chief Inspectorate of Factories, Tamil Nadu is required to be obtained for the project. Project proponent/ Construction contractor shall comply with all requirements of *Tamil Nadu Factories Rules 1950* and participate in periodic inspection. It is also to

[5] TNPCB&You2020.pdf

S. N.	Name of Agency	Description
		be ensured that no child labour is engaged during construction or operation phases of the project.
6.	Ministry of New and 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 energy in the wake of the two oil shocks of 1970.
7.	Tamil Nadu Energy Development Agency (TEDA)	Tamil Nadu Energy Development Agency (TEDA) is shouldering the responsibility of a state nodal agency (SNA) for the Ministry of New and Renewable Energy Sources (MNRE) and the state designated agency (SDA) for Bureau of Energy Efficiency (BEE). It aims to provide a platform to utilization of sustainable energy (renewable energy and energy efficient) technologies on mass scale to make them techno-economically and socio-culturally viable in the context of Tamil Nadu's energy scenario. The Government of Tamil Nadu realized the importance and need for renewable energy, and set up a separate Agency, as registered society, called the Tamil Nadu Energy Development Agency (TEDA) as early as 1985, as per G.O.Ms.No.163, P. & D. (EC) Department, dated 29.11.1984 with the following specific objectives: - • To promote the use of new and renewable sources of energy (NRSE) and to implement projects, therefore. • To promote energy conservation activities. • To encourage research and development on renewable sources of energy.
8.	Central Electricity Authority	CEA is a Statutory Body constituted under the erstwhile Electricity (Supply) Act, 1948, thereafter 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.
9.	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.
10.	Central Ground Water Authority (CGWA)	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. As per CGWA's guidelines effective from 01 June 2019, NOC is required for ground water withdrawal for all infrastructure projects drawing/proposing to draw ground water through an energised means. (with effect from 16.11.2015). For the proposed project (falling in "safe" category) NOC is required for ground water, abstraction, NOC may be provided that the fresh water resources are not affected through such abstraction. No disposal of brine/contaminated ground water shall be allowed in the premise. In case there are any overlain/underlain by fresh water aquifers, NOC will only be granted after submission of a hydrogeological study, undertaken

S. N.	Name of Agency	Description
		by a NABET accredited consultant. As per the guidelines for the issuance of NOC for ground water withdrawal, approval letters from various ministries, approved plan of water supply and details of water requirement, etc. should be computed and then only NOC is granted.[6]
11.	Gram Panchayat	Gram Sabha or the Panchayats are the local bodies which have been defined by the 73rd Constitutional Amendment Act, 1992. Panchayats have to be consulted before acquiring 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.

[6] INDEX (cgwb.gov.in)

3.2 Applicable Environment and Social Laws and Regulations

Table below summarizes the key regulations that are relevant to the project across its lifecycle. This table should be used to update/develop a comprehensive legal register for the Project.

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

S. No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Requirements	Applicable Permits
EHS Laws, Acts, Rules and Regulations						
1.	Environmental Protection	• Construction activities will generate air, water and noise emissions; and • Scattering of debris and construction material can contaminate the soil, water and surroundings.	• The Environment (Protection) Act 1986, as amended in April 2003; and • EPA Rules 1986, as amended in 2002.	Tamil Nadu Pollution Control Board (TNPCB)	As per Section 7 of Environment Protection Act, 1986 and Rule 3 of the Environment Protection Rule, 1986, no person carrying on any industry, operation and process shall discharge or emit any environmental pollutant in excess of prescribed standards. Compliance under the rules to maintain stipulated standards and environmental management through various supporting rules promulgated under the Act. FPEPL and contractors are required to ensure that Project implementation adheres to the various clauses laid down in the Act	Regulation is applicable but CTE/CTO is not required.
2.	Prevention and Control of Water Pollution	Wastewater generation during construction and operation of the Plant	The Water (Prevention and Control of Pollution) Act, 1974, amended in 1988	TNPCB	As per the section 24 of the Water (Prevention and Control of Pollution) Act, 1974, amended in 1988 no person shall knowingly cause or permit any poisonous, noxious or polluting matter into any stream or well or sewer or on land.	Regulation is applicable but CTE/CTO is not required.

S. No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Requirements	Applicable Permits
3.	Prevention and Control of Air Pollution	Movement of vehicles, operation of diesel generators for power at campsite or other construction activities.	The Air (Prevention and Control of Pollution) Act, 1981, amended in 1987.	TNPCB	As per section 22 of The Air (Prevention and Control of Pollution) Act, 1981, amended in 1987, no person operating any industrial plant, in any air pollution control area shall discharge or cause or permit to be discharged the emission of any air pollutant in excess of the standards laid down by the TNPCB. A solar power plant is clean option for power generation in comparison to non-renewable fossil fuels. Ministry of Environment, Forest and Climate Change (MoEF&CC) in its Office Memorandum No. J-11013/41/2006-IA-II (I) dated 13th May 2011 stated that the solar power projects are not covered under the ambit of EIA Notification, 2006 and therefore does not require prior environmental clearance. In addition to this, CPCB issued notification regarding harmonization of classification of industrial sectors under Red/Orange/Green/White categories which states that 'solar renewable power plants of all capacities' is classified as a "White Industry" (Part-A, Serial Number 35) and does not require Consent to Establish and Consent to Operate. Only intimation to the concerned regional officer of	Regulation is applicable but CTE/CTO is not required.

S. No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Requirements	Applicable Permits
					State Pollution Control Board (SPCB) shall suffice [7]	
4.	NOC And Consent to Establish and Operate for Batching Plant	Batching plant operation would lead to emission of fugitives. It also envisages wastewater generation which could lead to contamination of land and water resources. In addition, there would be generation of noise disturbance to the neighbouring villages.	The Water (Prevention and Control of Pollution) Act, 1974; The Air (Prevention and Control of Pollution) Act, 1981 & The Noise Pollution (Regulation and Control) Rules, 2000 and subsequent amendments.	TNPCB	Applicable. Needs to be obtained before the construction work is commenced, in case of setting up of batching plant.	Consent to establish (CTE)/ Consent to operate (CTO) from TNPCB
5.	License under Factories Act, 1948	Factory license is required as the project is generating, transforming or transmitting power.	Chapter I of The Factories Act, 1948	Directorate, Industrial Safety and Health, Government of Tamil Nadu	As per the section 6 of The Factories Act, 194, FPEPL would have to obtain registration of the power plant from the State Government or Chief Inspectorate of Factories, Tamil Nadu if 10 or more workers are engaged, triggering the applicability of the Factories Act.	Obtain Factories License Inspectorate of Factories if 10 or more workers are engaged
6.	Noise Emissions	Noise generated from operation of construction machinery	• The Noise (Regulation & Control) Rules, 2000 as amended in October 2002; and • As per the Environment (Protection) Act (EPA) 1986 the ambient noise levels are to be	TNPCB	As per the Rules 3 and 4 of the Noise (Regulation & Control) Rules, 2000 as amended in October 2002, noise emissions in the project area should not exceed standards specified in the Schedule.	Regulation is applicable but CTE/CTO is not required.

[7] *As per latest directions of Central Pollution Control Board, dated March 2016, Final report on revised categorization of industrial sectors under Red/ Orange/ Green/ White, solar power projects have been classified under White category of industries. As per the CPCB's direction to SPCB/PPCs, "there shall be no necessity of obtaining Consent to Operate for White Category of industries and intimation to the concerned SPCB/PPC shall suffice.*

S. No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Requirements	Applicable Permits
			maintained as stipulated by CPCB for different categories of areas like, commercial, residential and silence zones etc.			
7.	Hazardous Wastes Management	• The proposed project will generate waste oil from diesel generator during construction phase and used transformer oil during operation phase. • Solvents and chemicals used or cleaning etc.; and Management of damaged solar modules.	Hazardous and Other Wastes (Management and Trans boundary Movement) Rules, 2016 as amended in 2019	TNPCB	As per the Hazardous Waste and Other Wastes (Management and Trans boundary Movement) Rules 2016 and its amendment in 2019 the Rule 6 after sub-rule (1) states that: [8] An occupier shall not be required obtain an authorisation under this rule, from the State Pollution Control Board, in case the consent to establish or consent to operate, is not required from the State Pollution Control Board or Pollution Control Committee under the Water (Prevention and Control of Pollution) Act, 1974 (25 of 1974) and Air (Prevention and Control of Pollution) Act, 1981 (21 of 1981); Provided that the hazardous and other wastes generated by the occupier shall be given to the actual user, waste collector or operator of the disposal facility, in accordance with the Central Pollution Control Board guidelines. However, as per the Rules 4, 6, 8, 17, 18, 19 and 20 of the Hazardous and Other Wastes (Management and Transboundary Movement) rules	Hazardous waste authorization from the TNPCB

[8] https://tnpcb.gov.in/hazardous-waste-rules.php

S. No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Requirements	Applicable Permits
					following compliances are to be ensured by FPEPL: • Authorization for collection, reception, storage, transportation and disposal of hazardous wastes; • Liability of the occupier, transporter and operator of a facility: The occupier, transporter and operator of a facility shall be liable for damages caused to the environment resulting due to improper handling and disposal of hazardous waste listed in schedules to the Rules; and • The occupier and operator of a facility shall also be liable to reinstate or restore damaged or destroyed elements of the environment.	
8.	Construction and Demolition Waste	Collection, segregation, storage and disposal of construction and demolition (C&D) waste at construction phase of the project.	Construction and Demolition Waste Management Rules, 2016	Gram Panchayat	As per the Construction and Demolition Waste Management Rules, 2016, if waste more than 20 tons or more in one day or 300 tons per project in a month is generated then FPEPL shall submit waste management plan and get appropriate approvals from the local authority before starting construction or demolition work. FPEPL should also ensure responsible collection, store and disposal of the C&D waste.	To be complied.

S. No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Requirements	Applicable Permits
9.	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; and • The Central Electricity Authority (Measures relating to Safety and Electricity Supply) Regulations, 2010	Electricity Regulatory Commission	As per section 14 of The Electricity Act, 2003, FPEPL shall obtain license under the act. Under rules 12 and 7, FPEPL and the Contractors to ensure preventive measures for health and safety of humans and plant.	To be complied.
10.	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)	As per Section 3 of The Petroleum Act 1934 and Rule 116 of The Petroleum Rules 1976, FPEPL will be required to obtain a license from PESO, if the quantity of the fuel stored exceeds thresholds given in regulation.	To be complied.
11.	Surface Transportation	Movement of construction vehicles and other vehicles for transportation of workers	• The Motor Vehicles Act 1988, as amended by Motor Vehicles (Amendment) Act 2000, dated 14th August 2000. • The Central Motor Vehicles Rules 1989, as amended through 20th October 2004 by the Central Motor Vehicles (Fourth Amendment) Rules 2004.	State Transport Authority	FPEPL to ensure compliance of the Section 39, Motor Vehicle Act, 1988 as amended in 2017 and Rule 47, Motor Vehicle Rule, 1989.	Permit to be obtained from Commissionerate of transport and road safety under the provisions of motor vehicles act 1988

Biodiversity related laws[9]

[9] As per Tamil Nadu Forest Department document on Procedure for Permission/intimation for felling of trees (https://www.forests.tn.gov.in/app/webroot/img/Tree%20felling%20procedure.pdf), for private land, tree feeling permission is required for sandalwood trees, while prior intimation is required for scheduled trees such as black wood, rose wood, silver oak, teak and red sanders, The authority granting permissions is local District Forest Officer.
If any of the scheduled trees are present on site, prior permission/intimation will be required.

S. No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Requirements	Applicable Permits
12.	Forest Protection	Presence of nationally designated Forest Land in proximity to the Project Site	The Indian Forest Act, 1927	Tamil Nadu State Forest Department	Not applicable Approval of the Forest Department is required, in terms of 'Forest Clearance' (FC), if Project infrastructure or activities overlap nationally designated Forest Land. No Project infrastructure or activities are planned to overlap nationally designated Forest Land.	Forest Protection
13.	Wildlife Conservation	Presence of nationally designated wildlife habitats, including those of Schedule I species, in proximity to the Project Site	The Wildlife (Protection) Act, 1972 [WPA]	National Board for Wildlife	Not applicable Approval of the National Board for Wildlife is required, in terms of 'Wildlife Clearance' (WLC), if Project infrastructure or activities overlap nationally designated wildlife habitats, including corridors. No Project infrastructure or activities are planned to overlap nationally designated wildlife habitats, including corridors.	Wildlife Conservation
14.	Forest Conservation	Presence of nationally designated Forest Land in proximity to the Project Site	The Forest (Conservation) Act, 1980 [FCA]	Tamil Nadu State Forest Department	Not applicable Approval of the Forest Department is required, in terms of 'Forest Clearance' (FC), if nationally designated Forest Land needs to be diverted for Project-related non-forest purposes. No nationally designated Forest Land needs to be diverted for Project-related non-forest purposes.	Forest Conservation
15.	Tree preservation	Tree felling	Tamil Nadu Preservation of Private Forest Act, 1949 or the Tamil Nadu Hill Area	Tamil Nadu State Forest Department	If project area requires any tree felling approval from relevant forest department will be required to be	Tree cutting permission

S. No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Requirements	Applicable Permits
			(Preservation of Trees) Act, 1955,		taken. This will be determined once project land finalization is done.	
Social and labour-related Laws, Regulations and Acts						
16.	Labour	Engagement of workers for construction and operation of the plant	The Factories Act, 1948 and Tamil Nadu Factories Rules, 1950	Department of Labour, Government of Tamil Nadu	FPEPL / EPC Contractor shall comply with all requirements of Factories Rules and participate in periodic inspection.	To be complied.
17.	Contract Workers	Engagement of contract workers	The Contract Labour (Regulation and Abolition) Act, 1970 as amended in 2017	Department of Labour, Government of Tamil Nadu	As per Section 12 of the Contract Labour (Regulation and Abolition) Act, 1970 a contractor executing any contract work by engaging 20 or more contract labourers has to obtain a licence under the Act.	To be complied.
18.	Child Labour	Engagement of Child Labour at site	The Child Labour (Prohibition and Regulation) Act, 1986	Department of Labour, Government of Tamil Nadu	Section 3 under the Child Labour (Prohibition and Regulation) Act, 1986 (CLA, 1986) including amendment in 2016. No child below the age of 14 years shall be employed in any establishment mentioned in Schedule Part A and Part B of the CLA, 1986.	To be complied.
19.	Bonded Labour	Engagement of Bonded Labour at site	Bonded Labour (Abolition) Act 1976	Department of Labour, Government of Tamil Nadu	Rule 4 of the Bonded Labour System (Abolition) Act, 1976 specifies "After the commencement of this Act, no person shall- make any advance under, or in pursuance of, the bonded labour system, or compel any person to render any bonded labour or other form of forced labour."	To be complied.

S. No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Requirements	Applicable Permits
20.	Payment of Wages	Provision of wages to labour engaged at the site	Minimum Wages Act, 1948	Department of Labour, Government of Tamil Nadu	Section 12 of the Minimum Wages Act, 1948: The employer shall pay to every employee engaged in a scheduled employment under him wages at a rate not less than the minimum rate of wages fixed by the appropriate Government Authority for that class of employees in that employment without any deductions except as may be authorized within such time and subject to such conditions as may be prescribed. Every employer shall be responsible for the payment to persons employed by him of all wages required to be paid under this Act.	To be complied.
21.	Payment of Wages.	Equal wages to male and female workers at site	Equal Remuneration Act 1976	Department of Labour, Government of Tamil Nadu	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.	To be complied.
22.	Payment of Wages	Engagement of Labour at site	Workmen's Compensation Act, 1923	Department of Labour, Government of Tamil Nadu	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.	To be complied.
23.	Women at Workplace	Engagement of Female Labour at site	Maternity Benefit Act, 1961	Department of Labour, Government of Tamil Nadu	Section 4 of the Maternity Benefit Act, 1961 including amendment as in Maternity Benefit (Amendment) Act, 2017: - • "No employer shall knowingly employ a woman in any establishment during the six	To be complied.

S. No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Requirements	Applicable Permits
					weeks immediately following the day of her delivery or her miscarriage; • No woman shall work in any establishment during the six weeks immediately following the day of her delivery or her miscarriage; and • Without prejudice to the provisions of section 6, no pregnant woman shall, on a request being made by her in this behalf, be required by her employer to do during the period specified in sub- section (4) 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." Section 5 of the Maternity Benefit Act, 1961 including as amended in 2017. "As per the amendment in 2017, • Subject to the provisions of this Act, every woman shall be entitled to, and her employer shall be liable for, the payment of maternity benefit at the rate of the average daily wage for the period of her actual absence, that is to say, the period immediately preceding the day of her delivery,	

S. No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Requirements	Applicable Permits
					the actual day of her delivery and any period immediately following that day; • No woman shall be entitled to maternity benefit unless she has actually worked in an establishment of the employer from whom she claims maternity benefit, for a period of not less than eighty days in the twelve months immediately preceding the date of her expected delivery; • The maximum period for which any woman shall be entitled to maternity benefit shall be twenty-six weeks of which not more than eight weeks shall precede the date of her expected delivery; • A woman who legally adopts a child below the age of three months or a commissioning mother shall be entitled to maternity benefit for a period of twelve weeks from the date the child is handed over to the adopting mother or the commissioning mother, as the case maybe; and In case where the nature of work assigned to a woman is of such nature that she may work from home, the employer may allow her to do so after availing of the maternity benefit for such periods and on such	

S. No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Requirements	Applicable Permits
					conditions as the employer and the woman may mutually agree."	
24.	Contractor Labour License	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 valid registration.	Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 and Contract Labour (Regulation and Abolition) Act, 1970.	Department of Labour, Government of Tamil Nadu	Section 7 of the Act mandates the registration of establishments. FPEPL should ensure that contractor/ sub-contractors have a valid registration under the Building and Other Construction Works Act and Contract Labour (Regulation and Abolition) Act, 1970.	SPVs to obtain Principal Employer Registration under BOCW and Sub-cons to obtain BOCW License as applicable.
25.	Contract Labour	Principal Employer registration for engaging contract labour through third party is required.	The Contract Labour (Regulation and Abolition) Act, 1970	Department of Labour, Government of Tamil Nadu	Section 7 of the Act mandates the Principal Employer registration for engaging contract labour through third party.	SPVs to obtain Principal Employer Registration
26.	Migrant Workmen	Principal Employer registration for engaging migrant labour is required for direct/indirect labour.	The Inter-State Migrant Workmen (Regulation of Employment and conditions of service) Act, 1979	Department of Labour, Government of Tamil Nadu	Section 4 of the Act mandates that the Principal Employer registration should be obtained for engaging migrant labour through third party.	SPVs to obtain Principal Employer Registration
27.	Working Conditions	Working conditions of contracted Labour working at the site	Contract Labour (Regulations and Abolition) Act, 1970	Department of Labour, Government of Tamil Nadu	Section 16,17,18,19,20 and 21 of the said Act mandates the provision of the principal employer to ensure that all the contracted workers are provided with condition of services, rate of wages, holidays, hours of work as stipulated in the act and rules.	To be complied
28.	Transmission Line	Authority to place and maintain transmission lines	Indian Telegraph Act, 1885 The Indian Telegraph Act, 1885	TANTRANSCO	The compensation towards "damages" during implementation of such projects is governed by Section 67 & 68 of the Electricity Act read	To be followed as applicable.

S. No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Requirements	Applicable Permits
					with Section 10 & 16 of the Indian Telegraph Act, 1885	
29.	Transmission Line	Payment of Compensation for Tower footprint area and RoW	Guidelines for payment of compensation towards damages in regard to Right of Way for transmission lines	Ministry of Power	Compensation @ 85% of land value as determined by District Magistrate, or any other authority based on Circle rate/ Guideline value/ Stamp Act rates for tower base area (between four legs) impacted severely due to installation of tower/pylon structure Compensation towards diminution of land value in the width of Riqht of Way (RoW) Corridor due to laying of transmission line and imposing certain restriction would be decided by the States as per categorization / type of land in different places of States, subject to a maximum of 15% of land value as determined based on Circle ratel Guideline value / Stamp Act rates;	The compensation value to be equal or more than the specified amount as per the Guidelines.

3.3 Policy Framework in India

Policies with respect to the renewable energy in India and Tamil Nadu, focusing on the solar power, as released by the Government of India and Government of Tamil Nadu from time to time and applicable to the project are discussed briefly in table below:

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

S. N.	Name of the 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 (JNNSM)	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. 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.
3.	National Environmental Policy, 2006	Government of India released the National Environment Policy in 2006. The policy aims at mainstreaming environmental concerns into all developmental activities. It emphasises conservation of resources, and points that the best way to aid conservation is to ensure that people dependent on resources obtain better livelihoods from conservation, than from degradation of the resources.
4.	Tamil Nadu Solar Energy Policy 2019	The Government of Tamil Nadu realized the importance and need for renewable energy, and set up a separate Agency, as registered society, called the Tamil Nadu Energy Development Agency (TEDA) as early as 1985. The Tamil Nadu government has announced its Solar Energy Policy 2019 with the objective of achieving an installed capacity of 9,000 MW by 2023. The policy hopes to create a framework that will help accelerate development of solar installations in the State, promoting both utility category and consumer category solar energy generation through various enabling mechanisms.

3.4 Applicable International Standards and Guidelines

3.4.1 IFC Performance Standards

The performance standards stipulate that any proposed project shall meet the following requirements throughout the life of an investment by IFC or other relevant financial institution: -

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

These Performance Standards and guidelines provide ways and means to identify impacts and affected stakeholders and lay down processes for management and mitigation of adverse impacts. The applicability of the Performance Standards is discussed in table below.

Table 3-4: Applicability of IFC Performance Standards

S. No.	Performance Standard	Description and Applicability
1.	PS1 – Assessment and Management of Environmental and Social Risks and Impacts	APPLICABLE PS 1 establishes the importance of: • Integrated assessment to identify the environmental and social impacts, risks, and opportunities of projects; • Effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and • The project proponent's management of environmental and social performance throughout the life of the project. The PS 1 is applicable to projects with environment and/or social risks and/or impacts. The proposed project is a solar power project and will have environmental and social impacts such as stress on existing water resources, construction activities, direct or indirect impact on communities, etc.
2.	PS2 – Labour and Working Conditions	APPLICABLE PS-2 recognizes that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental rights of workers.
3.	PS3 - Resource Efficiency and Pollution Prevention	APPLICABLE PS3 recognizes that increased economic activity and urbanization often generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels. The objectives of PS 3 are:

S. No.	Performance Standard	Description and Applicability
		• To avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities. • To promote more sustainable use of resources, including energy and water. • To reduce project related GHG emissions. The proposed project is a clean energy project and will not have major pollution sources associated with it. The construction works for the development of project will entail generation of wastes like air emissions, wastewater, used oil from DG sets and construction debris. The operation phase will result in generation of minor quantities of waste such as used transformer oil, broken and defunct solar panels and wastewater from cleaning of solar panels.
4.	PS4 – Community Health, Safety and Security	APPLICABLE PS 4 recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts. Its main stress is to ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the Affected Communities. Objectives of PS 4 thus are: • To anticipate and avoid any adverse impacts on the health and safety of the Affected Community during the project life from both routine and non-routine circumstances. • To ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the Affected Communities. The proposed project will involve transportation of construction material and movement of construction machinery which may pose safety risks to the affected communities.
5.	PS5 – Land Acquisition and Involuntary Resettlement	PARTIALLY APPLICABLE PS 5 recognizes that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land. Its main aim is to anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use by providing compensation for loss of assets at replacement cost and ensuring that resettlement activities are implemented with appropriate disclosure of Information, consultation, and the informed participation of those affected. 100% of the proposed solar park land is belonging to private landowners and land is being purchased through negotiations on willing buyer and will seller basis. Stakeholder consultations at site confirmed that there were no economic/ livelihood activities on the concerned land. It was reported that due to lack of irrigation facilities and poor soil quality the land was kept barren for 30 years. The compensation paid for the land is more than the government circle rate and prevailing market rate. With respect to the proposed Transmission line route, As reported by the FPEPL and based on the site observations the right of way (RoW) of the transmission line does not include any residential structures or community structures within the RoW. As on date only route survey by FPEPL was completed and the team is under negotiations with the landowners for placing the transmission towers and the suitable route will be selected based on the acceptance among the landowners. Failure of negotiated settlements may Trigger the PS5 in the later Stage. Hence PS5 is partially applicable.
6.	PS6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources	APPLICABLE The requirements of this Performance Standard apply to projects (i) that are situated in modified, natural, and critical habitats; (ii) that potentially impact on or are dependent on ecosystem services over which the client has direct management control or significant influence; or (iii) that include the production of living natural resources e.g., agriculture, animal husbandry, fisheries, and forestry.

S. No.	Performance Standard	Description and Applicability
		PS-6 considers relevant threats to biodiversity and ecosystem services, owing to project-related direct and indirect impacts, with a focus on habitat loss, degradation and fragmentation, introduction or spread of invasive alien species and loss or degradation of priority ecosystem services, while recognizing the differing values attached to biodiversity and ecosystem services by Affected Communities and any other stakeholders, especially Indigenous Peoples.PS6 recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development. The Project Site, as well as the estimated area of influence of the project, contain natural and modified habitats. The Project infrastructure & activities can potentially impact biodiversity & ecosystem services. Therefore, PS6 is applicable to the Project.
7.	PS7 – Indigenous People	NOT APPLICABLE Performance Standard 7 recognizes that Indigenous Peoples, as social groups with identities that are distinct from mainstream groups in national societies, are often among the most marginalized and vulnerable segments of the population. In many cases, their economic, social, and legal status limits their capacity to defend their rights to, and interests in, lands and natural and cultural resources, and may restrict their ability to participate in and benefit from development. The PS 7 is not applicable to the project as; • There is no presence of Scheduled Tribes in the study area villages • No tribal land has been procured for the project; • No livelihood dependence on the land has been reported of tribal or non-tribal; and • No notified Schedule-V land is located within the project district. • The proposed Transmission line route does not traverse on any notified tribal land and no land belonging to scheduled tribe is falling within RoW.
8.	PS8 – Cultural Heritage	NOT APPLICABLE For the purposes of this Performance Standard, cultural heritage refers to tangible forms of cultural heritage, such as tangible moveable or immovable objects, property, sites, structures, or groups of structures, having archaeological (prehistoric), paleontological, historical, cultural, artistic, and religious values. The PS is not applicable to the project as; • The land on which the project is being setup does not contain any structures bearing cultural, historical, religious or spiritual significance; and • No sites bearing cultural, historical, religious or spiritual significance has been impacted by the project

3.4.2 IFC EHS Guidelines

IFC has released the following environmental, health and safety guidelines on 30th April 2007:

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

The key requirements stated in the EHS guidelines have been discussed in below.

ENVIRONMENTAL ATTRIBUTES

- Air Emissions and Ambient Air Quality,
- Energy Conservation,

- Wastewater and Water Quality,
- Water Conservation,
- Hazardous Materials Management,
- Waste Management,
- Noise and
- Contaminated Land

OCCUPATIONAL HEALTH AND SAFETY

- General Facility Design and Operation,
- Communication and Training,
- Physical/Chemical/Biological Hazards,
- Personal Protective Equipment (PPE) and
- Monitoring.

COMMUNITY HEALTH AND SAFETY

- Water Quality and Availability,
- Structural Safety of Project Infrastructure,
- Life and Fire Safety (L&FS),
- Traffic Safety,
- Transport of Hazardous Materials,
- Disease Prevention and
- Emergency Preparedness and Response.

CONSTRUCTION AND DECOMMISSIONING

- Environment Baseline environmental,
- Occupational Health and Safety and
- Community Health and Safety.

3.5 ADB Policies

3.5.1 ADB Safeguard Policy Statement, 2009

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

The SPS applies to all ADB-financed and/or ADB-administered projects and their components, regardless of the source of financing, including investment projects funded by a loan; and/or a grant; and/or other means, such as equity and/or guarantees. ADB works with borrowers and clients to put into practice the requirements of SPS.

The SPS supersedes ADB's Involuntary Resettlement Policy (1995), Policy on Indigenous Peoples (1998), and Environment Policy (2002). In accordance with the SPS, these previous policies apply to all projects and tranches of multi-tranche financing facility projects that were reviewed by ADB's management before 20 January 2010. The objectives of ADB's safeguards are to:

- Avoid adverse impacts of projects on the environment and affected people, where possible;
- Minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is not possible; and
- Assist borrowers and clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks.

ADB's SPS sets out the policy objectives, scope and triggers, and principles for three key safeguard areas:

- Environmental safeguards;
- Involuntary Resettlement safeguards; and
- Indigenous Peoples safeguards.

To help borrowers and clients and their projects achieve the desired outcomes, ADB adopts a set of specific safeguard requirements that borrowers and clients are required to meet in addressing environmental and social impacts and risks. These safeguard requirements are as follows:

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

In addition, ADB does not finance activities on the prohibited investment activities list (Appendix 5 of SPS). Furthermore, ADB does not finance projects that do not comply with its safeguard policy statement, nor does it finance projects that do not comply with the host country's social and environmental laws and regulations, including those laws implementing host country obligations under international law.

3.5.2 ADB Prohibited Investment Activities List

The following do not qualify for Asian Development Bank financing:

- Production or activities involving harmful or exploitative forms of forced labor, child labor;
- Production of or trade in any product or activity deemed illegal under host country laws or regulations or international conventions and agreements or subject to international phaseouts or bans, such as (a) pharmaceuticals, pesticides, and herbicides, (b) ozone-depleting substances, (c) polychlorinated biphenyls and other hazardous chemicals, (d) wildlife or wildlife products regulated under the Convention on International Trade in Endangered Species of Wild Fauna and Flora, and (e) transboundary trade in waste or waste products;
- Production of or trade in weapons and munitions, including paramilitary materials;
- Production of or trade in alcoholic beverages, excluding beer and wine;
- Production of or trade in tobacco;
- Gambling, casinos, and equivalent enterprises;
- Production of or trade in radioactive materials, including nuclear reactors and components thereof;
- Production of, trade in, or use of unbonded asbestos fibers;
- Commercial logging operations or the purchase of logging equipment for use in primary tropical moist forests or old-growth forests; and
- Marine and coastal fishing practices, such as large-scale pelagic drift net fishing and fine mesh net fishing, harmful to vulnerable and protected species in large numbers and damaging to marine biodiversity and habitats.

The proposed project does not involve the above-mentioned activities in the purview of the project development.

3.5.3 ADB Access to Information Policy, 2019

ADB's Access to Information Policy (AIP), which went into effect on 1 January 2019, reflects ADB's ongoing commitment to transparency, accountability, and participation by stakeholders.

The policy, led by a new overarching principle of clear, timely, and appropriate disclosure, contains principles and exceptions to information sharing with external stakeholders.

3.5.4 ADB Social Protection Strategy, 2001

ADB has designed a set of policies and programs for social protection in 2001, that is, to reduce poverty and vulnerability by promoting efficient labour markets, diminishing people's exposure to risks, and enhancing their capacity to protect themselves against hazards and interruption/loss of income. The basic aim of the Social Protection Strategy (SPS) is to assist individuals to break the cycle of poverty and enhance the quality of growth through adequate and developed social protection systems in the member countries of ADB. The type of risks covered through the SPS may be economic, environment or social/governance related.

The proposed project shall ensure that the requirements of the ADB's SPS are complied with. Priority shall be given to any identified vulnerable groups. Based on the gender analysis and status of women in the project area, measures for ensuring their overall development shall be taken up by the project proponent. FPEPL shall comply with applicable labor laws in relation to the Project. FPEPL shall also take the following measures to comply with the core labor standards[10]

- carry out its activities consistent with the intent of ensuring legally permissible equal opportunity, fair treatment and non-discrimination in relation to recruitment and hiring, compensation, working conditions and terms of employment for its workers (including prohibiting any form of discrimination against women during hiring and providing equal work for equal pay to men and women engaged by FPEPL and its sub-contractors.
- no restriction to workers from developing a legally permissible means of expressing their grievances and protecting their rights regarding working conditions and terms of employment;
- engage contractors and other providers of goods and services:
    a. who do not employ child labor[11] or forced labor[12]
    b. who have appropriate management systems that will allow them to operate in a manner which is consistent with the intent of (a) ensuring legally permissible equal opportunity and fair treatment and non-discrimination for their workers, and (b) not restricting their workers from developing a legally permissible means of expressing their grievances and protecting their rights regarding working conditions and terms of employment; and
    c. whose subcontracts contain provisions which are consistent with paragraphs above.

3.5.5 Gender and Development Strategy, 1998

The proposed Project will address and comply with the ADB's Policy on Gender and Development 1998. ADB's Policy on Gender and Development will adopt mainstreaming as a key strategy in promoting gender equity in all aspects of ADB operations. The emerging areas of concern for women

[10] The core labor standards are the elimination of all forms of forced or compulsory labor; the abolition of child labor; elimination of discrimination in respect of employment and occupation; and freedom of association and the effective recognition of the right to collective bargaining, as per the relevant conventions of the International Labor Organization.
[11] Child labor means the employment of children whose age is below the statutory minimum age of employment in the relevant country, or employment of children in contravention of International Labor Organization Convention No. 138 'Minimum Age Convention" (www.ilo.org)
[12] Forced labor means all work or services not voluntarily performed, that is, extracted from individuals under threat of force or penalty

are discussed; and the recommendations to development finance institutions contained in the Platform for Action were endorsed by the United Nations (UN). The key elements of ADB's policy will include the following.

- Gender sensitivity: to observe how ADB operations affect women and men, and to take into account women's needs and perspectives in planning its operations.
- Gender analysis: to assess systematically the impact of a project on men and women, and on the economic and social relationship between them.
- Gender planning: to formulate specific strategies that aim to bring about equal opportunities for men and women.
- Mainstreaming: to consider gender issues in all aspects of ADB operations, accompanied by efforts to encourage women's participation in the decision-making process in development activities.
- Agenda setting: to assist DMC governments in formulating strategies to reduce gender disparities and in developing plans and targets for women's and girls' education, health, legal rights, employment, and income-earning opportunities.

In this Project, the GAD policy will be taken into consideration during all stages of project activities to promote gender equity in providing compensation to the affected people, providing employment opportunities, in getting benefit out of the mitigation measures and community development programs implemented by FPEPL

An overview of ADB's Safeguard Policy Statement (SPS) and their applicability to the project is provided in the table below.

Table 3-5: Broad Overview ADB SPS and their applicability to the Project

S. No.	ADB's Policy/SPS	Overview	Applicability to the Project
1.	SPS 1: Environment	The Environmental safeguards are triggered if a project is likely to have potential environmental risks and impacts. The projects are initially screened to determine the level of assessment that is required. ADB categorises the projects into three project categories based on the severity, sensitivity and the magnitude of its potential environmental impacts: Category A (if the project likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. An environmental impact assessment (EIA), including an environmental management plan (EMP), is required); Category B (if the project likely to have potential impacts are less adverse than category A and minor impacts expected can be mitigated. An initial environmental examination (IEE), including an EMP, is required); and Category C (if the projects likely to have minimal or no adverse environmental impacts. An EIA or IEE is not required).	Applicable This SPS is applicable to environmental aspects like but not limited to air emissions, water and wastewater management, noise emissions, chemical management, hazardous material management.

S. No.	ADB's Policy/SPS	Overview	Applicability to the Project
2.	SPS 2: Involuntary Resettlement	The policy is designed to avoid the risk of impoverishment among those displaced as a direct result of ADB investment. The policy recognizes that restoring the incomes and living standards of the affected people is complex, and requires a development strategy that encompasses compensation, resettlement and rehabilitation packages to improve, or at least restore, their social and economic base. The ADB's Policy on Involuntary Resettlement stipulates three important elements in involuntary resettlement: (i) compensation for lost assets and loss of livelihood and income, (ii) assistance in relocation including provision of relocation sites with appropriate facilities and services, and (iii) assistance with rehabilitation to achieve at least the same level of well-being with the project as before.	Partially Applicable The land required for the proposed project development is being procured through private negotiations on Willing Buyer and Willing Seller basis. The said land is a private barren land and does not include any standing crops or any structures within it. As reported during the consultation there are no livelihood dependency among the landowners on the said land. Thus, it can be concluded that project specific land procurement has not resulted in any involuntary resettlements with respect to the proposed project site land. However, with respect to the proposed Transmission line route, though the right of way (RoW) of the transmission line does not include any residential structures or community structures as on date FPEPL team is under negotiations with the RoW landowners. Since the TL route is not finalized and status on IR is yet to be ascertained SPS-2 will be triggered for the project.
3.	SPS 3: Indigenous People	The Policy on Indigenous Peoples is triggered if a project directly or indirectly affects the dignity, human rights, livelihood systems, or culture of indigenous peoples or affects the territories or natural or cultural resources that indigenous peoples own, use, occupy, or claim as an ancestral domain or asset. The policy on states that the borrower/ client will ensure (i) that affected indigenous peoples receive culturally appropriate social and economic benefits; and (ii) that when potential adverse impacts on indigenous peoples are identified, these will be avoided to the maximum extent	Not applicable The region where the project is located does not fall under the Schedule V area and does not have any significant presence of tribal communities. The same was confirmed through community consultations. Based on the above inferences, it can be presumed that no indigenous people would have been affected due to project activities.

S. No.	ADB's Policy/SPS	Overview	Applicability to the Project
		possible. Where this avoidance is not feasible, based on meaningful consultation with indigenous communities, the Indigenous Peoples Plan (IPP) will be prepared which outlines measures to minimize, mitigate, and compensate for the adverse impacts.	
4.	Policy on Gender and Development	ADB's Policy on Gender and Development (1998) is the guiding framework for gender and development activities. The policy adopts gender mainstreaming as the key strategy for promoting gender equality and women's empowerment across the ADB funded projects. The Policy on Gender and Development (GAD) is guiding document to ensure that their needs and concerns are addressed and that gender issues in resettlement are mitigated. The policy adopts gender mainstreaming as a key strategy for promoting gender equity, and for ensuring that women participate and that their needs are explicitly addressed in the decision-making process.	Applicable This policy is applicable to social aspects such as recruitment and selection, terms of employment, equal opportunity and non-discrimination, parity in salary/ wages etc.

3.5.6 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 in table below.

Table 3-7: Relevant International Conventions

S. N.	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 17-9-1992 and also ratified the Copenhagen, Montreal and Beijing Amendments on 3rd March 2003.
2.	Kyoto Protocol	The Kyoto protocol was signed by India in August 2002 and ratified in February 2005. The convention pertains to the United Nations framework on Climate Change. The 3rd Conference of the Parties to the Framework Convention on Climate Change (FCCC) in Kyoto in December 1997 introduced the Clean Development Mechanism (CDM) as a new concept for voluntary greenhouse-gas emission reduction agreements between industrialized and developing countries on the project level.
3.	International Labour Organization conventions	India has ratified many of the International Labour Organization conventions, some of the key covenants are: - C1 Hours of Work (Industry) Convention, 1919 (14:07:1921, ratified);

S. N.	International Conventions	Salient Features
		- 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.	UN Guiding principles on Business and Human Right	The United Nations (UN) Guiding Principles on Business and Human Rights (GPs), which were endorsed by the Human Rights Council (HRC) in June 2011, are built on three pillars: states' duty to protect human rights, corporate responsibility to respect human rights, and access to effective remedies. All three pillars of the GPs – especially Pillar 1 and Pillar 3 – require states to take a number of measures to ensure that business enterprises do not violate human rights and that effective remedies are available in cases of violation. The UN Working Group on the issue of human rights and transnational corporations and other business enterprises (UNWG) 'strongly encourages all states to develop, enact and update' a national action plan (NAP) on business and human rights (BHR) as part of states' responsibility to disseminate and implement the GPs. In June 2014, the HRC passed a resolution calling upon states to develop NAPs. As of 29 February 2016, ten states have drawn up NAPs of which India was a party wherein it reaffirms India's commitments towards realization of human rights and promotion of socially responsible businesses in the country.
5.	Convention on Biological Diversity, 1992 (CBD or Rio Convention)	India is a Party to CBD since 1994. The objectives of the CBD are the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising from commercial and other utilization of genetic resources. The agreement covers all ecosystems, species, and genetic resources.
6.	Convention on the Conservation of Migratory Species of Wild Animals, 1983 (CMS or "Bonn Convention")	India is a Party to CMS since 1983. CMS is an intergovernmental treaty aimed at conservation and sustainable use of migratory animals and their habitats. It brings together Range States through which migratory animals pass and lays the legal foundation for internationally coordinated conservation measures throughout a migratory range. Parties strive towards protecting migratory species, conserving or restoring the places where they live, mitigating obstacles to migration and controlling other factors that might endanger them.
7.	Convention on Wetlands of International Importance especially as Waterfowl	India is a Contracting Party to the Ramsar Convention since 1982. It is an intergovernmental treaty that provides a framework for the conservation and wise use of wetlands and their resources. It includes all lakes and rivers, underground

S. N.	International Conventions	Salient Features
	Habitat, 1971 (Ramsar Convention)	aquifers, swamps and marshes, wet grasslands, peatlands, oases, estuaries, deltas and tidal flats, mangroves and other coastal areas, coral reefs, as also, human-made sites, such as fish ponds, rice paddies, reservoirs and salt pans. Contracting Parties commit to work towards the wise use of all their wetlands, designate suitable wetlands for the list of Wetlands of International Importance (the "Ramsar List") and ensure their effective management, as well as, cooperate internationally on transboundary wetlands, shared wetland systems and shared species
8.	Convention on International Trade in Endangered Species of Wild Flora and Fauna, 1975 (CITES)	India is a Party to CITES since 1976. It is an international agreement between governments aimed at ensuring that international trade in specimens of wild animals and plants does not threaten the survival of such species. Each CITES Party is expected to adapt its domestic legislation to ensure that the CITES framework is implemented at the national level.
9.	Convention Concerning the Protection of World Cultural and Natural Heritage, 1972 (UNESCO World Heritage Convention) (WHC).	India has been a State Party to the WHC since 1977. The WHC aims to identify and protect the world's natural and cultural heritage considered to be of outstanding universal value. State Parties to the WHC are expected to identify and nominate properties on their national territory to be considered for inscription on the World Heritage List, giving details of how a property is protected and providing a management plan for its upkeep. States Parties are also expected to protect the World Heritage values of the properties inscribed.
10.	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.

3.6 Categorisation of Project

3.6.1 Classification as per MoEF&CC, India

MoEF&CC had brought out notifications in 1989, with the purpose of prohibition/ restriction of operations of certain industries to protect ecologically sensitive Doon Valley. The notification introduced the concept of categorization of industries as "Red", "Orange "and "Green" with the purpose of facilitating decisions related to location of these industries. Subsequently, the application of this concept was extended in other parts of the country not only for the purpose of location of industries, but also for the purpose of Consent management and formulation of norms related to surveillance / inspection of industries.

According to the Final Document on Revised Classification of Industrial Sectors under Red, Orange, Green and White Categories; February 29,2016; Central Pollution Control Board; Table G-5: Final List of White Category of Industries, Sl. No 79, solar power generation through solar photovoltaic cell, wind power and mini hydel power has been classified under White Category.

- Newly introduced White category contains 36 industrial sectors which are practically non-polluting: and
- There shall be no necessity of obtaining the Consent to Operate" for White category of industries. An intimation to concerned SPCB / PCC shall suffice13.

[13] Final Document on Revised Classification of Industrial Sectors under Red, Orange, Green White Categories; February 29,2016; Central Pollution Control Board;

- EIA notification 2006 is non applicable to the solar photovoltaic (PV) power projects hence this project doesn't needs categorization under this notification.[14]

3.6.2 Classification as per IFC Performance Standards

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; and
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. IFC defines the project's area of influence as the primary project site(s) and related facilities that the client (including its contractors) develops or controls; shared 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.

Based on the data available for the project at this stage and applying the criteria stipulated by the IFC Policy on Environmental and Social Sustainability for environmental and social categorization of projects, FPEPL's proposed 50 MW solar project may be assigned as '***Category B***' with respect to environmental and social impacts. This is so basis the primary data available to date which indicates that the environmental and social risks and impacts of the proposed project activities are expected to be few in number, generally site-specific, largely reversible, and readily addressed through mitigation measures, which supports the '***Category B***' classification.

Additional rationale for the above categorization is as below[15]:

- Solar power project is a clean technology project using solar energy for generation of electricity.
- No harmful emissions are expected from the project operations;
- The Project Site does not coincide or overlap with any Designated Area;

[14] 2YME8DSI_OM Solar Parks dated 7th July 2017.pdf (environmentclearance.nic.in)

[15] As the land procurement was not complete till preparation of this ESIA report, the above project categorization is liable to revision depending on any changes mentioned in above aspects has potential to change project catgorisation.

3.6.3 Classification as per ADB Safeguard Policy Statement (SPS) (2009)

3.6.4 ADB Safeguard Categories

3.6.4.1 Safeguard Requirement 1: - Environment

Proposed projects are screened according to type, location, scale, and sensitivity and the magnitude of their potential environmental impacts, including direct, indirect, induced, and cumulative impacts. Projects are classified into the following four categories:

- ***Category A.*** A proposed project is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental and social impact assessment (ESIA), including an environmental management plan (EMP), is required.
- ***Category B.*** The proposed project's potential adverse environmental impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An initial environmental examination (IEE), including an EMP, is required.
- ***Category C.*** A proposed project is likely to have minimal or no adverse environmental impacts. An EIA or IEE is not required, although environmental implications need to be reviewed.
- ***Category FI.*** A proposed project involves the investment of ADB funds to or through a financial intermediary. The financial intermediary must apply and maintain an environmental and social management system, unless all of the financial intermediary's business activities have minimal or no environmental impacts or risks.

3.6.4.2 Safeguard Requirement 2: -Involuntary Resettlement

The involuntary resettlement impacts of an ADB-supported project are considered significant if 200 or more persons will be physically displaced from home or lose 10% or more of their productive or income-generating assets. For those involving involuntary resettlement, a resettlement plan is prepared that is commensurate with the extent and degree of the impacts: the scope of physical and economic displacement and the vulnerability of the affected persons. Projects are classified into the following four categories:

- ***Category A.*** A proposed project is likely to have significant involuntary resettlement impacts. A resettlement plan, which includes assessment of social impacts, is required.
- ***Category B.*** A proposed project includes involuntary resettlement impacts that are not deemed significant. A resettlement plan, which includes assessment of social impacts, is required.
- ***Category C.*** A proposed project has no involuntary resettlement impacts. No further action is required.
- ***Category FI.*** A proposed project involves the investment of ADB funds to or through a financial intermediary. The financial intermediary must apply and maintain an environmental and social management system, unless all of the financial intermediary's business activities are unlikely to generate involuntary impacts.

3.6.4.3 Safeguard Requirement 3: -Indigenous Peoples

The impacts of an ADB-supported project on indigenous peoples is determined by assessing the magnitude of impact in terms of:

- customary rights of use and access to land and natural resources;
- socioeconomic status;
- cultural and communal integrity;
- health, education, livelihood, and social security status; and

- the recognition of indigenous knowledge; and
- the level of vulnerability of the affected Indigenous Peoples community. Projects are classified into the following four categories:
  - ***Category A.*** A proposed project is likely to have significant impacts on indigenous peoples. An Indigenous Peoples Plan (IPP), including assessment of social impacts, is required.
  - ***Category B.*** A proposed project is likely to have limited impacts on indigenous peoples. An IPP, including assessment of social impacts, is required.
  - ***Category C.*** A proposed project is not expected to have impacts on indigenous peoples. No further action is required.
  - ***Category FI.*** A proposed project involves the investment of ADB funds to or through a financial intermediary. The financial intermediary must apply and maintain an environmental and social management system, unless all of the financial intermediary's business activities unlikely to have impacts on indigenous peoples.

This is so basis the primary data available to date which indicates that the environmental and social risks and impacts of the proposed project activities are expected to be few in number, generally site-specific, largely reversible, and readily addressed through mitigation measures, which supports the classification as below

Safeguard Requirements 1: Environment: The proposed project site is a solar power project which is a clean technology project using solar energy for generation of electricity and no harmful emissions are expected from the project operations, though the monitoring at the site was not done due to land procurement activities. Based on the ADB Policy on categorization of projects, the current project can be categorized as '***Category B***' with respect to environmental impacts. This is based solely on the primary data available to date. Environmental monitoring data was yet to be obtained for the project due to ongoing land purchase.

Safeguard Requirements 2: Involuntary Resettlement: The proposed project site land is being procured through negotiations based on Willing Buyer and Willing Seller basis and based on the assessment the project site land procurement does not result in Physical or economic displacement. However, the Transmission line route is yet to be finalized and are under negotiation stage with the landowners. Failure of negotiated settlements will trigger Involuntary Resettlement and the PAPs are proposed to be rehabilitated as per the LRP as developed for the project. Hence the project is **Categorized as B** for SR2-IR. If any IR reported, the PAPs will be compensated as per the LRP developed for the project.

Safeguard Requirements 3: Indigenous Peoples: The proposed solar site land including the TL route does not fall under Schedule-V areas as defined in the Indian Constitution under Article 342. The land being involved for solar plant and TL does not comprise of any tribal land/ land parcels owned by members belonging to the Indigenous Peoples (IP) or their dependency on the land for livelihood. Moreover, it is to be noted that there are no Scheduled Tribe population residing within the study area. Hence the proposed project is not expected to have impacts on indigenous peoples and is **Categorized as C.** No further action is required.

Additional rationale for the above categorization is as below:

- Solar power project is a clean technology project using solar energy for generation of electricity;
- No harmful emissions are expected from the project operations;
- The Project Site does not coincide or overlap with any Designated Area; and
- Available data suggests that the construction, operation and decommissioning of the proposed solar project are likely to have limited environmental and social impacts which can be readily addressed with mitigation measures.

3.7 Applicable Environmental Standards

3.7.1 Ambient Air Quality

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

Table 3-8: National Ambient Air Quality Standards

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

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

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

3.7.2 Ambient Noise Standards

As per the EHS guidelines of IFC, for residential, institutional and educational area, the one hourly equivalent noise level (Leq hourly) for daytime (6.00 a.m. to 10.00 p.m.) is **55 dB (A)** while the Leq

hourly for night time (10.00 p.m. to 6.00 a.m.) is prescribed as **45 dB (A).** Noise standards notified by the MoEF&CC vide gazette notification dated 14th February 2000 based on the *A- weighted equivalent noise level (Leq)* are as presented in table below.

Table 3-9: Ambient Noise Standards

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

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

3.7.3 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 3-10: Standards for Occupational Noise Exposure

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

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

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

3.7.4 Water Quality Standards

The designated best use classification as prescribed by CPCB for surface water is as given in table below.

Table 3-11: Primary Surface Water Quality Criteria for Designated Best Use Classes

Designated-Best-Use	Class	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	• Total Coliforms Organism MPN/100ml shall be 50 or less

Designated-Best-Use	Class	Criteria
		• pH between 6.5 and 8.5 • Dissolved Oxygen 6mg/l or more • Biochemical Oxygen Demand 5 days 20°C 2mg/l or less
Outdoor bathing (Organised)	B	• Total Coliforms Organism MPN/100ml shall be 500 or less • pH between 6.5 and 8.5 • Dissolved Oxygen 5mg/l or more • Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	• Total Coliforms Organism MPN/100ml shall be 5000 or less • pH between 6 to 9 • Dissolved Oxygen 4mg/l or more • Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Propagation of Wild life and Fisheries	D	• pH between 6.5 to 8.5 • Dissolved Oxygen 4mg/l or more • Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	• pH between 6.0 to 8.5 • Electrical Conductivity at 25°C micro mhos/cm Max.2250 • Sodium absorption Ratio Max. 26 • Boron Max. 2mg/l
	Below-E	• Not Meeting A, B, C, D & E Criteria

Source: Central Pollution Control Board

3.7.5 Drinking Water Quality Standards / Ground Water Quality

In India, 'IS 10500 (2012): Drinking Water' is used as drinking water quality standards. If ground water is used for drinking purpose, then this standard is used for checking suitability of ground water for the same. This standard specifies the acceptable limits and the permissible limits in the absence of alternate source. It is recommended that the acceptable limit is to be implemented as values in excess of those mentioned under 'Acceptable' render the water not suitable. Such a value may, however, be tolerated in the absence of an alternative source. However, if the value exceeds the limits indicated under 'permissible limit in the absence of alternate source' in col 4 of Tables 1 to 4 of the 'IS 10500 (2012): Drinking Water', the sources will have to be rejected.

4. Environmental and Socio-Economic Baseline

This section of the report presents information on the baseline condition of the physical, chemical, biological and social environment within the project area. Primary baseline information was not collected on site from project area and area of influence due to unfavourable site condition not permitting the monitoring to happen. Existing information sourced from scientific literature (both published and unpublished), engineering studies, technical reports and community socio-economic studies were used wherever available. Activities that facilitated establishment of the baseline data in the report include site survey, ecological survey, social consultations and interviews, processing of satellite imagery and secondary data review from established sources such as Indian Meteorological Department (IMD) and Census of India amongst others.

4.1 Environmental Baseline

Area in the 5-kilometre (km) radius from the project is considered as AoI of the project, for primary data collection. AoI covers project area, area traversed by project transmission line. Nearby villages which fall under AoI are Adappadakki village, Sembar village, Muddikkari village, Kanji Patti village, Periya Kannanur village.

Primary environmental baseline monitoring was not undertaken for ambient air quality, surface water quality, drinking water quality, ground water quality, ambient noise levels, soil quality and traffic survey due to ongoing land purchase activities.

Following sections presents data obtained during site visit for ecology and social sections and secondary sources for other aspects.

4.1.1 Physiography

Sivaganga District consists of two Revenue Divisions viz., Sivaganga and Devakottai, Nine Taluks viz., Sivaganga, Manamadurai, Ilayangudi, Thiruppuvanam, Kalaiyarkoil, Karaikkudi, Devakottai, Thiruppattur And Sigampunari, comprising of 521 Revenue Villages. The District has Twelve blocks viz. Sivaganga, Kalayarkoil, Manamadurai, Thiruppuvanam, Ilyankudi, Devakottai, Kannangudi, Sakottai, Kallal, Thiruppathur, Singampunari and S.Pudur comprising of 451 Village Panchayats. There are three Municipalities viz. Sivaganga, Devakottai and Karaikudi and Eleven Town Panchayats viz. Manamadurai, Thiruppathur, Thiruppuvanam, Singampunari, Ilayankudi, Nattarasankottai, Kottaiyur, Kandanur, Puduvayal, Pallathur, Kanadukathan, Nerkuppai. Sivaganga district has red soil and clay soil. The familiar landscape is of palm and acacias. The Vaigai River flows in the district which fill water to around 100 tanks. A small hillock in Piranmalai and small hillock at Kundrakudi are the hills in the district worth mentioning.[16] This project lies in the Kalaiyarkoil taluka of the district which has total 6 tehsils, 12 blocks and 521 villages. Major physiographic units in the region are residual hills and central upland.

The northern part of the district is drained by the rivers Pambar, Manimuttar and Sarugani rivers and the southern part is drained by Vaigai River. The northern, western part of the district comprising of Tiruppathur taluk is a high ground studded will hillocks and residual hills. The stretch trending northeast to southwest extending from Puduvayal to Manamadurai is an upland. The rest of the area is a plain alluvial terrain.

4.1.2 Geology

The northern part of Sivaganga and Tirupattur taluk are made up of rocks of chornockite – Kondalite groups and migmatite of archaean age comprises chornockite, garnet Sillimanite gneiss, Hornblende biotite gneiss. In gneiss rock quartz – feldspahic band and mafic enclaves are observed due to

[16] About District | Sivaganga District, Government of Tamil Nadu | The Land With A Hoary Past | India

segregation by differential composition. Numerous band and lenses of matabasic rocks i.e amphibole, pyroxinite and biotite, schist, quartzite, calc granulite and grey and pink granite occur within the group.

Hornblende biotite gneiss, garntiferous quartzo feldspathic gneiss is the major lithological unit in north and west. They are very coarse grained and highly feldspathic. Sillimanite bearing gneiss is seen in association with quartzite. The gneiss occurs at places as residual hilocks and knolls with gneissosity tranding NE to N-S having steep deep. The quartzite forms long ridges and folds. Clac gneiss and calc granulite occurs as thin bands within the garnet sillimanite gneiss and hornblend boitite gneiss and intensely folded.

The geological sequence of rocks around Sivaganga district is as follows. Recent alluvium of the Vaigai river and Upper Laterite and lateritic soils. It is followed by basal Gondwana Formation, 181 Showing the following sequence: Alternating grits and shales Micaceous sandstones Basal conglomerate and boulder bed — Unconformity — Archaean rocks

The Archaean Rocks: They are found on the western side of the Sivaganga town. The rocks consist of quartzites, mica-gneisses, pink and gray granitics. These rock types occur as parallel bands between ENEWSW and E-W with steep southward dips of 60° to 90°. A small inlier of one square mile of the gneissic rocks is seen in the Gondwana Formation.

Gondwana Formation: The western boundary between the Archaean rocks and Gondwana Formation runs in roughly NE to SW line from near Kallal in the north to Sivaganga Railway station. The Gondwana formation extend over a large area of 160 Square Km. They comprise a basal conglomerates and boulder-beds followed by sandstones, shales and grits. The plant fossils were collected from these shales. The Gondwana rocks have very low and irregular dips.

Dimension Stones (Granite): The district is occupied by hard crystalline rocks like leptynite, gneissic rock. These rocks are normally used as building materials purposes. The area is famous for multicolored granite (leptynite), commercially Known as “Kshmir White”.[17]

As per the reports by national water mission on existing network of monitoring wells in sivaganga district which has 238 wells out of which 196 are observation wells and 42 wells are piezometers. Kaliyarkoil block has 5 observation wells and 1 piezometeric location.[18] There might be other wells also but the mentioned one is monitored under the mission.

The district is underlained by the formations of quaternary, tertiary, mesozoic andazoic area.

The western and northwestern part of the district comprising the western part of the Sivaganga taluk and major part of Thirupathurtaluk are occupied by crystalline rocks of Archaean age which includes number of rock types namely feldspathic and mica gneiss, charnockites, quartzites, pegmatites and granitic intrusions.

Overlying the above formations, the upper Gondwana exposures are prominent in the north east – southwest trending belt near Sivaganga extending from Kallal to sivaganga and beyond in the southern part of the district. The lateritic capping in karaikudi taluk further north has been observed with its further continuity beyond kallal. However, the study of well section around Managiri, Koviloor and Talakavoor villages shows red yellow and purple shells which are generally fine grained and fossils showing horizontal bedding.

The lower as well as upper cretaceous formations do not crop out anywhere in the district and are encountered in the bore holes only. The formations suggestive of lower cretaceous are encountered in the bore holes drilled by ONGC near Karaikudi below 128m below ground level, comprises alternate layers of clay and shale with sandstone. The clay and shale are grey to black in colour. The sandstone is medium to coarse grained greenish and admixes with clay.

The formations suggestive of upper cretaceous are encountered in the bore holes drilled in the eastern part of the district only, east of Devakottai namely in Sathanaikottai, Kappalur etc., occurring between 200m and 295m BGL.

Project is located in the eastern part of the district where the formation suggestive of Eocene or Palaeocene are encountered in the bore holes drilled at Sathanaikottai, Kappalur, Devandathavu and

[17] 10082019Z3IQKDU0HydrogeologicalReport.pdf (environmentclearance.nic.in)
[18] Notes on Sivaganga District.pdf (nwm.gov.in)

at Neyvayal occurring between depth ranges 77m and 190 m BGL with maximum thickness of 82 m and consist mainly of clay and shale, dark greenish to black with shale or sand and sand stone lenses. Exposures of tertiary (Mio-pliocene age) formations are seen around Karaikudi, Sengarai, Sakkottai, Kottaiyur, Kalayarkoil and Manamadurai. The alluvial formation brought down by the river draining the district are found in major part of Karaikudi and to a smaller extent along the river course in Thirupattur taluk. It consists of clay, sandy clay, silky clays, sand and gravel with thickness ranging between 6m and 40m.[19]

4.1.3 Drainage

The district is drained by Kottakaraiyar, Tirumanimuttar, Vaigai and Pambar and all these rivers are ephemeral in nature. In a major part of the district the drainage pattern is sub-dentritic and dentritic and at places, the drainage pattern is controlled by geological structures also.

There are couple of 1st order streams that can be seen in the project area and some seasonal drains as well. Also, in the seasonal waterbody map there are many waterbodies all around the land but there is no waterbody inside the project area. The drainage map and seasonal waterbody map can be seen in figures below.

[19] Notes on Sivaganga District.pdf (nwm.gov.in)

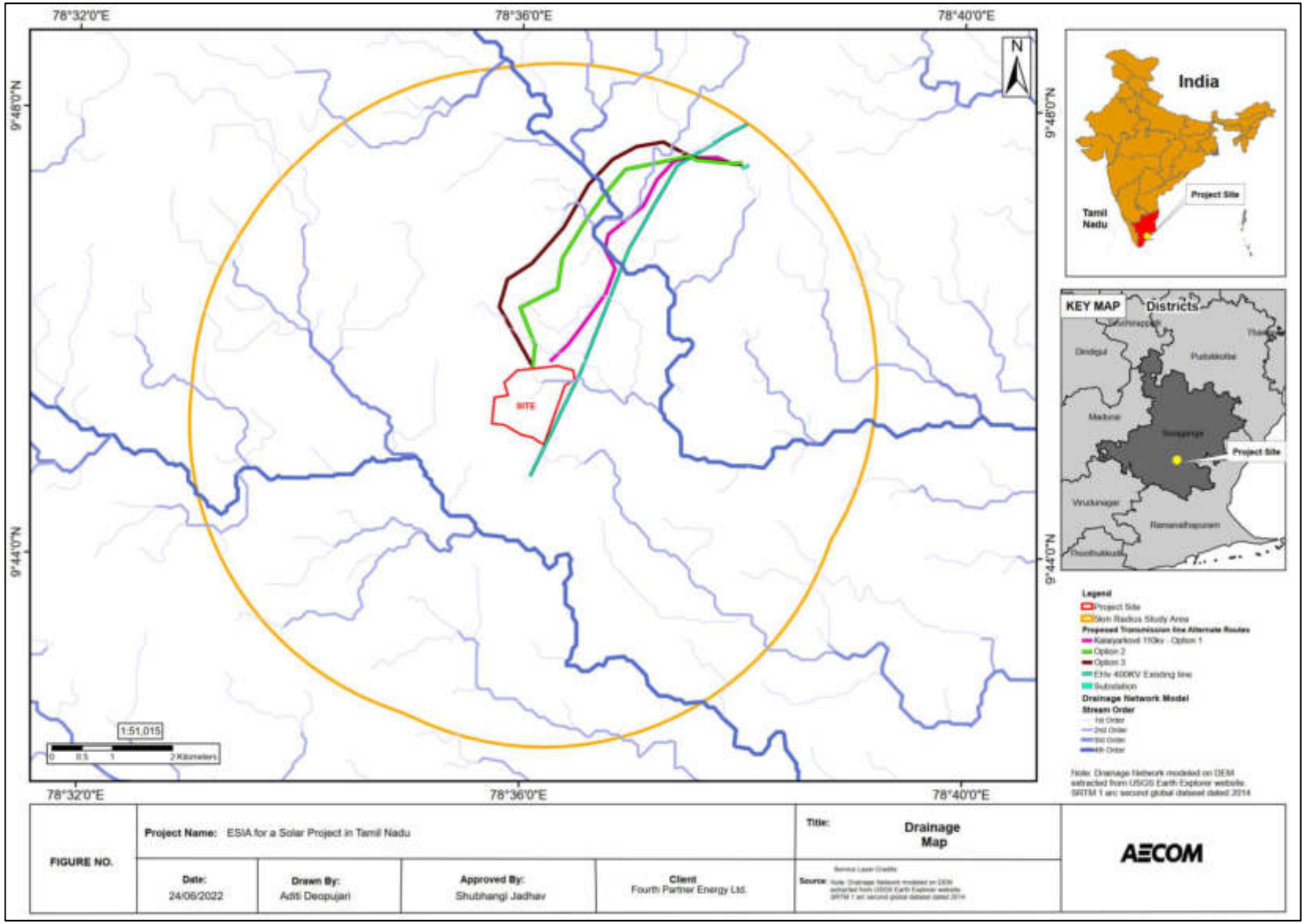

Figure 4-1: Map Representing Drainage within 5 km radius of site

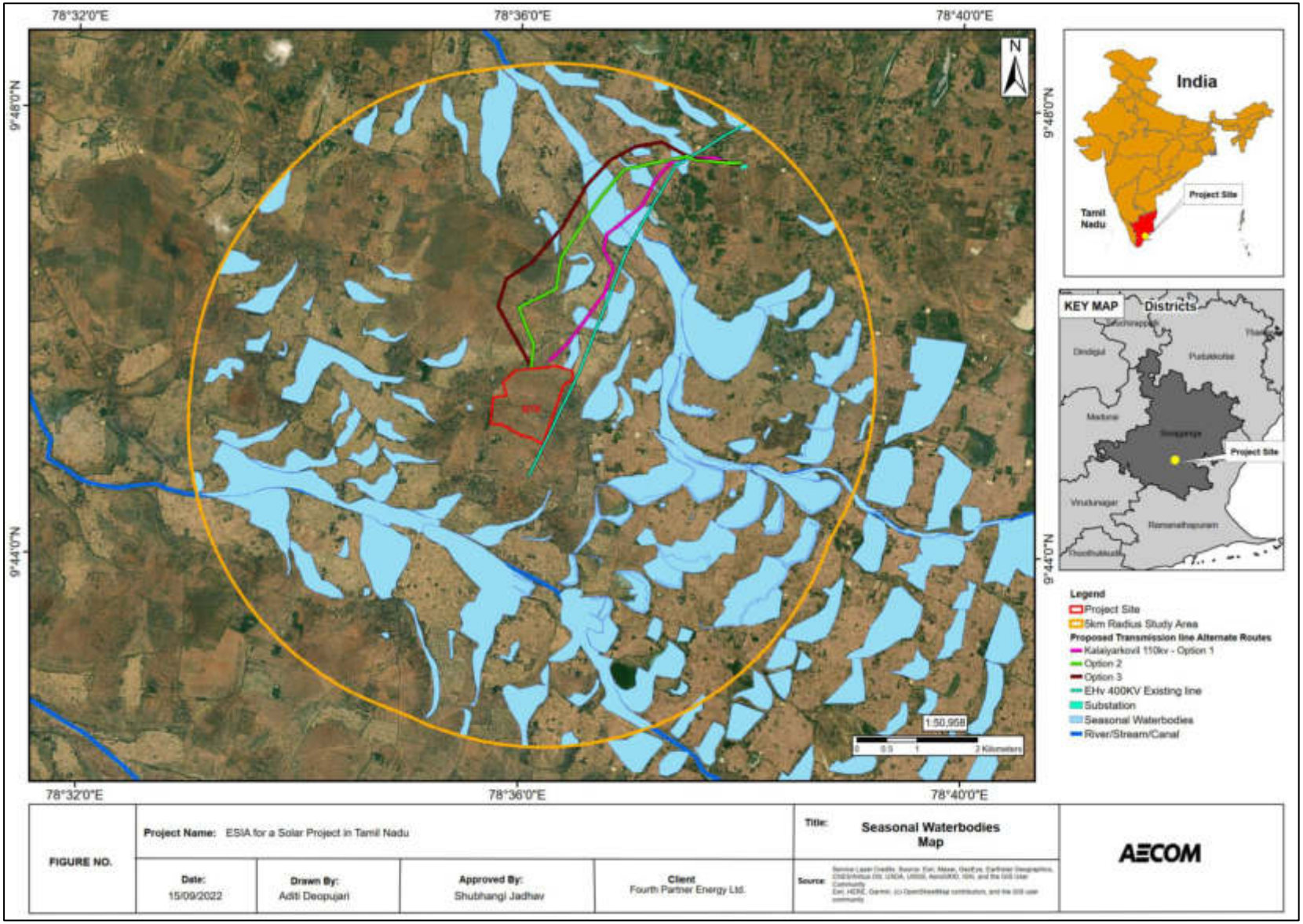

Figure 4-2: Map Representing Seasonal Waterbody Map

4.1.4 Land use and Land Cover

Sivaganga district was a part of the Ramanathapuram district. The district came into existence on 15.03.1985 as a result of the trifurcation of the composite Ramanathapuram district. Sivaganga district consists of 2 Revenue Divisions, 6 Taluks, 12 Community Development Blocks, 3 Municipalities, 12 Town Panchayats and 1 Census Town. There are 515 Revenue Villages in Sivaganga district, of which 508 villages are inhabited. The district Sivaganga is bounded by Pudukkottai district on the Northeast, Tiruchirapalli district on the North, Ramanathapuram district on Southeast, Virudhunagar district on Southwest and Madurai District on the West. The headquarters of Sivaganga District is located at Sivaganga, a Municipality with population of 40,403 as per Census, 2011. The city is located at a distance of 48 km from Madurai and 449 km from the state capital Chennai. The total geographical area of the district was the total area of the district is 4233 sq.kms. As per the District Census Handbook, Sivaganga (2011), in the district 4.08 % area is covered under the forest area, 25.9% of the total geographic area is cultivable land of which 73% was covered under the irrigation.

The land use pattern of the district has been provided below:

Table 4-1: Land use pattern of Sivaganga District

S. No.	Classification of Land use	Area (in hectares)
1.	Geographical area	429599.17
2.	Forest	17546.37
3.	Barren and Un-cultivable Land	4799
4.	Area under non-agricultural use	114583.77
5.	Pastures and Other Grazing Lands	1329.82
6.	Land Under Misc. Tree crops/Groves	6605.11
7.	Culturable Waste Land	18685.99
8.	Fallow Lands other than Current Fallows	113535.04
9.	Current Fallows	23349.96
10.	Net area sown	111501.11
11.	Net Irrigated land area sown	81427.58
12.	Net Un-Irrigated land area sown	30073.53

Source: District Census Handbook 2011: Sivaganga

The Project site specific land use within 5 km radius of the proposed project site and the land use of the project site village has been presented in the following table and figure.

Table 4-2: Land Use Specific To Project Area And Site

S. No.	Land use Type	Land use within 5 km radius of Project Site		Land use of Project Village	
		Area in Hectares	% of the total area	Area in Hectares	% of the total area
1	Forest Area	668.8	5.2	5	0.5
2	Area under Non-Agricultural Uses	4058.18	31.8	404.86	40.7
3	Barren & Un-cultivable Land Area	65.5	0.5	5	0.5
4	Permanent Pastures and Other Grazing Land Area	33.81	0.3	0	0.0
5	Land Under Miscellaneous Tree Crops etc. Area	52.37	0.4	5.45	0.5
6	Culturable Waste Land Area	607.83	4.8	37.8	3.8
7	Fallows Land other than Current Fallows Area	3156.39	24.8	219.61	22.1
8	Current Fallows Area	68.79	0.5	5	0.5
9	Net Area Sown	4032.57	31.6	311.6	31.3
10	Total Geographical Area	12744.24	100.0	994.32	100.0

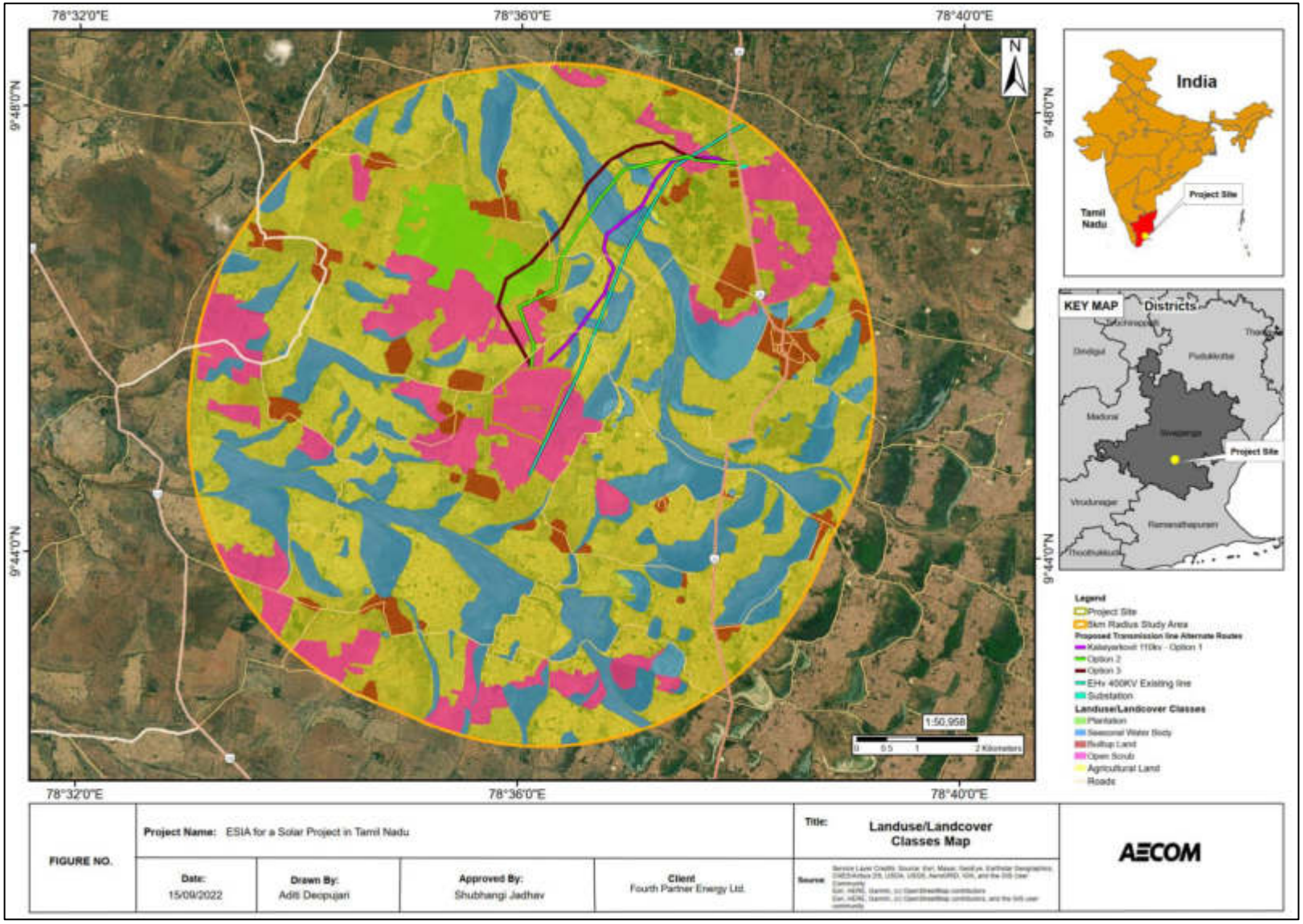

Figure 4-3: Map showing Landuse within 5 km radius of the Proposed Project site

4.1.5 Soil Types

The major soil types in the district are 1. Red soil, 2. Lateritic Soil, 3. Alluvial Soil and 4. Black Cotton soil. Red soils are prevalent in Devakottai, Tiruppathur and Sivaganga 182 taluks, while Lateritic soil is found in Karaikudi and Devakottai taluks. Alluvial soil along the river courses and Black Soil in Illayangudi, Manamadurai and Tiruppathur Taluks. Project site is located in a region with Laterite soil marked in red in the below figure. The surface is almost flat; hence limited site preparation is envisaged for levelling of the area. Map representing the soil type and soil texture in Tamil Nadu state is presented in figures below.

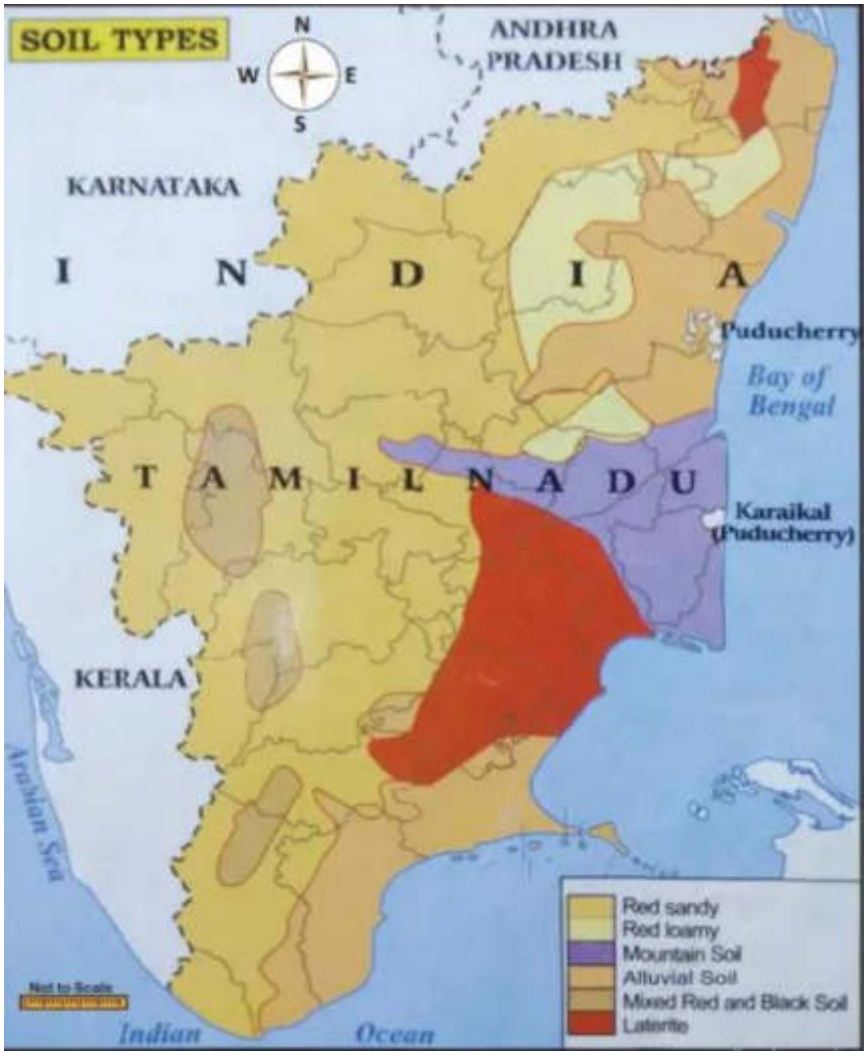

Figure 4-4: Soil Classification Map of Tamil Nadu State

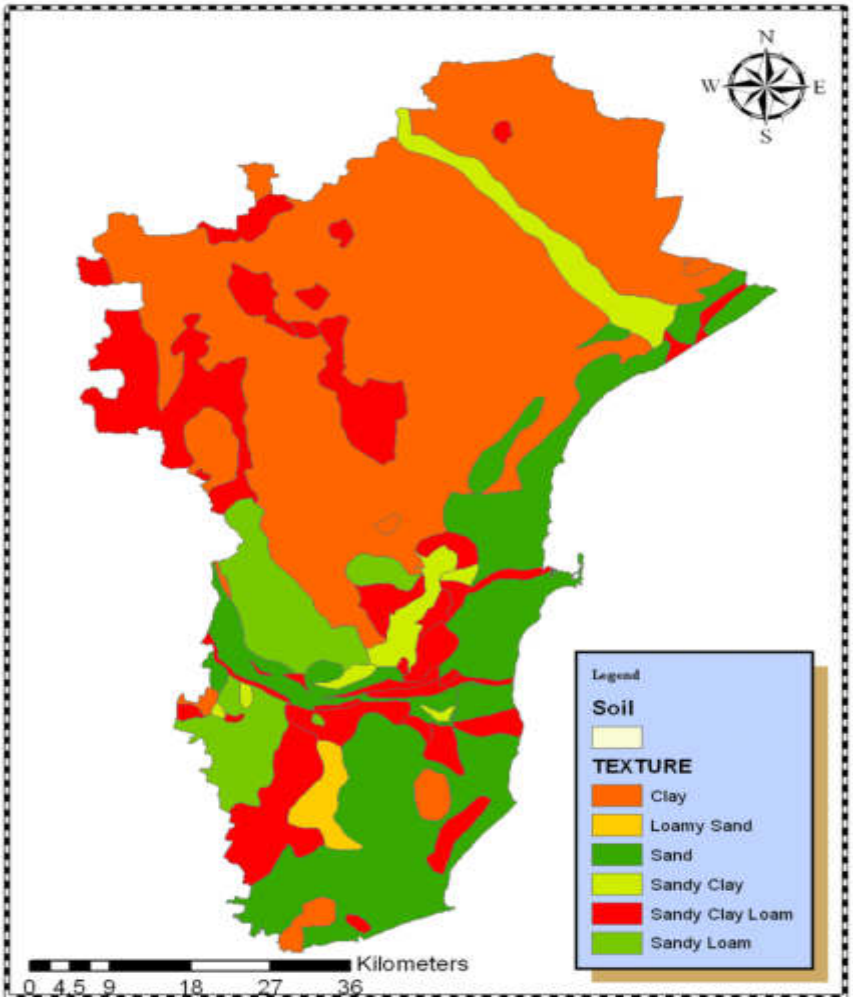

Figure 4-5: Soil Texture map of Tamil Nadu State

4.1.6 Hydrogeology

Two-third area of the district is underlain by sedimentary formations while rest by Archaean crystalline metamorphic complex. The important aquifer systems encountered in the district are classified into

i) Porous formations, viz., alluvium, sandstone etc

ii) Weathered and fractured crystalline formations consisting of Charnockite and Granite.

The aquifers of porous formation may be grouped as follows

i) Gondwana aquifers

ii) Lower Cretaceous Aquifers

iii) Upper Cretaceous Aquifers

iv) Tertiary Aquifers (Cuddalore Sandstone)

v) Alluvium

The geology consists of clay, sandy clay, silky clays, sand and gravel with thickness ranging between 6m and 40m.[20]. Pre- monsoon depth to water level (May 2006) ranged from 1.18 to 10.10 m bgl and post- monsoon depth to water level (Jan'2007) ranged between 0.86 to 18.25 m bgl.

[20] Notes on Sivaganga District.pdf (nwm.gov.in)

The project is proposed in Kalayarkoil taluka where ground water levels were reported as safe by CGWB.

Table 4-3: Dynamic Ground Water Resources Estimation of Kalayarkoil

Assessment Block	Net annual ground water availability	Existing Gross Ground Water Draft for Irrigation	Existing Gross Ground Water Draft for domestic and industrial water supply	Existing Gross Ground Water Draft for All uses	Category of the Block
Kalayarkoil	11615.78	459.43	211.99	671.43	Safe

Source: Sivaganga District, District Groundwater Brochure, Central Ground Water Board [21]

4.1.7 Climate and Meteorology

4.1.7.1 Rainfall

The normal annual rainfall over the district varies from about 861.8 mm. to about 988.6 mm. The normal south west monsoon rainfall varies from 275.8 to 401.1 mm while during NE monsoon the normal seasonal rainfall varies from 382.5 to 442.8 mm. A perusal of the rainfall pattern shows that in general the rainfall increases towards east. The district enjoys a tropical climate. The period from April to June is generally hot and dry. The weather is pleasant during the period from November to January. Usually, mornings are more humid than afternoons. The relative humidity varies between 65 and 85% in the mornings while in the afternoon it varies between 40 and 70%.

Recent data for last five (05) years collected from India Meteorological Department (IMD), Sivaganga shows that the October, November and December receives more rainfall when compared to other seasons of the year as shown in table below.

Table 4-4: Average Annual Rainfall (in mm) for Sivaganga District

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
2016	0.0	0.0	1.3	12.5	157.9	39.4	94.9	134.4	111.4	65.3	21.5	72.3
2017	73.5	1.1	39.3	9.8	58.2	127.7	89.2	184	125.5	118.3	82.9	58.1
2018	2.9	1.2	26.9	38.6	219.3	55.1	64.4	81.7	104.5	149.6	165.9	22.5
2019	0	3.1	0.0	4.9	12.3	22	85.5	125.1	221.4	266.5	113.5	112
2020	4.7	0.0	0.0	53.5	74.4	78.6	99.6	75.5	163	151.7	242.8	168.3

Source: IMD (http://hydro.imd.gov.in/hydrometweb/(S(rzx21qm1n5eyvwabunouztag))/DistrictRaifall.aspx)

Note:
(1) The District Rainfall in millimeters (R/F) shown are the arithmetic averages of Rainfall of Stations under the District.
(2) Blank Spaces show non-availability of Data

4.1.7.2 Wind Speed & Windrose

Annual wind rose prepared from daily surface wind data recorded at 0300 UTC for 1971 to 2000 for Madurai (A) indicates that most frequently occurring direction is from northwest (NW) to northeast (NE), on 60% of the years. The winds are seldom from the southeast (SE) direction at this synoptic hour. The annual wind rose suggests highest wind speed more than 11 mps come from the west (W).

Wind speeds recorded at the nearest IMD station, Madurai (A), for the period 1981-2010 is mentioned in the below table.

[21] http://cgwb.gov.in/District_Profile/TamilNadu/Sivaganga.pdf

Table 4-5: Windspeed (in kmph) for the region

Month	No. of days with wind speed (kmph)			
	62 or more	20-61	1-19	0
January	0	6	51	5
February	0	6	41	9
March	0	5	47	10
April	0	8	42	10
May	0	12	43	7
June	0	26	29	5
July	0	26	32	4
August	0	21	34	7
September	0	11	39	10
October	0	4	33	15
November	0	2	46	12
December	0	6	51	5x`x

Annual wind rose prepared from daily surface wind data recorded at 0300 UTC for 1971 to 2000 for Madurai (A) IMD station (year 1971-2000) indicates that most frequently occurring direction is from northwest (NW) to northeast (NE), on 60% of the years.

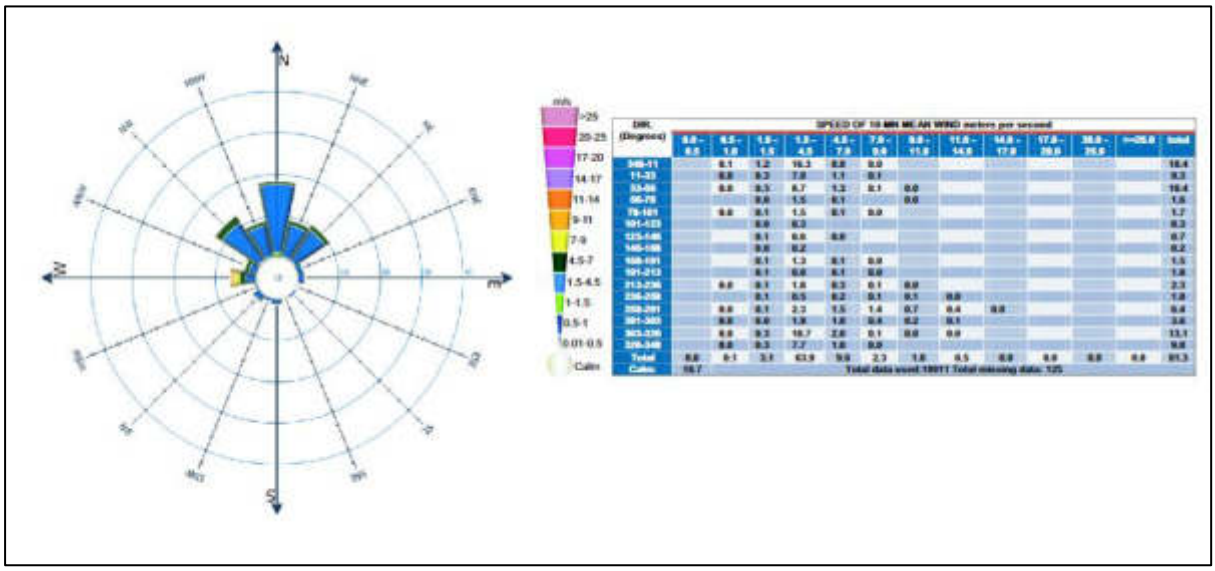

Figure 4-6: Windrose for Madurai (A) IMD Station

4.1.8 Natural Hazards

4.1.8.1 Wind Hazard

Sivaganga district is not that prone to wind and cyclone hazard and lie in moderate damage risk category as seen in the figure below.

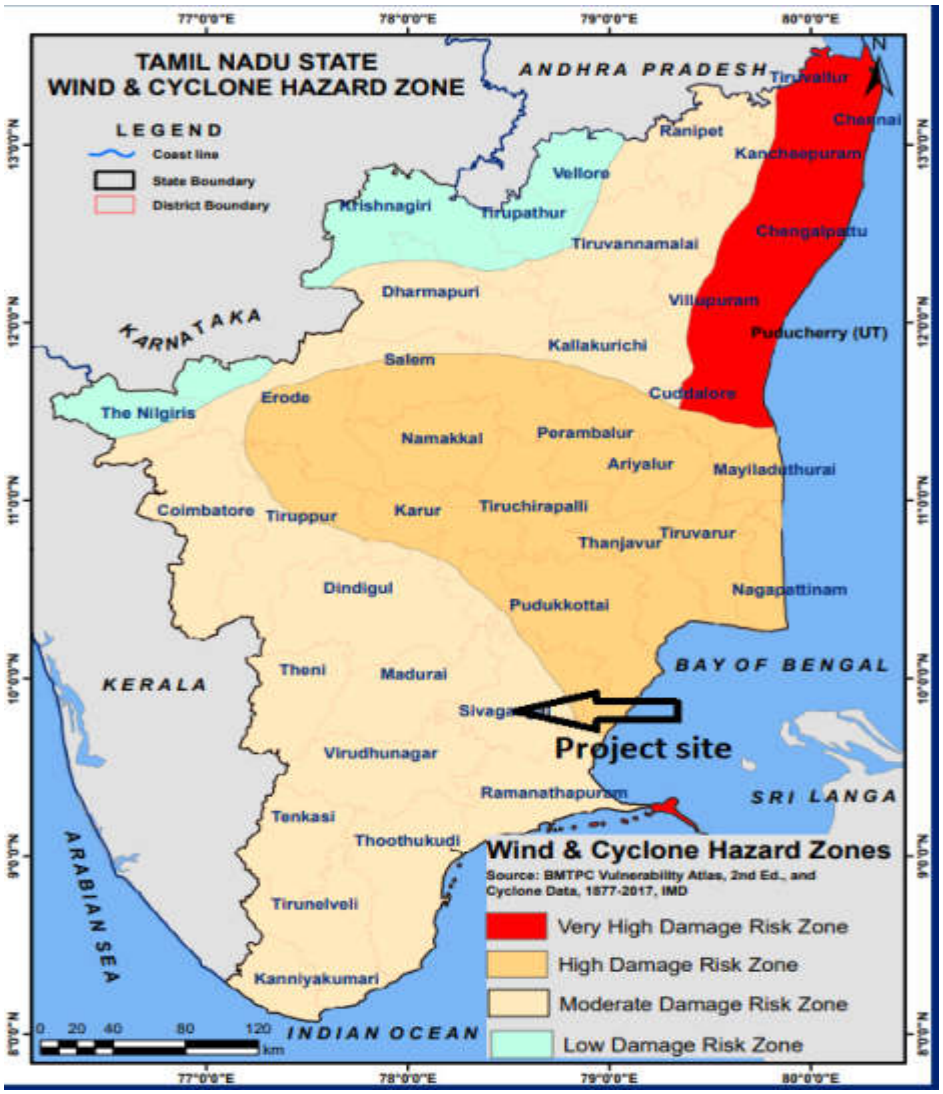

Figure 4-7: Wind Hazard map of Tamil Nadu state

Source: Tamil Nadu state disaster management [22]

4.1.8.2 Seismicity

Earthquake risk is high in the state of Tamil Nadu and as per the seismicity map of India, Tamil Nadu state mainly has zone-II (least active) and zone-III (moderate).[23]

The proposed project site in Sivaganga district falls under Zone – II (MSK VI) i.e. a Low risk Zone and can be seen in the figure below:

[22] tn_wind_cyclone_hazard_zone.pdf
[23] LS_EN_20032020_385_0.pdf (moes.gov.in)

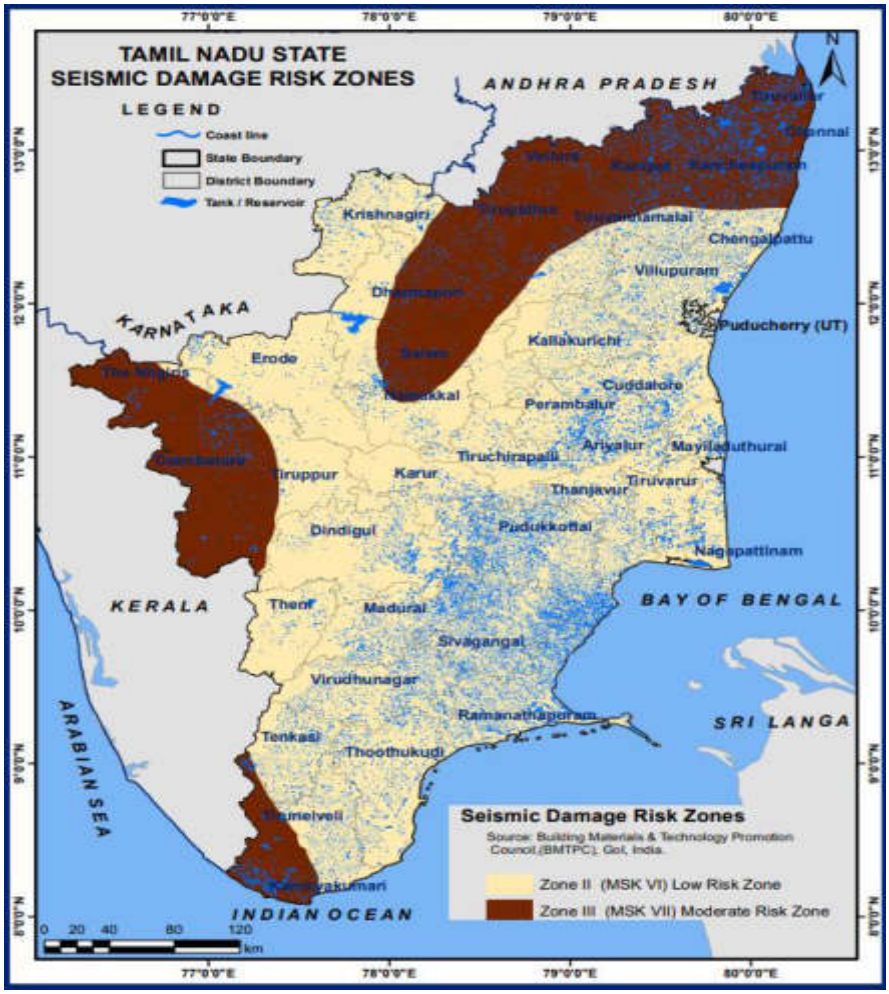

Figure 4-8: Earthquake Hazard Map of Tamil Nadu state

Source: Tamil Nadu state disaster management[24]

4.2 Biodiversity Profile

This section of the report summarizes the biodiversity baseline assessment carried out towards the ESIA. It delineates the area covered by the assessment, describes the methodology used for the assessment and establishes a biodiversity baseline covering species, habitats, and ecosystem services, invasive alien species and designated areas. This biodiversity baseline forms the basis for predicting the potential impacts of the project on biodiversity and suggesting mitigation measures to manage the predicted impacts.

4.2.1 Delineation of the Study Area

This sub-section delineates the area covered by the biodiversity assessment. It also briefly describes the geographical and ecological status of the said area.

The area covered by the assessment includes the following:

a) Area of Direct Influence: The area coinciding with the footprint of the Project, including the power plant, external transmission line and sub-station (estimated to contain the potential receptors of any direct Project-related ecological impacts), hereinafter referred to as the 'Project Site'; and

[24] tn_seismic_damage_zones.pdf

a) Area of Indirect Influence: The area within a 5 km buffer of the power plant boundary and 500 m buffer of the external transmission line and sub-station (estimated to collectively contain the potential receptors of any indirect Project-related ecological impacts), hereinafter referred to as the 'Buffer Area'

The Area of Direct Influence and the Area of Indirect Influence collectively constitute the area subjected to this biodiversity assessment (hereinafter referred to as the 'Study Area'). Areas beyond the said Study Area have been considered, as applicable, during the CH Screening process to ensure analysis of an ecologically appropriate area.

The Study Area forms a part of the inner coastal plains of southeast India. The terrain of the Study Area is largely plain and drained by small streams. The overall slope of the land is from northwest to southeast. The elevation ranges from 40 to 70 amsl. The climate is tropical wet and dry, with maximum rainfall during the northeast monsoon. The soil types in the Study Area include red, lateritic, alluvial and black soil.

The habitat profile of the Study Area constitutes of both natural and modified habitats. Natural habitats mainly consist of near-natural to moderately degraded shrubland and natural inland wetlands. Modified habitats mainly consist of arable lands, plantations and built spaces comprising rural habitation. The aquatic habitats consists of inland wetlands that mainly include small seasonal streams and collection ponds.

4.2.2 Approach and Methodology

This section outlines the approaches used to address the different components of the Study and the methodologies applied to achieve the objective of each.

4.2.2.1 Desk-based Assessment

Approach

The approach adopted for establishment of the biodiversity baseline involved the following strategy:

a) Conducting a generic assessment using the Integrated Biodiversity Assessment Tool (IBAT) to obtain numbers of IUCN Red List-assessed species potentially occurring within 50 km radius of the Project Site.
b) Extracting the corresponding list of IUCN Red List assessed species having ranges overlapping the Study Area to obtain a master-list of species potentially occurring within the Study Area.
c) Conducting a brief visit to the Study Area to verify the habitat profile therein, as also, the presence of any significant natural habitat, through walk-through and/or drive-through surveys.
d) Consulting the local Forest Department officials, as well as the local community, to verify occurrence of potential CH trigger species and habitats in the Study Area.
e) Establishing a habitat baseline consisting of those habitat types, as recognized by the IUCN Habitat Classification Scheme, noted through primary observations during the visit to the Study Area.
f) Establishing a species baseline consisting of those species for which suitable habitat-types are present within the Study Area, as verified during the visit to the Study Area.

The approach adopted for screening of species involved the following strategies:

a) Prior exclusion of entire groups of species, such as lower flora and fauna, for which screening-relevant data is known to be unavailable in the public domain.
b) Inclusion of only IUCN Red List designated globally threatened species during identification of potential CH triggers, with non-threatened species being included only if they are trigger species with respect to any KBAs overlapping the Study Area.

c) Screening out of potential CH trigger species based mainly on unavailability of adequate extent of suitable habitat-types or elevation range vis-à-vis the species-specific threshold number required to trigger CH.

The approach adopted for screening of habitats involved the following strategies:

a) Use of satellite imagery of the Study Area, as available in Google Earth, in conjunction with governmental maps of the Land Use Land Cover (LULC) of the corresponding area to characterize the habitat types therein
b) Use of governmental maps of notified Protected Areas and Eco-sensitive Zones, as available in governmental notifications, to identify boundaries of the nearest designated areas that are legally protected.
c) Use of the Integrated Biodiversity Assessment Tool (IBAT), along with Key Biodiversity Areas (KBA) maps to identify boundaries of the nearest designated areas that are internationally recognized, but not legally protected.

Methodology

The methodology applied for setting a biodiversity baseline for the Study Area involved the following steps:

i. Establishing a habitat baseline consisting of those habitat types, as recognized by the IUCN Habitat Classification Scheme, noted through primary observations during the visit to the Study Area.
ii. Establishing a species baseline consisting of those species for which suitable habitat-types are present within the Study Area, as verified during the visit to the Study Area.
iii. Establishing an ecosystem services baseline, focused mainly on provisioning and cultural ecosystem services, based on inputs received from the local community.

The methodology applied for CH screening with respect to species involved the following steps:

i. Excluding lower floral and faunal species from the screening exercise, considering the known unavailability of relevant screening data on the same, and including only higher floral species, namely Angiosperms, and higher faunal species, namely, Vertebrates, that is, Mammals, Birds, Reptiles, Amphibians, and Fishes.
ii. Screening out species that are not designated by the IUCN Red List as globally threatened, considering that non-threatened species are less likely to meet the applicable CH trigger thresholds, except for species that are triggers with respect to any KBAs overlapping the Study Area, considering that such species are more likely to meet the applicable CH trigger thresholds.
iii. Identifying the CH Criteria as per which each screened in species qualifies as a potential CH trigger with respect to the Study Area.
iv. Evaluating the identified potential CH trigger species, based on extent of occurrence (EOO), estimated global population, suitable habitat types and elevation range, to screen in any likely CH triggers as per CH Criteria 1, 2 and/or 3.

The methodology applied for CH screening with respect to habitats involved the following steps:

iv. Conducting a generic assessment using the Integrated Biodiversity Assessment Tool (IBAT) to obtain numbers of internationally recognised Designated Areas situated within 50 km of the centre of the Project Area.
v. Identifying, mainly from IUCN-associated websites, any internationally recognised designated areas that qualify as potential CH triggers, in terms of overlapping the Project Site and being classified as highly threatened or unique ecosystems, situated within the Study Area.
vi. Identifying, mainly from governmental maps, any nationally designated legally protected areas that qualify as potential CH triggers, in terms of overlapping the Project Site and being classified as highly threatened or unique ecosystems, situated within the Study Area.

vii. Evaluating the identified potential CH trigger habitats within the Study Area to screen in any likely CH triggers as per CH Criteria 4 and/or 5.

4.2.2.2 Field-based Assessment

Approach

The approach to the field-based assessment involved collection of primary data through walk-over surveys at accessible locations within the Study Area and collection of secondary data through opportunistic, informal interviews with local Project personnel, government officials and community members.

Methodology

The Study Area was visited during 28-29 June 2022. Primary data on species and habitats was collected through sampling of floral and faunal species. The timings of the primary data collection covered the diurnal faunal activity-period, from early morning till late evening, but excluded the nocturnal faunal activity-period.

Qualitative data on floral and faunal species was recorded through the visual encounter method. Records were based on direct sightings of species, as well as, indirect evidence, such as flowers, pods, calls, nests, burrows, droppings, scats, moults and tracks.

The field assessment included a rapid survey, specifically aimed at detecting presence of *Hemidactylus scabriceps* (Scaly Gecko), identified as a species of conservation concern through the CH screening conducted for the Project. The said rapid survey was focused on the Project Site and involved searches focused on habitat-types or habitat-features associated with the species, such as gravel heaps and palm-frond litter.

Figure below presents the details of the biodiversity sampling locations. Table below presents the details of the biodiversity sampling locations, including their geographical coordinates, elevation in meters, distance and direction with respect to the Project Site and their habitat type.

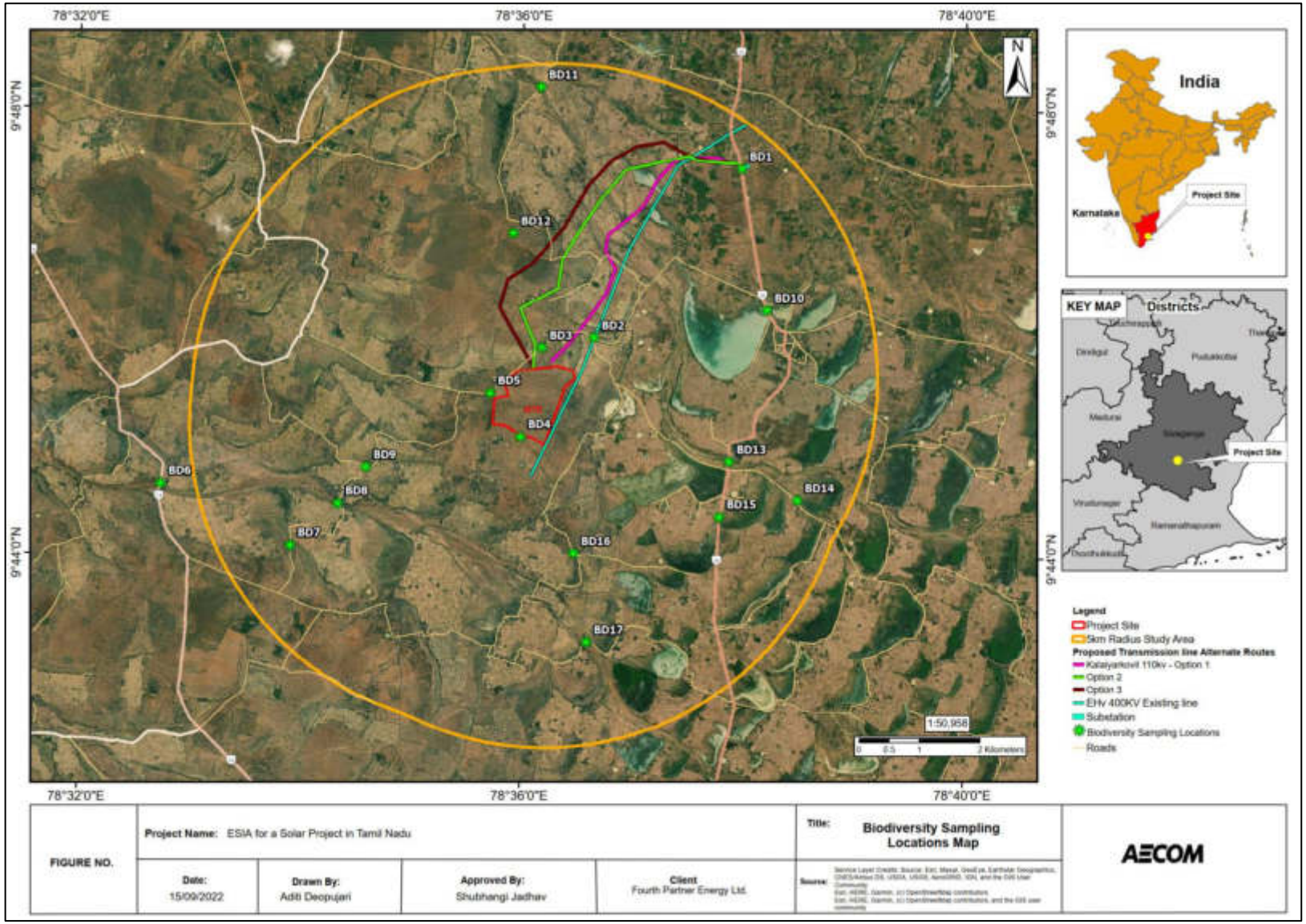

Figure 4-9: Map of the Biodiversity Sampling Locations in the Study Area

Table 4-6: Details of the Biodiversity Sampling Locations

Sampling site code	Location Coordinates	Elevation (meter)	Distance and Direction from Project Site	Habitat Type
BD1	9°47'28.77"N, 78°37'58.75"E	61	4.3 km Northeast, Substation	Modified
BD2	9°45'57.56"N, 78°36'39.19"E	52	0.6 km Northeast	Arable Land
BD3	9°45'52.14"N, 78°36'11.05"E	54	0.3 km North	Shrubland
BD4	9°45'4.10"N, 78°35'59.70"E	54	Within the Project Site	Shrubland
BD5	9°45'27.60"N, 78°35'43.20"E	60	0.11 km West	Arable Land
BD6	9°44'38.00"N, 78°32'45.00"E	60	5.5 km West	Wetland
BD7	9°44'5.20"N, 78°33'55.30"E	57	3.9 km Southwest	Wetland
BD8	9°44'27.80"N, 78°34'20.90"E	55	2.8 km Southwest	Wetland
BD9	9°44'47.30"N, 78°34'36.00"E	54	2.2 km Southwest	Wetland
BD10	9°46'12.80"N, 78°38'12.70"E	52	3.3 km East	Wetland
BD11	9°48'12.20"N, 78°36'9.70"E	59	4.6 km North	Wetland
BD12	9°46'53.50"N, 78°35'55.10"E	60	2.2 km North	Plantation
BD13	9°44'51.20"N, 78°37'52.70"E	46	2.9 km East	Shrubland
BD14	9°44'30.77"N, 78°38'29.89"E	43	4.2 km East	Shrubland
BD15	9°44'21.58"N, 78°37'47.53"E	45	3.1 km East	Wetland
BD16	9°44'1.59"N, 78°36'28.82"E	47	1.8 km Southeast	Wetland and Rural Habitation
BD17	9°43'13.86"N, 78°36'36.05"E	45	3.3 km Southeast	Wetland

Source: AECOM Primary Survey

Source: AECOM Primary Survey

Study Area-specific secondary data was collected through formal consultations with the following sources –

Tamil Nadu Forest Department

a) Range Forest Officer, Sivagangai Division

Project Personnel

a) Mr. Shivshankar Patel, EHS Team
b) Mr. B. Thillai Narayanan, Land Team

In addition, opportunistic informal consultations were conducted with a few members of the local community.

4.2.3 Species Profile of the Study Area

This sub-section describes the reported and recorded floristic and faunal species of the Study Area.

4.2.3.1 Floristic Species

The floristic species profile of the Study Area may be understood on the collective basis of the species recorded during the fieldwork and the species considered to be typical to the forest-types reported from the Study Area.

Reported Forest Types
As per the Champion and Seth Revised Classification of the Forest Types of India, the natural vegetation of the Study Area mainly represents the following forest types:

Type 6A/DS1 Southern Thorn Scrub [Sub-type DS1- Southern Thorn Scrub of Sub-group 6A – Southern Tropical Thorn Forests]

This forest-type is seen in the dry peninsular tract of India. Southern thorn scrub is found in degraded landscapes, dominated by almost impenetrable thorny thickets, with few trees here and there. Spiny climbers are common. Further degradation may result in sparse thickets, with abundant grass cover.

Species associated with these forests include:

Trees such as *Albizzia amara, Azadirachta indica, Chloroxylon swietenia, Wrightia tinctoria, Randia dumetorum, Canthium dicoccum*;

Shrubs such as *Zizyphus xylopyrus, Dichrostachys cinerea, Capparis divaricata, Securinega leucopyrus, , , Flacourtia indica*;

Herbs such as *Pterolobium indicum*.

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

Recorded Floral Species

A total of 29 floral species were recorded in the Study Area during the primary survey. These include 10 woody species, which would be part of the perennial groundcover of the Study Area, and 19 non-woody species, which would be part of the annual or seasonal groundcover of the Study Area.

Table -- presents the details of the floral species, including the scientific and common name, and its conservation status as per the IUCN Red List.

Table 4-7: Floral Species recorded in the Study Area

SN	Scientific Name	Common Name	Habit	IUCN Status*
Woody Species				
1	Acacia catechu	Black Cutch Tree	Tree	LC
2	Acacia leucophloea	White Bark Acacia	Tree	LC
3	Prosopis juliflora	Mesquite	Tree	-
4	Borassus flabellifer	Palmyra Palm	Tree	-
5	Eucalyptus sp.	-	Tree	-
6	Azadirachta indica	Neem	Tree	LC
7	Mangifera indica	Mango	Tree	DD
8	Ficus benghalensis	Banyan Tree	Tree	-

SN	Scientific Name	Common Name	Habit	IUCN Status*
9	Ficus religiosa	Peepal	Tree	-
10	Thespesia populnea	Indian Tulip Tree	Tree	LC
Non-woody Species				
11	Jatropha gossypiifolia	Bellyache Bush	Shrub	LC
12	Senna tora	Stinking Cassia	Shrub	-
13	Senna pallida	-	Shrub	LC
14	Cissus quadrangularis	Devil's Backbone	Shrub	-
15	Cereus pterogonus	Columnar Cactus	Shrub	-
16	Calotropis procera	Rubber Bush	Shrub	-
17	Ipomoea carnea	Bush Morning Glory	Shrub	-
18	Ziziphus nummularia	Jhar Beri	Shrub	-
19	Evolvulus nummularius	Roundleaf Bindweed	Herb	-
20	Croton bonplandianus	Ban tulsi	Herb	-
21	Tephrosia purpurea	Purple Tephrosia	Herb	-
22	Typha angustifolia	Lesser Indian Reedmace	Herb	LC
23	Argemone mexicana	Mexican Prickly Poppy	Herb	-
24	Phyllanthus sp.	-	Herb	-
25	Aristida sp.	-	Herb	-
26	Eragrostiella sp.	-	Herb	-
27	Cayratia trifolia	Bush Grape	Climber	-
28	Tribulus terrestris	Puncture Vine	Climber	LC
29	Citrullus colocynthis	Bitter Apple	Climber	-

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

Sources: AECOM Primary Survey, AECOM Primary Survey; IUCN (2021). The IUCN Red List of Threatened Species. Version 2021-3; The Plant List- http://www.theplantlist.org/

Figure 4-24 presents a photographic log of some of the floral species recorded in the Study Area.

Citrullus colocynthis

Cayratia trifolia

Eucalyptus sp.

Borassus flabellifer

Cereus pterogonus

Prosopis juliflora

Figure 4-10: Some Floral Species recorded in the Study Area

Source: AECOM Primary Survey

4.2.3.2 Faunal Species

This section of the report presents the higher faunal species, namely vertebrates, comprising mammals, birds, reptiles, amphibians and fishes, having reported ranges that overlap the Study Area. The detailed species-tables are provided as annexures to this report. Each annexed table gives the scientific and common names of each species and the conservation status assigned to it by the International Union for Nature and Natural Resources (IUCN). Names of the species recorded as part of the primary data appear in **bold** font in each table.

Mammals

At least fifty-one (51) species of mammals have reported ranges that fully or partially overlap the Study Area.

Significant species with respect to the IUCN Red List include 1 species designated as Endangered and 3 species as Vulnerable.

None of these species was recorded during the primary survey.

Appendix B presents details of the mammal species of the Study Area.

Birds

At least two hundred and sixty-one (261) species of birds, comprising 178 resident species and 83 migratory species, have reported ranges that fully or partially overlap the Study Area.

Significant species with respect to the IUCN Red List include 2 species designated as Endangered and 2 species as Vulnerable.

In all, 22 resident species and 3 migratory bird species were recorded in the Study Area during the primary survey.

Appendix C lists the resident bird species of the Study Area, with the names of any species recorded during the primary survey appearing in bold font.

Reptiles
At least fifty-five (55) species of reptiles have reported ranges that fully or partially overlap the Study Area.

Significant species with respect to the IUCN Red List include 1 species designated as Critically Endangered, 1 species as Endangered and 2 species as Vulnerable.

None of these species was recorded during the primary survey.

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

Amphibians
At least eighteen (18) species of amphibians have reported ranges that fully or partially overlap the Study Area.

None is significant with respect to the IUCN Red List.

None of these species was recorded during the primary survey.

Appendix E presents details of the amphibian species of the Study Area.

Fishes
At least one hundred and six (106) species of fishes have reported ranges that fully or partially overlap the Study Area.

Significant species with respect to the IUCN Red List include 2 species designated as Vulnerable.

None of these species was recorded during the primary survey.

Appendix F presents details of the fish species of the Study Area.

Photographic log of some of the floral species recorded in the Study Area are provided below.

	
Mycteria leucocephala	*Threskiornis melanocephalus* (Left) and *Plegadis falcinellus* (Right)

Fulica atra

Gallinula chloropus

Anastomus oscitans

Vanellus indicus

Figure 4-11: Some Faunal Species Recorded in the Study Area

4.2.3.3 Invasive Alien Species

At least one (01) floral species, reported from the Study Area, is designated as invasive alien species with respect to the Study Area. It is native to Central and South America. The said species was recorded as part of the primary data.

Sources: AECOM Primary Survey; IUCN (2021). The IUCN Red List of Threatened Species. Version 2021-3; Global Invasive Species Database, Invasive Species Specialist Group, IUCN; CABI Invasive Species Compendium; Invasive Alien Species of India, National Biodiversity Authority, Ministry of Environment, Forests and Climate Change, Government of India.

4.2.4 Habitat Profile of the Study Area

The habitat profile of the Study Area is dominated by modified habitats, interspersed with a few near-natural or slightly modified habitats. Each of these types include both, terrestrial and aquatic habitats. The habitats of the Study Area are fragmented mainly by metalled roads and dirt roads while the

aerial envelope of the study area is mainly interrupted by power distribution lines, pylons and transmission towers.

Figures below presents a map depicting the habitat profile of the Study Area.

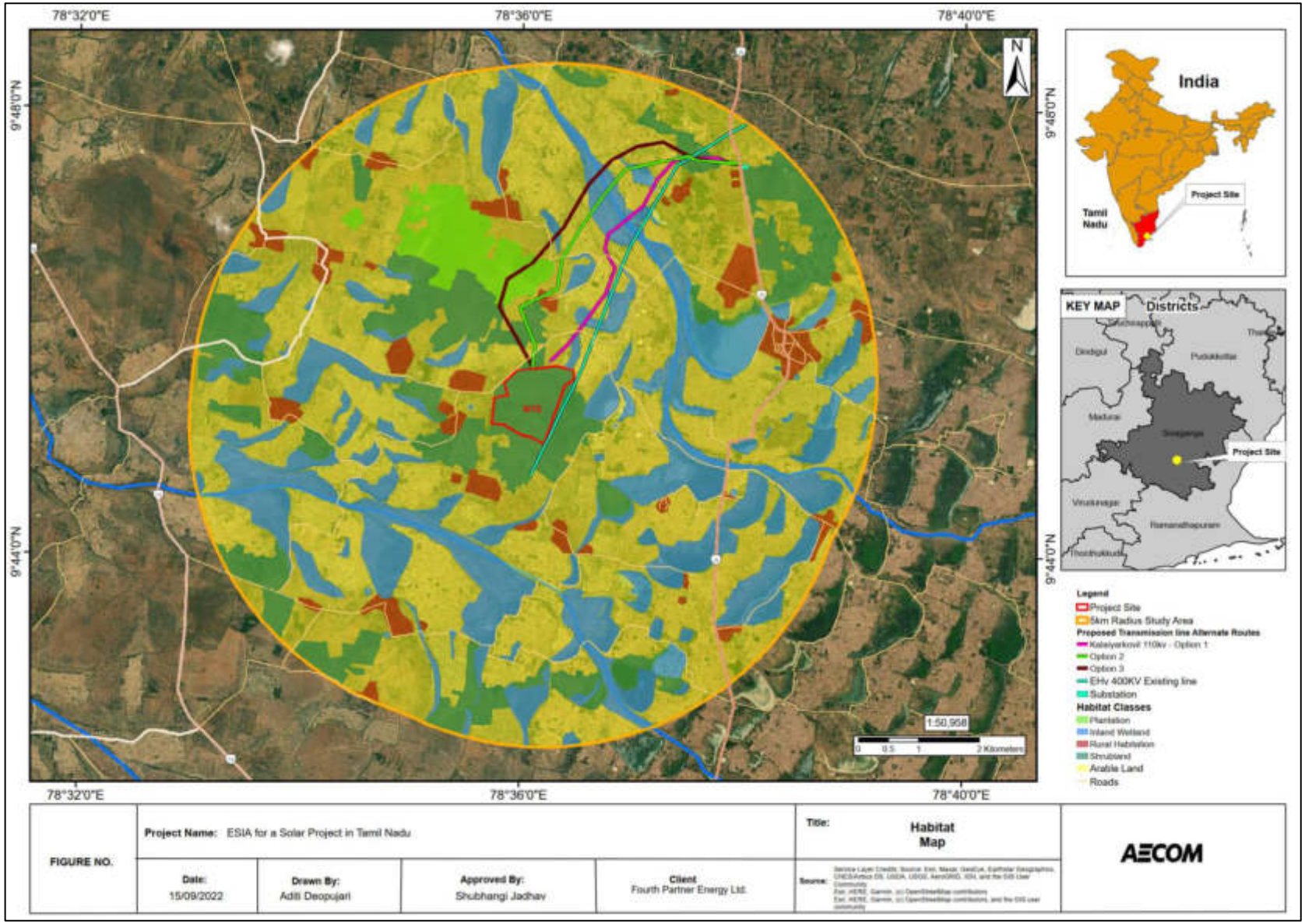

Figure 4-12: Habitat Map of the Study Area

4.2.4.1 Natural Habitats

Natural habitats constitute approximately 16% of the Study Area and mainly consist of patches of shrublands (13.5%) and natural inland wetlands (2.5%). The natural inland wetlands mainly include small seasonal streams and lakes. The natural habitats of the Study Area are likely to be supporting habitat specialist species.

Figure below presents a photographic log of some of the natural habitats recorded in the Study Area during the primary survey.

	
Inland Wetland in the Study Area	Dry Seasonal Stream in the Study Area

Figure 4-13: Natural Habitats in the Study Area

Source: AECOM Primary Survey

4.2.4.2 Modified Habitats

Modified habitats constitute approximately 84% of the Study Area and mainly consist of arable lands (58%), plantations (2.5%), artificial inland wetlands (19.5%), and rural habitation (4%). The artificial inland wetlands mainly include seasonal and permanent ponds. The modified habitats of the Study Area are likely to be supporting generalist species.

Figure below presents a photographic log of some of the modified habitats recorded in the Study Area during the primary survey.

	
Borassus flabellifer Grove in the Study Area	*Eucalyptus sp*. Plantation in the Study Area

Uncultivated Arable Land in the Study Area

Seasonal pond in the Study Area

Figure 4-14: Modified Habitats in the Study Area

Sources: AECOM Primary Survey

4.2.4.3 Critical Habitats

As per the IFC PS6 Critical Habitat (CH) Criteria 1, 2 and 3, habitats, either natural or modified, that are critical for the survival of IUCN Red List-designated globally threatened species, endemic or restricted range species and migratory and/or congregatory species are potential CH triggers. As per the IFC PS6 CH Criteria 4 and 5, highly threatened or unique ecosystems, as well as, spatial features that support key evolutionary processes, are also potential CH triggers.

CH Screening

The species of the Study Area were screened against CH Criteria 1, 2 and 3, while the habitats of the Study Area were screened against the Criteria 4 and 5.

CH Criterion 1 – Globally Threatened Species

Globally Threatened Species are defined as species designated by the IUCN Red List as Critically Endangered (CR), Endangered (EN) or Vulnerable (VU). As per CH Criterion 1, an area that supports a globally important concentration of a CR or EN species, as well as an area that supports a globally important concentration of a VU species, the loss of which would lead to the species being designated as EN or CR, both qualify as potential CH.

Thresholds stipulated for triggering CH Criterion 1 are:

(a) Areas that support globally important concentrations of an IUCN Red-listed CR or EN species (0.5% of the global population containing 5 reproductive units of a CR or EN species);

(b) Areas that support globally important concentrations of an IUCN Red-listed VU species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds specified in (a);

(c) As appropriate, areas containing nationally/regionally important concentrations of an IUCN Red-listed CR or EN species.

At least 15 species, that were screened in for evaluation as potential CH triggers and have geographic ranges overlapping the Study Area, are designated by the IUCN Red List as globally threatened. These include 1 species designated by the IUCN Red List as Critically Endangered (CR), 4 as Endangered (EN) and 10 as Vulnerable (VU).

The said 15 species qualify as potential CH triggers with respect to the Study Area as per CH Criterion 1.

Ch Criterion 2 – Endemic/ Restricted Range Species

Species which occur in a limited area are referred to as Endemic or Restricted Range species.

The species reported from the Study Area have first been evaluated as endemic or restricted range species based on their extent of occurrence (EOO), described as follows:

(a) For terrestrial vertebrates and plants, a restricted-range species is defined as those species that have an EOO less than 50,000 km^2

(b) For marine systems, restricted-range species are provisionally being considered those with an EOO of less than 100,000 km^2

(c) For coastal, riverine, and other aquatic species in habitats that do not exceed 200 km width at any point (e.g., rivers), restricted range is defined as having a global range less than or equal to 500 km linear geographic span (i.e., the distance between occupied locations farthest apart).

At least 2 species, that were screened in for evaluation as potential CH triggers and have geographic ranges overlapping the Study Area, meet one of the said definitions.

Thus, the said 2 species qualify as potential CH trigger species with respect to the Study Area as per CH Criterion 2.

CH Criterion 3 – Migratory and/or Congregatory Species

Migratory Species are defined as species of which a significant proportion of its members cyclically and predictably move from one geographical area to another, including within the same ecosystem. At least 7 such globally threatened Migratory Species, all birds, have reported ranges that include the Study Area, which may serve as wintering/summering destination, staging site or flight-corridor for these species.

Species whose individuals gather in large groups on a cyclical or otherwise regular and/or predictable basis are known as congregatory species. At least 14 globally threatened species, consisting of both resident and migratory species, which are known to form large congregations, have recorded ranges that include the Study Area.

Thresholds stipulated for triggering CH Criterion 3 are:

(a) areas known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle; and

(b) areas that predictably support ≥10 percent of the global population of a species during periods of environmental stress.

The Study Area is located within the Central Asian Flyway. Owing to the presence of wetlands in the Study Area, it is likely that migratory waterbirds occur in the Study Area during the September to March period every year, which coincides with the chief annual migratory season with respect to the Indian sub-continent.

However, the said wetlands appear less likely to support any significant congregations of the concerned species. Further, no significant migratory and/or congregatory habitat is reported from the Study Area or its vicinity. However, the seasonal ponds and uncultivated arable lands were found to support 30 individuals of *Plegadis falcinellus* (Glossy Ibis, IUCN Red List Status: LC) and 16 individuals of *Mycteria leucocephala* (Painted Stork, IUCN Red List Status: NT). The nearest IBA or KBA designated for migratory and/or congregatory waterbirds as a species-group is the Vandivoorand Kunnathur Tanks, which is situated 37 km west of the Study Area and is thus, a significant distance away.

Hence, it was concluded that only globally threatened migratory and/or congregatory species, owing to their relatively small and/or decreasing populations, may possibly occur in or around the Study Area in numbers required to meet the applicable CH trigger thresholds.

The 15 globally threatened species have geographic ranges overlapping the Study Area include 4 species classified by the IUCN Red List as migratory and/or congregatory.

Therefore, only the said 4 migratory and/or congregatory species are deemed potential CH triggers with respect to the Study Area as per CH Criterion 3.

CH Criterion 4 – Highly Threatened and/or Unique Ecosystems

Assessment of the Study Area towards Criterion 4 is based on national/regional level assessments carried out by governmental bodies, recognized academic institutions and/or internationally recognized NGOs.

Thresholds stipulated for triggering CH Criterion 4 are:

(a) areas representing ≥5% of the global extent of an ecosystem-type meeting the criteria for IUCN status of CR or EN; or

(b) areas not yet assessed by IUCN but determined to be of high priority for conservation by regional or national systematic conservation planning.

No part of the Study Area is assessed by IUCN towards the IUCN Red List of Ecosystems. Much of the Study Area is dominated by modified and near-natural habitats such as wetlands and cultivated and uncultivated arable lands. While these habitats support significant biodiversity, potentially including globally threatened, migratory and/or congregatory species, these habitats are not determined to be of high priority for conservation.

Hence, the said habitats are less likely to qualify as potential CH triggers as per CH Criterion 4.

CH Criterion 5 – Key Evolutionary Processes

Assessment of the Study Area towards CH Criterion 5 is based on structural attributes such as topography, geology, soil, temperature and vegetation or combinations of these variables, which can influence evolutionary processes that give rise to regional species-configurations or ecological properties. The overall aim of evaluating the Study Area against this criterion is to conserve genetic and species diversity, as also, processes which drive speciation, for the purpose of ensuring evolutionary flexibility in a rapidly changing climate.

Features associated with key evolutionary processes include:

- Landscapes with high spatial heterogeneity, which drive speciation
- Ecotones, which aid speciation and are associated with high species and genetic diversity
- Edaphic interfaces, which drive formation of unique plant communities characterized by endemism and rarity
- Connectivity between habitats, which facilitates migration and gene flow, aiding conservation of meta-populations in fragmented habitats.

The Study Area is not known to contain isolated sub-populations of any species.

Hence, the Study Area is less likely to qualify as potential CH with respect to CH Criterion 5.

Legally Protected or Internationally Recognized Areas

Assessment of the Study Area towards this criterion is based on overlap of the Project Site with a Legally Protected Area (LPA) or Internationally Recognized Area (IRA). As per PS6 Point 20, if a proposed project is located within an LPA or IRA, it would need to meet PS6 requirements for CH, depending on the qualifying biodiversity values present in the concerned LPA (including areas officially proposed for protection) or IRA.

For an area to be considered as an LPA towards this assessment, it must meet the IUCN definition: “A clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values.” Areas proposed by governments for such designation must also be treated as

LPAs. LPAs that meet the criteria of the IUCN's Protected Area Categories Ia, Ib and II are more likely to qualify as potential CH.

For the purposes of this assessment, an IRA is exclusively defined as a UNESCO Natural World Heritage Site, UNESCO Man and the Biosphere Reserve, Key Biodiversity Area and/or wetland designated under the Convention on Wetlands of International Importance (the Ramsar Convention).

Thus, project sites that are located fully or partially within nationally and/or internationally designated areas of high biodiversity value qualify as potential CH.

As per the IBAT result, 5 Designated Areas, comprising 1 Legally Protected Area (LPA) and 4 Key Biodiversity Areas (KBAs), are situated within 50 km of the Project Site location.

Figure below presents the IBAT result on Designated Areas which are Legally Protected Areas.

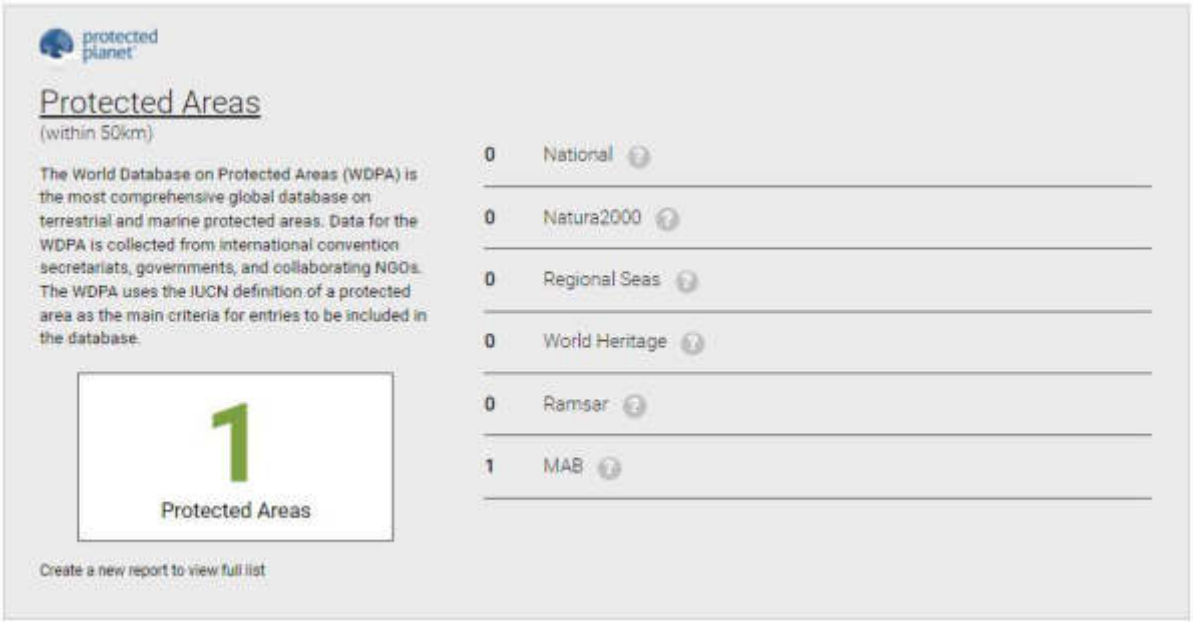

Figure 4-15: IUCN-listed Protected Areas situated within 50 km of the Project Site centre

Note: The IBAT result on Legally Protected Areas erroneously excludes Vettangudi Bird Sanctuary and Chitragudi & Kanjirankulam Bird Sanctuary, both of which are nationally designated legally protected areas situated within 50km of the Project Site. The IBAT result also erroneously includes Gulf of Mannar the nearest Man and Biosphere Reserve (MAB), which is situated over 60 km southeast of the Project Site.

Figure below presents the IBAT result on Designated Areas which are Internationally Recognized Areas, but not legally protected.

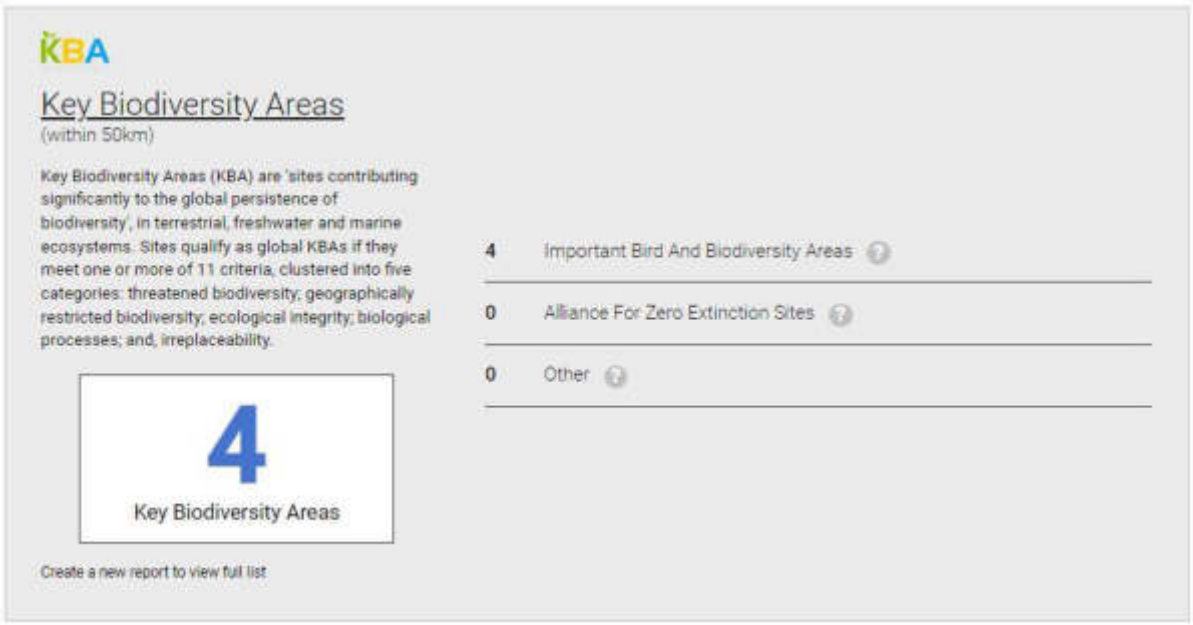

Figure 4-16: Key Biodiversity Areas situated within 50km of the Project Site centre

The LPAs and/or IRAs nearest to the Project Site are as follows:

Reserve Forests

These are the nearest LPAs with respect to the Project Site. They are relatively minor LPAs, nationally designated as Reserve Forests, which qualify as Category VI IUCN Protected Areas. As per maps available on the Tamil Nadu Forest Department website, they are situated 1.4 km North and 5.5 km Northwest, respectively, of the Project Site. The Reserve Forests consist of plantations and hence, technically represent modified habitats.

Source: https://www.forests.tn.gov.in/tnforest/app/webroot/img/contact-map/sivagangai.jpg

Vettangudi Bird Sanctuary

This is the nearest major LPA with respect to the Project Site. It is nationally designated as a Wildlife Sanctuary and qualifies as a Category IV IUCN Protected Area. It is situated 38.5 km north of the Project Site. It reportedly covers an area of approximately 40 ha and includes 3 ponds, situated in Vettangudi, Periyakollukudi and Chinna Kollukkudi villages respectively. The said ponds are known to serve as breeding and wintering habitats for waterbirds.

Source: https://sivaganga.nic.in/tourist-place/vettangudi-bird-sanctuary/

Vandivoorand Kunnathur Tanks

This is the nearest IRA with respect to the Project Site. It is a Key Biodiversity Area (KBA), situated approximately 37 km west of the Project Site. The trigger species for this KBA is *Pelecanus philippensis* (Spot-billed Pelican; IUCN Red List Status VU).

Chitrangudi and Kanjirankulam Bird Sanctuary

This is the next nearest IRA with respect to the Project Site. It is a Key Biodiversity Area (KBA), situated approximately 45 km south of the Project Site. The KBA consists of 2 legally protected wetlands, namely Chitrangudi Bird Sanctuary and Kanjirankulam Bird Sanctuary, covering areas of 48 ha and 104 ha, respectively. The trigger species for the KBA is *Pelecanus philippensis* (Spot-billed Pelican, IUCN Red List Status VU).

Figure below presents the LPAs and/or IRAs situated in proximity to the Project Site.

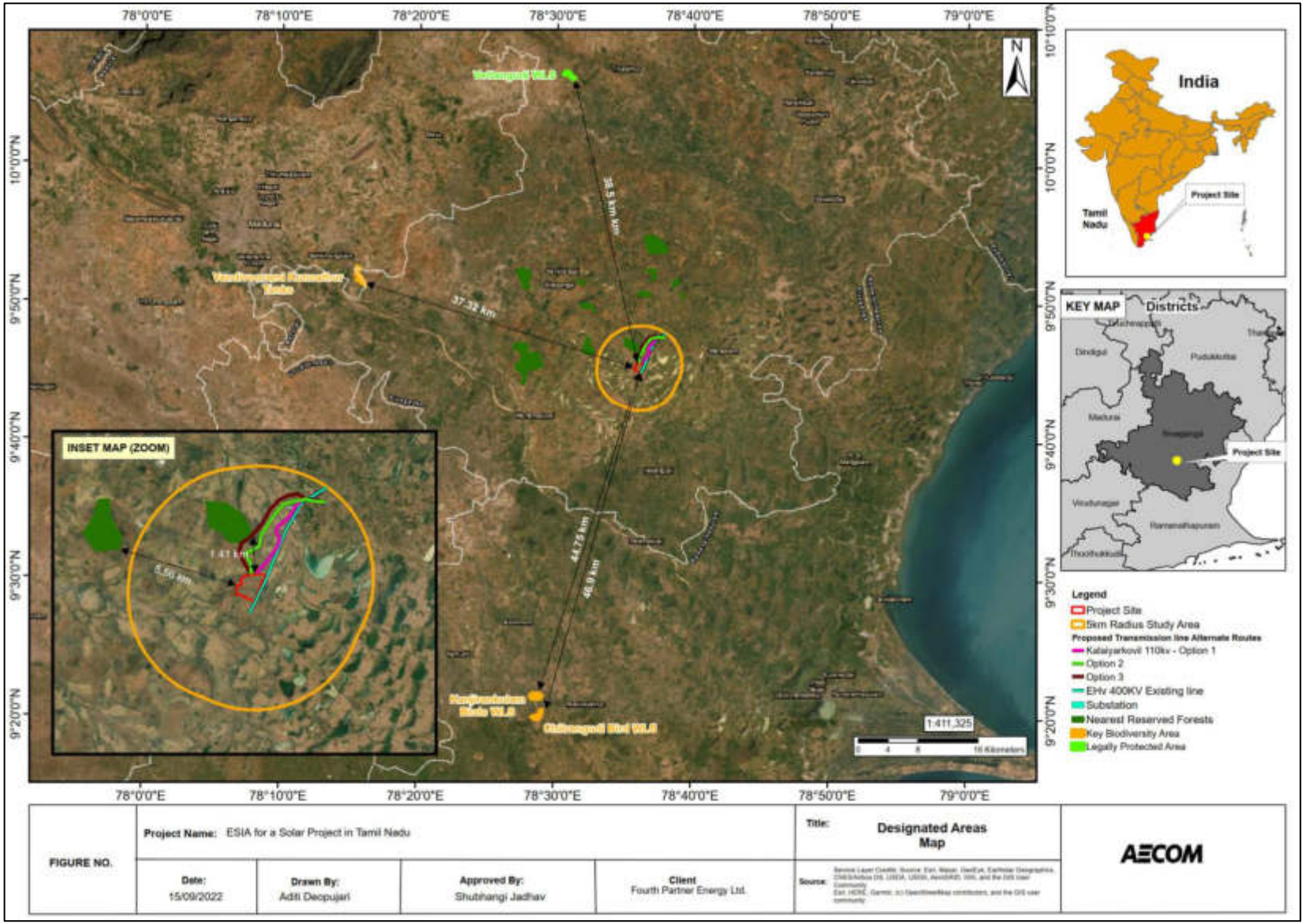

Figure 4-17: Designated Areas in proximity to the Project Site

Thus, potential CH triggers identified with respect to the Study Area consist of 15 species and no habitats.

Table below presents details of the potential CH triggers identified with respect to the Study Area

The screening process, which involved evaluation of the known attributes of each potential CH trigger species, such as its geographical range, global population and habitat needs, against the attributes of the Study Area, resulted in each of the 15 identified potential CH trigger species also being screened out with respect to the Study Area.

Hence, it may be concluded that the estimated area of influence of the Project is unlikely to contain, or be situated within, critical habitat, as defined by IFC PS6.

Note: For details on the screening process for each potential CH Trigger species, refer to the Critical Habitat Screening Report.

Table 4-8: Details of Potential CH Triggers

Scientific Name	Applicable CH Criteria	Global Population (Mature)	EOO (km2)	Suitable Habitat Types*	Elevation (in meters)
Critically Endangered					
Pelochelys cantorii	1a	-	-	F/W/M	-
Endangered					
Aquila nipalensis	1a, 3a	78042-110193	12600000	F/S/G/D/R	0-3000
Cyathea crinite	1a, 2a	-	4500-5000	F/W	1500-2200
Hemidactylus scabriceps	1a, 2a	-	29016	F/M	0-385
Manis crassicaudata	1a	-	-	F/S/Sh/G/Pl	0-1850
Sterna acuticauda	1a, 3a	10000-25000	4490000	W	700
Vulnerable					
Anaphalis beddomei	1b, 2a	20000	-	G/W	1300-2200
Bagarius yarrelli	1b	-	9387540	W	-
Clanga clanga	1b, 3a	(3900-10000)	15300000	F/Sh/G/W/M/A	0-1400
Crocodylus palustris	1b	(5700-8700)	-	W/M	420
Lissemys punctata	1b	-	-	W	0-500
Lutrogale perspicillata	1b	-	-	F/Sh/G/W/M	700
Macaca radiata	1b	-	-	F/S/Sh/A/P/Pl/U	0-1600
Rusa unicolor	1b	-	-	F/S/Sh/G/W/Pl	0-3900
Sterna aurantia	1b, 3a	30000-100000	9330000	W/M	600
Wallago attu	1b	-	10446620	W	-

**Suitable habitat-types where A- Arable Land, D-Desert, F- Forest, G- Grassland, M- Marine, P- Pastureland, Pl-Plantations, R- Rocky Areas, S- Savanna, Sh- Shrubland, U- Urban Areas and W- Inland Wetland*
Sources: IUCN 2021. The IUCN Red List of Threatened Species. Version 2021-3; Grimmett, R., C. Inskipp and T. Inskipp (2011). Birds of the Indian Subcontinent, Second Edition. Oxford University Press, London.

4.2.5 Ecosystem Services

This section presents an overview of the significant ecosystem services provided by the ecosystems of the Study Area to the local community, which consist of mainly priority provisioning ecosystem services, details of which are provided in this section. Besides these, the ecosystems of the Study Area would also be providing generic or standard regulating and supporting ecosystem services, such as groundwater recharge, surface water purification, soil erosion control, temperature regulation, soil replenishment, primary production, pollination and pest control.

4.2.5.1 Provisioning Services

The chief provisioning services provided by the Study Area to the local community include surface water & groundwater water for domestic use, soil for crop cultivation and naturally occurring plants that provide fodder.

The soil of the Study Area is used to cultivate crops, such as *Oryza sativa* (Rice). In most parts of the Study Area, arable land is subjected to low intensity, rainfed cultivation once annually. In some parts of the Study Area, arable land has been left uncultivated for many years.

The Study Area contains at least 2 major ponds, locally called *Samaranai*, in which rainwater collects and gets distributed through a system of canals and smaller ponds, accessed by the community for irrigation, watering of livestock and domestic use. Some of the said ponds are also used for culture fishery. The said ponds are situated outside the Project Site.

The natural vegetation of the Study Area, especially that growing in and around wetlands and in shrublands, is used to graze livestock, mainly cattle and sheep.

Photographs of some of the priority provisioning services provided by the Study Area are presented below.

Utilization of seasonal wetlands in the Study Area

Cattle grazing in the Project Site

Figure 4-18: Priority Provisioning Ecosystem Services of the Study Area

Source: AECOM Primary Survey

4.3 Socio-economic Profile

4.3.1 Socio-Economic Environment

The section endeavours to represent the socio-economic characteristics of the project area and identify the direct and indirect project impacts with the help of collection and analysis of primary and secondary data. Relevant information and statistical data used in the section have been drawn from secondary sources such as the Primary Census Abstract, 2011 - Census of India, 2011, Agriculture Census 2015-16-Ministry of Agriculture & Farmers Welfare, etc.

4.3.2 Approach and Methodology

Methodology adopted:

- Identification of project impacted area (direct and indirect project impact area) in accordance with the project site location; and
- A radius of five (05) kilometres from the project area was earmarked as the indirect project impact area for the ESIA. Identification of villages falling within the specified five (05) kilometres radii was undertaken.

Primary data collection:

- Interaction with relevant government stakeholders were undertaken;
- Interaction with Village Panchayat Members of the project villages was undertaken;
- Consultations with opinion leaders (village heads, Medical Officers, Farmers, etc.) were undertaken.
- Focus Group Discussions with the Women Groups and Agriculture Labours were undertaken; and
- Consultations with members involved in animal grazers were undertaken.
- Sample Socioeconomic Census Survey among the landowners were conducted.

Socio-Economic Baseline from the macro (district) level to micro (village) level was developed through consultations and is supplemented through secondary data base available in the public domain. As presented below.

Secondary data collection:

The following government publications (secondary database) were referred to while developing the socio-economic baseline for the study.

- Primary Census Abstract, 2011; Office of the Registrar General & Census Commissioner, India; Ministry of Home Affairs.
- Village Directory Abstract 2011, Office of the Registrar General & Census Commissioner, India; Ministry of Home Affairs; and
- District Census Handbook, Directorate of Census Operations, Tamil Nadu.

4.3.3 Administrative Profile

4.3.3.1 State profile: Tamil Nadu

Tamil Nadu State is situated at the Southeastern extremity of the Indian Peninsula bounded on the north by Karnataka and Andhra Pradesh on the east by Bay of Bengal, on the South by the Indian Ocean and on the West by Kerala State. It lies between 8 5' and 13 35' of northern latitude and 76 15' and 80 20' of eastern longitude with an area of 1,30,058 square kilometres. The state was ranked sixth among states in India according to the Human Development Index in 2011. The state has the highest number (10.56 per cent) of business enterprises and stands second in total employment (9.97 per cent) in India, compared to the population share of about 6 per cent. The region has been the home of the Tamil people since at least 1500 BC. Its official language is Tamil, which holds a status of being a classical language. Tamil has been in use in inscriptions and literature for over 2500 years.

Tamil Nadu is divided into four major divisions namely Pallava Nadu division, Chera Nadu division, Chola Nadu division and Pandya Nadu division and these four divisions are further subdivided into 38 districts. Districts are further divided into 226 Taluks, 1127 Revenue blocks,16,564 Revenue villages. Except Thamirabarani and Cauvery River, no other perennial rivers are flowing in the state and the state of Tamil Nadu is mostly dependent on monsoon rains and is prone to droughts. The climate of the state ranges from dry sub-humid to semi-arid. he state has two distinct periods of rainfall i.e. South-West Monsoon between June to September and North East Monsoon between October to December. Average annual rainfall of Tamil Nadu is 987 mm with a range varying from 317.4 mm to 1890.5 mm over the 63 years period (1951-2013). Amongst all districts, Nilgiris receives the maximum

average annual rainfall while districts, such as Thoothukkudi and Karur receive the least. Mean annual maximum temperature for Tamil Nadu is 32.2 degree Centigrade with arrange varying from 31.2 degree Centigrade - 33.2degree Centigrade. The highest value attained for maximum temperature (34.7degree Centigrade) is in the pre- monsoon season (MAM) while its lowest maximum value (29.8 degree Centigrade) is attained in Post monsoon season.[25]

As per Census 2011, Tamil Nadu has population of 7.21 Crores (72,147,030), an increase from figure of 6.24 Crore in 2001 census. Total male and female population are 36,137,975 and 36,009,055 respectively. Decadal growth rate (2001-11) was 15.6 % (11.19 % during 1991-01) The decadal change in rural population was 6.49 % and that of urban population was 27.16 %, for the period 2001-11. The state has a population density of 555 persons per sq.km which is above the national average of 382 persons per sq.km. Sex ratio has increased from 987 in 2001 to 995 in 2011. Total literacy rate in Tamil Nadu has shown an increasing trend over the years, increasing from 62.66% in 1991 to 80.33% in 2011. Gross Enrolment Rate is in higher education is 43% (2013-14).[26] Demographic profile of the state of Tamil Nadu has been provided in Table below.

Table 4-9: Demographic Profile of State of Tamil Nadu

Description	2011	2001
Population	72,147,030	62,405,679
Male	36,137,975	31,400,909
Female	36,009,055	31,004,770
Population Growth	15.61%	11.19%
Percentage of total Population	5.96%	6.07%
Sex Ratio	996	987
Child Sex Ratio	943	942
Density/km2	555	480
Density/mi2	1,437	1,243
Area (Km^2)	130,060	130,058
Area mi2	50,216	50,216
Total Child Population (0-6 Age)	7,423,832	7,235,160
Male Population (0-6 Age)	3,820,276	3,725,616
Female Population (0-6 Age)	3,603,556	3,509,544
Literacy	80.09 %	73.45 %
Male Literacy	86.77 %	82.42 %
Female Literacy	73.44 %	64.43 %
Total Literate	51,837,507	40,524,545
Male Literate	28,040,491	22,809,662
Female Literate	23,797,016	17,714,883

'Source: https://www.census2011.co.in/census/state/tamil+nadu.html

4.3.3.2 District profile: Sivaganga

Sivaganga lies between 9°43'and 10°42' North Latitude and 77°47' and 78°49' East Longitude. It covers an area of 4233 sq.kms. Sivaganga is the district headquarters. It is bounded by Pudukkottai district on the northeast, Tiruchirappalli district on the north, Ramanathapuram district on southeast, Virudhunagar district on southwest and Madurai district on the west. Sivaganga district was a part of the Ramanathapuram district. The district came into existence on 15.03.1985 as a result of the trifurcation of the composite Ramanathapuram district. Sivaganga district consists of 2 Revenue. Divisions, 6 Taluks, 12 Community Development Blocks, 3 Municipalities, 12 Town Panchayats and 1

[25] Tamil Nadu Climate Profile - https://www.environment.tn.gov.in/Document/tnsapcc/Chapter%203.pdf
[26] Tamil Nadu State Human Development Report-2017 - https://www.spc.tn.gov.in/TNHDR2017/salientfeatures_SHDR_2017.pdf

Census Town. There are 515 Revenue Villages in Sivaganga district, of which 508 villages are inhabited. There are no perennial rivers in the district. The river Vaigai is the only major one which enters into the district near Thiruppuvanam and flows through Sivaganga taluk. The district experiences a very dry and hot climate with low degree of humidity. Normally, the temperature varies from 22° C to 39° C. During the winter season (December to January) the temperature is below the normal. The normal annual rainfall over the district varies from about 861.8 mm. to about 988.6 mm with major rainfall through North-East Monsoon. The district

generally reported cent per cent cropping intensity. This indicates only one crop is raised in a year and the second crop is not followed in this district. Major field crops cultivated are paddy, sugarcane, groundnut, pulses and sesame with more than 70% of the total cropped area is paddy. Of the total 3026 habitations, 2860 were fully covered under rural water supply and 166 were partially covered. The total population in 2011 census in Sivaganga district was 1339101, the rural with 926256 and the urban with 41284. The percentage of decadal variation of the total population during 2001- 2011 in the district has been recorded as 15.90%. The density of

population of Sivaganga district was 316 per sq.km and the State average was 555. The sex ratio in the district was reported to be around 1003 whereas the child sex ratio was around 960. The literacy rate among persons, males and females were 79.9%, 87.9% and 71.9% respectively. The Sivaganga district is treated as an industrially backward district. The district is backward not only industrially but also in agriculture due to lack of irrigation facilities and also low rainfall. There are about 26 spinning mills and weaving mills in the district.

4.3.3.3 Project Area

The proposed solar power project is proposed to be developed in Pulavanvayal Village of Kalayarkoil Taluk (then Sivaganga Taluk as per census records, Kalayarkoil bifurcated from Sivaganga taluk in the year 2016), Sivaganga District. The total land requirement for the proposed project would be around 225.98 acres.

4.3.3.4 Study Area

The proposed project site is located within Pulavanvayal Revenue village and is considered to the direct impact zone. For the purpose of the study, the project site is divided into core zone a direct impact area (the area where the project will be located) and the buffer zone i.e., indirect impact area (within 05 km of the project area). Adappadakki , Alpattaviduthi , Kanjipatti, Kuruthanivariendal , Mudikkaraipudukkulam , Palkulam, Periakannanur, Pudukkilavachi , Pulavanvayal, Purasadiudappu , Sedambal , Sembar, Siramam, and Sirukanaperi, villages falls within the 5-kilometre radius of the project site. Being a solar power project, it is expected that the area of influence of the project will be within five (05) kilometre and the socio-economic impacts of the project is anticipated to be minimal, since the solar power projects in general do not have any significant impacts on community health and safety and the current project is not envisaged to have any physical resettlement or major economic impacts. Risks pertaining to community health and safety would be restricted primarily during the construction phase due to increased traffic movement and influx of labour migrants

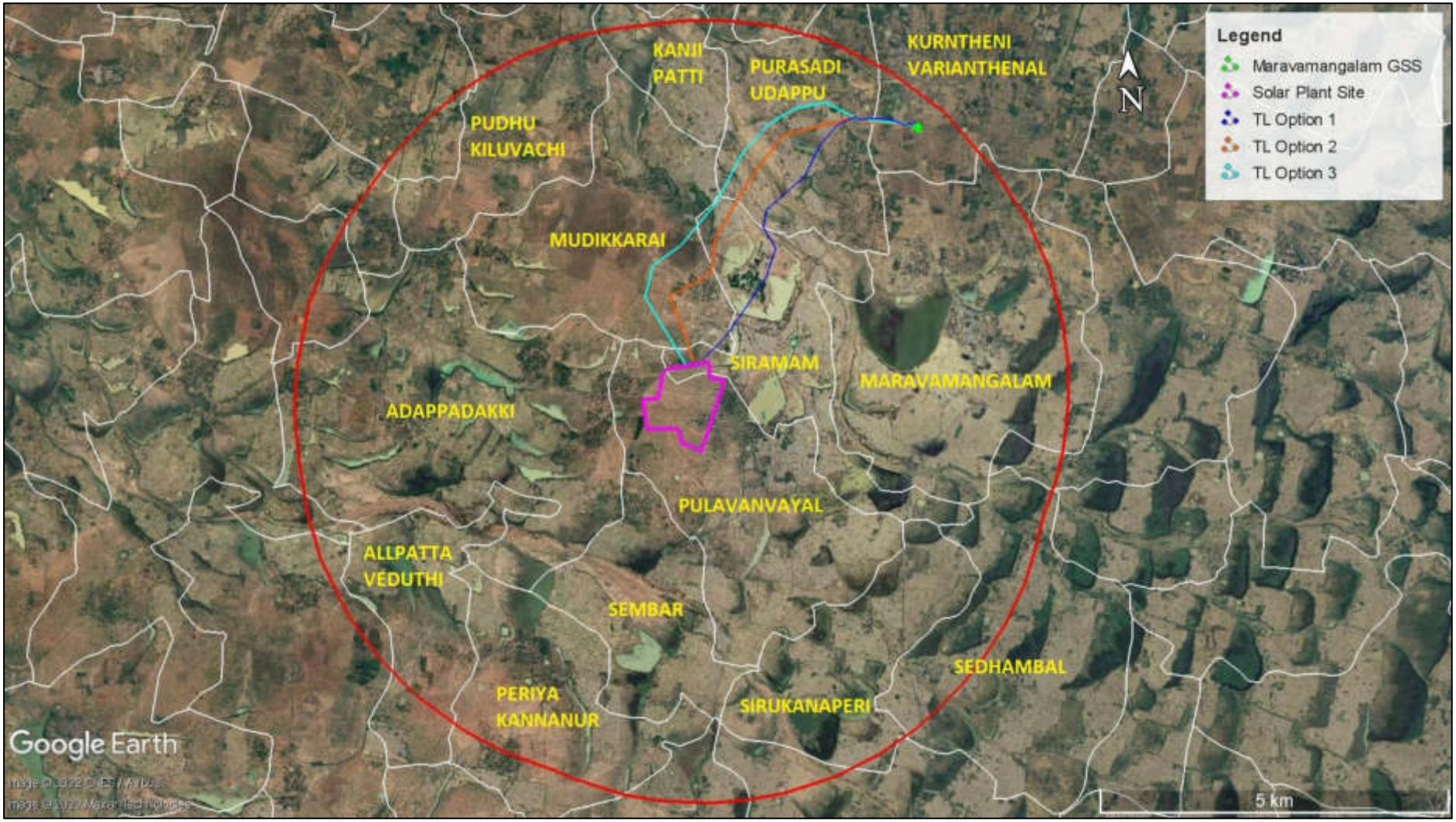

Figure 4-19: Map showing the Study Area Villages

Table 4-10: Revenue Villages falling within five (05) kilometre radii.

District	Tehsil	Revenue Villages
Core Zone: Project Villages		
Sivaganga	Sivaganga	Pulavanvayal
Buffer Zone: Study Area Villages (5km Radius)		
Sivaganga	Sivaganga	Adappadakki
		Alpattaviduthi
		Kanjipatti
		Kuruthanivariendal
		Mudikkaraipudukkulam
		Palkulam (Maravamangalam)
		Periakannanur
		Pudukkilavachi
		Purasadiudappu
		Sedambal
		Sembar
		Siramam
		Sirukanaperi

4.3.4 Demographic profile of the Study Area

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

4.3.4.1 Population level

Table below represents the population level of the study area.

Table 4-11: Population Level

Administrative Unit	Households	Total Population	Male Population	Female Population	Sex Ratio
District					
Sivaganga	**338938**	**1339101**	**668672**	**670429**	**1003**
Taluk					
Sivaganga	**74167 (21.9%)**	**288674 (21.6%)**	**142979 (21.4%)**	**145695 (21.7%)**	**1019**
Core Zone					
Pulavanvayal	**264 (0.1%)**	**1102 (0.1%)**	**578 (0.1%)**	**524 (0.1%)**	**907**
Buffer Zone	**5350 (1.6%)**	**20561 (1.5%)**	**10129 (1.5%)**	**10432 (1.6%)**	**1030**
Adappadakki	582	2303	1152	1151	999

Administrative Unit	Households	Total Population	Male Population	Female Population	Sex Ratio
Alpattaviduthi	180	776	401	375	935
Kanjipatti	149	618	310	308	994
Kuruthanivariendal	920	3558	1739	1819	1046
Mudikkaraipudukkulam	165	578	271	307	1133
Palkulam	1136	4498	2225	2273	1022
Periakannanur	334	1268	613	655	1069
Pudukkilavachi	287	1190	616	574	932
Purasadiudappu	387	1526	781	745	954
Sedambal	480	1603	749	854	1140
Sembar	217	715	346	369	1066
Siramam	155	619	299	320	1070
Sirukanaperi	358	1309	627	682	1088

Source: Primary Census Abstract, Census 2011

It can be noted from the table above that Sivaganga tehsil comprises of 21.6% of the total population of Sivaganga district. The core zone villages i.e. the direct impact villages comprises of 0.1% (1102) and Buffer Zone villages i.e. the indirect impact villages comprises of 1.5% (20,561) of the total population Sivaganga District. The sex ratio in the core zone village(Pulavanvayal) was 907 females for 1000 males and buffer zone villages it was 1030 where the district and tehsil sex ratio was 1003 and 1019 respectively.

4.3.4.2 Vulnerable groups

Vulnerable groups are those groups of people who may find it difficult to lead a comfortable life and lack developmental opportunities due to their disadvantageous positions. Further, due to adverse socio-economical, cultural and other practices present in each society, they find it difficult many a times to exercise their human rights fully[27].

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

The section below aims to define the status of these socially excluded categories/ groups within the study area. Within the project site village Pulavanvayal there are presence of Scheduled Caste population, however they are not socially secluded, and they live along with the mainstream people and there are no Scheduled Tribe Population within the Pulavanvayal Village. Among the landowners consulted (29 members) none of family were headed by a Physically challenged, elderly person and none belong to SC and ST community. Table represents the presence of Scheduled Caste and Scheduled Tribe population in the study area.

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

Table 4-12: Presence of Scheduled Caste and Scheduled Tribe population in the study area

Administrative Unit	Total Population	SC Population	SC %	ST Population	ST %
District					
Sivaganga	**1339101**	**227746**	**17.0**	**790**	**0.1**
Taluk					
Sivaganga	**288674**	**45579**	**15.8**	**63**	**0.0**
Core Zone					
Pulavanvayal	**1102**	**340**	**30.9**	**0**	**0.0**
Buffer Zone	**20561**	**4741**	**23.1**	**0**	**0.0**
Adappadakki	2303	801	34.8	0	0.0
Alpattaviduthi	776	217	28.0	0	0.0
Kanjipatti	618	19	3.1	0	0.0
Kuruthanivariendal	3558	414	11.6	0	0.0
Mudikkaraipudukkulam	578	0	0.0	0	0.0
Palkulam	4498	1158	25.7	0	0.0
Periakannanur	1268	306	24.1	0	0.0
Pudukkilavachi	1190	332	27.9	0	0.0
Purasadiudappu	1526	296	19.4	0	0.0
Sedambal	1603	413	25.8	0	0.0
Sembar	715	251	35.1	0	0.0
Siramam	619	292	47.2	0	0.0
Sirukanaperi	1309	242	18.5	0	0.0

Source: Primary Census Abstract, Census 2011

And in tehsil level SC population was about 15.8% and there was no presence of ST population. With respect to the study area villages highest number of SC population were reported in Siramam village (47.2%) and there are no ST population reported in the study area villages.

Based on the field observations and outcome of the stakeholder consultation it hereby confirmed that there are no presence of Scheduled Tribe population or no livelihood dependency of any scheduled tribe on the said project site land or no land belonging to scheduled tribe or no Assigned land is being involved in the project. The Scheduled Tribe population in the study area are usually involved in agriculture works, NREGA works from the neighbouring villages.

4.3.4.3 Gender Profile

The table below represents the gender profile of the study area.

Table 4-13: Gender Profile

Administrative Unit	Sex Ratio	Child Sex Ratio	Male Literates	Female Literates	Male Workers	Female Workers
District						
Sivaganga	1003	960	87.9%	71.9%	58.5%	34.1
Taluk						
Sivaganga	1019	949	87.6%	70.7%	57.6%	37.0%
Core Zone	907	741	78.5%	56.3%	58.0%	49.2%
Pulavanvayal	907	741	78.5%	56.3%	58.0%	49.2%
Buffer Zone	1030	995	81.3%	60.2%	62.7%	53.7%
Adappadakki	999	926	78.7%	57.8%	62.6%	55.3%
Alpattaviduthi	935	1296	76.5%	57.6%	52.4%	4.0%
Kanjipatti	994	795	78.2%	53.8%	58.7%	45.1%
Kuruthanivariendal	1046	1000	79.1%	58.6%	69.0%	66.9%
Mudikkaraipudukkulam	1133	1111	71.1%	49.4%	60.1%	56.0%
Palkulam	1022	1078	88.5%	69.6%	60.4%	44.7%
Periakannanur	1069	885	85.5%	59.2%	62.0%	37.1%
Pudukkilavachi	932	1032	76.5%	53.1%	69.0%	69.0%
Purasadiudappu	954	930	87.9%	67.7%	63.4%	58.9%
Sedambal	1140	949	73.1%	47.5%	60.3%	54.2%
Sembar	1066	1000	70.2%	50.1%	55.5%	65.0%
Siramam	1070	1194	79.5%	63.3%	67.9%	67.8%
Sirukanaperi	1088	789	85.1%	65.6%	60.8%	59.4%

Source: Primary Census Abstract, Census 2011

The gender profile of the study area is presented in the table above. The sex ratio of the study area i.e., the core and buffer zone are at 907 and 1030 females per 1000 males respectively, with respect to the Tehsil and district was about 1019 and 1003 respectively. Whereas the children sex ratio in the project village (**741**) is very less than that of the Tehsil(949) and District rate(960).

Education Level of Women

Literacy level amongst the women in the core and buffer zone of the study area was 56.3% and 60.2% respectively, Sedambal village in the buffer zone seems to have lowest women literacy rate of 47.5. On review of the literacy rate among all the administrative units presented in table above, it was observed that the female literacy rates in all administrative units were seems to less when compared to the male literacy level and the lowest female literacy rate is reported in Sedambal Village. However it was reported during consultation with the women groups, that girl children are encouraged to take up higher education in the recent past. Various initiatives were taken by the Government in order to

improve and promote inclusive education. Few notable schemes are Beti Bachao Beti Padhao, Sukanya Samriddhi Yojana, Chief Minister's Girl Child Protection Scheme (Tamil Nadu), National Scheme of Incentive for the Girls of Secondary Education, Periyar EVR Nagammai Free Education scheme, etc. Beti Bachao Beti Padao (BBBP) Scheme programmes which have been launched with the primary objective to empower the girl chid and ensure her education, essentially addressing the pre and post birth discrimination against the girl child.

Women Participation in Workforce

Overall, the women participation in the workforce in the region is less than 50 percent, which is less than that of male workforce participation Sivaganga District has 34.1% Sivaganga tehsil had 37% and at the village level 49.2% for the core zone villages and 53.7% for the buffer zone villages. The lowest(4% where as men workers participation rate was 52.4**%**) women workers participation was reported in the Alpattaviduthi village. It was reported during the consultation with the opinion leaders and women groups, generally the people in the region encourages the girl children to pursue higher education and in general the average age for marriage for girl is around 21-24 years. Women are usually reported to be involved in agriculture labour work and NREGA works and very few of them are reported to engaged in industrial labour work (Cotton Spinning Factory within the study area).

Political participation, decision-making and agency

As per Article 243D of the Constitution of India provides for not less than one-third reservation for women out of total number of seats to be filled by direct election and number of offices of chairpersons of Panchayats. However, as per the information available with the Ministry, 21 States including Tamil Nadu made provision of 50% reservation for women in Panchayati Raj Institutions. With respect to Sivaganga district in 2019 Local Body elections, the women representation was around 59.1%.

Crime and Domestic Violence Against Women

As per NCRB Report 2020, in total 157 crimes were registered under IPC and SLL. Of which 24 cases have been reported to be Cruelty by Husband or his relatives, 28 cases registered on Kidnapping & Abduction of Women, 9 reported cases of Rape, about 49 cases were reported under Child Rape and there were no reported cases on domestic violence. Based on the outcome of the consultation with the women groups in the study area villages, it was reported that there are no reported such case in the recent past and women and girls are free to move without fear and have are reported to be equally treated, girl children are encouraged to pursue higher education, given property rights, etc. Alcoholism is not reported to be a major problem in the study area, though the situation is worse comparted to the other parts of the state.

4.3.5 Education level

For measurement of literacy level in the census, any person aged seven years or above, who can both read and write any Indian language with understanding, is considered to be a literate person. The literacy level of the study area has been represented in this section.

The literacy level of the study area is presented in the table below:

Table 4-14: Literacy profile of Study Area

Administrative Unit	Total Population	Literate Population	Literate Male Population	Literate Female Population
District				
Sivaganga	**1339101**	**959744 (79.9%)**	**526304 (87.9%)**	**433440 (71.9%)**
Taluk				
Sivaganga	**288674**	**204308 (79.1%)**	**111685 (87.6%)**	**92623 (70.7%)**
Core Zone				
Pulavanvayal	**1102**	**679 (67.8%)**	**408 (78.5%)**	**271 (56.3%)**
Buffer Zone	**20561**	**13024 (70.6%)**	**7376 (81.3%)**	**5648 (60.2%)**
Adappadakki	2303	1411 (68.2%)	811 (78.7%)	600 (57.8%)
Alpattaviduthi	776	482 (67.5%)	286 (76.5%)	196 (57.6%)
Kanjipatti	618	361 (65.9%)	212 (78.2%)	149 (53.8%)
Kuruthanivariendal	3558	2192 (68.6%)	1232 (79.1%)	960 (58.6%)
Mudikkaraipudukkulam	578	299 (59.6%)	167 (71.1%)	132 (49.4%)
Palkulam	4498	3130 (79%)	1741 (88.5%)	1389 (69.6%)
Periakannanur	1268	828 (71.8%)	472 (85.5%)	356 (59.2%)
Pudukkilavachi	1190	695 (65.3%)	424 (76.5%)	271 (53.1%)
Purasadiudappu	1526	1084 (78%)	624 (87.9%)	460 (67.7%)
Sedambal	1603	860 (59.4%)	490 (73.1%)	370 (47.5%)
Sembar	715	387 (59.8%)	219 (70.2%)	168 (50.1%)
Siramam	619	392 (71.1%)	213 (79.5%)	179 (63.3%)
Sirukanaperi	1309	903 (74.8%)	485 (85.1%)	418 (65.6%)

Source: Primary Census Abstract, Census 2011

Table above represents the literacy level in the study area. It can be noted that the literacy level in the core and buffer zone was 67.8% and 70.6% respectively, which is less than the district literacy rate. In all administrative units, the female literacy rate is less than that of male literacy rate. The literacy level at Sivaganga District was at 79.9% and at Sivaganga Tehsil the literacy rate was 79.1%.

At the village level, the lowest literacy rate (59.4%) was at Sedambal Village and highest literacy rate (74.8%) was at Sirukanaperi Village. During consultations with the panchayat representatives, it was stated that the people are encouraging their children to pursue higher education, the villages are acccesed to the schools up to Higher Secondary (12th Std.) and the nearest higher education facilities

such as colleges and skill development institutes are accessible from the nearby towns Sivaganga, Madurai, etc.

4.3.6 Occupation and Livelihood

Occupational pattern distribution of a population in an area indicates the development and diversification of an economy. The trend suggests that developed countries have higher distribution of population in the services and secondary sectors and the developing or underdeveloped countries have higher concentration of population in the primary (i.e. the agricultural) sector. For the Census Survey, the occupations are classified into Cultivators, Agricultural Labourers, Household (HH) Industries and Others[28].

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

Table 4-15: Occupational pattern in the Study Area

Administrative Unit	Workers			Main Workers	Cultivators			Agriculture Labours			HH Workers			Other Workers		
	Total	Male	Female		Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
District																
Sivaganga	**620171 (46.3%)**	***391305 (58.5%)***	***228866 (34.14%)***	**461102 (74.4%)**	**141003 (22.7%)**	**88407 (22.6%)**	**52596 (23%)**	**199563 (32.2%)**	**100085 (25.6%)**	**99478 (43.5%)**	**14656 (2.4%)**	**7126 (1.8%)**	**7530 (3.3%)**	**264949 (42.7%)**	**195687 (50%)**	**69262 (30.3%)**
Taluk																
Sivaganga	**136244 (47.2%)**	***82339 (57.6%)***	***53905 (37%)***	**103663 (76.1%)**	**33045 (24.3%)**	**20818 (25.3%)**	**12227 (22.7%)**	**53502 (39.3%)**	**26151 (31.8%)**	**27351 (50.7%)**	**2294 (1.7%)**	**1146 (1.4%)**	**1148 (2.1%)**	**47403 (34.8%)**	**34224 (41.6%)**	**13179 (24.4%)**
Core Zone																
Pulavanvayal	**593 (53.8%)**	***335 (58%)***	***258 (49.24%)***	**176 (29.7%)**	**173 (29.2%)**	**159 (47.5%)**	**14 (5.4%)**	**338 (57%)**	**112 (33.4%)**	**226 (87.6%)**	**1 (0.2%)**	**0 (0%)**	**1 (0.4%)**	**81 (13.7%)**	**64 (19.1%)**	**17 (6.6%)**
Buffer Zone	**11947 (58.1%)**	***6349 (62.7%)***	***5598 (53.66%)***	**9294 (77.8%)**	**3823 (32%)**	**2064 (32.5%)**	**1759 (31.4%)**	**6018 (50.4%)**	**2909 (45.8%)**	**3109 (55.5%)**	**144 (1.2%)**	**70 (1.1%)**	**74 (1.3%)**	**1962 (16.4%)**	**1306 (20.6%)**	**656 (11.7%)**
Adappadakki	1358 (59%)	*721 (62.6%)*	*637 (55.34%)*	1332 (98.1%)	530 (39%)	293 (40.6%)	237 (37.2%)	487 (35.9%)	266 (36.9%)	221 (34.7%)	6 (0.4%)	1 (0.1%)	5 (0.8%)	335 (24.7%)	161 (22.3%)	174 (27.3%)
Alpattaviduthi	225 (29%)	*210 (52.4%)*	*15 (4%)*	220 (97.8%)	139 (61.8%)	133 (63.3%)	6 (40%)	80 (35.6%)	71 (33.8%)	9 (60%)	2 (0.9%)	2 (1%)	0 (0%)	4 (1.8%)	4 (1.9%)	0 (0%)
Kanjipatti	321 (51.9%)	*182 (58.7%)*	*139 (45.13%)*	302 (94.1%)	52 (16.2%)	31 (17%)	21 (15.1%)	238 (74.1%)	126 (69.2%)	112 (80.6%)	1 (0.3%)	0 (0%)	1 (0.7%)	30 (9.3%)	25 (13.7%)	5 (3.6%)
Kuruthanivariendal	2417 (67.9%)	*1200 (69%)*	*1217 (66.9%)*	2182 (90.3%)	1096 (45.3%)	548 (45.7%)	548 (45%)	1101 (45.6%)	491 (40.9%)	610 (50.1%)	28 (1.2%)	11 (0.9%)	17 (1.4%)	192 (7.9%)	150 (12.5%)	42 (3.5%)
Mudikkaraipudukkulam	335 (58%)	*163 (60.1%)*	*172 (56.03%)*	152 (45.4%)	263 (78.5%)	134 (82.2%)	129 (75%)	55 (16.4%)	18 (11%)	37 (21.5%)	11 (3.3%)	5 (3.1%)	6 (3.5%)	6 (1.8%)	6 (3.7%)	0 (0%)
Palkulam	2360 (52.5%)	*1345 (60.4%)*	*1015 (44.65%)*	1920 (81.4%)	94 (4%)	49 (3.6%)	45 (4.4%)	1393 (59%)	686 (51%)	707 (69.7%)	51 (2.2%)	34 (2.5%)	17 (1.7%)	822 (34.8%)	576 (42.8%)	246 (24.2%)
Periakannanur	623 (49.1%)	*380 (62%)*	*243 (37.1%)*	161 (25.8%)	482 (77.4%)	273 (71.8%)	209 (86%)	78 (12.5%)	70 (18.4%)	8 (3.3%)	10 (1.6%)	3 (0.8%)	7 (2.9%)	53 (8.5%)	34 (8.9%)	19 (7.8%)
Pudukkilavachi	821 (69%)	*425 (69%)*	*396 (68.99%)*	795 (96.8%)	4 (0.5%)	1 (0.2%)	3 (0.8%)	775 (94.4%)	394 (92.7%)	381 (96.2%)	4 (0.5%)	1 (0.2%)	3 (0.8%)	38 (4.6%)	29 (6.8%)	9 (2.3%)
Purasadiudappu	934 (61.2%)	*495 (63.4%)*	*439 (58.93%)*	383 (41%)	106 (11.3%)	85 (17.2%)	21 (4.8%)	647 (69.3%)	255 (51.5%)	392 (89.3%)	2 (0.2%)	2 (0.4%)	0 (0%)	179 (19.2%)	153 (30.9%)	26 (5.9%)
Sedambal	915 (57.1%)	*452 (60.3%)*	*463 (54.22%)*	758 (82.8%)	122 (13.3%)	67 (14.8%)	55 (11.9%)	682 (74.5%)	312 (69%)	370 (79.9%)	4 (0.4%)	2 (0.4%)	2 (0.4%)	107 (11.7%)	71 (15.7%)	36 (7.8%)
Sembar	432 (60.4%)	*192 (55.5%)*	*240 (65.04%)*	431 (99.8%)	405 (93.8%)	184 (95.8%)	221 (92.1%)	18 (4.2%)	5 (2.6%)	13 (5.4%)	1 (0.2%)	0 (0%)	1 (0.4%)	8 (1.9%)	3 (1.6%)	5 (2.1%)

Administrative Unit	Workers			Main Workers	Cultivators			Agriculture Labours			HH Workers			Other Workers		
	Total	Male	Female		Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
Siramam	420 (67.9%)	*203 (67.9%)*	*217 (67.81%)*	8 (1.9%)	45 (10.7%)	21 (10.3%)	24 (11.1%)	355 (84.5%)	170 (83.7%)	185 (85.3%)	10 (2.4%)	5 (2.5%)	5 (2.3%)	10 (2.4%)	7 (3.4%)	3 (1.4%)
Sirukanaperi	786 (60%)	*381 (60.8%)*	*405 (59.38%)*	650 (82.7%)	485 (61.7%)	245 (64.3%)	240 (59.3%)	109 (13.9%)	45 (11.8%)	64 (15.8%)	14 (1.8%)	4 (1%)	10 (2.5%)	178 (22.6%)	87 (22.8%)	91 (22.5%)
Grand Total	768955 (46.6%)	*480328 (58.4%)*	*288627 (34.9%)*	574235 (74.7%)	178044 (23.2%)	111448 (23.2%)	66596 (23.1%)	259421 (33.7%)	129257 (26.9%)	130164 (45.1%)	17095 (2.2%)	8342 (1.7%)	8753 (3%)	314395 (40.9%)	231281 (48.2%)	83114 (28.8%)

Source: Primary Census Abstract, Census 2011

Table above denotes that majority of the population in all administrative units are engaged in agricultural activities as their main occupation. Sivaganga district has 54.9 % of workforce population engaged in agricultural activities. With respect to the Tehsil about 63.6% workers were engaged in agricultural activities.

However, with respect to the study area, about 86.2% (29.2% Cultivators and 56.9 % Agriculture Labours) of the workers from core zone villages and 82.4% (31.9% Cultivators and 50.4% Agriculture Labours) of the buffer zone villages were involved in agriculture activities. Though the overall figure shows that the major source of livelihood is related to agriculture and allied activities, breakup shows that majority of the workers were involved only as agriculture labour and the same was confirmed during the stakeholder consultation with the village representatives and landowners. Due to lack of irrigation facility and the agriculture activities are dependent on monsoon, only one crop is being cultivated. There are no major industries in the region except a Cotton Spinning mill at Purasadiudappu village which is at the distance of 10km from the proposed project site and it was also reported the presence of a Sugar mill and a Distillery in the region. Though there are presence of few small-scale industries in the region very few of the villagers are engaged in employment with these industries. The educated youths from the villages have mostly migrated to the nearby towns and cities in search of decent jobs.

In addition to the agriculture activities about few farmers (around 20%) were holding one or two cows in each house. The milk produced are mostly self-consumed or sold locally. There are no major dairy units in the villages. In addition, 3-4 families in each village are fulltime grazers involved in cattle rearing usually sheeps/goats with each growing 50-70 goats/sheeps. As reported during the consultation among few shepherds, they expressed that there would not be any adverse impact or loss of livelihood due to the proposed project.

4.3.6.1 Agriculture and Irrigation Sources

As discussed in the earlier section Agriculture and allied activities being the major source of livelihood in the region. Based on the outcome of the consultation, it was reported that the study area villages are of mostly rainfed region and agriculture is dependent on monsoon and does not have any perennial source of irrigation facility. Hence only once crop is usually cultivated and paddy being the major crop cultivated. Some of the other crops cultivated in the region are sugarcane and pulses. With respect to the project site land, 100% of the land is observed to be kept barren at the time of site visit and as per the consultation with the landowners and revenue officials, the said project site land was kept barren since 30 years and no crops were cultivated.

4.3.7 Physical Infrastructure and Civic Amenities

4.3.7.1 Health Profile and Infrastructure

During consultations with the Pulavanvayal Panchayat representative it was stated that there is no Primary Health Centre within the village, the nearest Government hospital is Maravamangalam Primary Health Centre (PHC) and Satharasankottai Primary Health Centre(PHC), with respect to nearest private allopathic hospitals and clinics are present at Kalayarkoil, Sivaganga. As reported during consultation, mostly people prefer to go to Government hospital in case of ailment.

The nearest medical facility to the project site is Maravamangalam Block PHC which is at a distance of around 5.3km. The PHC is of 30 bed capacity with facilities include Maternity Care, Ambulance, Immunization, Stabilization, etc. The study area is covered by 108 Ambulance services and under National Health Mission (NHM). Anganwadi centres are located within the project village. For major ailments the patients are referred to General Hospital located at Kalayarkoil and further private multi-speciality hospitals as Sivaganga and Madurai. As reported, there are no existing common illness or disease endemic to the region.

4.3.7.2 Drinking Water

Drinking Water supply is primarily through panchayat supplied water pipes connecting to houses, however as reported during the consultation drinking water is the major concern. Though the Panchayat supplied piped drinking water facilities are present it was reported to be inadequate.

4.3.7.3 Sanitation

Swachh Bharat Abhiyan scheme was stated to be implemented in study area villages. Consultations with panchayat representatives indicated that though physical structures are in place, the practice of open defecation is still prevailing.

4.3.7.4 Religious and Archaeological Important Sites

The proposed project site is to be developed within private land, there are no presence of any religious or cultural important places within the project site and along the proposed TL connecting the PSS and GSS. The nearest ASI Notified Archaeological Important place is Rock-cut temples with inscriptions located at Kunnakkudi, Sivaganga District at the distance of 39 km(aerial) from the project site.

4.3.8 Socioeconomic Profile of PAFs

As part of the assignment consultations were conducted among the sample landowners belonging to the project site land. Of the total 29 landowners, consultation was conducted with 12 landowners (41%) of which 3 members were women participants (25%). All the landowners consulted belong to Other Backward Caste (OBC) and only one member follows Christianity, and all the other members belongs to Hindu religion. Average size of the family members was 4. Of the 29 landowners consulted, only 3 landowners are primarily dependent on agriculture activity (holding land in the neighbouring villages) and other members were involved in agriculture activities along with agriculture related business and few members involved in Business (3 members). Among the landowners consulted, 8 landowners reported to have about 44 numbers of cows and 220 number of goats/ sheeps. The range of annual income among the landowners consulted was INR. 3 Lakhs to INR. 3.6 crores per annum. Of the landowners consulted 8 landowners reported to hold four-wheeler (car and Tractor) and all the landowners owns two wheelers. All the landowners hold a Pakka concrete roofed house and had electricity and sanitation facilities. All the landowners confirmed that they are willingly selling their land and the compensation were made at the market rate which was arrived on negotiation with the landowners. Among the landowners, 10 landowners reported using the compensation amount for reinvestment in purchasing another piece of land and being invested in business.

Table 4-16: Socioeconomic Survey of PAFs

S. No	Particulars		Numbers / Value
1	Number of Landowners		29
2	Number Consulted		12 (41%)
3	Religion	Hindus	11 (92%)
		Christian	1 (8%)
4	Sex	Male	9 (75%)
		Female	3 (25%)
5	Education Level	Primary (up to 5th Std)	1 (8%)
		Secondary (up to 8th Std)	6 (50%)
		Higher Secondary (up to 12th Std)	2 (17%)
		Graduation and above	3 (25%)
6	Social Group	OBC	12 (100%)

S. No	Particulars		Numbers / Value
7	Income Source	Agriculture	3 (25%)
		Agriculture and Allied Business	2 (17%)
		Agriculture and Cattle Farm	2 (17%)
		Agriculture and Private Employed	1 (8%)
		Agriculture, Cattle Farm and Allied business	1 (8%)
		Business	3 (25%)
8	Income Level	3-5 Lakhs	2(17%)
		5-10 Lakhs	4(33%)
		10-15 Lakhs	2(17%)
		15-50 lakhs	2(17%)
		> 1 Crore	2(17%)
9	Compensation Utilization	Business	3 (17%)
		Education	1 (33%)
		Education and Investment	1 (17%)
		Purchased Land	6 (17%)
		Purchased Land and Business	1 (17%)
10	Household Assets	Pakka House	12 (100%)
		Two-Wheeler	12 (100%)
		Four-Wheeler	7 (58%)
		Tractor	1 (33%)
		Toilet Facility	12 (100%)
11	Vulnerability	HH Headed by Physically Challenged	None
		HH Headed by Elderly > 60	None
		HH with BPL Card	None


View of Proposed Solar Power Project site

Consulation with Openion Leaders, Landowner and Land Aggregator

Consulation with Panchayat Member

Consulation With Agriculture Labours / Grazers Pothakudi Village

Consultation with Agriculture Labours, Farmers – Siramam Villlage

Consulation with Shepherd – Pothokudi Village

Consultation with NREGA Workers / Agriculture Labours – Siramam Village

Access Road Connecting the Project Site with State Highway

Bus Connectivity to the Project Site Village and neighbouring villages

Maravamangalam Block PHC

Anganwadi along with OHT Drinking Water Tank – Siramam Village

5. Stakeholder Engagement and Consultation

5.1 Introduction

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

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

The AECOM team visited the project site from 22nd- 24th June 2022. The team was able to conduct consultations with stakeholders from the project village and few buffer zone villages as well. For the purpose of the project, stakeholder mapping has been carried out with the following objectives.

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

5.2 Stakeholder Consultation and Disclosure Requirement for the project

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

Table 5-1: Overview of Disclosure And Stakeholder Consultation Requirement

Institution/ Regulatory Body	Reference Regulation/ Standard	Requirements
IFC	PS-1	• Community engagement is to be undertaken with the affected communities and must be free of external manipulation, interference, or coercion, and intimidation. • Furthermore, in situations where an affected community may be subject to risks or adverse impacts from a project, the proponent must undertake a process of consultation so as to provide the affected communities with an opportunity to express their views on the project risks, impacts, and mitigation measures, as well as allow the proponents to consider and respond to them. • *Informed participation:* For projects with significant adverse impacts on affected communities, the consultation process must ensure that free, prior and informed consultation with affected

Institution/ Regulatory Body	Reference Regulation/ Standard	Requirements
		communities occurs and that processes exist to facilitate participation by those affected. • Apart from such a consultation process, the project proponents are also to establish a Grievance Redressal Mechanism, which will allow the affected communities' concerns and grievances about the project proponent's environmental and social performance to be received and allow for steps to be taken to resolve the same • *Broader stakeholder engagement:* The proponent must identify and engage with stakeholders that are not directly affected by the project but those that have established relationships with local communities and/or interest in the project – local government, civil society organizations, etc. – and establish a dialogue.
ADB	ADB Safeguard Requirements-2	• The borrower/client will conduct meaningful consultation with affected persons, their host communities, and civil society for every project identified as having involuntary resettlement impacts. Meaningful consultation is a process that (i) begins early in the project preparation stage and is carried out on an ongoing basis; (ii) provides timely disclosure of relevant and adequate information; (iii) is undertaken in an atmosphere free of intimidation or coercion; (iv) is gender inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups; and (v) enables the incorporation of all relevant views of affected people and other stakeholders into decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues. • SPS 2 principle: Pay particular attention to the needs of vulnerable groups, especially those below the poverty line, the landless, the elderly, women and children, and Indigenous Peoples, and those without legal title to land, and ensure their participation in consultations. • Disclose IESE and SCA executive summaries and Land Access & Livelihoods Restoration Plan in an accessible place and in a form and language(s) (Tamil and English) understandable to affected people and other stakeholders

5.3 Stakeholder Categorisation

A stakeholder is "any identifiable group or individual who can affect the achievement of an organization's objectives or who is affected by the achievement of an organization's objectives"[1]. Stakeholders thus vary in terms of degree of interest, influence and control they have over the project.

Stakeholder Identification

Identification of all affected communities and stakeholder groups according to the degree of their vulnerability to the impacts of the Project should be undertaken. They can be classified into "Primary" and "Secondary Stakeholders" according to their degree of influence of the project and vice versa.

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

While those stakeholders who have a direct impact on or are directly impacted by the project are known as **Primary Stakeholders** and those who have an indirect impact or are indirectly impacted are known as **Secondary Stakeholders**.

Stakeholder Analysis

Stakeholder analysis takes into consideration a more comprehensive view of the stakeholder's groups interest, how they would be affected and to what extent and the influence they could have on the Project. These aspects would cumulatively provide the basis for constructing the stakeholder engagement strategy. The key stakeholders identified in the above section have been categorized into four major groups: inform, monitor, consult and engage deeply. The stakeholder analysis takes into consideration a more comprehensive view of the stakeholders' groups interest, how they would be affected and to what extent and the influence that they could have on the project. These aspects would cumulatively provide the basis for constructing the stakeholder engagement strategy Keeping in mind the nature of the project and its setting, the stakeholders have been identified and listed below.

Table 5-2: Stakeholder Group Categorisation

Stakeholder Groups	Primary Stakeholders	Secondary Stakeholders
Community	• Local Laborers • Landowners • Agricultural Laborers	• Local community • Vulnerable Communities • Grazing land users
Institutional Stakeholders	• Developers and Contractors • Gram Panchayats	• Civil Society/ Local NGOs
Government Bodies	• Regulatory Authorities • District Administration	
Other Groups	• Migrant Workforce	

5.4 Approach and Methodology of Stakeholder Analysis

The significance of a stakeholder group is categorized considering the magnitude of impact (type, extent, duration, scale and frequency) or degree of influence (power and proximity) of a stakeholder group and urgency/likelihood of the impact/influence associated with the particular stakeholder group in the project context. The magnitude of stakeholder impact/influence is assessed taking the power/responsibility[1] and proximity[2] of the stakeholder group and the group is consequently categorized as negligible, small, medium or large. The urgency or likelihood of the impact on/influence by the stakeholder is assessed in a scale of low, medium and high. As part of the stakeholder engagement process tools like personal interviews, consultation and focused group discussions were used. Participant list for the stakeholder consultations undertaken have been provided as **Appendix A** and Survey Questioners are provided in **Appendix H & I.** The overall significance of the stakeholder group is assessed as per the matrix provided below.

Table 5-3: Stakeholder Significance and Engagement Requirement

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

1. Power/Responsibility: Those stakeholders to whom the organisation has, or in the future may have, legal, financial, and operational responsibilities in the form of regulations, contracts, policies or codes of practice.
2. Proximity: indicates stakeholders that the organisation interacts with most, including internal stakeholders, those with long-standing relationships and those the organisation depends on its day-to-day operations.

5.5 Stakeholder Analysis

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

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

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

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

Table 5-4: Stakeholder Analysis

Stakeholder Category	Relevant Stakeholders	Profile/Status	Impact/Influence of the project on this Stakeholder Group	Impact/Influence of the Stakeholder Group on the project	Expectations, Opinions Key Concerns of Stakeholders	Overall Rating of Stakeholder Influence
Primary Stakeholder	Landowners / TANTRANSCO	• The entire solar project is to be developed on private land. The required land is to be proposed to be procured by executing sale deeds on willing buyer and willing seller basis. • As observed during the site visit and reported by the landowners and village representatives the project site land is barren and not utilized for any cultivation and there was no livelihood dependency on the land. • The TL line route is in the planning stage and there are no standing structures within the project site and along the proposed TL route as per information available now. The required RoW is to be sourced through private negotiations may trigger IR and cannot be determined at this stage. • The compensation for the TL RoW and Tower footprint area to be at the replacement cost as per entitlement matrix and LRP developed for the project. • TANTRANSCO is responsible for providing clearances and permits for erection of the power project and commissioning of	• Constituting the most critical stakeholder group, landowners from whom the land is being sourced; • The level of impact of loss of land for solar project site is envisaged to be negligible as the land is barren and are being paid at the replacement cost • The land below the TL route will be allowed to use by the landowner post implementation, however there will be hindrance in use of tractor and heavy machineries within RoW.	The impact associated with the landowners are related to grievances associated to compensation payment, loss of common property resources adjacent to the project. And with respect to the TANTRANSCO it mostly on the compliance by the players operating the power plant.	• The major concern of the stakeholder group is that of compliance and Job / business opportunities and economic development of the region.	High

Stakeholder Category	Relevant Stakeholders	Profile/Status	Impact/Influence of the project on this Stakeholder Group	Impact/Influence of the Stakeholder Group on the project	Expectations, Opinions Key Concerns of Stakeholders	Overall Rating of Stakeholder Influence
		the project including evacuation of power.				
	Contractors and Sub-contractors	As indicated earlier, FPEPL is the developer for the proposed solar power project. The required land is being procured through willing buyer and willing seller basis. The EPC contract for the project is in the process of being finalised.	• Hassle-free procurement of the identified plots of land for the project; and • Smooth operation of the construction activity and to complete the work within the scheduled time and cost.	• Non-compliance to the legal requirements. • Not meeting the community expectations; and • Leaving behind a legacy of conflict-ridden relationship with local communities.	The contractors and sub-contractors play an important role during the project construction phase for timely commissioning of the project with quality construction and within the stipulated budgetary provisions.	Medium
	Local Labourers	• A considerable section of the working population of the local area are agriculture labourers. • Due to the lack of industries in the region, the availability of employment in the unskilled category is limited; and • Skilled laborers and educated youths are reported to be migrated to the nearby towns and metropolitan cities in search of decent jobs.	The local wage earners have developed high expectations for employment in the project.	• Any labour unrest and protests will cause delays in construction schedule and create a non-congenial social atmosphere; and • The delay in construction activities will have financial implications on the project.	The major concerns of this stakeholder group include: - • Regular payment of wages for the work rendered; • Continued employment even beyond the completion of construction work; • Health and Safety issues at work; and • Wages, leaves, etc. as per labour laws applicable etc.	Medium
	Gram Panchayats (GPs)	• Constituting the lowest strata of Decentralized Local Governance in the Country, a typical Panchayat consists of one or more revenue villages. This body of local governance was created through the 73rd	The project will create collective benefit for the local community.	• GPs play an important role in overall mobilization and shaping the perception and opinions of the people in the project area. They also serve as the official forum for consent and	The expectations/ concerns of the GPs include; • Employment Opportunities for the Local Youth;	Medium

Stakeholder Category	Relevant Stakeholders	Profile/Status	Impact/Influence of the project on this Stakeholder Group	Impact/Influence of the Stakeholder Group on the project	Expectations, Opinions Key Concerns of Stakeholders	Overall Rating of Stakeholder Influence
		Amendment to the Constitution of India; and Sarpanch and other members of the Gram Panchayat need to be actively involved in various activities relating to the economic development and social justice of their Panchayat. The smooth and hassle-free functioning of the project is also the onus of the Panchayats.		approval required for the project.	• Community development activities for development of local area; and • Nature of impact that the project would have on the livelihoods of communities.	
	Regulatory Authorities	• The office of District Industries Commissioner (DIC) regulates Industrialization at the District Level. • Tamil Nadu Transmission Corporation Limited (TANTRANSCO) for power evacuation/ grid connectivity etc.	The project will comply with the applicable regulatory framework comprising of the guidelines and policies of the State Government such as State Renewable Energy Policy 2019. Permission and coordination with the District Industries Centre, Sivaganga is mandatory for creation of local infrastructure and smooth operation of the industry.	-	The main expectation of the Regulatory Authorities from the project Proponents is abidance to all applicable guidelines, policies and laws.	Low
	District/Tehsil Administration	• The project area is administered at three levels by different Government Bodies: at the district level, at the block/tehsil level and at the Panchayat level in each village/or cluster of villages.	The process of land sale deed registration land parcels was in progress at the time of the site visit.	• There are several permissions and regulatory approvals that are required prior to as well as after the construction of the project from the District Administration. Delay in issuance of the relevant permits can adversely	The key concerns of the District Administration authorities might include. • Matters concerning local employment. • Preference to local youths in matters of vehicle hire and	Low

Stakeholder Category	Relevant Stakeholders	Profile/Status	Impact/Influence of the project on this Stakeholder Group	Impact/Influence of the Stakeholder Group on the project	Expectations, Opinions Key Concerns of Stakeholders	Overall Rating of Stakeholder Influence
		• In this context, local administration refers to the district level and block level administration comprising of the offices of the Tehsildar, District Magistrate Collectors, and Revenue officer etc.; and The sub-registrar of the revenue department is responsible for registration of sale of land, land mutation, updating of records of transfer of land.		impact the timely execution of the project. Similarly, unresolved matters relating to land such as litigation, non-payment of compensation and encroachment might create complications, drag the firm into legal disputes thereby delaying project execution.	issuance of contract job etc.; and Local area development through Community Development interventions.	
	Migrant Workforce	• As on date no project related activities were carried out in the project site. An estimated workforce comprising of 200-230 workers will be employed for a duration of 6 months of skilled and highly skilled categories of about 130 are expected to be mostly migrant workers and will be engaged in the project-specific construction activities.	• Migrant workers may see this as a better economic and livelihood opportunity for them; and • The fluctuation of the supply of local labour in harvest and other agricultural peak seasons can be met by deployment of migrant workers.	• Retaining the migrant workforce, especially during the construction phase of the project is extremely critical.	The major concerns of this stakeholder group may include. • Regular payment of wages for the work rendered. • Continued employment even beyond the completion of construction work. • Health and Safety issues at work. • Holidays and leaves as per labour laws applicable etc.; and • Issues relating to conflicts with the local labour and host community.	Low
Secondary Stakeholders	Local Community	• The stakeholder group comprising of local communities	• The Community Development activities focused on	• The broad support of the local community will create	• Expectations of getting employment	Low

Stakeholder Category	Relevant Stakeholders	Profile/Status	Impact/Influence of the project on this Stakeholder Group	Impact/Influence of the Stakeholder Group on the project	Expectations, Opinions Key Concerns of Stakeholders	Overall Rating of Stakeholder Influence
		around a radius of 5 kms inhabit 14 villages • The community in the study area is dependent on agriculture and allied activities.	education and health, among others should also target at the neighbouring villages and the immediate local community which will lead to improvement in livelihood.	a hindrance free or risk-free business process.	benefits from the project; and • Growing community demands for implementing welfare interventions in the region by the project Proponent.	
	Vulnerable Communities	• This stakeholder group comprises of SC and ST Communities in the study area Which constitutes 23.4% of Scheduled Caste Population and 0% of Schedule Tribe population. These Scheduled Caste population are not socially secluded, and they live along with the mainstream people.	• In view of the poor social and economic conditions of the Vulnerable Communities as identified as part of Stakeholder Engagement Activity, the project Proponent may have to provide engagement avenues to its members.	• The stakeholder group will have a negligible impact on the project as no land belonging to the SC/ST been sourced for the project. As on date, project activities do not have influence or impact on the project. Involvement of any vulnerable population will be compensated as per the LRP.	• Key concerns of this stakeholder group will primarily revolve around targeted support being extended for availing the benefits of community interventions by the project Proponent.	Low
	Agricultural Laborers	• Based on the Census data also as confirmed during the consultation, the majority of the working population is dependent on agriculture labour. Due to lack of perennial irrigation sources and cultivation based on the dependency of monsoon only single crop is cultivated. During the agriculture lean season the agriculture laboures mostly move to neighbouring villages in search of agriculture	• The project villages are of mostly rainfed agriculture lands and does not have any perennial source of irrigation. • The local community will be benefitted by means of the local employment opportunities that will be generated.	• The stakeholder group will have a negligible impact on the project.	Expectations of getting employment benefits from the project;	Low

Stakeholder Category	Relevant Stakeholders	Profile/Status	Impact/Influence of the project on this Stakeholder Group	Impact/Influence of the Stakeholder Group on the project	Expectations, Opinions Key Concerns of Stakeholders	Overall Rating of Stakeholder Influence
		labour work and get employed through the NREGA scheme.				
	Civil Society/Local NGOs	• The local NGOs, mostly based out Kalayarkoil, Sivaganga, are acting as a social watchdog in matters relating to securing the livelihoods of rural communities along with their related socio-cultural facets; and • However, the number of such NGOs active in the study area is highly limited.	With respect to contributing towards the cause of local development, the project proponent can either participate in the ongoing developmental activities of the Government or might take up interventions on its own or through partnerships with NGOs and CBOs after obtaining prior approval from competent authorities.	• The NGOs and Civil Society Groups often play a critical role in bringing to the limelight the issues of vulnerable communities in the society; and • They can also play a major role in community mobilization, building trust and even participate in implementing Community Development initiatives.	The opinion of the NGOs and Civil Society Groups towards a project is determined largely by whether the impacts of setting up of the development venture is being viewed/ perceived in positive light by the local population with special reference to the vulnerable communities or not. The key concerns of this stakeholder group centres around justice and equal opportunities in matters of economic and social development being provided to the Vulnerable Communities.	Low

Note: *It is significant to note that the stakeholder analysis is based on the situation during site visit for this ESIA report. The stakeholder influence on the project is dynamic and may change during the project life. Consequently, the stakeholder analysis needs periodical reassessment and updated by client.*

Summary of overall stakeholder influence is presented in the table below.

Table 5-5: Summary of overall stakeholder influence

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

5.6 Stakeholder Consultations and Engagement

The section provides a summary of the consultations undertaken with the Stakeholders of the project. As part of the assessment primary stakeholders such as landowners, panchayat representatives, regulatory authorities, etc were being consulted by using questioners and focused group discussion were conducted among the secondary stakeholders like local community, women agriculture workers, grazers.

5.6.1 Consultation with Panchayat Member, opinion leaders and Landowners of Pulavanvayal Village

Summary of consultations undertaken with the Panchayat member, Opinion Leaders, Landowners of Pulavanvayal village on 22nd June 2022 has been presented in the table below.

Basic details	
Location: Pulavanvayal Village, Kalayarkoil Tehsil	District: Sivaganga
Project Title: ESIA of 50 MW solar power project of FPEPL	Date: 23rd June 2022
Stakeholder Group Title: Panchayat Member, Opinion Leaders, Landowners of Pulavanvayal Village	
Objective of the Interview/Consultation	
To understand the socio-economic baseline of Pulavanvayal village and an assessment of the perception of the upcoming project amongst the community members.	
Key discussion points	
1	**What is the demographic of the village?** Pulavanvayal village has approximately 1200 population residing from 270 houses. Most of the houses are observed to be pakka and semi-pakka.
2	**Communities present in the village and their primary occupational activity.** • Among the total population about 30% of the population belong to Scheduled Caste community. Some of the notable communities are Yadavs, Maravar, Kallar and SC. There are no presence of Scheduled Tribe population.

Basic details	
3	**Occupational Pattern and Livelihood Activities.** • Primary occupational activity comprises of cultivators and agricultural labourers. The agricultural activity was largely dependent on rainfall in the area. Women are also engaged as agricultural labourers, cattle rearing and in NREGA works. • About 5 families engaged in cattle rearing and there are no designated grazing area within or adjacent to the proposed project site. • There are no industries located in the region, except a Cotton Spinning mill located at distance of about 7 km from the project site. Few women are reported to engaged in this spinning mill as unskilled labours.
4	**Agricultural Crops Grown in the area** • The primary agricultural crops grown in the village is Wheat and few patches of sugarcane. Most of the crops harvested are sold to the local market or dealers in Kalayarkoil. Cultivation is carried out mostly during monsoon season. There is no permanent source of irrigation and most of the cultivations are rainfed. **Livestock Population** • It was stated that all households in the village possess cow and sheep. Majority of the milk produced are self-consumed or sold locally. Sheep / Goat reared are sold to the local market and through the local traders. About 4-5 houses do cattle rearing
5	**Migration Trend in the Village** • It was stated that the educated youth population of the village have migrated to nearby towns in search of skilled and decent jobs.
6	**Educational Profile** • Within the Pulavanvayal village, a school up to class 8 Std. is there. The higher education facilities like higher secondary school, technical studies such as ITI, Diploma, colleges etc., are located from the nearby towns Kalayarkoil, Sivaganga and Madurai. The people in the village encourage the girl children to take higher studies up to Under graduation.
7	**Health Profile** • Within Pulavanvayal village there are no allopathic hospital, the nearest hospital is located at Maravamangalam which is located at a distance of 5km. • The village is covered by 108 Ambulance service under National health Mission. • In case of ailment people mostly prefer to visit government PHC at Maravamangalam and Satharasankottai. • The Anti-venom stabilization and Anti-rabis stocks and Covid-19 screening is done and has 30 beds for in-patient care.
8	**Women Profile** • All girl children of Pulavanvayal village were enrolled in school. The literacy rate among the women is less compared to national and state averages. • Women of the village are primarily engaged as agricultural labours during major agricultural activities such as cropping and harvesting seasons and engaged in NREGA works during agriculture lean season.
9	**Youth Profile** The youth of Pulavanvayal village were primarily engaged as agricultural labourers, move to nearby towns in search of unskilled labour works and educated youths have migrated to the nearby towns, cities in search of job opportunities.
10	**Social Perception of Project:** The landowners and the opinion leaders welcome the project and the project being developed in unproductive land will not result in any economic / livelihood loss, moreover the project will create job opportunities within the village and induced development in the region.

Basic details	
11	**Perception among the Landowners** • In total 6 landowners belonging from both Pulavanvayal village were consulted. • Unanimously all the farmers expressed their willingness to give their land for the project, as the proposed project site land is barren, and they were paid higher than the market price • Most of the farmers consulted have invested on buying another land from the compensation money. • They do not have any grievance related to the land procurement and disbursement of compensation.
12	**Benefits/ Expectations from the Project** • Induced Development benefits due to project development such as improved road connectivity, • Increased employment opportunities, the region is mostly dependent on agriculture and allied activities and job opportunities are mostly seasonal. The project should hire local workforce to create regular income opportunities to the local. • Small trade and business opportunities to be given to the local traders and community. • Infrastructure and facilities improvement under CSR fund i.e., Skill Development Training, Irrigation facilities, Drinking Water Facility, etc.
13	**Concerns regarding the Project** No reported grievance.

5.6.2 Focused group discussion with Women Agriculture Labours, Farmers, NREGA Workers of Siramam Village

Summary of consultations undertaken with the Women groups, Agriculture Labours, NREGA on 23rd June 2022 has been presented in the table below.

Basic details	
Location: Siramam Village, Kalayarkoil Tehsil	District: Sivaganga
Project Title: ESIA of 50 MW solar power project of FPEPL	Date: 23rd June 2022
Stakeholder Group Title: Women Agriculture Labours, Farmers, NREGA Workers of Siramam Village	
Objective of the Interview/Consultation	
To understand the socio-economic baseline of Siramam village and an assessment of the perception of the upcoming project amongst the community members.	
Key discussion points	
1	**What is the demographic of the village?** Siramam village has approximately 700 population residing from 160 houses. Most of the houses are observed to be pakka and semi-pakka.
2	**Communities present in the village and their primary occupational activity.** • Among the total population about 50% of the population belong to Scheduled Caste community. Some of the notable communities are Yadavs, Maravar, Kallar and SC. There are no presence of Scheduled Tribe population.
3	**Occupational Pattern and Livelihood Activities.** • Primary occupational activity comprises of cultivators and agricultural labourers. The agricultural activity was largely dependent on rainfall in the area. Women are also engaged as agricultural labourers, cattle rearing and in NREGA works.

Basic details	
	• About 3-4 families engaged in cattle rearing and there are no designated grazing area within or adjacent to the proposed project site. • There are no industries located in the region, except a Cotton Spinning mill located at distance of about 5 km from the project site. Few women are reported to engaged in this spinning mill as unskilled labours.
4	**Agricultural Crops Grown in the area** • The primary agricultural crops grown in the village is Wheat and few patches of sugarcane. Most of the crops harvested are sold to the local market or dealers in Kalayarkoil. Cultivation is carried out mostly during monsoon season. There is no permanent source of irrigation and most of the cultivations are rainfed. **Livestock Population** • It was stated that all households in the village possess cow and sheep. Majority of the milk produced are self-consumed or sold locally. Sheep / Goat reared are sold to the local market and through the local traders. About 3-4 houses do cattle rearing
5	**Migration Trend in the Village** • It was stated that the educated youth population of the village have migrated to nearby towns in search of skilled and decent jobs.
6	**Educational Profile** • Within the Siramam village, a school up to class 5th Std. is there. The higher education facilities like higher secondary school is available at Maravamangalam Village and technical studies such as ITI, Diploma, colleges etc., are located from the nearby towns Kalayarkoil, Sivaganga and Madurai. The people in the village encourage the girl children to take higher studies up to Under graduation.
7	**Health Profile** • Within Siramam village there are no allopathic hospital, the nearest hospital is located at Maravamangalam which is located at a distance of 3km. • The village is covered by 108 Ambulance service under National health Mission. • In case of ailment people mostly prefer to visit government PHC at Maravamangalam and Satharasankottai.
8	**Women Profile** • All girl children of Siramam village were enrolled in school. The literacy rate among the women is less compared to national and state averages. • Women of the village are primarily engaged as agricultural labours during major agricultural activities such as cropping and harvesting seasons and engaged in NREGA works during agriculture lean season.
9	**Youth Profile** The youth of Siramam village were primarily engaged as agricultural labourers, move to nearby towns in search of unskilled labour works and educated youths have migrated to the nearby towns, cities in search of job opportunities.
10	**Social Perception of Project:** None of the members consulted were aware about the project. However they welcomed the project as there will be new employment opportunities will be generated in the villages.
11	**Benefits/ Expectations from the Project** • Increased employment opportunities, the region is mostly dependent on agriculture and allied activities and job opportunities are mostly seasonal. The project should hire local workforce to create regular income opportunities to the local. • Infrastructure and facilities improvement under CSR fund i.e., Skill Development Training, Drinking Water Facility, etc.
13	**Concerns regarding the Project**

Basic details	
	No reported grievance.

5.6.3 Consultation with Women Agriculture Labours, Cattle Grazers of Pothakudi Village

Summary of consultations undertaken with the Women groups, Grazers on 23rd June 2022 has been presented in the table below .

Basic details	
Location: Pothukudi Village, Sedambal Panchayat, Kalayarkoil Tehsil	District: Sivaganga
Project Title: ESIA of 50 MW solar power project of FPEPL	Date: 23rd June 2022
Stakeholder Group Title: Women Agriculture Labours, Grazers of Pothakudi Village	
Objective of the Interview/Consultation	
To understand the socio-economic baseline of Pothakudi village and an assessment of the perception of the upcoming project amongst the community members.	
Key discussion points	
1	**What is the demographic of the village?** Pothukudi village has approximately 300 population residing from 80 houses. Most of the houses are observed to be pakka and semi-pakka.
2	**Communities present in the village and their primary occupational activity.** • Among the total population about 20% of the population belong to Scheduled Caste community. There are no presence of Scheduled Tribe population.
3	**Occupational Pattern and Livelihood Activities.** • Primary occupational activity comprises of cultivators and agricultural labourers. The agricultural activity was largely dependent on rainfall in the area. Women are also engaged as agricultural labourers, cattle rearing and in NREGA works. • About 5-6 families engaged in cattle rearing and there are no designated grazing area within or adjacent to the proposed project site.
4	**Agricultural Crops Grown in the area** • The primary agricultural crops grown in the village is Wheat and few patches of sugarcane. Most of the crops harvested are sold to the local market or dealers in Kalayarkoil. Cultivation is carried out mostly during monsoon season. There is no permanent source of irrigation and most of the cultivations are rainfed. **Livestock Population** • It was stated that all households in the village possess cow and sheep. Majority of the milk produced are self-consumed or sold locally. Sheep / Goat reared are sold to the local market and through the local traders. About 5-6 houses do cattle rearing with each family holing about 50-70 goats/sheeps. • The grazers reported that there are no designated Grazing land in the villages.
5	**Does the Proposed project site is a dedicated Grazing land?** No, dedicated grazing fields are located within the village.
6	**Perception about the project and will there be any hindrance to grazing?** • They welcome the project as it may create new employment opportunities as the area is dry and not feasible for doing extensive cultivation. The project development may create sustainable income source among the locals. • The proposed project will not be a hindrance to the people involved in grazing as the proposed project site is not a dedicated grazing land or not obstructing the traditional path to reach the grazing fields.
7	**Educational Profile** • Within the Pothakudi village, a school up to class 5th Std. is there. The higher education facilities like higher secondary school is available at Maravamangalam Village and technical studies such as ITI, Diploma, colleges etc., are located from

Basic details	
	the nearby towns Kalayarkoil, Sivaganga and Madurai. The people in the village encourage the girl children to take higher studies up to Under graduation.
8	**Health Profile** • Within Pothakudi village there are no allopathic hospital, the nearest hospital is located at Maravamangalam which is located at a distance of 7km. • The village is covered by 108 Ambulance service under National health Mission. • In case of ailment people mostly prefer to visit government PHC at Maravamangalam and Satharasankottai.
9	**Social Perception of Project:** None of the members consulted were aware about the project. However, they welcomed the project as there will be new employment opportunities will be generated in the villages.
10	**Benefits/ Expectations from the Project** • Increased employment opportunities, the region is mostly dependent on agriculture and allied activities and job opportunities are mostly seasonal. The project should hire local workforce to create regular income opportunities to the local. • Infrastructure and facilities improvement under CSR fund i.e., Skill Development Training, Water ATM, etc.
11	**Concerns regarding the Project** No reported grievance.

5.6.4 Consultations with Land Aggregator

Summary of consultations undertaken with the land Aggregator in regard understanding the land procurement process in the table below

Basic details	
Location: Kalayarkoil, Kalayarkoil Tehsil	District: Sivaganga
Project Title: ESIA of 50 MW solar power project of FPEPL	Date: 24th June 2020
Stakeholder Group Title: Land Aggregator involved in Land Procurement	
Objective of the Interview/Consultation	
To understand the land procurement process, determination of compensation value and perception about the landowners in regard to selling land for the project, etc.	
Key discussion points	
1	**Extent and Type of Land** • The total land required for the proposed solar power project is about 225.98 Acres • 100% of the land identified are private barren land and no government land is being involved in the project. • The RoW for the proposed TL line is in planning stage and preference will be given to keep the TL through private land. Appropriate compensation will be paid as per the applicable guidelines.
2	**Mode of Land Sourcing** • The required land is sourced through Land Aggregator appointed by FPEPL i.e. Aditya Energy, Land is being procured based on the willing buyer and willing seller basis.
3	**Determination of Compensation Value** • The compensation value for the land is being determined through consultation with the landowners and the compensation value is fixed which is two times the government circle rate and higher than the prevailing market value of the region.
4	**Involvement of SC/ST Land** • No land belonging to SC/ST population is procured for the proposed project development.
5	**Current Status of Land Procurement**

	• As on the date of site visit (22nd to 24th June 2022), of total 225.98 acres sale deeds were executed for about 82 acres and Power of attorney from the landowners were obtained for 109 acres.
6	**Grievance related to Land Procurement** • As on date there are no reported grievance among the landowners.

5.6.5 Consultations with Medical Officer, Maravamangalam Block PHC

Summary of consultations undertaken with the land Aggregator in regard understanding the land procurement process in the table below

Basic details		
Location: Maravamangalam Village		District: Sivaganga
Project Title: ESIA of 50 MW solar power project of FPEPL		Date: 23rd June 2022
Stakeholder Group Title: Medical Officer, Maravamangalam Village, Kalayarkoil Tehsil		
Objective of the Interview/Consultation		
To understand the existing health facilities in the project vicinity, health status and common illness if any among the local community and the perception about proposed solar power project.		
Key discussion Points		
1	**Nearest Health Facility** It was stated that there is no Primary Health Centre functional within the project villages, the nearest Government hospital is Block PHC Maravamangalam.	
2	**People – availing medical facilities** People are availing medical aids mostly from the Block PHC Maravamangalam, including maternity care. For major ailments the patients are referred to Government General Hospital located at Kalayarkoil and further private multi-speciality hospitals as Sivaganga and Madurai.	
3	**Existing Medical Facility** • The PHC is having maternity care centre and is of 30 bed capacity. The study area is covered by 108 Ambulance services and under National Health Mission (NHM). Delivery, Stabilization Theatre, Ambulance, RCH Activity, Immunization, etc are being provided at this PHC. • Antivenom stocks are being maintained and administered at Kalayarkoil GH • Covid-19 screening is carried out in Maravamangalam PHC and referred to the Kalayarkoil GH for quarantine facility and further referral treatment.	
4	**Is there a common illness endemic to the region?** As reported, there are no existing common illness or disease endemic to the region.	

6. Analysis of Alternatives

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

- No Project Scenario;
- Alternate Location for the Proposed Project;
- Alternate Transmission Line Route
- Alternate Methods of Power Generation;
- Alternate Technology for Proposed Project

6.1 No Project Scenario

India being a tropical country is blessed with good sunshine over most parts, and the number of clear sunny days in a year are also quite high. The country receives solar energy equivalent to about 5,000 trillion kWh per year, with most parts receiving over 4-7 kWh per sq. m per day. India's equivalent solar energy potential is about 6,000 million GWh of energy per year.

According to a survey conducted by the World Energy Council, as the population increases and as the growing rate of electrification places huge requirements on energy supplies, the total primary energy demand of India is expected to increase by almost 150% by 2035. The anticipated power supply position of Tamil Nadu in terms of energy requirement and demand for the year 2022-2023 is given in table below.

Table 6-1: Anticipated Power Supply Position of Tamil Nadu in 2022-2023

State	Requirement (Million Units)	Availability (Million Units)	Surplus (+)	
			Million Units	%
Tamil Nadu	119,789	122,319	2,530	2.1

Source: Load Generation Balance Report, 2022-2023, Central Electricity Authority, Ministry of Power[32]

In this report, actual power supply position in terms of energy for various states/Uts during the year 2021-2022 for the state of Tamil Nadu showed that the energy supplied was 638 MU i.e. 0.6% less than what was required. Tamil Nadu is the State with highest installed capacity of Renewable Energy (RE) in the Country. The Maximum solar power harnessed was 3,633 MW on 05.03.2022 and the maximum energy generated was 27.2 MU on 01.03.2022. The total Solar power generated during 2021-22 is 7,137.30 MU which is 16.72% higher than 2020-21.

Focusing on renewable energy sources, Tamil Nadu is at the forefront of India's renewable energy (RE) transformation. The State government has initiated steps to add 20,000 MW of Solar power generating Stations in the next 10 years. The Government of Tamil Nadu has signed a memorandum of understanding on 06.09.2021 for Rs.1,32,500 crore with Indian Renewable Energy Development Agency (IREDA), for advisory services in the renewable energy sector. With environmental pollution concerns being raised against thermal plants globally, the Government of Tamil Nadu is keen in investing more on renewable energy sources like Solar, Wind and Hydel in the next five years. [33]

The proposed project is an opportunity to utilize the solar potential of the area for power generation. A "No Project Scenario" assumes that the project will not be carried out. A "No Project Scenario" will not solve the issue of progressive deficit at National level. An alternative without the project is undesirable, as it would worsen the power supply-demand scenario, which would be a constraint on economic growth. Additionally, continued use of traditional fossil fuel sources for power generation will have adverse effect on the environment.

[32] L.G.B.R. Report - Central Electricity Authority (cea.nic.in)
[33] energy_e_pn_2022_23_0.pdf (tn.gov.in)

6.2 Location Selection – Project Site

Solar power projects are non-polluting energy generation projects and are dependent on the availability of sufficient solar irradiation. The state of Tamil Nadu receives good amount of solar irradiation. Due to its geographical and environmental advantages, Tamil Nadu has huge potential for solar power generation. Among the renewable sources of energy, solar energy has a huge potential for power generation in Tamil Nadu. There are 250-300 days of clear sun with an available average radiation of 4 to 6 kWh/sq. metre over a day. There is a capacity to generate 1.5 million units/MW/year through solar photovoltaic systems & up to 2.5 million units/MW/ year through solar thermal systems.[34]

The following additional criteria have been considered for site selection:

- The proposed site is located away from major settlements;
- The site does not fall under any reserved or protected forests;
- The land procured for the site mainly comprises of barren land in nature and practically unusable for any other purpose; and
- No environmentally sensitive features such as water bodies, forests, archaeological sites are located in the immediate site surroundings.

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

6.3 Location Selection – Transmission Line Route

As per information provided by FPEPL, a 110 kV line will be stringed between Project land parcel and 110/22 K.V. Tamil Nadu transmission corporation at Maravamangalam, Sivaganga district which is 5.54 kms. Proposed route was provided and is mentioned in section 2.4.3 of the report. There were two other alternative routes suggested in the route alignment survey report and that are reported to be passing from the reserved forest area. The RoW of the transmission line is yet to be finalized and is mostly passing through agricultural land parcels as observed during site visit. If any changes would be made in the future for the TL route, then the final route for the transmission line would be selected based on the following factors.

- To avoid any habitations along the route;
- No house or community structures are located under the transmission line;
- Areas requiring extensive clearing of vegetation have been avoided; and
- Selection of the transmission route avoids any environmental sensitive site, if identified.

Hence, with multiple benefits of clean energy production, employment generation and attempt to elevating the standards of rural economies, the project would prove advantageous to all realms of the society and nation. The transmission line details were not available, however, as per the discussions with the Site representative, the project with all the chosen options such as site selection, mode of power generation, selections of technology, etc., is appropriate alternative causing minimal disturbance to the surrounding regions.

6.4 Alternate Method of Power Generation

As of October 2021, India's renewable energy capacity stood at 1.49 GW representing ~38.27% of the overall installed power capacity and providing a great opportunity for the expansion of green data centres. In October 2021, India's renewable energy capacity increased by 1,522.35 MW (megawatt).

As of September 2021, India had 101.53 GW of renewable energy capacity and represents ~38% of the overall installed power capacity. The country is targeting about 450 Gigawatt (GW) of installed renewable energy capacity by 2030 – about 280 GW (over 60%) is expected from solar. By December 2019, 15,100 megawatts (MW) of wind power projects were issued, of which, projects of 12,162.50

[34] Solar Energy | TEDA

MW capacity have already been awarded. Power generation from renewable energy sources in India reached 127.01 billion units (BU) in FY20 and installed renewable power generation capacity has gained pace over the past few years, posting a CAGR of 17.33% between FY 2016-2020. Solar power installed capacity has increased by more than 18 times from 2.63 GW in March 2014 to 49.3 GW in at the end of 2021. In FY22, till December 2021, India has added 7.4GW of solar power capacity, up 335% from 1.73 GW in the previous year. Off-grid solar power is growing at a fast pace in India, with sales of 329,000 off-grid solar products in the first half of 2021.

With a potential capacity of 363 GW and with policies focused on the renewable energy sector, Northern India is expected to become the hub for renewable energy in India.[35]

Coal fired power plants have the highest Greenhouse Gas (GHG) emission intensities on a lifecycle basis. Although natural gas, and to some degree oil, have noticeably lower GHG emissions. Biomass, nuclear, hydroelectric, wind, and solar photovoltaic all have lifecycle GHG emission intensities that are significantly lower than fossil fuel-based generation. UNEP's report estimates that the lifecycle GHG emission intensity of solar power generation is consistent with renewable energy sources including biomass, hydroelectric and nuclear.

As per the estimation of International Atomic Energy Agency (IAEA) the grams of carbon equivalent (including CO_2, CH_4, N_2O etc.) per kilowatt-hour of electricity (g Ceq/ kWh) for Solar energy project are low and scores better when compared with other forms of conventional and non-conventional sources of energy.

Various power generation options can be evaluated on the levelled cost of power generation which includes the capital and O&M costs and reliability of power generation in terms of plant load factor. The comparative analysis of various power generation options based on these factors has been presented below.

Table 6-2: Comparative analysis of Various Power Generation Options

S. No.	Power Generation Method	Cost (Rs/kWh) *	Plant Load Factor**	Average Life Cycle of GHG Emission (tonnes CO_2e/ GWh) ***
1.	Coal	2.5	65-85%	888
2.	Natural Gas	3.9	70-85%	500
3.	Hydro	3.8	30-50%	26
4.	Nuclear Power	2.5-5.7	65-85%	28
5.	Wind Energy	4.2	25-40%	26
6.	Solar	15.3-17.1	10-15%	85

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

Although power generation options using conventional sources offer advantages such as lower levelled costs of power generation and higher plant load factors, the operation and maintenance of solar power projects does not involve air emissions or effluent discharges. Other environmental pollution (stack emissions, ash management etc.) issues are also insignificant.

Considering all the above-mentioned favourable scenarios existing nationally and locally for solar power generation, there is no requirement of an alternative method. Low GHG emissions during the entire project life cycle; availability of appropriate lands, solar power generation is the most appropriate alternative in the project area.

6.5 Alternate Project Technology

There are different types of solar panels available for accumulation of solar energy, the proposed project intends to utilize Crystalline Silicon Photovoltaic Technology based on general comparisons of various parameters such as temperature & efficiency, cost effectiveness, durability, and bankability of modules. The production of polycrystalline cells is more cost-efficient which are manufactured by

[35] Renewable Energy Industry in India: Overview, Market Size & Growth | IBEF

cooling a graphite mould filled with molten silicon. These cells have module efficiency of around 17.01%.

The energy accumulated from the solar panels is converted from DC to suitable AC power for feeding to the grid. This process is environmentally advanced than creating battery bank for storage of energy, which minimizes the hazards related to handling and disposal of batteries. A comparison of the characteristics of the most popular cell technologies have been presented in below.

Table 6-3: Characteristics of Some PV Technology Classes

Parameter	Crystalline	Thin Film	Thin Film	CPV
Types of Materials	Polycrystalline	Amorphous Silicon, CdS, CdTe etc.	Micro Amorphous	Triple Junction GaAs Cell & lens, tracker
Handling	Better protection against breakage	Not Guaranteed	Guaranteed but not proven	Installation would be at site. Not Guaranteed
Power Efficiency	13-16%	6-8%	9-11 %	20-25%
Technology	Well Developed	Stable for Proven Performance	Under development	Under development
Module Weight	Light weight modules	Heavier modules	Heavy modules	Heaviest System
Area utilization	Higher power generated per unit area due to high efficiency	Less power per unit area	Less power per unit area	Highest power per unit area
Temperature Effects	Temperature variations affect output	Least impact of Temperature variations	Lesser impact of Temperature variations	High variation
Irradiance	Used particularly for Normal radiations	Better performance with Diffuse radiations	Better performance with Direct and Diffuse radiations	Works only for Normal radiations
Module quantity	Lesser no. required due to high efficiency	More modules required	Moderate number of modules required	Lowest nos. of modules required
Output per MW installed	High	Highest Output in Indian Conditions	Varies as per sunlight condition and various locations	Very High (due to tracking)
Transportation Cost	Lower Transportation cost	Higher cost	Lesser cost compared to amorphous	High cost
Mounting Structure	Fewer Mounting structure required per KW power	More Mounting structures required	More Mounting structures required	Sophisticated mounting required
Land Requirement	Lesser space required per MW	Largest space requirement	Larger space required per MW	Lowest space required
Inverter	High inverter flexibility	Limited inverter flexibility	Limited inverter flexibility	Limited inverter flexibility
Cost	High cost per Watt	Lower cost per Watt	Higher Cost per watt	Highest cost per Watt
Stabilization	Stable power output at initial stages	Stability achieved after 4-6 months	Stability achieved after 4-6 months	Unknown
Power Degradation	Less Degradation	Lower Degradation	Lower Degradation	High Degradation
Plant Maintenance	Less maintenance required after installation so lower cost	Highest maintenance required, so highest maintenance cost	Less maintenance required after installation so lower cost	High maintenance required, so high maintenance cost
Cooling Requirement	Not required	Not required	Not required	Requires active or passive cooling which could increase cost
Cabling	Well known, and lower cabling losses	Well Understood but yet difficult due to higher number of arrays	Well Understood but yet difficult due to higher number of arrays	Complex and under development. Cabling losses expected to be high

The calculation of the performance ratio for a given solar power installation needs to take into account several key losses. These typically fall into three broad categories:

- Irradiation Losses
- PV Module Losses
- System Losses
- As per the PV-Syst report, all these losses have been analysed and taken into consideration before selection of the technology.

7. Impact Assessment

This chapter describes the environmental and social impacts identified by accessing the primary and secondary information gathered. Impacts have been identified based on review of available project information, discussions with representatives of the project and the local community, as well as sector-specific professionals and subject experts. Impacts anticipated during the operation phase have also been included and classified.

Additionally, this chapter evaluates the significance of each identified impact based on the collective severity of its spread, duration, intensity, and nature. Mitigation measures have been suggested for each identified impact evaluated as significant.

7.1 Impact Assessment Criteria

Identified impacts have been appraised along the criteria of spread, duration, intensity and nature. As presented in table below, each appraisal criterion is further classified based on the level or type of its spread, duration, intensity, or nature, while stating the defining limit of each level or type.

Table 7-1: Impact Assessment Criteria

Criteria	Sub-Classification	Defining Limit	Remarks
Spread: Refers to area of direct influence from the impact of a particular project activity.	Local spread	impact is restricted within the footprints of the Project boundary	In case of biodiversity, the farthest directly impacted habitat or ecosystem service would be considered
	Medium Spread	impact is spread up to 2 km around the project area	In case of biodiversity, the farthest directly impacted habitat or ecosystem service would be considered
	High spread	impact is spread beyond 2 km from footprint boundary of the Project	In case of biodiversity, the farthest directly impacted habitat or ecosystem service would be considered
Duration: Based on duration of impact and time taken by an environmental aspect to recover to its original state	Short Duration	when impact is likely to be restricted for a duration less than 2 years	In case of biodiversity, the anticipated recovery time of impacted habitats or ecosystem services would be considered
	Medium Duration	when impact extends up to five years	In case of biodiversity, the anticipated recovery time of the impacted habitats or ecosystem services would be considered
	Long Duration	when impact extends beyond five years	In case of biodiversity, the anticipated recovery time of the impacted habitats or ecosystem services would be considered

Criteria	Sub-Classification	Defining Limit	Remarks
Intensity: Defines the magnitude of impact	Low intensity	when changes in the prevailing (baseline) environmental conditions does not exceed 20%	In case of biodiversity, percentage of loss or degradation of habitats and/or ecosystem services would be considered
	Moderate intensity	when changes in the prevailing (baseline) environmental conditions does not exceed 30%	In case of biodiversity, percentage of loss or degradation of habitats and/or ecosystem services would be considered
	High intensity	when changes in the prevailing (baseline) environmental conditions exceeds 30%	In case of biodiversity, percentage of loss or degradation of habitats and/or ecosystem services would be considered
Nature: Refers to whether the effect is considered beneficial or adverse	Beneficial	-	Useful to Environment and Community
	Adverse	-	Harmful to Environment and Community

Table below presents the Impact Significance Matrix applied in order to assess the overall significance of the impacts appraised as per the Impact Assessment Criteria outlined in table below.

Table 7-2: Impact Significance Matrix

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

Spread	Duration	Intensity	Overall Significance	
			Adverse	Beneficial
Medium	Short	High		
Medium	Long	High		
High	Short	High		
High	Medium	High		
High	Long	Medium		
High	Low	Low		
High	Low	High		

7.2 Impact Identification

Table below presents the Activity-Impact Interaction matrix for pre-construction, construction, operation and decommissioning phases of the project, based on environmental and occupational health and safety variables. Each of the impacts identified has been further discussed and corresponding mitigation measures have been proposed.

Table 7-3: Activity- Impact Interaction Matrix – Pre-Construction, Construction, Operation & Decommissioning Phase

Project Activities	Receptors/Resources										
	Aesthetics and Visual impacts	Ambient Air and Noise Quality	Soil Quality	Surface and Ground water Quality	Water resources	Land Use	Traffic & Transport	Ecological Impact	Social-Economic Impact	Community Health and Safety	Occupational Health and Safety Hazards
Pre-Construction and Construction Phase											
Land Procurement											
Site Clearance, Site Levelling and Grading											
Sourcing and Transportation of Construction Materials and equipment											
Storage and Handling of Raw Materials and Debris											
Establishment and Use of Labour Camp											
Civil Works (PV Module foundations, access road construction etc.)											
Operation of DG sets											
Erection of Solar Modules and Laying of Transmission Lines											
Transformer yard construction											
Handling and Disposal of Wastes											
Operation Phase											
Solar Panel Operation											

Project Activities	Receptors/Resources										
	Aesthetics and Visual impacts	Ambient Air and Noise Quality	Soil Quality	Surface and Ground water Quality	Water resources	Land Use	Traffic & Transport	Ecological Impact	Social-Economic Impact	Community Health and Safety	Occupational Health and Safety Hazards
Maintenance of ancillary facilities such as store, yard, site office											
Site Maintenance and Security											
Handling and Disposal of Waste											
Material Handling and Storage											
Water Requirements for employees											
Repair and Maintenance of Solar Panels											
Inspection and maintenance of transmission lines											
Decommissioning Phase											
Removal of Solar Panels											
Removal of Foundations											
Site Restoration											
Waste Management											
Material Handling and Storage											
Water Requirement for Employees											
Loss of Employment											

7.3 Environmental Impacts and Mitigation Measures

7.3.1 Impacts during the Pre-construction and Construction Phase

During the construction phase, the following activities may have impacts on environment:

- Site Preparation;
- Excavation and levelling;
- Hauling of earth materials and wastes;
- Cutting and filling;
- Erection of concrete and steel structures;
- Painting and finishing;
- Clean up operations; and
- Landscaping

7.3.1.1 Ambient Air Quality

Anticipated Impacts

The impact on ambient air quality is anticipated due to the various Project activities. Project components such as site preparation, transmission cable laying, switchgear, internal road network, transportation of raw materials and porta cabins, along with land clearing, levelling, excavation, grading activities, vehicle movement and Diesel Generator (DG) sets operation. The main impacts associated with construction activities will be:

- **Dust Generation:** resulting from earthworks such as levelling, grading, excavation works, piling and movement of vehicles across dirt/unpaved roads, especially during windy conditions.
- **Exhaust Emissions:** Exhaust emissions of SO_2, NO_X, CO, CO_2 and PM_{10} will be attributed predominantly to the construction of the plant, road activities such as movement of trucks and vehicles during construction works and point source emissions from the batching plant to be installed during construction phase. These emissions will be restricted to the project area and are anticipated to be generated in medium concentration. However, it will be dispersed rapidly within the area leading to an impact of low significance. This implies the effects to be of localized nature and temporary which indicates that any deterioration in air quality at project location is unlikely to be significant and is expected to be transient.

Mitigation Measures

- The FPEPL and contractors shall ensure the reduction and control of air emissions from construction activities by minimizing dust from material handling sources.
- Loading and unloading of raw materials should be carried out in the most optimum way to avoid fugitive emissions.
- Sprinkling of water to be carried out by the respective contractors to suppress dust from construction activities.
- Best practices such as halting of activity during sustained strong winds should be opted for. It shall be ensured that all stockpiles are covered, and storage areas provided with enclosures to minimize dust from open area source.
- Stock piling and storage of construction material will be oriented after considering the predominant wind direction.
- Vehicles engaged for the project will be required to obtain “Pollution under Control” (PUC) certificates.
- Sufficient stack height needs to be provided to D.G. sets as per the Central Pollution Control Board (CPCB) norms.
- Speed of vehicles on the village road and on the internal roads shall be limited to 10-15 km/hr in order to reduce fugitive dust emissions.
- Cease or phase down work if excess fugitive dust is observed, or there is any community grievance related to dust. Investigate the source of dust and ensure proper dust suppression.

Significance of Impact

The impact on ambient air quality will have moderate intensity with medium spread for a short duration which will result in an overall moderate impact without mitigation. With mitigation, after control of intensity the significance of the impact will reduce to minor owing to the short duration of construction.

Table 7-4: Impact Significance – Ambient Air Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Ambient Air Quality	Without Mitigation	Medium	Short	High	Moderate

Aspect	Scenario	Spread	Duration	Intensity	Overall
	With Mitigation	Local	Short	Medium	Minor

7.3.1.2 Soil Quality

Anticipated Impacts

The project location has a solid textured soil. Loose topsoil will be generated due to excavation on project site during site levelling for erection of module structures and internal roads preparation. The impact anticipated here is loss of topsoil, which can be due to inappropriate storage. However, these activities and associated impacts are limited to be within the project boundary and during construction phase only. The intensity of the impact can be considered as medium as the site was observed to be relatively flat and levelling would be required only at a few places. Soil contamination may result due to accidental spillage and inappropriate storage of PV panel components, diesel or transformer oil during construction phase.

Mitigation Measures

- Provide appropriate storage of topsoil in an isolated and covered area to prevent its loss in high solar and runoff.
- Allow only covered transportation of topsoil within the project site.
- Use topsoil at the time of plantation and it can be given to nearby agricultural field after taking consent with the landowners/farmers.
- Low height native plantation /grass cultivation activities will be undertaken to appease the chances of soil erosion by client and its contractors.
- Store hazardous material like diesel and used oil in isolated room and on impervious surface to prevent seepage into project site soil.
- Storage and disposal of hazardous waste in line with Hazardous Waste (Management, Handling & Transboundary Movement) Rules, 2016. Hazardous waste will be disposed to State Pollution Control Board authorised vendor only.
- Filling and transfer of oil to and from the container shall be on impervious surface.
- Provision of mobile toilets and septic tanks for usage of project team / workers
- Broken solar panels should be stored on paved surface and be handed back to manufacturers/ authorised recycler.
- Provision of mobile toilets and septic tanks for usage of project team / workers
- Disposal of recyclable solid waste through local vendors with appropriate permission from concern authorities. Recyclable waste to be disposed to recycler.
- Storage and disposal of hazardous waste in line with Hazardous Waste (Management, Handling & Transboundary Movement) Rules, 2016. Hazardous waste will be disposed to State Pollution Control Board authorised vendor only.

Significance of Impact

Considering the distribution of impact within the project boundary and short duration of construction phase with low intensity makes impact of low significance and can be controlled with the recommended mitigation measures.

Table 7-5: Impact Significance – Soil Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Soil Quality	Without Mitigation	Medium	Short	High	Moderate
	With Mitigation	Local	Short	Moderate	Minor

7.3.1.3 Impact on Surface and Ground Water Quality

Anticipated Impacts

Surface Water:

The surface topography of the project site can be characterized as mix (flat and mild undulations). Alteration of soil structure during construction could lead to erosion and subsequent siltation in the surface water bodies at the nearby areas. Changes in surface hydrology can in turn adversely affect conditions that maintain healthy biological resources especially the avifauna. Accidental spillage of hazardous materials, improper disposal of solid, liquid and hazardous wastes and contaminated surface runoffs from the Site.

During the construction works, there is a possibility of contaminated runoff from the site as the activities involve the installation of solar modules, underground cables, soil compaction, increased run off and sedimentation of surface waters. Any spillage of chemicals or disposal of waste in or near surface seasonal streams can cause water pollution issues in nearby areas.

Ground Water:

As per ground water resource estimation report published by national water mission on Sivaganga, project area is categorised as "Safe"[36]. During the construction phase, labour camp and portable cabins will be set up at the project site and hence generation of domestic wastewater from the labour camp and portable cabins is anticipated. Improper disposal of sewage and wastewater from worksite and construction debris can contaminate the groundwater resources.

Mitigation Measures

- Construction of dedicated storm water drains for reduction any contamination to runoff due to project activities. Storm water drains shall be designed considering natural topography to avoid any obstruction to natural flow and final outlet shall be connected to propose storm water drains by Solar Power Park Developer;
- Proper drainage to be provided for wastewater generated from the Porta Cabins and labour camps and shall be treated on Site septic tanks and soak pits as per the specifications in IS 2470:1995 (Part I and Part II);
- Periodic monitoring shall be carried out to ensure that the waste water is not finding its way into surface and groundwater;
- All solid wastes such as construction debris, used or waste oil, paint cans, etc. will be stored on impervious surface in secure location to avoid soil and groundwater contamination;
- Paved impervious surface and secondary containment to be used for fuel storage tanks;
- Loading and unloading protocols should be prepared and followed for diesel oil and used oil;
- Drip paned provided to vehicles with leaks to prevent water contamination;
- Leak proof holding tanks for sanitary waste water to protect the shallow ground water level.

Considering the distribution of impact within project boundary and short duration which will result in an overall moderate impact without mitigation. However, with proper implementation of suggested mitigation the overall impact will be negligible.

Table 7-6 Impact Significance – Impact on Surface and Ground Water Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact on Surface and Ground Water Quality	Without Mitigation	Local	Short	High	Moderate
	With Mitigation	Local	Short	Moderate	Minor

[36] http://cgwb.gov.in/District_Profile/TamilNadu/Sivaganga.pdf

7.3.1.4 Impact on Water Availability

Anticipated Impacts

In the construction phase, water will be required for civil work during the preparation of concrete, construction of the foundation and building structure of all facilities, as well as for worker needs water for their daily use. The Project's water use has the potential to result in decreased water available for other users, particularly in the Project area where known water resource challenges. As per the information provided by the Site personnel and as mentioned in the detailed project report, Underground water through Bore holes shall be used during construction and O&M stage. Domestic water requirement will be only for drinking, which will be met by packaged drinking water.

Mitigation Measures

Water for construction activities, flushing and washing purpose will be met through water supplied from tankers. It is to be ensured that pre-treatment is provided to ground water, in case ground water is utilized for drinking. It is also suggested that the quality of water from the bore wells is monitored regularly to check for contamination. The other mitigation measures to be implemented are:

- The water for construction should only be sourced from authorized sources if in case it gets procured through tankers for any activity.
- The drainage will be designed in such way that natural storm water flow is maintained.
- It shall also be ensured that levelling of project site will not cause accumulation of surface runoff in adjacent surrounding areas.
- Conserve water at all project locations and ancillary facilities and if possible recycle and reuse water utilising every opportunity.
- Water recharge facilities and rainwater harvesting need to be included in the design;
- Sourcing of water tanker from area where ground water is reported to be under "Safe" category should be considered by the EPC contractor.
- No chemicals / oils to be stored near any water body.
- All chemicals / oils to be stored on impervious surface with provisions of spill containment kits.
- No waste will be disposed in any water body.
- No water will be sourced directly for project use or by workers.
- Workers will be trained for the same.
- The rainwater harvesting plan to support ground water percolation.
- Machinery and vehicles shall be thoroughly checked for the presence of leaks if any;
- To prevent contamination of water, for sewage management, toilets with septic tanks to be provided.
- Toilets and septic tanks should be located more than 500 m away from surface or ground water source.
- Periodic monitoring shall be carried out to ensure that the wastewater is not finding its way into natural water channels.

Significance of Impact

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

Table 7-7: Impact Significance – Impact on Water Availability

Aspect	Scenario	Spread	Duration	Intensity	Overall
	Without Mitigation	Medium	Short	High	Moderate

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact on Water Availability	With Mitigation	Local	Short	Moderate	Minor

7.3.1.5 Ambient Noise Quality

Anticipated Impacts

Construction will cause increased noise levels due to activities such as grading, excavating and drilling for foundations, concrete batching, construction of ancillary structures, and operation of diesel generators, material movement and site clean-up, and construction equipment like dozer, scrapers, concrete mixers, generators, pump, rock drills etc. There is potential for disturbance to habitations in proximity of construction site. Movement of traffic during night hours can also disturb the local community. Approximately 90 – 92 dB (A) of noise is expected to be generated from construction activities which will attenuate to less than 45 dB(A) i.e. night time prescribed noise level at about 80 m. The nearest habitations from the proposed Project site include Adappadakki, Pulavanvayal which are at a distance of less than 1 kms.

Mitigation Measures

- Use DG set with acoustic enclosure
- Restrict major noise generating activities during night time 10:00 pm to 6:00 am
- Provide personal protective equipment (e.g. ear muffs) to all workers wherever noise is generated due to machinery operation.
- Regular maintenance of project vehicles.
- Special acoustic enclosures should be provided for individual noise generating equipment's, wherever possible.
- Low noise equipment shall be used as far as practicable
- The number of equipment operating simultaneously shall be reduced as far as practicable
- Workers should be prevented from continuous exposure to noise.
- Provision of personal protective equipment (PPE) to workers, wherever noise is generated due to machinery operation.
- During material movement, honking should be done cautiously to avoid disturbance to locals.
- In case of complaints of higher noise levels and uncomforting received from the inhabitants of nearby settlements possibility of putting noise barriers near to the receptor need to be considered.
- All nearby community will be informed about the GRM and the grievance would be addressed on priority bases.

Significance of Impact

The impact due to noise and vibration will have moderate intensity with a local spread for a short duration which will result in an overall minor impact without mitigation. However, with proper implementation of suggested mitigation the impact will be reduced to minor.

Table 7-8: Impact Significance – Ambient Noise Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Ambient Noise Quality	Without Mitigation	Mitigation	Short	High	Moderate
	With Mitigation	Local	Short	Moderate	Minor

7.3.1.6 Solid and Hazardous Waste Management

Anticipated Impacts

The construction activities such as site clearance, excavation works, and installation of modules will generate different types of solid and hazardous wastes. The construction demobilization which will entail removal of machinery, and other temporary structures will also result in generation of waste. The following types of wastes will be generated due to construction of the project:

- Domestic solid waste and sewage from labour accommodations;
- Used oil, oil lined containers, oil-soaked rags from generator and other construction machinery;
- Packaging waste such as gunny bags, plastics, etc.;
- Empty paint containers, metal scrap, chemical lined containers etc.;
- Broken or damaged solar panel(s); and
- Construction debris.

The construction debris generated due to the construction activities will have the potential for spread to areas outside the project boundary during construction phase. The dust particles from debris generated during construction activities can be carried along with the wind into nearby areas, thereby increasing the particulate matter in the area. However, this will happen only for a temporary period as the construction activities will be for small duration only. Improper disposal of solid waste from the labour camps and lack of proper sanitation facility for labour can lead to unhygienic conditions due to open defecation and spread of diseases in the area. It can also lead to discontent of local community and result in conflicts with the labour engaged at site.

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

Mitigation Measures

- The quantity of domestic waste generated daily from the labour accommodations will be small and limited as most of the workers will be hired locally. Also, one labour camp will be set up wherein migrant workers will be accommodated. The EPC Contractor shall ensure that the labour camp has adequate waste disposal facilities. Arrangements for collection of garbage in dustbins and daily disposal to the nearest dumpsite/local waste disposal agency shall be made.
- Provision of segregated toilets for male and female workers (if any) in the ratio of 1:15 and 1:10 (toilet to workers) respectively shall be made at the project site in order to maintain hygienic and clean surroundings. Washing and bathing areas should be provided with proper drainage system so that wastewater is not accumulated in the project site. Disposal of sewage shall be made through a septic tank – soak pit arrangement.
- Waste/used oil generated from generators and construction machinery and equipment, oil lined containers, oil-soaked rags etc. should be stored on paved surface in a secure location at the project site. Appropriate secondary containment capable of containing 110 percent of the content of the largest storage tank should be provided. The used oil and oil lined containers, which are characterized as hazardous wastes according to the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, should be sold to Tamil Nadu Pollution Control Board (TNPCB) approved vendors at frequent intervals.
- The excavated material generated will be reused for site filling and levelling to the maximum extent possible.
- Ensure contractual obligation that necessitates broken solar panels will be accepted by manufacturer.

- Waste oil from transformer will be collected and stored in paved and enclosed area and subsequently sold to SPCB authorised recyclers.
- All packaging material should also be collected at the storage area and sold to authorized scrap dealers. Storage of oil/chemicals shall be undertaken on paved impervious surface and secondary containment shall be provided for fuel storage tanks.
- Construction debris and excavated material to be stored in a confined area to prevent spread by wind or water. The construction debris to be used for backfilling of excavated areas and for foundation works at site.
- Recyclables viz. paper, plastic, glass, scrap metal waste etc. will be properly segregated and stored in designated waste bins/containers and periodically sold to local recyclers. Any recyclable waste should be encouraged to be recycled at the site. Any waste/damaged part of solar panel(s), broken solar panels will be sent back to panel vendor for disposal.

Significance of Impact

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

Table 7-9: Impact Significance – Waste Storage and Disposal

Aspect	Scenario	Spread	Duration	Intensity	Overall
Waste Storage and Disposal	Without Mitigation	Medium	Short	High	Moderate
	With Mitigation	Local	Short	Moderate	Minor

7.3.1.7 Traffic and Transport

Anticipated Impacts

The construction phase shall involve transportation of construction materials, solar modules and mounting structures. The project site can be accessed through NH 36 which starts at Vikravandi and ends at Manamadurai. This NH is connected with the State Highway numbered 34 which further leads to the project site after taking a turn to the village road. Parallel to SH 34 is SH 29 and the project site can be accessed from here as well. Transmission line from the project area stretches to the substation at Marvamangalam which lies at SH 29. This road network will be utilized for transportation of machines and solar modules. The Project construction activities will lead to additional traffic and increased risk of traffic related accidents and industries to community and to workers.

The traffic density along the State Highway is low and has adequate carrying capacity to accommodate the additional traffic due to the construction activities. However, the village road is narrow (~3-5 m wide) and hence increased vehicular movements in the Project area, through the village roads may have adverse impacts in the community due to increased risk of traffic related accidents, injuries and increased pollution.

Mitigation Measures

A Traffic Management Plan is required for the management of traffic due to movement of vehicles for transport of equipment and material. Additional traffic on the village road connecting to Project site can be managed by following mitigation measures:

- Only trained drivers with valid license shall be recruited by the EPC Contractor for transfer of material;
- Training program for all the drivers, regarding awareness about road safety and adopting best transport and traffic safety procedures shall be provided before initiation of the decommissioning activities;

- Mitigation measures such as emphasizing 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;
- The villagers shall be made aware about the schedule prior to the movement of trucks and transportation in the Project area.
- Drivers while on the village road to project site should be cautious of the vehicle speed and FPEPL to regularly monitor the same with the help of EPC contractors.

Significance of Impact

Table 7-10: Impact Significance – Impact on Traffic and Transport

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact on Traffic and Transport	Without Mitigation	Medium	Short	High	Moderate
	With Mitigation	Local	Short	Moderate	Minor

7.3.1.8 Occupational Health and Safety

Anticipated Impacts

Occupational Health and Safety (OHS) of workers is important during construction and operation phases where local and migrant workers are involved. The activities included in the construction phase that have potential impact to OHS of workers are land clearance for establishment of temporary structures, batching plant, access road, mobilisation of equipment and solar PV installation.

There are likely to be potential impacts on worker's health and safety due to exposure to risk through the project development activities. The following occupational health and safety risks are frequently present, in particular during the construction phase:

- Mobile vehicles and heavy equipment accidents;
- Heat stress when working in humid and high temperatures;
- Manual handling and musculoskeletal disorders;
- Hand are vibration impacts from concrete breakers, grinders, hammer drills, chipping hammers, chainsaws, scrabbles and needle guns;
- Temporary or permanent hearing loss from noise generated machinery used for excavation or piling work;
- Dermatitis that can rise from contact with small substances such as wet cement and asphalt;
- Tripping due to uneven surfaces and obstacles;
- Falling during working at height;
- Fire due to hot works, smoking and failure in electrical installations; and
- Electrical shocks.

Mitigation Measures

The above identified risks are typical on any construction site of this nature. Therefore, it is anticipated that the sub-contractor will have the necessary management measures in place to manage potential OHS issues under their responsibility. Appropriate OHS programme and procedures are also expected to be in place to align with the local regulations, as well as IFC PS-2. The procedure will include at minimum, the following measures:

- Develop and implement a Health and Safety (H&S) plan to follow throughout the construction phase;

- Provide occupation health and safety orientation training to all employees and workers consisting of basic hazard awareness, site-specific hazards, safe working practices, and emergency procedures;
- The contractors will be committed to ensure all Health and Safety measures are in place to prevent accidents and reduce the consequences of non-conformance events;
- The contractors will provide training, awareness and supervision to ensure all of its construction workers comply with the OHS procedures;
- The contractor will provide appropriate resources i.e. PPE to workers on Site; and
- An emergency response procedure and infrastructure will be available on Site to ensure provision of first aid for personnel in case of emergency.

Heat related Stress

- As the construction work will be carried out in months of extreme heat, heat- related illness can have significant impact on health of the workers engaged at the site. Heat-related illness is a spectrum of disorders due to environmental exposure to heat. It includes conditions such as heat cramps, fainting, convulsion, heat fatigue, rashes, and heat exhaustion as well as the more severe condition known as heat stroke. The heat stress can be due to many factors such as air temperature, humidity, radiant heat, wind speed, workload, physical fitness of the worker, hydration status of the workers and clothing (including PPE that may restrict air flow across the skin and hinder evaporation of sweat).
- Additionally, Ultraviolet (UV) radiation burns occurs when the skin is exposed to UV radiation from been out in the sun or from activities such as welding. The symptoms include reddening and inflammation of the skin and blistering and peeling of the skin in severe cases.

Mitigation Measures

The above identified risks are typical on any construction site of this nature. Therefore, it is anticipated that the EPC contractor will have the necessary management measures in place to manage potential issues under their responsibility. The procedure will include at minimum the following measures:

- Increase air velocity for indoor workers by using natural cross-ventilation from windows and doors or mobile or ceiling fans. This increases both evaporation of sweat and convective heat loss, and may significantly improve thermal comfort at air temperatures as high as 40°C;
- Operate effective general and local exhaust ventilation and air conditioning;
- Avoid non-essential sources of hot ventilation (e.g. air conditioner outlets adjacent to working areas);
- Install a shield between employees and a source of radiant heat such as curtains on windows or other insulating barrier, enclose the heat source, or move the heat source away from employees;
- Provide cooled drinking water as close as possible to the work site;
- Arrange shade for outdoor workers where practicable;
- Provide a cool rest area in which workers can take their meal breaks and tea breaks;
- Modify the work schedule or shift times so that outdoor and physiologically demanding work is done in the early morning or late afternoon, when it is generally cooler, and the sun's radiation is less intense than during the middle of the day;
- Allow workers to self-regulate their pace of work. This may involve working continuously at less than full capacity, and/ or working for short periods followed by rest pauses in a cool area;
- Workers should be encouraged to present to work in a well hydrated state, and take frequent small drinks throughout each shift to replace fluid lost through sweating;

- Diuretic Fluids such as tea, coffee, alcohol and some soft drinks should not be used to replenish fluid lost due to heat;
- Use PPE that reduces exposure to ultra violet radiation and heat (such as reflective masks or aprons, large brimmed hat, sunscreen); and
- Workers returning from periods away from hot environments should be given the opportunity to acclimatise before being expected to undertake work in very hot conditions at full capacity.

Significance of Impact

The health and safety impacts will have high intensity with a local spread for a short duration which will result in an overall moderate impact without mitigation. However, with proper implementation of suggested mitigation, the intensity can be reduced to minor.

Table 7-11: Impact Significance – Impact to Occupational Health and Safety of Workers

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact to Occupational Health and Safety of Workers	Without Mitigation	Medium	Short	High	Moderate
	With Mitigation	Local	Short	Moderate	Minor

7.3.2 Impacts during Operation Phase

7.3.2.1 Visual Impacts and Aesthetics

Anticipated Impacts

Visual impacts are assessed with reference to the presence of PV panels, reduced vegetation, erection of ancillary facilities and transmission lines/towers. The visual effects are evaluated with reference to passing motorists and fixed settlement, primarily the villages in close proximity to the site.

The Project site is located on flat to undulated land and is visible from considerable distance along the village roads present within the study area. There will be a significant change to visual quality of the area resulting from the development and change in land use that will alter the landscape.

Presence of a large area of PV panels is not expected to constitute a risk for glare since it is situated far from airport, and residential dwellings.

Also, no visual impacts are anticipated due to the PV system design, which is specifically designed to include dark, light-absorbing materials and covered with an anti-reflective coating (ARC) for glass surfaces, which reduces the reflectance from PV panels to 2.5%-2.6% while at the same time improving their efficiency. However, there will be a change of landscape due to installation of solar panels and related structures.

Mitigation Measures

The solar panels to be installed at a low height and to be kept closer to the ground so that it does not pop out of the general landscape of the area. The panels to be arranged in a systematic manner which will give an aesthetic sense to it.

Significance of Impact

The impact on aesthetics and visual aspects will have low intensity with a local spread for a long duration which will result in an overall minor impact without mitigation. The residual minor impact, even after control of intensity and spread, will remain minor owing to the duration of project.

Table 7-12: Impact Significance – Aesthetic and Visual Impacts

Aspect	Scenario	Spread	Duration	Intensity	Overall
Visual and Aesthetics	Without Mitigation	Local	Long	Low	Minor

Aspect	Scenario	Spread	Duration	Intensity	Overall
	With Mitigation	Local	Long	Low	Minor

7.3.2.2 Impact on Soil and Water Quality

Anticipated Impacts Due to Contamination

Operation of solar photovoltaic panels for power generation will not have any direct impact on soil. However, compaction of soils from increased levelling and grading of areas within the site will result in lower permeability and therefore, decreased infiltration and increased runoff. Water, as will be used for the washing activities may contaminate the soil if chemical is used for washing. Without appropriate measures, runoff from PV panels, compacted areas and hard standing areas in addition to erosion by wind may increase erosion and increase the sediment load in run-off.

In operation phase water is used for cleaning of solar panels, where in the use of chemicals cannot be ruled out. Hence, run-off from the plant site with leaked solar washed wastewater, waste oil, and seepages from hazardous waste stored without secondary containment may affect the ground water quality. Portable cabins will be set up for site officials, equipped with urinals and toilets during the construction phase. Proper septic tanks will be constructed for discharge of wastewater, hence the risk of wastewater runoff into the surface water would be reduced.

Anticipated Impacts Due to Improper Waste Handling

Once the plant is commissioned there will be limited disturbance to soil. With reference to Section 2, solid wastes generated during operation will include domestic solid waste; lubricant, used oil/waste oil and oil contaminated rags and limited quantities of broken solar panels. Domestic waste will be collected be local waste collectors. Since the PV panels have a lifespan of 20-25 years, limited quantities of solar panels will be generated during operation (only faulty broken panels).

Mitigation Measures

- Disturbance to soil from repair and maintenance activity will be limited and will ensure proper restoration of soil wherever excavation is undertaken.
- Options of buyback agreements for defunct panels and for replacement and disposal of transformer oil by the supplier are to be explored, otherwise arrangements for disposal of defunct panels and waste oil to authorized recyclers are to be made.
- Fuel and used oil will be stored in demarcated storage areas with adequate secondary containment and appropriate capacity. Spill control and prevention mechanism will be developed, and all the staff will be trained.
- If the solar panels are washed with chemicals, it should be ensured that the chemicals are non-hazardous and biodegradable;
- Storage of oil/chemicals shall be undertaken on paved impervious surface and secondary containment shall be provided for fuel storage tanks;
- During the washing and maintenance of the solar panels adequate storage area shall be designed to collect the washed water.

Significance of Impact

The impact on land due to improper waste disposal and other operational activities will have high intensity with a local spread for a short duration which will result in an overall moderate impact without mitigation.

Table 7-13: Impact Significance – Impacts on Soil Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
	Without Mitigation	Local	Short	Moderate	Moderate

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impacts on Soil Quality	With Mitigation	Local	Long	Low	Minor

The impact on water resources will be of moderate intensity with high spread and long duration for water quality, which will result in an overall major impact without mitigation. However, impact on surface and ground water quality can be moderated by mitigation measures, as discussed above.

Table 7-14 Impact Significance – Surface Water Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impacts on Surface Water Quality	Without Mitigation	High	Long	Moderate	Moderate
	With Mitigation	High	Long	Low	Minor

7.3.2.3 Impact on Water Availability

Anticipated Impacts

During the operational phase, the water requirements for the plant will be predominantly for washing of solar PV modules periodically to remove bird droppings, dust and other dirt and domestic water consumption. Whereas, for domestic water consumption for the Project will be restricted to manpower engaged at Project site.

As informed, water from borewell and tankers will be used for panel cleaning and domestic purpose. Both dry cleaning and wet cleaning will be used. Water Required for Module cleaning is approximately 3 litres, and it was known that borewell water will be used for the same. As a standard practice, panel cleaning cycle is every 15 days. However, approval for the borewell water extraction needs to be obtained. During consultations it was known that ground water level is around 200-250 fts around the vicinity of the project land. In total 450 kilo litres of water is used per cleaning cycles. Ground water will be used during operation phase, depletion of ground water resources due to extraction during operation phase of the project is anticipated. It was noted that the FPEPL aims to be water neutral in the next 25 years for which water and wastewater management plan is under planning stage and will be finalized shortly.

Extent of dry cleaning and wet cleaning incidentally depends on seasonal weather conditions, topography of the area, soiling Effect etc., therefore, as a standard practice FPEPL's asset management conducts assessment of feasibility of dry-cleaning and on that basis extent (number of cycles) of dry cleaning will be decided. Therefore, this would be confirmed at the fag end of construction period.

Additionally, run-off from the plant site with leaked waste oil, and seepages from hazardous waste stored without secondary containment may affect the ground water quality.

Mitigation Measures

Following mitigation measures are recommended:

- Rooftop rainwater harvesting system will be provided within the plant premises. The water harvested will be stored at the Site and will be used for module cleaning instead of tanker water.
- The site office shall be provided with sewage line and the collected sewage shall be channelized to a septic tank with soak pit arrangement.
- If the solar panels are washed with chemicals, it should be ensured that the chemicals are non-hazardous in nature.

- Fuel and used oil will be stored in demarcated storage areas with adequate secondary containment and appropriate capacity. Spill control and prevention mechanism will be developed, and all the staff will be trained.

Significance of Impact

The impact on water resources will be of moderate intensity with high spread and long duration for water quantity, which will result in an overall major impact without mitigation. However, impact on ground water quantity can be moderated by mitigation measures, as discussed above.

Table 7-15: Impact Significance – Impact on Water Availability

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impacts on Water Availability	Without Mitigation	High	Long	Moderate	Major
	With Mitigation	High	Long	Low	Moderate

7.3.2.4 Occupational Health and Safety of Workers

Anticipated Impacts

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's health and safety during operation phase due to exposure to risks such as:

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

Also, Electromagnetic Fields (EMF) emanate from any wire carrying electricity. Possible effects associated with the electric and magnetic fields from transmission lines (or similar electrical sources) fall into two categories:

- Short-term effects that can be perceived and may represent a nuisance
- Possible long-term health effects.

The issue of whether there are long-term health effects associated with exposure to fields from transmission lines and other sources has been investigated for several decades. There is little evidence that electric fields cause long-term health effects. Estimates of magnetic-field exposures have been associated with certain health effects in studies of residential and occupational populations. Research in this area is continuing to determine whether such associations might reflect a causal relationship

Mitigation Measures

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

Mitigation measures that will be followed include the following:

- Regular electrical safety training to workers with safety procedures and other safety requirements that pertain to their respective job assignments;
- 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.
- Loading and unloading operation of equipment should be done under the supervision of a trained professional.
- All material will be arranged in a systematic manner with proper labelling and without protrusion or extension onto the access corridor.
- 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 and monitored that they are used by the employees
- The transformer yard should be provided with fire extinguishers and sand buckets at all strategic locations to deal with any incident of fire; and
- There should be arrangement for hygienic and scientific sanitation facilities for all the labourers working in the site.
- An accident reporting, and monitoring record shall be maintained.

Significance of Impact

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

Table 7-16: Impact Significance – Occupational Health and Safety of Workers

Aspect	Scenario	Spread	Duration	Intensity	Overall
Occupational Health and Safety of Workers	Without Mitigation	Local	Long	High	Moderate
	With Mitigation	Local	Long	Low	Minor

7.3.3 Impacts during Decommissioning Phase

7.3.3.1 Environment and Occupational Health & Safety

Anticipated Impacts

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 re-vegetation.

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 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:

- Issue of loss of job when the workers will be asked to leave;
- Improper disposal of demolition waste and obsolete machineries will lead to contamination of soil and discontent of community;
- Demolition activity is anticipated to generate dust and exhaust emissions which can be carried downwind to habitations;
- Risks associated with health and safety issues such as trip and fall, electrical hazard etc.;
- The decommissioning activities of dismantling the solar power plant and removing the ancillary facilities can lead to increased noise levels;
- During the dismantling of the solar power plant, visual intrusions will be likely by removal of ancillary facilities, but their consequence will be negligible due to fact that such impact would be temporary (over a short period);
- Depending on the type used, photovoltaic cells may contain toxic substances such as gallium arsenide, copper-indium-gallium-selenide and cadmium telluride. If any solar panel is damaged during dismantling of the facility, these toxins are likely to spill and leach into the soil and water of the area, posing threat to environmental and public health;
- If the solar panels are not handled or disposed of appropriately during the decommissioning phase, any toxic substances contained within them are likely to escape into the surrounding air, water or soil, creating serious environmental and public health risks.

Mitigation Measures

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

- The proponent shall inform the workers and local community about the duration of work;
- The workers shall be clearly informed about the expected schedule and completion of each activity;
- All waste generated from decommissioning phase shall be collected and disposed of at the nearest municipal disposal site;
- Sprinkling of water is being carried out to suppress dust from decommissioning activities and transport movement;
- All necessary PPEs shall be used by the workers during demolition work;
- FPEPL will be committed to ensure all health and safety measures are in place to prevent accidents and/or reduce the consequences of non-conformance events;
- Institution of suitable training modules for project personnel and labour contractors involved in the dismantling process to ensure avoidance or minimization of solar panel damage as far as

possible and adherence to appropriate decontamination protocols in the event of any unavoidable damage and adhere to proper safe disposal methods.

In addition to above, it is anticipated that the contractor will have the necessary management measures in place to manage potential OHS issues under their responsibility. Appropriate OHS programme and procedures are also expected to be in place to align with the local regulations, as well as IFC PS-2. The procedure will include, at minimum, the following measures:

- Develop and implement a health and safety plan to follow throughout all phases of a project;
- Provide occupation health and safety orientation training to all employees consisting of basic hazard awareness, site-specific hazards, safe working practices, and emergency procedures;
- The contractors will be committed to ensure that all Health and Safety measures are in place to prevent accidents and reduce the consequences of non-conformance events;
- The contractors will provide training, awareness and supervision to ensure all of its construction workers comply with the OHS procedures;
- The contractor will provide appropriate resources i.e. PPE to workers on Site; and
- An emergency response procedure and infrastructure will be available on Site to ensure provision of first aid for personnel in case of emergency

Significance of Impact

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

Table 7-17: Impact Significance – Environment Occupational Health and Safety Hazards

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

7.3.3.2 Impact on Land Due to Improper Waste Disposal

Anticipated Impacts

The PV modules have a lifespan of 20-25 years. The PV modules contain heavy metals and cannot be disposed in landfills. A PV module is essentially made up of glass, metals, silicon and polymer fractions, and there are few materials like polymers as well as metals (small quantities of zinc, tin, copper and silver), metallic compounds and alloys which are classified as potentially hazardous. PV waste recycling is still at a nascent stage globally, both in terms of technical standards and physical infrastructure. So, at present, PV module recycling is not commercially viable.

The polymer component used in solar modules is difficult to recycle and can only be incinerated which again poses a significant health and environmental risk due to the formation of highly corrosive gases at the incineration stage. If landfilled inappropriately, waste and waste constituents can find ways into soil and water, resulting in a potentially damaging impact on the ecosystem. The scope of the India e-waste rules do not include solar panels and therefore there is no legal responsibility for any party to take back or recycle solar panels.

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

Mitigation Measures

- Project developer to research and be involved in programmes and research for recycling solar panels.
- Project developer h to ensure that solar panels are disposed of in accordance with the law and best practice.
- Project developer to develop protocol/procedure for dismantling and handling panels.
- Project-personnel and labour contractors involved in the dismantling process to receive training ensure avoidance or minimization of such damage as far as possible and adherence to appropriate decontamination protocols in the event of any unavoidable damage.

Significance of Impact

Table 7-18: Impact Significance – Impact on Land due to Improper Disposal of Waste

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact on Land Due to Improper Waste Disposal	Without Mitigation	High	Medium	High	Major
	With Mitigation	Local	Short	Medium	Moderate

7.4 Ecological Impacts and Mitigation Measures

The following sections present the ecological impacts anticipated directly from the Project. The said impacts are listed as per the Project phases during which they are anticipated. Each impact is evaluated for significance and measures, based on international industrial good practices, to mitigate it as per the mitigation hierarchy, are suggested.

7.4.1 Impacts during the Construction Phase

Change in Land Use: The removal of vegetation to clear the Project Site for construction will cause loss of near-natural to slightly modified habitat. Although the Project site is not situated within a CH, approximately 5% of the Project Site, involving approximately 0.05 sq km area of the proposed power plant footprint and 625 m of the proposed TL footprint, contain habitat-types, namely palm groves and sandy or alluvial soils (Please refer to figure 7-1) associated with the endemic species *Hemidactylus scabriceps* (Scaly Gecko, IUCN Red List Status: EN). The palm grove area present in the power plant footprint is one of the various habitat-types in which the species has been recorded (Srikanthan et al 2018). As per the IUCN Red List assessment, the said habitat is considered neither suitable for nor of major importance to the species, but, as per published literature, may nevertheless represent potential habitat for the species. As per the IUCN Red List assessment, the sandy or alluvium soils present in the TL footprint are deemed a habitat-type of major importance to the species.

Both the concerned areas/lengths of land are contiguous with significantly larger areas of similar habitat-types. The palm-grove area within the power plant footprint represents approximately 10%, and a peripheral component, of the overall area of the concerned habitat-type. Hence, its removal is likely to cause loss, but not fragmentation, of habitat with respect to the species. The sandy or alluvial soil area within the TL footprint represents approximately 1%, and an interior component, of the overall area of the concerned habitat-type. Hence, construction of the TL is likely to cause loss, and partial as well as temporary fragmentation, of habitat with respect to the species.

Figure below presents a map indicating the sections of the power plant and TL footprints that overlap potential habitat of the species.

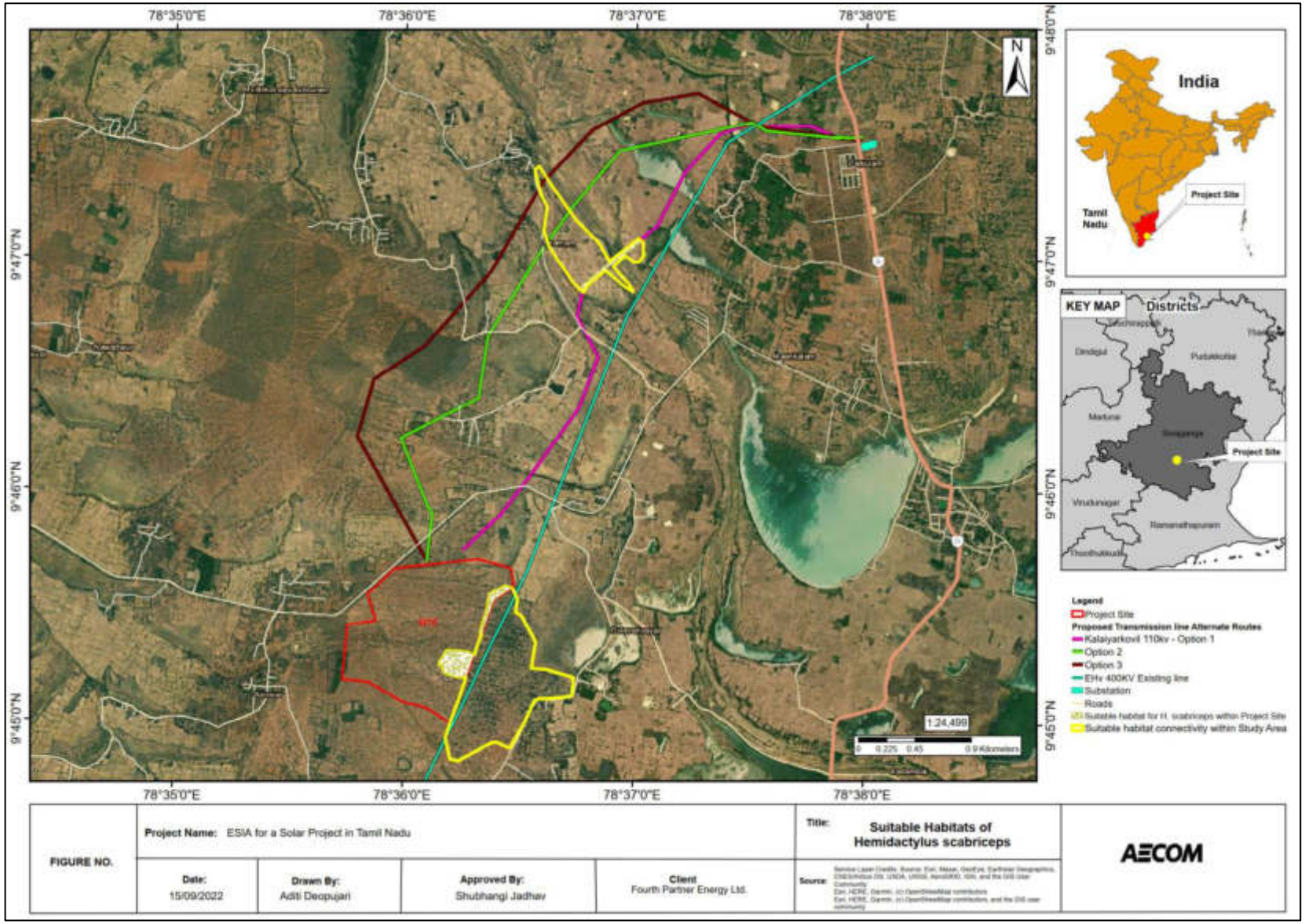

Figure 7-1: Potential *Hemidactylus scabriceps* Habitats Overlapped By The Project Site

The habitat loss at the Project Site will directly cause loss of habitat for fauna and loss of provisioning ecosystem services, mainly fodder, for the local community. The removal of natural vegetation would also indirectly cause exposure of soil to desiccation by wind and sunlight, loss of soil anchorage and increased vulnerability of soil to erosion by wind and water, leading to changes in the soil regime and the corresponding loss or degradation of the related ecosystem services.

The loss of the natural habitat at the Project Site is of moderate significance, mainly owing to the presence of potential habitat of an endemic species, namely *Hemidactylus scabriceps* (Scaly Gecko) within the Project Site.

Source: Srikanthan, A.N., G.C. Kumar, A.J. Urs & S.R. Ganesh (2018). Appearances are deceptive: molecular phylogeny recovers the Scaly Gecko Hemidactylus scabri-ceps (Reptilia: Squamata: Gekkonidae) as a member of a scansorial and rupicolous clade. Journal of Threatened Taxa 10(9): 12147–12162; https://doi.org/10.11609/ jott.3964.10.9.12147-12162; Ganesh, S.R., Achyuthan, N.S., Jayasekara, D., Vidanapathirana, D., Kannishka, S., Wickramasinghe, L.J.M., Samarawickrama, P., Botejue, M., Gabadage, D., Karunarathna, S., Pushpamal, V., Perera, N., de Alwis Goonatilake, S. & Wikramanyake, S. 2021. Hemidactylus scabriceps. The IUCN Red List of Threatened Species 2021: e.T178314A1531148. https://dx.doi.org/10.2305/IUCN.UK.2021-3.RLTS.T178314A1531148.en. Accessed on 11 August 2022.

Laying of roads and paving of surfaces: The laying of roads or paving of surfaces within the Project Site will hinder or obstruct the percolation of rainwater into the ground. This will cause reduction of groundwater recharge and increase in surface run-off, leading to loss or degradation of soil and sub-soil habitats, as well as, the related regulating and supporting services.

This impact is of moderate significance owing to relatively low availability of comparable alternative habitats and ecosystem services around the Project Site.

Movement of vehicles and heavy machinery: Movement of vehicles and operation of construction machinery would expose the natural environment to vehicular emissions and unnatural levels of dust, noise, light and vibrations. This would generally lead to pollution of natural resources and possible contamination of food webs. It would cause compaction of soil substrates, leading to injury or death of soil organisms. It would also reduce percolation of rainwater into sub-soil layers and increase surface run-off, impacting the natural groundwater recharge process and destroying or degrading the related ecosystem services.

This impact is of moderate significance owing to relatively low availability of comparable alternative habitats and ecosystem services around the Project Site, as well as presence of potential habitat of an endemic species downgradient of the Project Site.

Artificial Illumination: Use of artificial lighting to illuminate the Project Site and during night-time will lead to unnatural illumination in the area during the natural dark part of the day. Use of vehicles during night may also lead to artificial illumination. Interruption of the natural night period by light is known to disrupt the natural biological cycles of many floristic and faunal species.

This impact is of moderate significance owing to relatively low availability of comparable alternative habitats and ecosystem services around the Project Site, as well as presence of potential habitat of a nocturnal endemic species within and adjacent to the Project Site.

Installation of solar panels: The introduction of the large, geometrically arranged, reflective surfaces of solar panels into a natural area would cause visual obstruction or visual irritation to wild fauna, especially aerially moving fauna. The solar panelling would inevitably introduce potential for 'Lake Effect', leading to false landings, collisions and entrapment of waterbirds, as well as false egg-laying by water insects. The overall visual effect of the solar panelling would also degrade the aesthetic qualities of the natural landscape, thus affecting the cultural services of the area.

This impact is of high significance owing to the Project Site being situated in proximity to human habitations and wildlife habitats, especially wetland habitats used by migratory and/or congregatory species.

Installation of transmission cables: Installation of over-head transmission cables would disrupt the aerial habitat space of the area, leading to death or damage to aerially moving organisms such as birds and bats through accidental collision and electrocution. Installation of underground transmission cables would disturb the natural soil-profile and fragment sub-soil habitats. These effects would lead to injury or death of organisms, thereby impacting ecosystems and the related ecosystem services.

Based on the site survey and overview of the satellite imagery, potential avian high-use areas, i.e., wetland habitats within 50m of the TL, have been identified for the TL route presented in figure below.

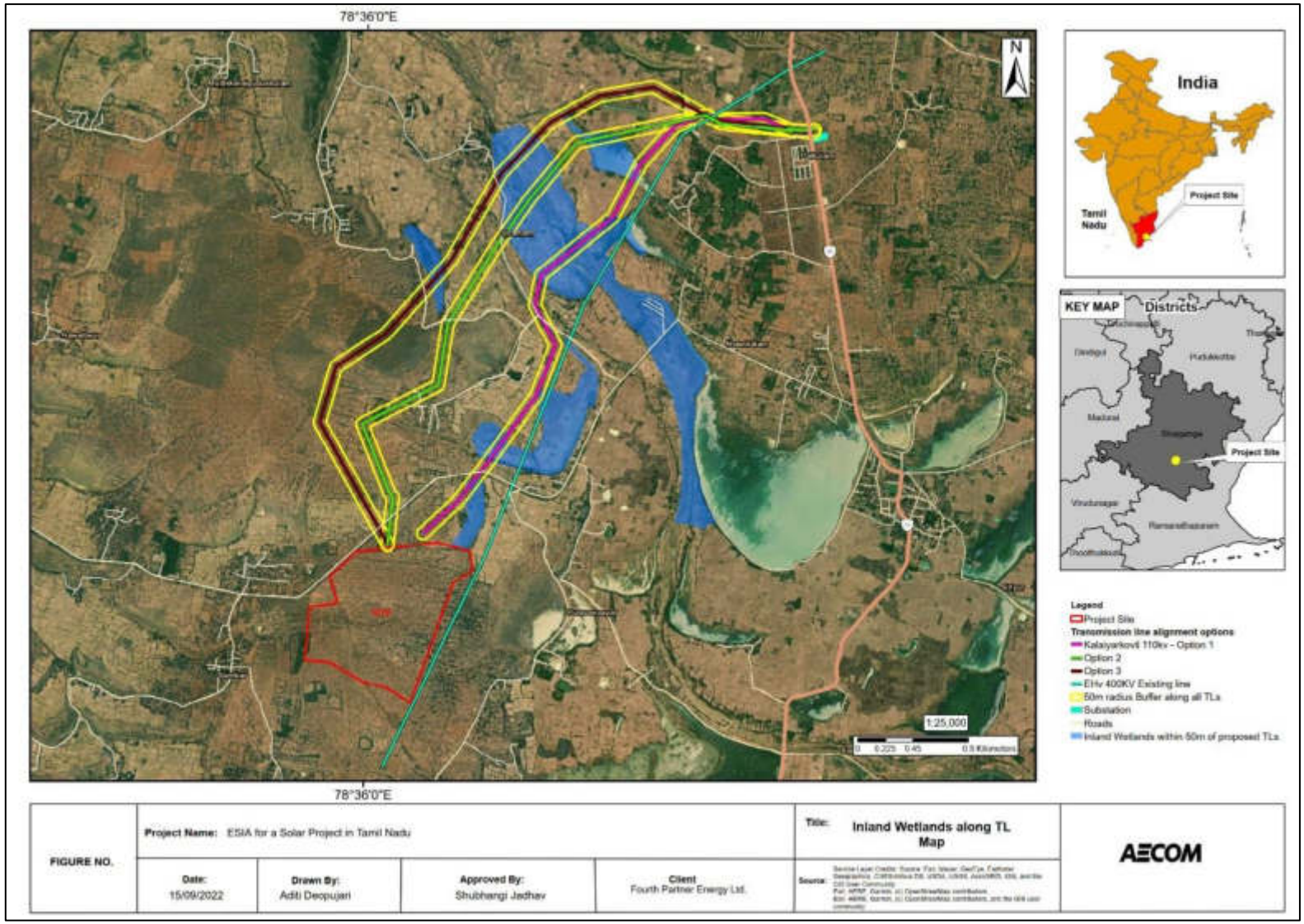

Figure 7-2: Inland Wetlands (potential HUAs) within 50m distance of the proposed TL routes

This impact is of high significance owing to the Project Site being situated in proximity to wildlife habitats, especially wetland habitats used by migratory and/or congregatory species.

Specific Measures for Conservation of Hemidactylus scabriceps

- The significance of potential habitat loss for the endemic *Hemidactylus scabriceps* (Scaly Gecko; IUCN Red List Status: EN), in terms of removal of palm-grove vegetation towards clearing of the Project Site, is evaluated as moderate. However, in view of the highly threatened status of the species, a precautionary approach is recommended, involving conservation of the approximately 0.05 square km of palm-grove habitat (Please refer to figure 7-1) within the Project Site as a set-aside for the species. The Client shall design the layout of the solar power plant infrastructure to exclude the said palm-grove area, to the extent feasible.
- The Client shall minimizing overlap with sandy or alluvial soil habitats, to the extent feasible, while finalizing the TL alignment of the Project.
- The Client shall employ an appropriate herpetofauna expert to survey the palm-grove area within the Project Site for presence of *Hemidactylus scabriceps* immediately prior to removal of the said vegetation towards site clearance, with appropriate relocation of any individuals of the species encountered during the survey.
- The Client shall arrange for an expert reptile handler to be available during any pre-construction and construction activity, to carry out rescue and relocation of any individuals of the species encountered during the said activities.

General Measures for Conservation of Biodiversity

- The Client shall consider offsetting loss of natural vegetation at the Project Site by planting ideally the same species, but higher numbers, of trees and shrubs, as applicable, in or adjacent to the Project Site, as feasible. (Species typical to the natural forest-types of the Study Area, as reported in the baseline data, may be used in plantations. Alternatively, advice may be sought from the local forest department office, which can also provide saplings of local native species for plantation.)
- The Client shall ensure that the species used for any plantation are strictly native and not alien or invasive with respect to the concerned plantation site.
- The Client shall consider minimizing the number and the width of all internal roads.
- The Client shall maintain the connectivity and integrity of existing natural water-channels while building internal roads or embankments.
- The Client shall ensure that vehicles and machinery used in the construction activities comply with the prescribed emission standards.
- The Client shall consider restricting movement of construction-related vehicles, especially heavy vehicles or machinery, strictly to pre-designated routes.
- The Client shall consider restricting construction activities requiring high levels of illumination to daylight hours to prevent disruption of the natural night period by artificial lighting.
- The Client shall consider avoidance or damping of construction noise and vibrations to the maximum extent possible
- The Client shall consider institution of efficient systems for containment and disposal of waste or spillage
- The Client shall prohibit harvesting of fuelwood or wild foods (including fauna) by construction labour
- The Client shall consider use of seamed paving instead of contiguous concrete surfaces to reduce hindrance to rain-water percolation
- The Client shall consider planting relatively tall-growing native vegetation at a suitable distance along the boundary of the project site to visually screen it from wildlife habitats in the

surrounding area, as also, to help counter the heat island effect created by the solar installations.

- The Client shall consider installing the solar panels in as small and discrete clusters as feasible, rather than installing them in continuous swathes.
- The Client shall use crystalline silicon type solar panels over other currently available technologies, to avoid introduction of toxic chemicals into the local ecosystems.
- The Client shall consider using solar panels with anti-reflective coating (ARC), preferably in conjunction with white, non-polarizing gridding, to reduce reflectiveness and light-polarization.
- The Client shall ensure that lights are provided with downward-facing shades to limit the dispersion of illumination into adjacent habitats.
- The Client shall consider insulating phase conductors to avoid electrocution risk.
- The Client shall install bird flight divertors (BFDs) on transmission lines to increase their visibility to aerially moving fauna, especially in any HUAs identified in Figure 7-2.

Source - APLIC (Avian Power Line Interaction Committee) (2012) Reducing Avian Collisions with Power Lines: The state of the art in 2012. Edison Electric Institute and APLIC. Washington, D.C.

Aspect	Scenario	Extent	Duration	Intensity	Type	Significance
Degradation of Habitats	Without Mitigation	Medium	Long	High	Adverse	Moderate
	With Mitigation	Local	Medium	Moderate	Adverse	Minor
Fragmentation of Habitats	Without Mitigation	Medium	Long	High	Adverse	Moderate
	With Mitigation	Local	Long	Moderate	Adverse	Minor
Loss of Ecosystem Services	Without Mitigation	Medium	Long	Moderate	Adverse	Moderate
	With Mitigation	Medium	Medium	Low	Adverse	Minor

7.4.2 Impacts during the Operation and Maintenance Phase

Physical Hindrance by On-ground Installations: The physical presence of the solar panelling and related installations would hinder faunal movement within and through the area, affecting their current access to habitats and resources. Certain bird species such as raptors are known to avoid PV sites and surrounding areas leading to loss of hunting/nesting habitat. The regular activity of humans in the solar park can also deter raptors, thus changing the bird community structure in the nearby areas. The solar panelling and related installations would also cast a shadow on the soil underneath, cutting off the existing natural insolation available to the soil and ground flora of the shaded area. Altered insolation patterns would also affect the existing soil-moisture conditions. These effects would collectively degrade or alter the existing floristic profile of the affected area, thus impacting its existing primary production and the associated ecosystem services. Owing to the length of solar panel-strings, as also, the large scale of the proposed installations, the physical presence of the solar panelling would lead to fragmentation of existing contiguous faunal habitats and prevent faunal access to habitats and habitat features such as roosts, feeding grounds, nest sites, tools and nesting materials beyond the solar park.

This impact is of moderate significance mainly owing to the presence of potential habitat of a terrestrial endemic species within and adjacent to the Project Site.

Electrocution Risk from On-ground Installations: Small fauna, such as reptiles and rodents, and aerially moving fauna, such as insects, birds and bats, may accidentally encounter electrical components of the project installations, leading to injury or death.

This impact is of moderate significance mainly owing to the presence of potential habitat of an endemic reptile species within and adjacent to the Project Site.

Reflectivity of Solar Panels (Albedo Effect): Aerially moving diurnal organisms, mainly birds, are deemed especially vulnerable to the long-term impacts of solar panel reflectivity. Detours taken by migratory birds as an avoidance response to disturbances or irritants in their natural flight path are known to cause an often-fatal increase in the flight energy expenditure of many long-distance migrant species. The unnatural polarization of light caused by solar panels is known to trigger maladaptive behaviours in polarization-sensitive organisms and alter their ecological interactions, including preferential egg-laying on panel surfaces by insects. Such faunal behaviour-alteration could lead to undesirable long-term impacts on food webs in which affected species occupy critical trophic niches. Birds in flight, mistaking the reflective surface of the panels for water, may collide with the panels in an attempt to drink it. Birds that drink water on the wing (such as swallows) are at a greater risk of mortality from this effect than those that drink from a perched position.

Source: Gábor Horváth, György Kriska, Péter Malik and Bruce Robertson (2009). Polarized light pollution: a new kind of ecological photo-pollution. Front Ecol Environ 2009; 7(6): 317–325; Taylor, R., Conway, J., Gabb, O. and Gillespie, J. (2019). Potential ecological impacts of ground-mounted photovoltaic solar panels: An introduction and literature review. Report for BSG Ecology.

This impact is of moderate significance owing to the Project Site being situated in proximity to habitats of migratory and/or congregatory waterbirds.

Heat Generation by Solar Panels (Heat Island Effect): The large-scale solar installation would heat the air in and around the project site, leading to an overall rise in the ambient temperature, thereby degrading the natural environment of the area. This effect is known to significantly affect areas up to approximately 300 m from the perimeter of the solar-panelled area and up to a height of 5-18 m. The latest available research indicates that temperatures over a PV plant were regularly 3–4°C warmer than associated natural habitats at night. The impact of increase in ambient temperature is known to be especially deleterious to organisms of warm tropical regions, where the normal temperatures are likely to be already near the tolerance limits of the organisms.

Sources: Nicolas Barth, Benjamin W. Figgis, Ahmed Ennaoui, Said Ahzi, "Field-scale Computational Fluid Dynamics applied to wind velocity profiles of photovoltaic plant: Case of the QEERI solar test facility Doha Qatar", Renewable and Sustainable Energy Conference (IRSEC) 2016 International, pp. 613-618, 2016; Barron-Gafford, G. A. et al. "The Photovoltaic Heat Island Effect: Larger solar power plants increase local temperatures." Sci. Rep. 6, 35070; doi: 10.1038/srep35070 (2016)

This impact is of moderate significance mainly owing to the presence of potential habitat of a terrestrial endemic species within and adjacent to the Project Site.

Physical Hindrance by Overhead Transmission Lines: The physical presence of overhead transmission lines would disrupt the existing contiguous aerial habitat of the area, leading to death or injury to aerially moving organisms such as birds and bats, through accidental collision with cables.

This impact is of moderate significance owing to the Project Site being situated in proximity to habitats of migratory and/or congregatory waterbirds, a species group deemed particularly vulnerable to collision/electrocution risk with respect to transmission lines.

Physical Hindrance by Underground Installations: The physical presence of underground installations, such as the solar panel mounting foundations and underground transmission cables, would occupy a large area of sub-soil habitats. This would lead to loss of habitat area for sub-soil species and hinder their access to resources.

This impact is of moderate significance mainly owing to the presence of potential habitat of a terrestrial, partially fossorial, endemic species within and adjacent to the Project Site.

Project Site Illumination: Use of artificial lighting to illuminate the project site in the night-time 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.

This impact is of moderate significance mainly owing to the presence of potential habitat of a nocturnal endemic species within and adjacent to the Project Site.

Project-related Traffic: The movement of project-related vehicles and personnel to, from and around the Project Site would increase the ambient levels of vehicular emissions, dust, noise, vibrations and artificial illumination in and around the project site. This would lead to pollution of the natural environment. Also, disruption of the night-period by illumination is known to disturb natural floral and faunal biological cycles.

This impact is of moderate significance owing to relatively low availability of comparable alternative habitats and ecosystem services around the Project Site, as well as presence of potential habitat of a nocturnal endemic species within and adjacent to the Project Site.

Use of Herbicides: Herbicidal chemicals, if used to prevent or control the growth of plants which could cut off sunlight from the solar panelling, would be toxic to most organisms and may have a tendency to persist or bio-accumulate, contaminating the soil, surface water, groundwater and food-chains of the area.

This impact is of moderate significance owing to relatively low availability of comparable alternative habitats and ecosystem services around the Project Site, as well as presence of potential habitat of an endemic species downgradient of the Project Site.

Use of Dust Settling Chemicals: Dust-settling chemicals, if used to prevent dust from coating the surface of the solar panels, would be toxic to organisms and may have a tendency to persist or bio-accumulate, contaminating the soil, surface water, groundwater and food-chains of the area.

This impact is of moderate significance owing to relatively low availability of comparable alternative habitats and ecosystem services around the Project Site, as well as presence of potential habitat of an endemic species downgradient of the Project Site.

Spillage of Materials: Heat transfer fluids, belonging to chemical groups such as Glycols, Nitrates, Nitrites, Chromates, Sulphates and Sulphites, if used in the project systems, would be toxic to organisms. Spillage of these chemicals, either as part of routine operations, or accidentally, could lead to their leaching into the local environment, contaminating the natural soil and water resources of the area.

This impact is of moderate significance owing to relatively low availability of comparable alternative habitats and ecosystem services around the Project Site, as well as presence of potential habitat of an endemic species downgradient of the Project Site.

Mitigation Measures

- The Client shall consider restoring the soil and natural vegetation of any construction-phase roads which are not necessary for carrying out operation or maintenance activities.
- The Client shall consider insulating electrical components to prevent electrocution of fauna through accidental contact with on-ground project-installations.
- The Client shall consider restricting maintenance-related activities to the daytime.
- The Client shall avoid use of artificial lighting in and around the project site to the extent possible.

- The Client shall consider using low-intensity artificial lighting, such as LED, to prevent insects from being attracted to the site.
- The Client shall consider ensure that lights are provided with downward-facing shades to limit the dispersion of the illumination into adjacent habitats.
- Ensure that operation or maintenance activities, that require illumination, are restricted to daylight hours to prevent disruption of the natural night period by artificial lighting.
- Prohibit the use of herbicides in the facility.
- Prohibit the use of dust-settling chemicals in the facility.
- Institute effective training modules and operational systems to ensure prevention of spillages of toxic substances.
- Install effective containment systems to prevent any accidental spillage from leaching into the local environment.
- The Client shall monitor the TL corridor to record any bird collision/electrocution incidents and identify any additional/different avian high use areas (HUAs) or critical avian habitats after establishment of the transmission line.
- The Client install additional or improved bird flight deflectors (BFDs) on Transmission lines, if required.
- The Client shall regulate Project-related activities around the transmission line corridor to address monitoring findings.

Source - APLIC (Avian Power Line Interaction Committee) (2012) Reducing Avian Collisions with Power Lines: The state of the art in 2012. Edison Electric Institute and APLIC. Washington, D.C.

Aspect	Scenario	Extent	Duration	Intensity	Type	Significance
Degradation of Habitats	Without Mitigation	Medium	Long	High	Adverse	Major
	With Mitigation	Local	Medium	Moderate	Adverse	Moderate
Fragmentation of Habitats	Without Mitigation	Medium	Long	High	Adverse	Moderate
	With Mitigation	Local	Long	Moderate	Adverse	Minor
Loss of Ecosystem Services	Without Mitigation	Medium	Long	Moderate	Adverse	Moderate
	With Mitigation	Medium	Medium	Low	Adverse	Minor

7.4.3 Impacts during the Decommissioning Phase

Damage to Solar Panels: If any solar panel is damaged during dismantling of the facility, polluting materials are likely to be introduced into the air, soil and water in and around the project site, thereby degrading its natural resources.

This impact is of moderate significance since the Project Site is situated in proximity of natural habitats.

Unsafe Disposal of Solar Panels: If the solar panels are not handled or disposed of appropriately during the decommissioning phase, any toxic substances contained within them are likely to be introduced into the air, water or soil of the disposal site, thereby degrading its natural resources.

This impact is of moderate significance since the Project Site is situated in proximity of natural habitats.

Mitigation Measures

- The Client shall consider instituting suitable training modules for project-personnel and labour contractors involved in the dismantling process to ensure avoidance or minimization of solar panel damage and adherence to appropriate decontamination protocols in the event of any unavoidable damage.
- The Client shall institute suitable training modules for project-personnel and labour contractors involved in the dismantling process to ensure adherence to appropriate safe disposal protocols.
- The Client shall ensure meticulous removal and sensitive disposal of transmission line components and other waste, following the best prescribed practices

Aspect	Scenario	Extent	Duration	Intensity	Type	Significance
Degradation of Habitats	Without Mitigation	Medium	Long	High	Adverse	Moderate
	With Mitigation	Local	Medium	Moderate	Adverse	Minor
Fragmentation of Habitats	Without Mitigation	Medium	Long	High	Adverse	Moderate
	With Mitigation	Local	Long	Moderate	Adverse	Minor
Loss of Ecosystem Services	Without Mitigation	Medium	Long	Moderate	Adverse	Moderate
	With Mitigation	Medium	Medium	Low	Adverse	Minor

7.5 Socio- Economic Impacts and Mitigation Measures

7.5.1 Impacts During the Pre-Construction Phase

7.5.1.1 Impact On Animal Grazing

Consultations were undertaken with cattle rearing group engaged in grazing of animals adjacent to the project site. Discussions with the shepherds engaged in animal rearing/ grazing reveals that the proposed project site is not the designated grazing land and the proposed project site boundary does not obstruct the movement of cattle for grazing.

Significance of Impact

Impact on animal grazing is assessed to be Insignificant without any enhancement measures.

Table 7-19: Impact Significance – Animal Grazing

Aspect	Scenario	Spread	Duration	Intensity	Overall
Animal Grazing	Without Enhancement measures	Local	Short	Low	Insignificant
	With Measures	Local	Short	Low	Insignificant

7.5.1.2 Impact on Agriculture

As reported in the earlier sections, the proposed project site land is barren and no crops were cultivated for 30 years, hence the impact on agriculture activity due to the proposed solar power plant is negligible. However, the proposed Transmission line corridor connecting the PSS to be placed within the solar plant and the existing GSS at Maravamangalam village are mostly traversing through the private agriculture land. Since the route is in planning stage and FPEPL is under negotiation with the landowners. Due to placing of 110kV TL towers, though the predominantly Paddy (Rice) is being cultivated in the area and no horticulture plantations are being done, there will be hindrance in movement and use of machineries within the agriculture field. The landowners within the RoW to be compensated as per the LRP as being developed for the project.

Significance of Impact

Impact on agriculture activity in solar plant site is assessed to be Insignificant without any enhancement measures.

Impact on agriculture activity in along the RoW of the proposed TL route is assessed to be Moderate without any enhancement measures and Minor with enhancement measures.

Table 7-20: Impact Significance – Agriculture

Aspect	Scenario	Spread	Duration	Intensity	Overall
In Solar Site	Without Enhancement measures	Local	Short	Low	Insignificant
	With Measures	Local	Short	Low	Insignificant
Withing RoW of TL	Without Enhancement measures	Local	Long	Medium	Moderate
	With Measures	Local	Long	Low	Minor

7.5.1.3 Impact on Livelihood

Based on the outcome of the consultation and field observations, major source of livelihood in the region during post monsoon season is cultivation and agriculture labour and during agriculture lean season they were primarily dependent on construction labours, cattle rearing, NREGA work, etc. The compensation for the project site land is paid at the replacement cost arrived through private negotiation between landowners and FPEPL. Land compensation for erecting transmission line (Tower footprint and RoW) and crop loss will be made as per the LRP being developed for the project. The LRP ensures fair and no discrimination in prevalent in issuing compensation to the women PAPs. Loss of crop and hindrance during TL stringing will be for short period only during the construction period and the landowners will be allowed to use the land within the RoW for agriculture activity.

Significance of Impact

Impact on livelihood is assessed to be Insignificant without any enhancement measures and Minor with enhancement measures.

Table 7.21: Impact significance – Livelihood

Aspect	Scenario	Spread	Duration	Intensity	Overall
Animal Grazing	Without Enhancement measures	Local	Short	High	Moderate
	With Measures	Local	Short	Medium	Minor

7.5.1.4 Impact on Restriction of Access

Withing the project site there is a designated village road passing within the project site layout, the road was observed to be worn out and being unfit for road use. As part of the project component, the road is planned to be upgraded and the locals will not be having any restrictions to use the road. And with respect to TL, there will not be any restrictions on access to the RoW for the landowners and grazers except during the construction activity on the safety aspects.

Significance of Impact

Impact on restriction of access to the neighbouring villages is assessed to be Moderate without any enhancement measures and Minor with enhancement measures.

Table 7-22: Impact significance – Restriction Of Access

Aspect	Scenario	Spread	Duration	Intensity	Overall
Restriction of Access	Without Enhancement measures	Local	Long	Medium	Moderate
	With Measures	Local	Long	Low	Minor

7.5.2 Impacts During The Construction and Operation Phases

7.5.2.1 Impacts on Local Economy

During the construction and operational phase of the project, the impact the local economy is likely to be positive as the project will lead to increase in local employment opportunities and increased demand for materials and services through local contracting. Efforts should be made to ensure that maximum proportion of the demand for manpower and materials is met locally through contractors and vendors.

Significance of Impact

Impact on local economy is assessed to be minor without any enhancement measures and moderate with enhancement measures.

Table 7-23: Impact Significance – Local Economy

Aspect	Scenario	Spread	Duration	Intensity	Overall
Local Economy	Without Enhancement measures	Medium	Short	Medium	Moderate
	With Measures	Medium	Long	Medium	Moderate

7.5.2.2 Employment opportunities

During the peak construction phase, the manpower requirement will be around 200 to 230 (contractual workers). Consultations with the project proponent indicated that most of the manpower requirement in the unskilled and semi-skilled categories will be sourced from the local area and will comprise of youth from the neighbouring villages. Employment of local youths in the project-specific construction activities will positively contribute to the livelihood of the local villages. Specific clauses to encourage the employment of local youths should be incorporated into the EPC contract agreement between FPEPL and the EPC contractor.

Significance of Impact

Impact on employment opportunities is assessed to be minor without any enhancement measures and moderate with enhancement measures.

Table 7-24: Impact Significance – Employment Opportunities

Aspect	Scenario	Spread	Duration	Intensity	Overall
Employment Opportunities	Without Enhancement measures	Medium	Short	Moderate	Moderate
	With Measures	Medium	Short	Low	Minor

7.5.2.3 Labour Rights and Welfare

Approximately 200-230 of labours especially in the skilled and highly skilled categories to be employed during the construction of which 130 members would be migrant. The site representative of FPEPL confirmed that a labour camp will be set up within the site with the capacity to accommodate 130 workers. The migrant workers will be provided accommodation in the labour camp. It was reported by FPEPL that the labour camp will have a capacity to accommodate 130 labourers. Adequate numbers of toilets, along with separate toilets and bathrooms for women workers, with adequate drinking water facility, kitchen etc. will be provided as basic amenities in the proposed labour camp. As reported no migrant women workers or family members are to be involved for the project and labour camp would be provided for only men. However, facilities including separate toilets, restrooms, would be provided for local women workers being employed. The size of the rooms will be 5 meters in length x 3.5 meters in breadth and 3.5 meters in height. Each room will be provided with electrical power points along with lights and fans in each room. The EPC Contract will be providing the minimum wages to the labourers including overtime wage as per the Building and Others Construction Workers Act. In addition, benefits in terms of Employee State Insurance (ESI) should be provided to each worker engaged on site. The workers should be aware of their rights and benefits due to them so that no issues emerge. Toilet facilities and drinking water should be provided to all workers on site as well. Grievance Redressal Mechanism for workers should be developed and communicated to the workers so that the workers can approach the management if any concerns or issues are faced by them without any fear of retribution or intimidation.

Significance of Impact

Impact on Labour Rights and Welfare is assessed to be minor without any enhancement measures and moderate with enhancement measures.

Table 7-25: Impact Significance – Labour Rights and Welfare

Aspect	Scenario	Spread	Duration	Intensity	Overall
Labour Rights and Welfare	Without Enhancement measures	Medium	Short	Medium	Moderate
	With Measures	Medium	Short	Low	Minor

7.5.2.4 Labour Influx

It is anticipated that during the construction phase there will be an influx of migrant workers. During the site visit, it was mentioned by the site representative that for specialized work activities, migrant workers are envisaged to be engaged. Of the total 200-230 labours to be employed, around 130 labours would be migrant. The site representative of FPEPL confirmed that a labour camp will be set up within the site with a capacity to accommodate 130 labourers. All basic amenities. Adequate numbers of toilets, along with separate toilets and bathrooms for women workers, with adequate drinking water facility, kitchen etc. will be provided as basic amenities in the proposed labour camp. However, engagement of migrant labourers might lead to a conflict with the local population if proper orientation is not provided. The basic issues related with migrant labourers may include:

- Conflict amongst workers and between workers and local community members based on behavioural/ cultural practices.
- Discontent amongst local community members on engagement of outsiders as workforce.
- Mild outbreaks of infectious diseases due to interaction between the local population.
- Safety and security issues for local women.
- Use of community facilities such as temples, transport facilities, public spaces may lead to discontent between the local community and the migrant workforce.

Table 7-26: Manpower Requirement – Construction and Operation

Type of Manpower	FPEPL		EPC / Sub-cons	
	Local	Migrant	Local	Migrant
Construction Phase				
Technical Staff	1	4	2	4
Skilled Labours				10
Unskilled Labours			100	120
Operation Phase				
Technical Staff		2		
Skilled Labours			10	5
Unskilled Labours			20	

Source: FPEPL

Significance of Impact

Impact on Labour Influx is assessed to be minor without any enhancement measures and moderate with enhancement measures

Table 7-27: Impact significance – labour influx

Aspect	Scenario	Spread	Duration	Intensity	Overall
Labour Influx	Without Enhancement measures	Local	Short	Medium	Moderate
	With Measures	Medium	Short	Low	Minor

7.5.3 Impacts During the Decommissioning Phase

7.5.3.1 Loss of Employment Opportunities

The manpower requirement during the O&M phase was reported by the project proponent to be in the range of 15 to 20 workers who will be engaged on daily basis. The workers will be engaged by the O&M contractor. Some of the key activities to be performed by workers engaged in O&M phase such as housekeeping, solar panel cleaning, bush cutting, security fall under the unskilled and semi-skilled categories for the purpose of which local youth from the neighbouring villages can be sourced.

However, in an event of decommissioning, there is a high probability that the manpower engaged in O&M activities might lose employment. This will adversely impact the livelihood of the concerned people.

Significance of Impact

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

Table 7-28: Impact Significance – Employment opportunities

Aspect	Scenario	Spread	Duration	Intensity	Overall
Employment opportunities	Without Mitigation	Medium	Short	Moderate	Moderate
	With Mitigation	Medium	Short	Low	Minor

Mitigation Measures for the identified social impacts

- As part of its Community Development programme, FPEPL may collaborate with the Pulavanvayal Village to improve village level infrastructure (Drinking Water), education promotion programs, skill improvement, etc. as part of the CSR budget. Few suggestive Community Development programs based on the felt needs expressed during the stakeholder consultation are highlighted below.
  - Improving the Drinking water facility at village level, though the villages are reported to be having piped water supply through respective panchayats, it was not adequate to feed the population.
  - Skill Development and observing local skill force through various education promotion and skill development programs among the local population encourages the local youth to pursue education.
- FPEPL must effectively implement Stakeholder Engagement Plan (SEP) / Grievance Redressal Mechanism (GRM) to take necessary actions to record / resolve any reported grievance related to the restriction of access road and other community level grievances if Preference to fulfil the manpower requirement in the unskilled and semi-skilled categories be sourced from the local area and will comprise of youth from the neighbouring villages. Employment of local youths in the project-specific construction/ operation activities will positively contribute to the livelihood of the local villages.
- The site specific GRM procedures was already developed by FPEPL and they are yet to be communicated to the community and other stakeholders. FPEPL to disseminate GRM procedures along adequate awareness to the stakeholders on lodging their grievances through GRM.
- FPEPL / the EPC Contractor will develop and implement the Labour Management plan which will ensure transparency in hiring workers, Fair and Equal remuneration for similar jobs, promoting non-discrimination, defining and communicating the Terms of employment, addressing workers grievances.
- The project through the contractor agreement shall ensure that the construction contractors commit and adhere to social obligations including community relations, Code of Conduct, awareness of GRM Procedures, handling complaints and grievances, adherence to labour laws, promote gender equality and international commitments etc. Similarly, water usage amongst the labourers shall be monitored and controlled to minimize generation of wastewater.
- The EPC Contractor needs to ensure that all the required amenities – adequate washrooms, adequate lighting and ventilation in the rooms wherein the labourers will be accommodated, adequate quantities of clean and potable drinking water, access to appropriate medical services etc. is provided in the labour camp.

- Ensure equal participation of women and men in livelihood restoration plans with project developers and local government authorities.
- Ensure the application of the principle of equal remuneration for men and women for work of equal value. Ensure that the recruitment procedure is transparent and that there is no discrimination.
- The project shall ensure that no child or forced labour is engaged by contractors and all wage payments are done without any discriminations or delays by the contractors. Similarly, adequate sanitation and waste disposal facility shall be ensured at the project site.
- The project 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.
- FPEPL should ensure that the accommodation provided to the migrant workers during the construction phase should comply with the provisions of PS 2 of IFC's Policy on Environment and Social Sustainability relating to worker accommodation.
- Action plans as suggested in the Social Compliance Audit to be effectively implemented.

7.6 Impact of Climate Change on Solar PV Power Plant

Due to global temperature rise and speed at which climate change is occurring, it is evident that countries are becoming vulnerable to climate change, which reduces the development path. Since climate change is expected to impact natural and human systems adversely by inducing changes in these systems, India can be considered highly vulnerable, as the extent of exposure is very high when compared to most countries in the world. Climate change is only likely to exacerbate India"s already high physical exposure to climate-related disasters as 65 percent of India is drought prone, 12 percent flood prone and 8 percent susceptible to cyclones. Consequently, climate change is likely to impact livelihoods by disrupting social, cultural, economic, ecological systems, physical infrastructure and human assets, accentuating health risks hence posing severe risks to the development of the country.

At the same time, recognising that the impacts of climate change will vary across States, sectors, locations, and that different approach will need to be adopted to fit specific sub-national contexts and conditions. All Indian States are preparing State Action Plans for Climate Change (SAPCCs) with the NAPCC. Like many other States with similar developmental contexts, Tamil Nadu too has high dependence on natural resources and faces the threat of climate change and its impacts. Available evidence shows that there is high probability of increase in the frequency and intensity of climate related natural hazards and hence increase in potential threat due to climate change related natural disasters. In the (relative) absence of State level climate models and/or vulnerability studies, as well as low community awareness, Tamil Nadu is potentially mere sensitive and vulnerable to climate change and its impacts.[37] District wise climate projections till 2100 was done as part of this action plan, Sivaganga district projections can be found in the below:

[37] Tamilnadu-Final-report.pdf (moef.gov.in5)

Table 7-29: Climate Parameters Projections

Parameters Measured	Sivaganga District		
	2010-2040	2040-2070	2070-2100
Change in maximum temperature in °C with reference to 1970-2000	1.1	1.9	2.7
Change in minimum temperature in °C with reference to 1970-2000	1.1	2.4	3.5
District wise percentage change in annual rainfall with reference to 1970-2000	-4	-2	4

Source: Tamil Nadu State Action Plan Change For Climate Change[38]

A report was shared by national disaster management authority of India after cyclone Gaja hit coasts of Tamil Nadu in 2018. This report also included cyclone prone districts of India touching the coast based on the frequency of total cyclones and severe cyclones. It states that ninety-six districts including 72 districts touching the coast and 24 districts not touching the coast but lying within 100 km from the coast have been classified based on their proneness. Out of 96 districts, 12 are very highly prone, 41 are highly prone, 30 are moderately prone, and the remaining 13 are less prone. Based on the incidences of cyclones, strength of wind speed, Probable Maximum Storm Surge (PMSS), Probable Maximum Precipitation (PMP), the proneness of cyclones in various districts of India has been categorized. Table below clearly shows that Nagapattinam District of Tamil Nadu falls under category P2, whereas Thanjavur District falls under category P3. These two districts were the worst affected by Cyclone Gaja. Sivaganagi district where project will be located is not included in the same.

Table 7-30: Cyclone Prone Districts Of Tamil Nadu Touching The Coast Based On The Frequency Of Total Cyclones And Severe Cyclones; Strength Of Actual/Estimated Wind Speed With Rating Of 2, 4, 7 And 10, PMSS And PMP For All Districts

Districts	No of severe cyclones	Total no of cyclones	Strength of wind speed	PMSS	PMP	Mean rating	Category of proneness
Puddukottai	3	3	4	10	7	5.4	P2
Cuddalore	5	5	7	5	10	6.4	P2
Kanchipuram	7	7	4	5	10	6.6	P2
Tiruvarur	3	5	7	7	7	5.8	P2
Nagapattinam	3	3	7	7	10	6.4	P2
Chennai	3	3	10	5	7	5.6	P2
Thoothukudi	3	3	4	10	7	5.4	P2
Viluppuram	3	3	7	5	10	5.6	P2
Ramanathapuram	3	3	4	10	5	5	P3

[38] Tamilnadu-Final-report.pdf (moef.gov.in)

Districts	No of severe cyclones	Total no of cyclones	Strength of wind speed	PMSS	PMP	Mean rating	Category of proneness
Tirunelvelli	3	3	4	10	5	5	P3
Thanjavur	3	3	7	7	5	5	P3
Tiruvallur	3	3	7	5	7	5	P3
Kanyakumari	3	3	4	5	3	3.6	P3

Source: National Disaster Management Authority Of India[39]

ADB conducted a climate risk assessment for the project and rated it a medium risk project based on different parameters like temperature increase, flood, precipitation increase, landslide etc. Breakdown to which is mentioned in the figure below. The study performed used Aware geographic data set which based on the coordinates of the project gives the risk assessment on various parameters. For the current project, it marked flood and water availability as a high risk, temperature change, precipitation increase, wind speed increase and solar radiation change as medium risk category and others in the low-risk range.

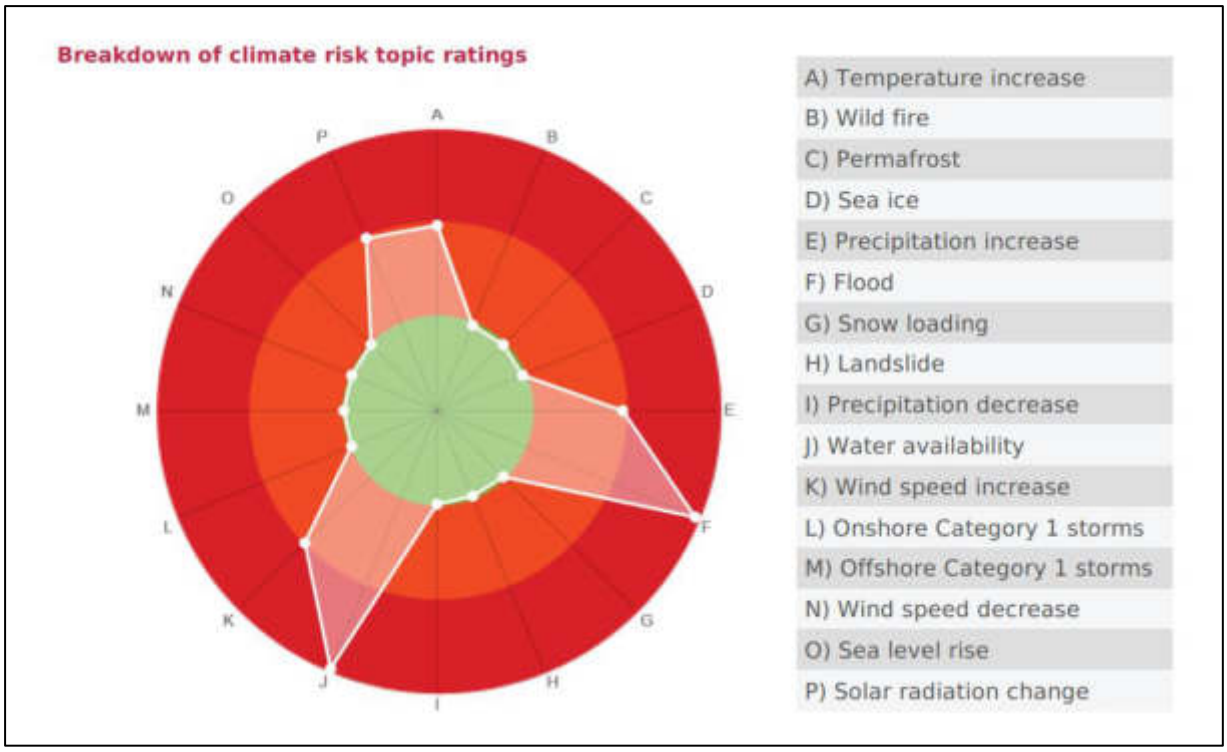

Figure 7-37: Project Climate Risk Ratings Based on AWARE Geographic Data Set by ADB

7.6.1 Anticipated Impacts

7.6.1.1 Construction Phase

This ESIA has focused on the following aspects related to the climate change:

- The potential effects of the project on climate, in particular the magnitude of greenhouse gases (GHGs) emissions emitted during both construction and operation

[39] Untitled-1 (ndma.gov.in)

- The impact of climate change on the project over its lifetime;
- The impact of the project on the climate resilience of wider (social, environmental and economic) systems over time.

GHG Emissions from Solar Power Plant

The potential sources of GHG emissions during construction phase will be vehicular movement, DG set exhaust including unburnt hydrocarbon and carbon-monoxide, and exhaust emissions from construction equipment and machinery. Over 90% of the fuel used for transportation is petroleum based which includes primarily gasoline and diesel[40]. There is also an environmental footprint when equipment is delivered to the project site, and during the construction stage. However, even when all these factors are considered, the lifetime emissions from solar power are much less than those produced by fossil fuels.

The US-based National Renewable Energy Laboratory (NREL)[41] estimated that solar power produces lifetime emissions of 40g CO2 equivalent per kilowatt-hour. And more over a study by Nature Energy[42] was more optimistic which estimates the emissions below 21 g CO2 eq / kWh. For comparing, many coal power plants produce over 1,000 g CO2 eq / kWh, and even the “cleanest” coal power is generally above 700 g CO2 eq / kWh. Natural gas generation is less polluting, with emissions above 400 g CO2 eq / kWh, but still 10 times higher than the NREL estimate for solar power.

The GHG emissions from construction activities cannot be determined at this stage as the design details, construction plan and details of the construction materials are still in the process of getting finalized, but the impact assessment and mitigation measures in this section will consider the likely impact of the project due to climate change during construction phase to ensure minimum impact. Hence the GHG emissions from the proposed solar power plant is not likely to have serious impact on the climate change during construction phase.

The impact of climate change on the project

Some of the key impacts of climate change on the proposed project are:

- Rise of atmospheric temperature and heat: The rise in atmospheric temperatures will likely reduce air quality with increase in particulate matter and ozone pollution in the atmosphere and impact the ambient air quality during the construction phase.
- Increase in rainfall and flood: The region where the Solar Power Plant is proposed to be less susceptible to flood and the same has been shown in figure below.

[40] Sources of Greenhouse Gas Emissions | US EPA
[41] Life Cycle Greenhouse Gas Emissions from Solar Photovoltaics (Fact Sheet), NREL (National Renewable Energy Laboratory)
[42] Understanding future emissions from low-carbon power systems by integration of life-cycle assessment and integrated energy modelling | Nature Energy

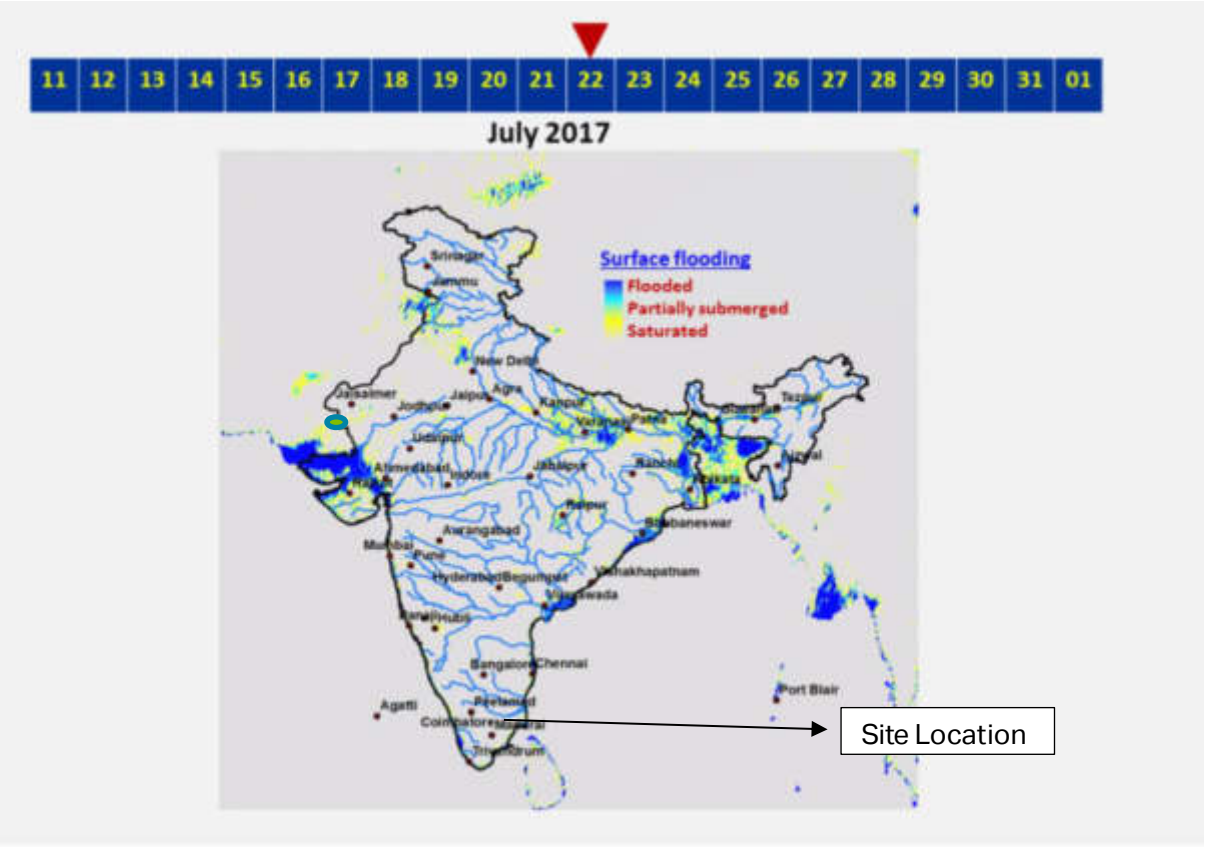

Figure 7-47: Flood Scenario in Tamil Nadu State as recorded on 22nd July 2017

Source: ISRO Website (https://www.isro.gov.in/flood-monitoring-using-scatsat-1-satellite)

- The rainfall is the main source for the availability of water both in surface and sub surface. The quantum of rainfall varies every year depending upon the monsoon. However, the extraction of surface and sub surface water is increasing year by year. It leads to environmental impact on the water sources like depletion of water level, deterioration of water quality. It makes the demand for the quantification of available water and also its quality for various purposes like agriculture, industries, drinking and domestic purposes. The long-term fluctuations of water levels range from G.L. to 14.0m in many parts of the Sivaganga District. The analysis reveals that the water level has gone down in the north, west and central parts of the Sivaganga District. The inference taken from the annual fluctuation is due to lack of rainfall which in turn affects the groundwater levels in phreatic aquifer. Kalayarkoil falls in the east of Sivaganagi, so precautions need to be taken while extracting ground water for operation phase and proper recharge facility needs to be designed at the project level.
- Exhaust Emissions: There is likely to be significant CO2 emissions during construction phase arising from vehicular emissions, DG set emissions and exhaust emissions from heavy earth moving equipment and construction machineries. However, the quantum of emissions during the temporary construction phase will be of short duration and impact is not likely to be significant. The technology selected for power generation uses solar energy which is an environmentally friendly source.

Mitigation Measures

- FPEPL collects hydrogeology data and runs it for flood risk assessment for projects depending upon site locations. The same is ongoing for the project.
- Use of machines, DG, equipment and vehicles only with appropriate pollution fitness certificates. Also carry out periodic maintenance of equipment and vehicles.

- Estimate, maintain and publish carbon footprint (month wise) during construction activities and operational phase and reduce vehicular movement where possible.
- Avoid use of Ozone Depleting Substances during construction phase.

7.6.1.2 Operational Phase

Solar Power Plant is an environmentally friendly power generation technology which has potential to significantly reduce green-house gases (GHG) emissions as it does not use any fossil fuel and thereby reduces the greenhouse gas emissions associated when compared with fossil fuel-based electricity generation system. However, the proposed 50 MW Solar PV Power Plant, like all other Solar Power Plants and their components is vulnerable to fluctuating weather conditions and climate change in broader perspective. The photovoltaic panels of the solar power plant are vulnerable to extreme weather conditions like hail, storm, extreme temperature, cyclones or floods. The climate change factors like extremely high or low temperatures, and high wind could reduce the yield of solar modules. Research have shown that for each degree of global temperature rise, solar modules could lose around 0.45% of their rated output (Source: "Global warming will hit solar panel performance", *PV-magazine dated 16/08/2019*). However, the design of solar panels will take into consideration the Solar Radiation Assessment Report, which is likely to minimize the impact of climate change on solar panels 'operating efficiency throughout the design life of 25 years. Considering the design of solar panels have taken into account the impact of climate change on the rated outputs, the impact is not likely to be significant.

GHG Emissions from Solar Power Plant

As per the estimation of International Atomic Energy Agency (IAEA) the grams of carbon equivalent (including CO_2, CH_4, N_2O etc.) per kilowatt-hour of electricity (g Ceq/ kWh) for Solar energy project are low and scores better when compared with other forms of conventional and non-conventional sources of energy. The estimated average life cycle of GHG emissions from solar power plant is approximately 85 tonnes CO_2e/ GWh as against 500-880 tonnes CO_2e/ GWh for natural gas and coal respectively. Installing a 50MWac (75MWdc) power plant is equivalent to planting about 20,000 matured trees. Also, this power plant will help to reduce 160055 metric tons of CO2 emission for first year.

The impact of climate change on the project over its lifetime

Some of the key impacts of climate change on the proposed project are:

- Rise of atmospheric temperature and heat: This climate change will likely increase the ambient temperature of the region and the country resulting in warmer winter and hotter summer. The increased risk of heat waves could impact the solar panels and deformation of Plant & accessories and road surfaces resulting in reduction in service life. Increased temperatures are likely to lead to issues with expansion of joints and cracking of internal plant and concrete pavements/structures exposed directly to atmosphere. Higher summer temperatures will likely reduce air quality with increase in particulate matter and ozone pollution in the atmosphere and impact the ambient air quality.
- Increase in rainfall and flood: The climate change due to increase in rainfall and flood across the region may further aggravate the current scenario and increase in frequency and intensity of heavy rainfall events, which are likely to increase the water level. However, it is recommended to take into consideration flood protection measures enhancement through site elevation above the maximum flood level and with adoption of flood protection/erosion protection measures, hence the impacts of climate change on project production phase are not deemed significant. It was known that FPEPL with the help of 3rd party consultant performs hydrological study from IMD run flood study for 25 years based on site conditions and currently this study is on-going. It was also reported that the technical due-diligence report done for the project will include the temperature increase and will incorporate in the design consideration.
- Exhaust Emissions: The technology selected for power generation uses solar energy which is an environmentally friendly source. Although there will be vehicular movement to and from the

power plant during operation phase, the incremental increase of GHG emissions in the ambient air quality will be negligible due to very low number of vehicular movements.

Mitigation Measures:

- Green belt development within near by villages ;
- Adopt recycling/reuse of water to minimize freshwater consumption. This could be achieved by adopting various initiatives e.g. recycling treated wastewater for toilet flushing, landscaping etc.
- Use of machines, DG, equipment and vehicles only with appropriate pollution fitness certificates. Also carry out periodic maintenance of equipment and vehicles.
- Design and construct rainwater harvesting structure to retain the rainwater/stormwater and minimize freshwater consumption.
- Estimate, maintain and publish carbon footprint (month wise) during construction activities and operational phase and reduce vehicular movement where possible.
- Avoid use of Ozone Depleting Substances during operation phase.

7.6.1.3 Climate Transition Risk

Government of India and State Government of Tamil Nadu's commitment towards building a sustainable and climate resilient future for its people, Tamil Nadu State Action Plan on Climate Change (TNSAPCC) was endorsed by Ministry of Environment, Forests and Climate Change (MoEF&CC), Government of India (GoI) in 2015. The approach of the TNSAPCC is to create and define a overarching climate response framework at the State Government level to reduce vulnerability; reduce hazards and exposure; pool, transfer, and share risks; prepare and respond effectively; and increase capacity to cope with unforeseen events, while articulating flexible sector specific response strategies and actions keeping in mind the overall Vision.

The ADB's Checklist for Preliminary Climate Risk Screening was used to check on project sites climate screening. Details of the same are as follows:

Risk Rating

Screening Questions		Score	Remarks
Location and Design of Project	Is siting and/or routing of the project (or its components) likely to be affected by climate conditions including extreme weather-related events such as floods, droughts, storms, landslides	1	likely Solar modules likely to be selected shall be compatible with the climatic condition Sivaganga District, Tamil Nadu
	Would the project design need to consider any hydro-meteorological parameters (e.g., sea-level, peak river flow, reliable water level, peak wind speed etc.)?	0	Note Likely The project area do not have high intensity rainfall
Materials and Maintenance	Would weather, current and likely future climate conditions (e.g. prevailing humidity level, temperature contrast between hot summer days and cold winter days, exposure to wind and humidity hydrometeorological parameters likely affect the selection of project inputs over the life of project outputs (e.g. construction material)?	1	Likely Project can be established within a short time period of 15 months (approx..) therefore temporary impact of climate change on material and maintenance may occur.
	Would weather, current and likely future climate conditions, and related	1	Likely

Screening Questions		Score	Remarks
	extreme events likely affect the maintenance (scheduling and cost) of project output(s)?		
Performance of project outputs	Would weather/climate conditions, and related extreme events likely affect the performance (eg. annual power production) of project output(s) (e.g. hydropower generation facilities) throughout their design life time?	1	Likely Although project has been designed after consideration of temperature variation (annually), significant variation in temperature over the period of project life cycle may affect its performance. Dust particles due to the nearby traffic can also affect the production capacity
Total Risk Score:		4	

- Note:

Options for answers and corresponding score are provided below:

Response	Score
Not Likely	0
Likely	1
Very Likely	2

Responses when added that provide a score of 0 will be considered low risk project. If adding all responses will result to a score of 1–4 and that no score of 2 was given to any single response, the project will be assigned a medium risk category. A total score of 5 or more (which include providing a score of 1 in all responses) or a 2 in any single response will be categorized as high risk project.

Based on the above risk rating, the project is assessed to have medium risk with respect to impact of climate change.

Table 7-31: Impact Significance – Climate Change

Aspect	Scenario	Overall
Climate Change	Without Mitigation	Moderate
	With Mitigation	Minor

7.7 Cumulative Impact Assessment

Cumulative Impact Assessment (CIA) is the process of (a) analyzing the potential impacts and risks of proposed developments in the context of the potential effects of other human activities and natural environmental and social external drivers on the chosen Valued Environmental and Social Components (VECs) over time, and (b) proposing concrete measures to avoid, reduce, or mitigate such cumulative impacts and risk to the extent possible.

Cumulative impacts[43] are a result of effects that act together (including those from concurrent or planned future third-party activities) to affect the same resources and/or receptors as project under consideration (e.g. the combined effect of other similar projects in the general area). An effect to a resource in itself may not be considered significant but may become significant when added to the existing and potential effects eventuating from similar or diverse developments in the area.

[43] As per *Good Practice Handbook on Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets by IFC (2013),* cumulative impacts are those that result from the successive, incremental, and/or combined effects of an action, project, or activity (collectively referred to as "developments") when added to other existing, planned, and/or reasonably anticipated future ones. For practical reasons, the identification and management of cumulative impacts are limited to those effects generally recognized as important on the basis of scientific concerns and/or concerns of affected communities.

The other project located in the surrounding area of FPEPL is given in table below:

Table 7-32: Details of proposed solar projects near project site

Name of the Project	FPEPL	Distance from proposed project site
648 MW solar project	Adani green energy Kamuthi	Kamuthi is approximately at a 50 kms distance from the project area
5 MW solar project	Sapphire Industrial Infrastructures Private Limited	Located at a distance of 17.24 kms in the same district near sivaganga city

Tamil Nadu plans to increase solar potential of the state to 20k MW by 2030 so there is a possibility of other soalr projects in the nearby area. But as of now there's one adani solar project which is 50kms away from the project area and is operational and located towards south of the project boundary. It spans a vast area of 2,500 acres, equivalent to about 950 Olympic-sized football fields. The massive plant comprises 2.5 million solar modules, 380,00 foundations, 30,000 tonnes of structure, 6000 km of cables, 576 inverters and 154 transformers.[44] Another project which is located in the same district and developed by sapphire industrial infrastructure pvt. Ltd. is a solar photovoltaic based power generation project. The total installed capacity of the SPV modules is 5.009616 MW.[45]

In addition to above, there has been a substantial increase in renewable energy developments in India, and legislation is evolving to facilitate the introduction of Independent Power Producers (IPPs). Hence it is anticipated that additional renewable energy power plants will come within 50 km radius of the project area boundary.

Since no information could be ascertained that any other industry or renewable power projects is planned within 5 km radius of project location, no obstruction to common property resources is anticipated. The potential cumulative impacts identified for the project has been highlighted in the following sub sections.

7.7.1 Environmental Impacts

Air Quality and Soil Characteristics
No prominent projects are proposed in nearby areas. The construction activity of project will last for 15 months, the cumulative impact on ambient air quality can be considered low.

Ambient Noise
It is to be noted that ambient noise levels depend on various factors such as the exact number of vehicles/equipment being used at the construction site, number of hours of operation etc. Since construction activities will be temporary in nature and will be carried out during the daytime and will not last for more than 15 months, cumulative noise impact is considered low.

Soil and Water Quality
There will be wastewater generation from cleaning the solar panels. The domestic wastewater may be generated from site office of the operation team. Septic tanks with soak pits should be provided to treat sewage during operation stage. Due to the proposed project, wastewater will be generated during operation phase and there is a potential to impact soil and water quality if wastewater generated is not handled properly. In addition to this, solid and hazardous waste will be generated from the solar park hence cumulative impact on water quality can be considered moderate to high.

7.7.2 Impacts on Biodiversity and Ecosystem Services

The chief Valued Ecological Components (VECs) with respect to the area under consideration include presence of habitats suitable to globally threatened species and other habitat-specialist species as described in the biodiversity baseline.

[44] One Of The World'S Largest Solar Power Project in Kamuthi, Tamil Nadu (adanigreenenergy.com)
[45] Microsoft Word - MB_PDD_22032011_Clean (unfccc.int)

7.7.2.1 Impact on Biodiversity

The main cumulative impact envisaged is the increased risk of collision and electrocution for migratory birds from the introduction of new transmission lines into the Study Area. Another major impact envisaged is the fragmentation or loss of suitable natural habitat of globally threatened and/or endemic or range-restricted species, especially *Hemidactylus scabriceps* (Scaly Gecko, IUCN Red List Status: EN). Cumulative impact would also result from the generation of a large, reflective, water-mimicking surface by the collective solar panelling which would increase risk of false landings and the resulting injury and entrapment for water-birds.

The mitigation measures stipulated in this report will alleviate the impacts on biodiversity, considering that the existing projects are at a significant distance (approximately over 15 km) from the Project Site and more information is not available on proposed or upcoming projects

7.7.3 Socio-economic Impacts

7.7.3.1 Impact on land

The total land requirement for the proposed project would be around 225.98 acres which includes installation of Solar modules of 50MW capacity along with site office, inverter room, and other associated facilities. The entire project land was observed barren and does not involve any livelihood dependency on the said land by the landowners. During site visit, it was observed that the project site does not hold any permanent structures, or a grass land suitable for extensive grazing also there are no presence of any religious or cultural important places within the project site and along the proposed TL connecting the PSS and GSS and will have no bearing/ impact on any scared place. The land falling withing the RoW of the proposed transmission line will be cleared for laying transmission line and post implementation of the project the ownership of the RoW land lies with the respective owners. However there will be permanent hindrance in using machineries and growing tall trees below the RoW.. The project of FPEPL will have no economic impacts as no farming activities or other livelihood pursuits are being undertaken on solar plant site and with respect to TL RoW there may be loss of crops during construction phase which will be compensated as per the LRP developed for the project.

7.7.3.2 Migrant Workers

During the O&M phase, all the projects proposed to be set up in the solar power park will not involve any migrant labor. Only skilled personnel will be hired from outside the project area, who will be accommodated in rented accommodation complying with the relevant provisions of PS 2 of the IFC policy on environmental and social sustainability. Most of the civil works being small in nature should be handled by the local contractors from the nearby regions. This would ensure that the workers are from local area. Only skilled workers for erection of solar modules and operation of cranes should be sources from outside and their numbers should be relatively less.

As a strategic principle, all the proponents should decide to engage local people during construction to avoid migration of labor from far off places. This will not have any stress on the local and moreover provide job opportunities to the local population.

7.7.3.3 Impact on Infrastructure

The road connectivity in the area is good therefore transportation of solar modules and other construction materials/ machineries will not lead to any disturbances to the habitations. There will be no disturbance to habitations as the erection activities will be undertaken at a considerable distance from human settlements.

7.7.4 Conclusion

The Project will have minor as well as short term impact during construction phase. Minor impact due to generation of dust and fugitive emissions are expected during construction phase only. Minor impact is expected to resource utilization like land, water and socio-economic conditions of the Project area villages. Land for the proposed Project is owned by farmers, who are dependent on rain for farming. Impact analysis reveals that minor impact is anticipated on livelihood of local community. The

impacts on environment and social parameters is assessed to be minor during operation phase of the proposed project.

The Project would change overall character of the region and would contribute to the conversion of rural dry waste land to landscapes with industrial character. However, no existing highly scenic view or aesthetically unique or distinctive landscape would be forfeited by the introduction of these types of Projects. The Project represents conversion from a natural environment of dry agricultural fields to build environment with an industrial character. The area is unpopulated, and no residents would be subject to alteration of view in association with proposed Projects. The Project would change the landscape pattern of the area and likely to have some impact on biological diversity through habitat loss, degradation and fragmentation.

Therefore, minor cumulative impact may be expected due to the Project and other Projects which may come in future in the area at present.

The Project also has a positive impact in terms of employment generation for the local people during entire Project lifecycle. The impacts identified both during construction and operation phase can be minimized and mitigated by adopting suitable mitigation measures as suggested in the ESIA report. Based on the conclusion drawn from the ESIA study the proposed Project can be categorized as Category B (as per SPS1 and 2) and Category C as per SPS3, which specifies that this Project is expected to have limited adverse environment and social impacts which can be mitigated by adopting suitable mitigating measures.

8. Environment and Social Management Plan

8.1 Introduction

The purpose of an Environmental and Social Management Plan is to ensure that social and environmental impacts, risks, and liabilities identified during the ESIA process are effectively managed during the operation and closure of the proposed project. An Environmental and Social Management Plan (ESMP) is an important component of an ESIA as it provides an important tool that can be used to measure and check, in a continuous mode, the efficacy of the mitigation measures and project commitments incorporated in the ESIA to minimize or eliminate identified negative impacts. The ESMP also aligns the schedule for implementation of management plans.

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;
- Monitor the FPEPL's compliance with all the mitigation measures and commitments in the ESIA report;
- Monitor the FPEPL's compliance with legal standards and limits for waste discharge and emissions;
- Provide early warning signals on potential environmental changes, so that appropriate actions can be taken to prevent or minimize environmental and social impacts;
- Put in place a sound and cost-effective contingency plan that can be activated for prompt response to any accidental occurrence;
- Encourage and achieve the highest environmental and socio-economic performance and response from individual employees and contractors throughout the duration of the project; and
- Routinely check all measures/devices put in place for effective monitoring of project functions and activities.

The ESMP delineates the monitoring and management measures to avoid and/or minimize such impacts by allocating management responsibility and suggesting skill requirement for implementation of these measures. Also, the ESMP shall ensure a continuous communication process between FPEPL, project developer, workers (including sub-contractors), local community and other stakeholders. In addition, the ESMP may also be used to ensure compliance with statutory requirements, and corporate safety & environmental and social management policies.

An ESMP is, therefore, a tool which ensures continuous assessment of the environmental and social impact of a project operation as well as proactive response to the impacts to reduce their overall effect on the identified environmental and social parameters. It makes an organization to do the right thing at the right time rather than responding to situations borne out of statutory or legal compulsion.

In this section, an ESMP is presented to be used throughout the life span of the proposed project. This ESMP will facilitate environmental and social management of the proposed project and procedures are provided to help prevent, avoid, or minimize negative environmental impacts that may occur during project operations and decommissioning phase. It was also observed that a corporate level Environmental and social management system was in place and the same is applied to for all their assets.

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. FPEPL's Organization structure at the time of construction and operation phase with project level responsibilities is given in figures below.

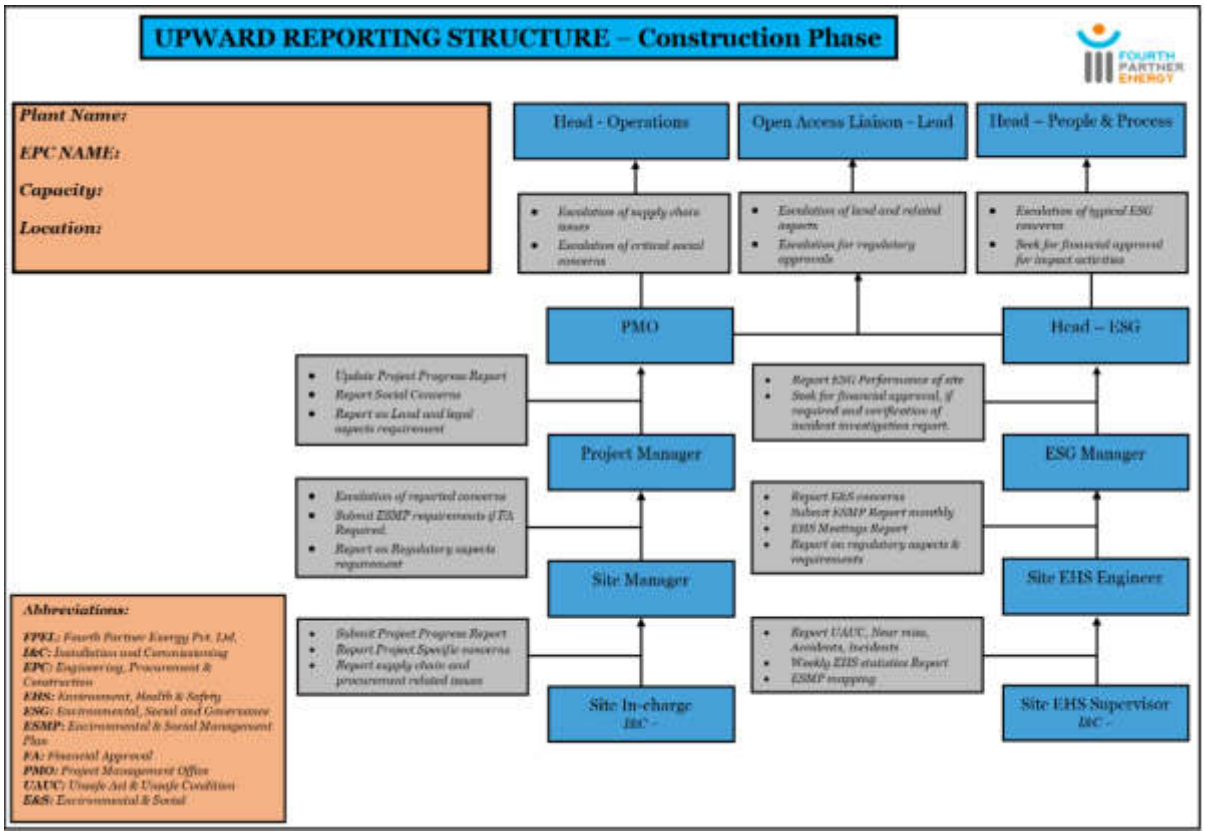

Figure 8-1: Project Organization Structure (Construction Phase)

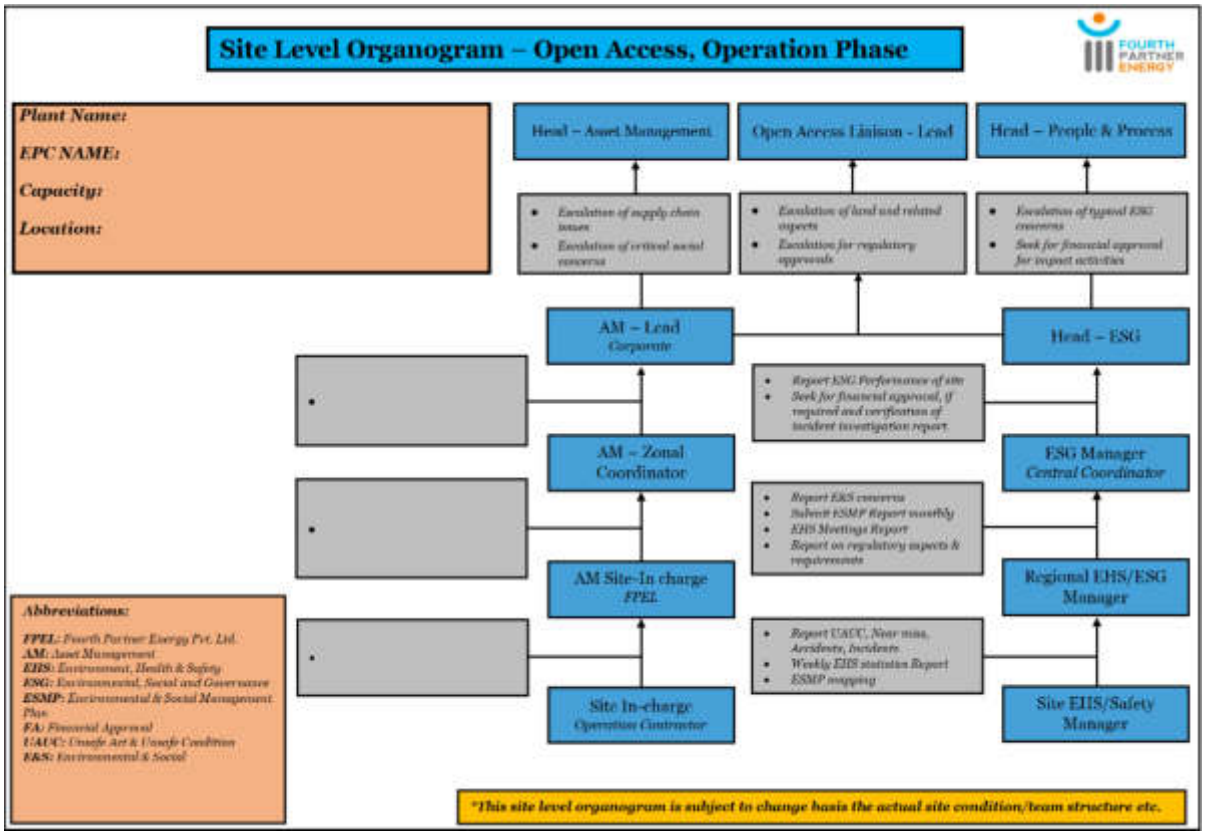

Figure 8-2: Project Organization Structure (Operations Phase)

The overall management and coordination of the project with respect to EHS will be managed through the Head, EHS at the corporate level. Also, a designated EHS professional/EHS Project (by FPEPL) is assigned at the project level to manage the EHS functions and activities during the construction stage (including supervising the day-to-day activities of the Sub-contractors and their team). The Site level EHS Project will in turn report to FPEPL Corporate. FPEPL will be responsible for the O&M of the project. As per the recent discussion with the site representative, EPC contractor is yet to be finalized and decided on the roles and number of individuals to be involved in the project. It was also known that the above organizational structures will be followed at construction and operation phases. Though, the below figure 8-3 shows the EHS organogram in simpler manner. Managing all the EHS related activities will be done by FPEPL itself through a third-party contract and it will be done only for the period of construction. Same will be an intermediate between EHS EPC and EHS zonal head (FPEL).

For operations and management activities, FPEPL will be responsible in the long term. However, it was also known that the PPA agreement done with the company for construction phase will have an additional initial 2-3 years of operation and maintenance activities post which everything will be solely maintained by FPEPL.

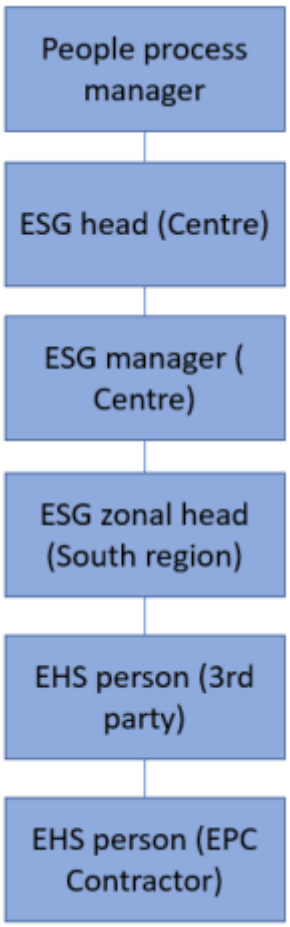

Figure 8-3: EHS Organogram

8.3 Roles and Responsibilities

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

Head-People and process as ESMS Head

- Lead the ESMS committee to ensure effective implementation of the ESMS and policy requirements at all levels of the organisation;
- Ensure that the EHS &Social Policy are approved and effectively communicated to relevant stakeholders, and provide directives for implementation and fulfilment of policy commitments;
- Ensure that E&S roles and responsibilities are properly defined, understood and carried out at all levels within the organisation;
- Ensure that adequate resources are provided for effective implementation of the ESMS;
- Report progress of ESMS implementation to the Board;
- Disclose information on material E&S aspects to other stakeholders as required, on periodic basis with due approval from the Board

ESG head as ESMS manager

ESG -Head at the corporate level would be appointed as the ESMS Manager and will be assigned with the following roles and responsibilities:

- Ensure all activities of the ESMS process are completed;
- Ensure ESDD & ESIA reviews are conducted and incorporated into the decision-making process at FPEPL;
- ESAP and ESMP are documented, accepted, and incorporated into the action plans at the site and all offices of FPEPL; and
- Report on progress and adherence to ESMS and items on ESAP/ESMP.

Apart from the project related aspects, Site In-charge with open access team will also have additional responsibilities of community lesioning such as:

- Managing all grievances of the project and their outcomes;
- Implementing, monitoring and updating the ESMP;
- Keep record of the Community Development activities being undertaken for the project, if any;
- Keep the Project Manager informed on the progress of Community Development activities undertaken at project site;
- Conduct periodic (formal and informal) meetings with local community for understanding their grievances and inform them about the Grievance Redressal Mechanism and ensure effective implementation.

Project Managers as ESMS Site in-charge

The asset level or onsite ESMS Site In-charge shall be responsible for:

- Ensuring ESAP and ESMP are implemented and followed-throughout the project lifecycle;
- Ensuring contractors, sub-contractors and vendors adhere to practices in line with ESMS; and
- Monitoring initiatives and progress against ESMS policy to be submitted to the ESMS Manager at the frequency established.

EPC Contractor (during construction phase)

The HSE officer of the EPC contractor will be overall responsible for management of environmental and social aspects, labour management during the construction phase. Being the project proponent, for all the environmental and social related activities, FPEPL will have the ultimate responsibilities. The detailed roles and responsibilities of the EPC Contractor have been provided in the table below:

Aspect	Roles and Responsibilities
Air Quality Management	• Ensure the reduction and control of air emissions from construction activities by minimizing dust from material handling sources, loading and unloading of materials and stockpiles. • Sprinkling of water to be carried out to suppress dust from construction activities. • Ensure that the vehicles engaged for project have a valid “Pollution under Control” (PUC) certificate and the speed of vehicles shall be limited on village roads to reduce fugitive dust emissions. • Provide sufficient stack height to D.G. sets as per the CPCB norms.
Soil Quality	• Provide appropriate storage of topsoil in an isolated and covered area to prevent its loss during high wind and runoff. • Use topsoil at the time of plantation

Aspect	Roles and Responsibilities
	• Reuse Construction debris in paving on site approach road to prevent dust generation due to vehicular movement. • Re-vegetation to be done in the area after the completion of construction, in order to reduce the risk of soil erosion.
Surface and Ground Water Quality	• Construction of dedicated storm water drains considering natural topography for reduction any contamination to runoff due to project activities. Storm water drains shall be designed to avoid any obstruction to natural flow and final outlet shall be connected to propose storm water drains by Solar Power Park Developer; • Proper drainage to be provided for wastewater generated from the Porta Cabins and labour camps and shall be treated on Site septic tanks and soak pits as per the specifications in IS 2470:1995 (Part I and Part II); • Provide separate toilets for male and female workers (if any) in the ratio of 1:15 and 1:10 (toilet to workers) at the project site in order to maintain hygienic and clean surroundings. Washing and bathing areas should be provided with proper drainage system so that wastewater is not accumulated in the project site. • Conduct Periodic monitoring to ensure that the waste water is not finding its way into surface and groundwater; • All solid wastes such as construction debris, used or waste oil, paint cans, etc. will be stored on impervious surface in secure location to avoid soil and groundwater contamination; • Paved impervious surface and secondary containment to be used for fuel storage tanks; • Loading and unloading protocols should be prepared and followed for diesel oil and used oil; • Leak proof holding tanks for sanitary waste water to protect the shallow ground water level. • Conservation of water to be undertaken at all project locations and ancillary facilities and if possible, recycling and reuse of water to be taken utilising every opportunity.
Noise Level	• Mobile noise sources such as cranes, earth moving equipment and HGVs shall be routed in such a way that there is minimum disturbance to receptors. • EPC Contractor shall instruct their safety officers to arrange for inherently quiet construction equipment and machines to maintain the noise level to minimum. • Only manual construction activities shall be carried out during night-time (i.e. no use of machinery). It is also to be ensured that no village road will be utilized for movement of equipment during the night-time. All loud and sudden noises will be avoided wherever possible and fixed noise sources shall be located at least 50 m away from the site boundary. • Rubber padding/noise isolators will be used for construction equipment or machinery. • Temporary noise barriers shall be provided surrounding the high noise generating construction equipment. • The personnel involved in high noise generating activities shall be provided with adequate PPEs to minimize their exposure to high noise levels. • Construction vehicles and machinery will be well maintained and not kept idling when not in use.

Aspect	Roles and Responsibilities
Solid and Hazardous waste management	• Distribute appropriate number of properly contained litter bins and containers properly marked as "Municipal Waste" and ensure that the waste is disposed at a regular interval. • Ensure that the waste is • Domestic and construction waste like recyclables viz. paper, plastic, glass, scrap metal waste etc. will be properly segregated and stored in designated waste bins/containers and periodically sold to local recyclers. • Any wastage/damaged part of solar panel will be sent back to panel vendor for disposal. • Used oil, oil-soaked rags, empty oil lined containers and other hazardous waste should be stored in leak proof containers at designated locations in enclosed structures over impermeable surface with adequate labelling as per the provisions of the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016. Hazardous wastes shall be disposed within ninety days of generation to MPCB approved vendors. • Maintain a register of all hazardous materials used and accompanying MSDS must present at all times. • Spilled material should be tracked and accounted for.
Traffic and Transport	• Only trained drivers with valid license shall be recruited by the EPC Contractor for transfer of material; • Ensure that all the traffic rules are obeyed at all the times and driving under the influence of any drug or alcohol shall be strictly prohibited; • Mitigation measures such as emphasizing 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; • The villagers shall be made aware about the schedule prior to the movement of trucks and transportation in the Project area.
Occupational Health and Safety	• Implement the H&S plan provided by the project proponent at the site; • Provide occupation health and safety orientation training to all employees and workers consisting of basic hazard awareness, incident management, site-specific hazards, safe working practices, and emergency procedures; • Ensure all Health and Safety measures are in place to prevent accidents and reduce the consequences of non-conformance events; • Provide training, awareness and supervision to ensure all of its construction workers comply with the OHS procedures; • Provide appropriate resources i.e. PPE to workers on Site; and • An emergency response procedure and infrastructure will be available on Site to ensure provision of first aid for personnel in case of emergency.
Heat related Stress management	• Increase air velocity for indoor workers by using natural cross-ventilation from windows and doors or mobile or ceiling fans. • Operate effective general and local exhaust ventilation and air conditioning; • Avoid non-essential sources of hot ventilation (e.g. air conditioner outlets adjacent to working areas);

Aspect	Roles and Responsibilities
	• Install a shield between employees and a source of radiant heat such as curtains on windows or other insulating barrier, enclose the heat source, or move the heat source away from employees; • Provide cooled drinking water as close as possible to the work site; • Arrange shade for outdoor workers where practicable; • Provide a cool rest area in which workers can take their meal breaks and tea breaks; • Modify the work schedule or shift times so that outdoor and physiologically demanding work is done in the early morning or late afternoon; • Allow workers to self-regulate their pace of work. • Workers should be encouraged to present to work in a well hydrated state, and take frequent small drinks throughout each shift to replace fluid lost through sweating; • Diuretic Fluids such as tea, coffee, alcohol and some soft drinks should not be used to replenish fluid lost due to heat; • Use PPE that reduces exposure to ultra violet radiation and heat (such as reflective masks or aprons, large brimmed hat, sunscreen); and • Workers returning from periods away from hot environments should be given the opportunity to acclimatise before being expected to undertake work in very hot conditions at full capacity.
Labour Management	• Ensure that no bonded labour, child labour or forced labour are engaged for project-specific construction activities; • Comply with all the applicable regulations concerning labour and working conditions; • Regularly report on issues relating to labour and working conditions to the project proponent; • Provide a platform for raising, processing and redressing grievances of all the contractual workers; • Undertake regular engagements with internal stakeholders with special reference to contractual workers; • Ensure non-discrimination in matters of terms of employment and payment of wages to all contractual workers including migrant workers; • Ensure usage of PPEs by all contractual workers while performing duty at site; and • Ensure that all facilities and basic amenities as required by relevant national legislations and international best practice are provide din the Labour Camp/ Worker Accommodation facilities. • Develop project specific labour management policy (including local labours) which shall be complied by EPC and OM contractors.

Community Liaison Officer (CLO)

The CLO would be expected to undertake the following roles:

- Since the project is being implemented in phases and TL route is yet to be finalized, the CLO will be the contact person to receive and resolve the grievances related to the land sourcing and other community level grievances.
- Manage, review and develop the Social Program to ensure that it fulfils Project requirements, including measures observed in this ESMP and monitor the implementation;
- Co-ordinate and evaluate the effectiveness of all program elements;

- Manage the implementation of community health program, including coordination with HSE team on OHS measures associated with management of impact to community health;
- Coordinating the HSE team on implementation of the Project vehicle safety measures associated with management of impact to community safety;
- Coordinating with Human Resource (HR) team person to ensure implementation of labour related measures required in this ESMP;
- Consultation with community and liaison with relevant stakeholders in implementing the required stakeholder and grievance management measures, including liaison with related government bodies as necessary;
- Leading collaboration to establish and implement the Project grievance mechanism during construction phase, and supervise contractor's social performance as required in this ESMP; and
- Managing social monitoring and reporting the results to the Project Manager.

8.3.1.1 Inspection, Monitoring and Audit

Training is one common method of supplying individuals with additional skills and knowledge. In order to be successful in EHSS management, training programs need to be thought out carefully and systematically. A robust social and environmental, health and safety training plan is important for effective implementation of ESMS.

The EHS Engineer along with recommendations from EHS Projects and EHS Head (at corporate) will ensure that the job specific training and EHS induction training needs are identified based on the specific requirements of the ESMS and existing capacity of site and project personnel (including the Contractors and Sub-contractors) to undertake the required actions and monitoring activities. Some of the specific trainings that will be carried out routine basis are as follows:

- ESMS Checklists and procedural guidance;
- Occupational Health & Safety;
- Fire Safety and Prevention;
- Emergency Response Preparedness;
- Operational Training;
- HR Induction Training;
- PPE Training;
- Driver Safety; and
- Implementation of Environmental and Social Management/Action plans

The above listed trainings are the preliminary trainings which will be undertaken at the inception stage once the employee/worker joins the company and/or Project. Post that, monthly refresher trainings will be undertaken, especially for the workers. Other training will be identified and implemented during the project lifecycle as per the need assessment, as part of mitigation measure and also capacity building of the staffs.

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

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

In case of contractors or turnkey contractors having sufficiently well-developed standards on EHS management, the training can be sub-let to the same for their respective employees and FPEPL will monitor the completion and sufficiency status of these programs. In case of subcontractors, the training and capacity building will be done by the HSE Manager with site responsibilities, along with the contractor's EHS manager to ensure such trainings of the contracted staffs either directly or through trainers of FPEPL. Subsequently the responsibility can be passed on to the sub-contractors for all future training programs.

8.4 Documentation and Record Keeping

Documentation and record keeping system must 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 Management System;
- Legal Register (maintained at sites and copies available at corporate level);
- Preparation of site specific plans
- Work instructions;
- Incident reports;
- Emergency preparedness and response procedures;
- Resource consumption Records;
- Training records;
- Monitoring reports including ESMP implementation reports and copies of environmental compliance;
- Auditing reports; and
- Complaints register, and issues attended/closed.

8.5 Training

Training is one common method of supplying individuals with additional skills and knowledge. In order to be successful in EHSS management, training programs need to be thought out carefully and systematically. A robust social and environmental, health and safety training plan is important for effective implementation of ESMS.

The HSE Manager along with recommendations from Regional HSE Manager, Regional Project Manager and Site Manager will ensure that the job specific training and EHS induction training needs are identified based on the specific requirements of the ESMS and existing capacity of site and Project personnel (including the Contractors and Sub-contractors) to undertake the required actions and monitoring activities. Some of the specific trainings that will be carried out routine basis are as follows:

- ESMS Checklists and procedural guidance;
- Occupational Health & Safety;
- Fire Safety and Prevention;
- Emergency Response Preparedness;
- Operational Training;
- HR Induction Training;
- PPE Training;
- Driver Safety; and

- Implementation of Environmental and Social Management/Action plans

The above listed trainings are the preliminary trainings which will be undertaken at the inception stage once the employee/worker joins the company and/or Project. Post that, monthly refresher trainings will be undertaken, especially for the workers. Other training will be identified and implemented during the Project lifecycle as per the need assessment, as part of mitigation measure and also capacity building of the staffs.

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

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

To ensure the competency of the employees, the ESMS Manager will establish and maintain procedures to ensure that employees and workers working under each relevant function and level are aware of the significant environmental aspects and safety risks, actual or potential, of their work activities and consequences and the benefits of improved personal performance. Their role and responsibility in meeting policy and procedure requirements and health, safety and environmental arrangements including emergency preparedness and response requirements. The potential consequences if operating procedures are not followed. In case of subcontractors, the training and capacity building will be done by the HSE Manager with site responsibilities, along with the contractor's EHS manager to ensure such trainings of the contracted staffs either directly or through trainers of 3rd party. Subsequently the responsibility can be passed on to the sub-contractors for all future training programs.

8.6 Environment and Social Management Plan and Procedures

At the project level, FPEPL need to develop and implement following plans for management of environmental and social aspects of the project during entire life cycle of the project phase:

- Environment and Social Management Plan
- Waste Management Plan
- Storm Water Management Plan
- Occupational Health and safety Plan
- Contract Worker Accommodation Plan
- Traffic Management Plan
- Emergency Preparedness and Response Plan
- Environment and Social Monitoring Plan
- Land access and livelihood restoration Plan

8.6.1 Environment and Social Management Plan

The environmental and social management plan proposed during planning and designing phase mainly focuses on the aspects related to land procurement and resettlement, permit compliances, procurement of materials and landscaping. Detailed ESMP proposed for the planning and designing phase is given in the sections below.

8.6.1.1 ESMP during Construction Phase

Major environmental, social, and biological aspects considered during the Construction phase are:

- Water resources (ground and surface water) and their quality
- Ambient Air and Noise quality
- Soil quality
- Noise levels
- Solid and hazardous waste generation
- Ecology and biodiversity
- Local Economy of the area

Detailed ESMP proposed during the construction phase is given in ***Table 8-1.***

8.6.1.2 ESMP during Operation Phase

The environmental and social management plan proposed during the operation phase has been prepared considering the impacts this project may have on the surround environment and human beings' due operational activities.

The major aspects covered during the operation phase are ambient temperature, solid and hazardous waste generation, wastewater management, ecology and biodiversity.

Detailed ESMP proposed during the construction phase is given in ***Table 8-2.***

8.6.1.3 ESMP during Decommissioning Phase

During decommissioning phase, all the environmental, social and biologicals aspects that were considered for the construction phase have been taken into consideration. The major aspects covered in the ESMP proposed during decommissioning phase are land use, air quality, water quality, soil quality, noise levels and solid and hazardous waste generation. Detailed ESMP proposed during decommissioning phase is presented in ***Table 8-3.***

Table 8-1: ESMP during Pre-Construction Phase

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements/ Further Actions
1.	Permit Compliance	Non-compliance to various Environmental Permits required and pertaining to the proposed Solar Power project or there could be legal Implications to FPEPL	Major	• Site has to obtain various Environmental Permits such as no-objection certificate (NOC) for abstraction of ground water under Environment protection Act Environment Protection Act -1986, in case groundwater is used through installation of groundwater abstraction well or bore well, Factory License under Factories Act, 1948, NOC from Gram Panchayat for Initiation of construction activities, as applicable, and other permits related to workers and living conditions.	Minor	• FPEPL should ensure Periodic EHS audits should be conducted to verify permit requirements and associated compliances
2.	ESMP Implementation	Inadequate implication of ESMP by Developer/Contractor	Moderate	• Site Specific Environment management system and procedures should be prepared before construction work commences; • Social, Environment, Health and Safety Organization Chart shall be prepared at Corporate level and Site-specific level; • Proper procedure shall be developed for training of personnel & contractor, ESMP monitoring and reporting (externally & internally); • ESMP shall be part of the tender and bid documents so that contractor can include cost related to ESMP	Minor	• FPEPL and its contractor should ensure periodic audits should be conducted to verify the implementation and effectiveness of the management systems
3.	Procurement of Machineries and Construction Equipment	Inadequate implication of ESMP by Developer/Contractor	Moderate	• The contractor shall follow all stipulated conditions for pollution control as suggested in ESMP and as per the regulatory requirements	Minor	• Development of EMS management system and procedures before construction work

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements/ Further Actions
	(such as Diesel Generators, Batching Plant, Concrete mixing plant etc.)			• No such installation by the Contractor shall be allowed till all the required legal clearances are obtained from the competent authority • Equipment's conforming to the latest noise and emission control measures shall be used. • PUC certificates for all vehicles and machinery shall be made available for verification whenever required.		
4.	Protection & Conservation of Biodiversity	• Loss, degradation or fragmentation of habitat for wildlife, possibly including a globally threatened endemic reptile species	Moderate	Client shall consider the following as precautionary measures: • Avoidance of approximately 0.05 sq km of palm grove area (as marked in map in Figure 7.1) within the Project Site, to the extent feasible, while designing power plant layout. • Selection of the TL route to minimize overlap with sandy/alluvial soil areas (as marked in map in Figure 7-1), to the extent feasible. • Survey of palm-grove area within the Project Site by reptile expert, immediately prior to unavoidable site clearance, with relocation of any *Hemidactylus scabriceps* (H.s.) individuals encountered. • Presence of an expert reptile handler during any pre-construction and construction activity, with relocation of any H.s. individuals encountered. • Develop an ecological chance-find procedure to be kept available at the	Minor	• Power plant layout design team to avoid palm grove area of Project Site, to the extent feasible • Identification & engagement of appropriate expert to survey palm grove area of Project Site • Identification & engagement of reptile handler to relocate any H.s. individuals encountered during any unavoidable vegetation removal from palm grove area of Project Site.

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements/ Further Actions
				Project Site office, with site personnel being trained to perform the same • Plantation of diverse native vegetation to compensate for that lost to unavoidable land-clearance at the Project Site, if feasible • Maintenance of connectivity and integrity of any existing natural water-channels while building internal roads or embankments.		
5.	Land Access Impacts	• Loss of Livelihood due to erection of Transmission line • Hindrance in use of machinery within the RoW and restriction to grow tall trees		The compensation to be determined as per the LRP as developed for the project. Awareness on GRM procedures to be created among the landowners and relevant stakeholders		• Close Out report to be submitted to ADB on completion of all land transactions. • Grievance Registers and documents on SEP

Table 8-2: ESMP during Construction Phase

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements/ Further Actions
1.	Ambient Air Quality	• Fugitive Dust due to movement of project vehicles and site clearance; and • Emission from Diesel Generators.	Moderate	• The FPEPL and contractors shall ensure the reduction and control of air emissions from construction activities by minimizing dust from material handling sources. • Loading and unloading of raw materials should be carried out in the most optimum way to avoid fugitive emissions. • Sprinkling of water to be carried out by the respective contractors to suppress dust from construction activities. • Best practices such as halting of activity during sustained strong winds should be opted for. It shall be ensured that all stockpiles are covered, and storage areas provided with enclosures to minimize dust from open area source. • Stock piling and storage of construction material will be oriented after considering the predominant wind direction. • Vehicles engaged for the project will be required to obtain "Pollution under Control" (PUC) certificates. • Sufficient stack height needs to be provided to D.G. sets as per the CPCB norms. • Exhaust emissions of construction equipment to be adhered to emission norms as set out by MoEF&CC/ CPCB. • Speed of vehicles on the village road and on the internal roads shall be limited to 10-15 km/hr in order to reduce fugitive dust emissions.	Minor	• FPEPL /Contractor to ensure all vehicles used for transportation must have a PUC certificate. • Monthly check on the exhaust emissions of the construction equipment's and ambient air quality. • As per rule 6 of the central motor vehicle rules, 1989 all transport vehicles to undergo fitness test every year after 2 years of initial registration[46]

[46] Scheme_of_Setting.pdf (morth.nic.in)

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements/ Further Actions
				• Cease or phase down work if excess fugitive dust is observed, or there are any community grievance related to dust. Investigate the source of dust and ensure proper dust suppression.		
2.	Soil Quality	• Topsoil Loss	Moderate	• Provide appropriate storage of top soil in an isolated and covered area to prevent its loss during high wind and runoff. • Allow only covered transportation of top soil within project site. • Use top soil at the time of plantation. • Construction debris to be reused in paving on site approach road to prevent dust generation due to vehicular movement. • Re-vegetation to be done in the area after the completion of construction, in order to reduce the risk of soil erosion.	Minor	• Procedure to be developed for utilization of top soil which may include isolated storage of top soil and its utilization for cover the surface or for gardening; • Records to be maintain for generation and utilization of top soil.
3.	Surface and Ground Water Quality	• Possibility of contaminated runoff from the site entering ground; • Domestic water runoff from the portable toilets into the ground water can lead to degradation of water quality.	Moderate	• Construction of dedicated storm water drains for reduction any contamination to runoff due to project activities. Storm water drains shall be designed considering natural topography to avoid any obstruction to natural flow and final outlet shall be connected to propose storm water drains by Solar Power Park Developer; • Proper drainage to be provided for wastewater generated from the Porta Cabins and labour camps and shall be treated on Site septic tanks and soak pits as per the specifications in IS 2470:1995 (Part I and Part II);	Minor	• Monthly monitoring of storm water drains to check any contamination into drains; • Monthly monitoring of wastewater drains, septic tank and soak pit to check any waste findings or leakage find its way to surface and ground water;

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements/ Further Actions
				• Periodic monitoring shall be carried out to ensure that the waste water is not finding its way into surface and groundwater; • All solid wastes such as construction debris, used or waste oil, paint cans, etc. will be stored on impervious surface in secure location to avoid soil and groundwater contamination; • Paved impervious surface and secondary containment to be used for fuel storage tanks; • Loading and unloading protocols should be prepared and followed for diesel oil and used oil; • Drip paned provided to vehicles with leaks to prevent water contamination; • Leak proof holding tanks for sanitary wastewater to protect the shallow ground water level.		• Monthly monitoring or inspection of fuel storage area, fuel loading/unloading area and hazardous waste storage area for any spillages or leakages into storage areas
4.	Impact on Water Availability	• Depletion on Ground and Surface water resources due to project water demand	Moderate	• Conservation of water to be undertaken at all project locations and ancillary facilities and if possible, recycling and reuse of water to be taken utilising every opportunity. • Restoration plan to accommodate the loss of groundwater to be undertaken.	Minor	• Water Consumption Records on daily basis; • Water recycling and reuse plan on yearly basis
5.	Noise Level	• Disturbance to habitants • Vehicular noise from heavy vehicles utilized to deliver construction materials and solar plant parts • Noise from DG sets • Construction noise from using mobile	Moderate	• In case of complaints of uncomforting noise received from the inhabitants of nearby settlements through Grievance Redressal Mechanism (GRM) there should be considered possibility of putting noise barriers near to the receptor. • Mobile noise sources such as cranes, earth moving equipment and HGVs shall be routed in such a way that there is minimum disturbance to receptors.	Minor	• Monthly monitoring of noise level should be conducted and compared with the ambient noise standard. It should also be made sure that the levels do not exceeded the national ambient

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements/ Further Actions
		equipment, and concrete mixing		• Contractor shall instruct their safety officers to arrange for inherently quiet construction equipment and machines to maintain the noise level to minimum. • Only manual construction activities shall be carried out during night-time (i.e. no use of machinery). The hours of operation for specified pieces of equipment or operations, especially mobile sources operating through community areas should be limited. It is also to be ensured that no village road will be utilized for movement of equipment during the night-time. All loud and sudden noises will be avoided wherever possible and fixed noise sources shall be located at least 50 m away from the site boundary. • Rubber padding/noise isolators will be used for construction equipment or machinery. • Temporary noise barriers shall be provided surrounding the high noise generating construction equipment. • The personnel involved in high noise generating activities shall be provided with personal protective devices to minimize their exposure to high noise levels. • Construction vehicles and machinery will be well maintained and not kept idling when not in use.		air quality standard (NAAQS) level; • Training to drivers of construction equipment
6.	Solid and Hazardous waste	Contamination of Land and water resources,	Moderate	• Distribute appropriate number of properly contained litter bins and containers properly marked as "Municipal Waste". • Domestic and construction waste like recyclables viz. paper, plastic, glass, scrap metal waste etc. will be properly segregated and stored in	Minor	• Monthly EHS audits should be conducted by FPEPL; • Training to Solid and Hazardous Waste Handlers

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements/ Further Actions
				designated waste bins/containers and periodically sold to local recyclers. • Any wastage/damaged part of solar panel will be sent back to panel vendor for disposal. • Used oil should be stored at designated locations in enclosed structures over impermeable surface. • Maintain a register of all hazardous materials used and accompanying MSDS must present at all times. • Spilled material should be tracked and accounted for. • Hazardous wastes shall be stored in leak-proof containers and dispose, to disposal facilities registered with the Central Pollution Board.		
7.	Traffic and Transport	• Community Health and Safety • Traffic related accidents and injuries; • Increased pollution	Moderate	• Only trained drivers with valid license shall be recruited by Contractor for transfer of material; • Training program for all the drivers, regarding awareness about road safety and adopting best transport and traffic safety procedures shall be provided before initiation of the decommissioning activities; • Mitigation measures such as emphasizing 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;	Minor	• Traffic management plan; • Maintain records of driving licenses; • Training to drivers; • Grievance Redressal of any complaint received related to traffic

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements/ Further Actions
				• The villagers shall be made aware about the schedule prior to the movement of trucks and transportation in the Project area.		
8.	Occupational Health and Safety	• Material handling and storage • Possible injuries associated with working with transmission line laying • Other occupational hazards • Accidents during cutting, chipping and piling • Physical injuries when workers involved in loading/unloading activities and don't adhere to proper ergonomics discipline. • Trip and fall hazards • Violation of the privacy and dignity of women involved in the work force. • Other occupational hazards • Diseases due to unhygienic condition	Moderate	• Develop and implement a Health and Safety (H&S) plan to follow throughout the construction phase. Also, ensue that the H&S plan is provided to the EPC contactor for implementation at the site; • Provide occupation health and safety orientation training to all employees and workers consisting of basic hazard awareness, site-specific hazards, safe working practices, and emergency procedures; • The contractors will be committed to ensure all Health and Safety measures are in place to prevent accidents and reduce the consequences of non-conformance events; • The contractors will provide training, awareness and supervision to ensure all of its construction workers comply with the OHS procedures; • The contractor will provide appropriate resources i.e. PPE to workers on Site; and • An emergency response procedure and infrastructure will be available on Site to ensure provision of first aid for personnel in case of emergency.	Minor	• labour engaged for working at height should be trained for temporary fall • All the workers should be made aware of the possible occupational risks/hazards by the way of an OHS training/awareness program • An accident reporting, and monitoring record should be maintained • Proper hygienic and scientific sanitation facilities for all the labourer's working in the site with spate exclusive arrangements for men & women to ensure the privacy and dignity of all individuals

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements/ Further Actions
						• GRM is properly maintained and followed on site. • Contractor should inform the labour about Emergency Preparedness Plan (EMP) and communication system to be followed during emergency situation.
9.	Protection & Conservation of Biodiversity	• Loss, degradation or fragmentation of habitat for wildlife, possibly including a globally threatened endemic reptile species	Moderate	The Client shall consider the following: • Plantation of diverse native vegetation to compensate unavoidable vegetation removal towards site clearance, offset Project-related heat generation and screen solar panelling from adjacent habitats • Restriction of movement of vehicles and operation of heavy machinery to pre-designated routes • Restriction of construction activities to daytime • Avoidance of artificial illumination during night-time • Avoidance or damping of dust, noise and vibrations to the maximum extent possible • Institution of efficient systems for containment and disposal of waste or spillage • Prohibition of harvesting of water, fuelwood or wild foods (including fauna) by construction labour	Minor	• Training of Project personnel, EPC contractors and labour to sensitize towards biodiversity and ecosystem services conservation • Internal monitoring for compliance with any mitigation measures adopted, including monitoring of TL corridor

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements/ Further Actions
				• Use of seamed paving instead of contiguous concrete surfaces to reduce hindrance to rain-water percolation • Organization of solar panelling into discrete clusters, to minimize contiguous reflective surface, if feasible • Insulation of on-ground Project-related electrical components to avoid electrocution risk to fauna • Installation of bird flight diverters on overhead transmission cables, near wetland habitats identified, to minimize collision-risk to aerially moving fauna. • Survey of palm-grove area within the Project Site by reptile expert, immediately prior to unavoidable site clearance, with relocation of any Hemidactylus scabriceps (H.s.) individuals encountered. • Presence of an expert reptile handler during any construction activity, with relocation of any H.s. individuals encountered. • Ensure that a suitably current and updated version of the ecological chance-find procedure is available at the Project Site office, with site personnel being trained to perform the same		
10.	Local Economy (EPC Contractor)	• The project will lead to increase in local employment opportunities and increased demand for materials and services	Minor	• Efforts should be made to ensure that maximum proportion of the demand for manpower and materials is met locally through contractors and vendors.	Moderate	• Informal training to EPC Contractor on the need for local sourcing of manpower and materials.

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements/ Further Actions
		through local contracting.				
11.	Impact on Involuntary Resettlement	• Though the land is being sourced through private negotiations on willing buyer and willing seller basis. Since the procurement is under progress, future transactions may lead to IR issue.	Moderate	• FPEPL to ensure fair and transparent land transactions are made and no landowners are forced to sell their land. • Negotiations with the landowners to be promptly recorded and status on land transactions communicated to the ADB through closeout report. • Any vulnerable landowners are being encountered in the process of land procurement to be reported to ADB in the Compensation Close out report. • If in case any vulnerable PAPs are reported to be affected due to the project, to be compensated as per the LRP as developed for the project.	Minor	• Closeout Report mentioning the status of the Land transactions and impact on vulnerable groups if any.

Table 8-3: ESMP during Operation Phase

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
1.	ESMP Implementation	• Inadequate implication of ESMP by Developer/Contractor	Moderate	• Site Specific Environment management system and procedures should be prepared before operation commences, as required; • Social, Environment, Health and Safety Organization Chart shall be prepared for Site level; • Proper procedure shall be developed for training of personnel & contractor, ESMP monitoring and reporting (externally & internally);	Minor	• FPEPL and its contractor should ensure quarterly audits conducted to verify the implementation and effectiveness of the management systems
2.	Impact on Soil and Water Quality	• Contamination of land and soil; • Impacts due to improper waste handling	Moderate	• Disturbance to soil from repair and maintenance activity will be limited and will ensure proper restoration of soil wherever excavation is undertaken. • Options of buyback agreements for defunct panels and for replacement and disposal of transformer oil by the supplier are to be explored, otherwise arrangements for disposal of defunct panels and waste oil to authorized recyclers are to be made. • Fuel and used oil will be stored in demarcated storage areas with adequate secondary containment and appropriate capacity. Spill control and prevention mechanism will be developed, and all the staff will be trained. • If the solar panels are washed with chemicals, it should be ensured that the chemicals are non-hazardous and biodegradable; • Storage of oil/chemicals shall be undertaken on paved impervious surface and secondary	Minor	• Quarterly check of solid and hazardous waste storage areas, fuel storage areas, chemical storage areas and monthly visual check of spillage or any leakages from these areas

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
				containment shall be provided for fuel storage tanks; • During the washing and maintenance of the solar panels adequate storage area shall be designed to collect the washed water.		
3.	Water Availability	• Depletion of water resources due to project water demand	Major	• The site office shall be provided with sewage line and the collected sewage shall be channelized to a septic tank with soak pit arrangement. • conservation of water to be undertaken at all project locations and ancillary facilities and if possible, recycling and reuse of water to be taken utilising every opportunity.	Moderate	• Maintaining water consumption records on daily basis; • Prepare programme for water recycling and reuse and minimize tanker Water • There should not be a leakage in the storage tankers for which regular inspections should happen.
4.	Occupational Health and Safety of Workers	• Electrocution • Fire due to short-circuit • Possible injuries associated with working at height • Diseases due to unhygienic condition	Moderate	• Regular electrical safety training to workers with safety procedures and other safety requirements that pertain to their respective job assignments; • Occupational health and safety plan should be developed for operations phase • 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.	Minor	• Labour engaged for working at height should be trained for temporary fall • All the workers should be made aware of the possible occupational risks/hazards by the way of an OHS training/awareness program • An accident reporting, and monitoring record should be maintained • Proper hygienic and scientific sanitation

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
				• Loading and unloading operation of equipment should be done under the supervision of a trained professional. • All materials will be arranged in a systematic manner with proper labelling and without protrusion or extension onto the access corridor. • 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 and monitored that they are used by the employees • The transformer yard should be provided with fire extinguishers and sand buckets at all strategic locations to deal with any incident of fire; and • There should be arrangement for hygienic and scientific sanitation facilities for all the labourers working in the site. • An accident reporting, and monitoring record shall be maintained. • Ensure proper sanitation facilities.		facilities for all the labourer's working in the site with spate exclusive arrangements for men & women to ensure the privacy and dignity of all individuals • GRM is properly maintained and followed on site. • Contractor should inform the labour about Emergency Preparedness Plan (EMP) and communication system to be followed during emergency situation.
5.	Biodiversity and Ecosystem Services	• Loss, degradation or fragmentation of habitat for wildlife, possibly including a globally threatened endemic reptile species	Moderate	The Client shall consider the following: • Restore the soil and natural vegetation of any construction-phase roads which are not required in the operation and maintenance phase. • Ensure that all on-ground electrical components are adequately insulated to prevent electrocution of fauna through accidental contact with Project-installations.	Minor	• Trainings for site personnel, contractors and labour to sensitize towards biodiversity conservation • Internal monitoring for compliance with any mitigation measures adopted

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
		• Increase in risk of injury/death by collision/ electrocution for globally threatened resident, migratory and/or congregatory avifaunal species		• Avoid use of artificial lighting in and around the project site as far as possible. • Use low-intensity artificial lighting, such as LED, to prevent insects from being attracted to the site. • Ensure that lighting fixtures are provided with downward-facing shades to limit the dispersion of the illumination. • Ensure that operation or maintenance activities, that require illumination, are restricted to daylight hours to prevent disruption of the natural night period by artificial lighting. • Prohibit the use of herbicides in the Project Site. • Prohibit the use of dust-settling chemicals in the Project Site. • Institute effective training modules and operational systems to ensure prevention of spillages of toxic substances. • Install effective containment systems to prevent any accidental spillage from leaching into the local environment. • Ensure that a suitably current and updated version of the ecological chance-find procedure is available at the Project Site office, with site personnel being trained to perform the same • Monitor TL corridor to record any bird collision/electrocution incidents, including carcass monitoring, and identify any additional/different avian high use areas		

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
				(HUAs) or critical avian habitats after establishment of the transmission line. • The TL monitoring report should inform adaptive management measures such as installing additional or improved bird flight deflectors (BFDs) on Transmission lines.		
6.	Employment Opportunities	• Most of the manpower requirement in the unskilled and semi-skilled categories will be sourced from the local area and will comprise of youth from the neighbouring villages; and • Employment of local youths in the project-specific construction/ operation activities will positively contribute to the livelihood of the local villages.	Minor	• Specific clauses facilitating the employment of local youths can be incorporated into the EPC contract agreement between FPEPL and contractor.	Moderate	• Review of a monthly statement prepared by the EPC/ O&M Contractor highlighting the details of the manpower employed – location-wise, skill-wise

Table 8-4: ESMP during Decommissioning Phase

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements/ Further Actions
1.	Environment and Occupational Health and Safety	• Issue of loss of job when the workers will be asked to leave; • Improper disposal of demolition waste and obsolete machineries will lead to contamination of soil and discontent of community; • Demolition activity is anticipated to generate dust and exhaust emissions which can be carried downwind to habitations; • Risks associated with health and safety issues such as trip and fall, electrical hazard etc.; • The decommissioning activities of dismantling the solar power plant and removing the ancillary facilities	Moderate	• The proponent shall inform the workers and local community about the duration of work; • The workers shall be clearly informed about the expected schedule and completion of each activity; • All waste generated from decommissioning phase shall be collected and disposed off at the nearest municipal disposal site; • Sprinkling of water is being carried out to suppress dust from decommissioning activities and transport movement; • All necessary PPEs shall be used by the workers during demolition work; • FPEPL will be committed to ensure all health and safety measures are in place to prevent accidents and/or reduce the consequences of non-conformance events; • Institution of suitable training modules for project personnel and labour contractors involved in the dismantling process to ensure avoidance or minimization of solar panel damage as far as possible and adherence to appropriate decontamination protocols in the event of any unavoidable damage and adhere to proper safe disposal methods. • Appropriate OHS programme and procedures are also expected to be in place to align with the local regulations, as well as IFC PS-2. The procedure will include, at minimum, the following measures: • Develop and implement a health and safety plan to follow throughout all phases of a project; • Provide occupation health and safety orientation training to all employees consisting of basic hazard awareness,	Minor	• Waste Management Plan for Decommissioning activities; • Training records to workers; • Waste Disposal Records; • OHS programmes and procedures confirming IFC PS-2

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements/ Further Actions
		can lead to increased noise levels; • During the dismantling of the solar power plant, visual intrusions will be likely by removal of ancillary facilities, but their consequence will be negligible due to fact that such impact would be temporary (over a short period); • Depending on the type used, photovoltaic cells may contain toxic substances such as gallium arsenide, copper-indium-gallium-selenide and cadmium telluride. If any solar panel is damaged during dismantling of the facility, these toxins are likely to spill and leach into the soil and water of the area, posing		site-specific hazards, safe working practices, and emergency procedures; • The contractors will be committed to ensure that all Health and Safety measures are in place to prevent accidents and reduce the consequences of non-conformance events; • The contractors will provide training, awareness and supervision to ensure all of its construction workers comply with the OHS procedures; • The contractor will provide appropriate resources i.e. PPE to workers on Site; and • An emergency response procedure and infrastructure will be available on Site to ensure provision of first aid for personnel in case of emergency.		

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements/ Further Actions
		threat to environmental and public health; • If the solar panels are not handled or disposed of appropriately during the decommissioning phase, any toxic substances contained within them are likely to escape into the surrounding air, water or soil, creating serious environmental and public health risks.				
2.	Improper Waste Disposal	• Top Soil Loss • Contamination of land and soil by hazardous waste • Soil Contamination	Major	• Provide appropriate storage of topsoil in an isolated and covered area to prevent its loss in high wind and runoff. • Demolition debris would be properly transported in trucks outside the site with cover to prevent spillage and contamination of local soil • Re-vegetation done in the area after the completion of demolition and dismantling work in order to reduce the risk of soil erosion. • In case of any accidental spill, the soil will be cut and stored securely for disposal with hazardous waste. • Store hazardous material (like used oil) in isolated room with impervious surface. Filling and transfer of oil to and from the container shall be on impervious surface.	Moderate	• The workforce shall be sensitized to handling and storage of hazardous substances viz. fuel oil, machine oil/fluid etc. • The workers engaged in handling hazardous substances shall

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements/ Further Actions
				• Hazardous wastes, when accumulated, be disposed to facilities registered with the TNPCB. • Mini Spill Kit shall be provided at site to counter any spill incident. • Cleared or disturbed areas would be rehabilitated as soon as possible to prevent erosion. • Used and broken Solar panels shall be collected at a designated place and sent back to the manufacture.		be briefed about the possible hazards and the need to prevent contamination.
3.	Protection & Conservation of Biodiversity	Loss or degradation of habitat for wildlife, possibly including a globally threatened endemic reptile species	Moderate	The Client shall consider the following measures: • Restore land-use/ natural vegetation of the Project Site • Restore land under the footprint of access roads • Restrict decommissioning activities to daytime hours • Avoid artificial illumination during night-time • Avoid or damp dust, noise and vibrations to the maximum extent possible • Prohibit harvesting of fuelwood or wild foods (including fauna) by labour • Ensure meticulous removal and sensitive disposal of solar panels and other waste, following the best prescribed practices • Ensure that a suitably current and updated version of the ecological chance-find procedure is available at the Project Site office, with site personnel being trained to perform the same	Minor	• Trainings for site managers, contractors and labour to sensitize towards biodiversity conservation • Internal monitoring for compliance with any mitigation measures adopted
5.	Labour Rights and Welfare	• skilled and highly skilled categories to be which will be sourced from locally & outside the project area.	Minor	• The workers should be aware of their rights and benefits due to them so that no issues emerge. • Adequate sanitation, drinking water and waste disposal facilities should be provided to all workers on site as well; • The project shall ensure that no child or forced labour is engaged by contractors and all wage payments are done	Moderate	• Periodic/ surprise audits and checks

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements/ Further Actions
				without any discriminations or delays by the contractors; and • Grievance Redressal Mechanism for workers should be developed and communicated to the workers so that the workers can approach the management if any concerns or issues are faced by them without any fear of retribution or intimidation.		

8.6.2 Waste Management Plan

All project generated wastes will need to be managed and disposed of in a manner to prevent potential impacts on the environment and risks to human health. A Waste Management Plan (WMP) for the proposed project has been developed.

The construction, operation and decommissioning phase of the proposed project will generate various type of waste which will need appropriate collection, transportation, primary treatment and disposal. Hence, to serve the purpose, a Waste Management Plan has been formulated to demonstrate:

- Inventorization of waste in different type of categories like domestic solid waste, construction debris, wastewater, sludge from wastewater septic tanks, hazardous waste etc.;
- Maintain the site in a clean and tidy state to reduce the attraction of pest species, impacts on the local environment and negative impacts on visual amenity; and
- Suggestion of options for waste handling and disposal during construction and operation phase of the project.

The plan shall be applicable to the FPEPL and Contractor engaged by FPEPL for the proposed project. The elements of the plan will be directly implemented by the contractor staff deployed on site while overall management and responsibility will lie with FPEPL.

8.6.2.1 Waste Type and Quantity Generated

All wastes generated from the project will be categorised as either non-hazardous or hazardous following an assessment of the hazard potentials of the material, in line with local and national requirements.

Construction Phase

The waste will be generated from construction activities like site clearing, levelling, excavation etc. Other categories of waste will be produced daily and comprise of the following:

- Scrap metal;
- Soil waste;
- Food waste from kitchen premises of labour accommodation;
- Construction debris;
- Broken or damaged solar panels; and
- Sewage from temporary toilets.

The operation phase will require the use of hazardous materials such as diesel or petrol to cater the fuel equipment and vehicles and maintain equipment. The following hazardous wastes will also be produced from construction activities.

- Oily rags;
- Used oil and oil filters - from generators or vehicle maintenance; and
- Scrap and packaging material.

Operation Phase

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

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

- Oily contaminated rags from cleaning activities;
- Used oil/ waste oil from machinery.

Decommissioning Phase

Waste generated during decommissioning phase of the project will generate:

- Demolition waste; and
- Obsolete Machinery

8.6.2.2 Waste Management, Handling and Disposal

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

- A buy back agreement for defunct solar panels is required by FPEPL / contractor;
- A designated area needs to be demarcated within the module premises for storage of defunct and broken solar panels with restricted access and on impervious surface;
- All fuel storage should be equipped with secondary containment and spillage trays;
- It is to be ensured that hazardous waste (defunct/broken solar panels, used oil, oily rags etc.) is disposed of through TNPCB authorized vendor/ recycler;
- Transportation of defunct solar panels is required to be undertaken as per the procedures specified by the Manufacture of Solar Panels.
- Proper PPEs are to be provided to the workers handling the broken solar panels;
- The workers at site are also on regular basis appraised about the potential health risks associated with handling of solar panels.
- Domestic solid waste will be segregated onsite and will be disposed of at site as approved by local authority.
- Excavated material to be used for backfilling and levelling and other debris shall be used for road construction.
- Wastewater generated from module cleaning will be used for groundwater discharge. Waste from site office and SCADA (Supervisory control and data acquisition) will be disposed through soak pits and septic tank.
- All the hazardous waste needs to be collected and disposed of through approved recyclers in accordance to the Hazardous and other wastes (Management and transboundary Movement) Rules, 2016.

8.6.3 Storm Water Management Plan

The purpose of Storm Water Management Plan (SWMP) is to ensure prevention and control of any adverse impact caused by un-regulated storm water runoff from the main plant to the nearby natural drainage channels, surface water bodies, public and private properties.

Following measures will be taken as part of the Storm Water Management Plan:

- The peripheral drains will be provided outside the plant boundary during construction phase, which will prevent the silt contaminated surface run-off from site to enter into the adjoining lands.
- No surface run-off from within the solar power plant site will be directly discharged into any nallah/water body.
- Rainwater collected from the project site will be used to stored and if feasible recharge to the ground water through onsite rainwater harvesting tank/pits.

- Adequate arrangements for storm water management during construction period to be made to avoid sediment runoff from the site and to avoid water logging. Storm water flow would be directed to the existing channels with silt traps to avoid sedimentation of the channels or the receiving water body;
- Avoidance of disturbance of flows into natural watercourses i.e. provision should be made for temporary or permanent measures that allow for attenuation, control of velocities and capturing of sediment upstream of natural watercourses.
- As part of the water management, during the construction FPEPL have mentioned in their ESMS that adequate arrangements for storm water management during construction period will be made to avoid sediment runoff from the site and to avoid water logging. Storm water flow would be directed to the existing channels (if present) with silt traps to avoid sedimentation of the channels or the receiving water body.

8.6.4 Water and Wastewater Management Plan

Contamination of water on land i.e., surface water and ground water contamination can happen due to various construction activities. Leakage/spillage of chemicals, oil, improper disposal of waste, etc. can act as major source of water contamination. Also, proper drainage facilities will be constructed during the construction stage to avoid overflow or contamination with natural flow paths especially during the rainy season. The contractors will maintain account of the usage of oil, has inbuilt technical methods and procedures for oil monitoring mechanism, and has mitigation plan for any oil spillage. Following mitigation measures should be incorporated to avoid/reduce the potential impacts.

- The contractor shall arrange for water required for construction in such a way that the water availability and supply to nearby communities remain unaffected.
- Water required for domestic (labor camps and office purposes) and construction use should be taken from sources which have valid permission / permits for the same. In case of use of ground water, appropriate permission from Central Ground Water Board should be obtained for the same.
- All wastes arising from the construction should be disposed in an environmentally accepted manner.
- Any water obtained during dewatering shall either be re-used for construction purpose or recharge to the ground water at suitable aquifer levels. If reuse or groundwater recharge is not possible, then the contractor shall discharge water obtained from dewatering to the nearby drainage system with necessary permissions.
- Any domestic wastewater e.g., sewage should be disposed of suitably with help of septic tank. Adequate care shall be taken not to install mobile toilets in / near the natural drainage areas.
- Open defecation should not be permitted.
- Period monitoring shall be done to check siltation and also to ensure that flow of water is maintained through cross drains and other channels to avoid their blockade/ choking.
- Side drain shall be constructed to guide the water to natural outfalls to maintain natural drainage pattern, if required.
- Water quality monitoring for the same parameters, which were monitored during the baseline studies, shall be implemented by the Contractor by hiring the services of the NABL accredited and MoEF&CC Notified laboratory.
- No vehicles or equipment should be parked, re-fuelled or repaired near water bodies.
- Temporary paved areas should be constructed to be used while refuelling the machineries
- Machinery and vehicles should be thoroughly checked for the presence of leaks if any. Drip pans should be provided with vehicles with leaks to prevent it from reaching the nearby water body.

- All equipment operators, drivers, etc. should be trained in immediate response for spill containment and eventual clean-up.
- All equipment operators, drivers and workers shall be provided with training in immediate response for spill containment and eventual clean-up. Emergency response procedures and reporting shall be made readily available by the contractor in simple and local language.
- Fuel oil, chemicals, etc. should be stored away from water sources, on paved impervious surface and secondary containments for spills collection should be provided.
- Spill control kits should be available for control of any accidental spillage of oil, fuel or chemicals.
- Labour construction camps should be located away from habitation and water course.
- Wherever required, storm water / drainage lines will be provided for proper management of storm water drainage lines to collect/connect surface runoff (during monsoon) from the project site.
- Anti-mosquito / larvicide should be used to control vector borne disease.
- Separate storm water drainage should be included in the design itself. The drains shall be maintained on regular basis to avoid water logging or flooding.
- Turfing of embankment slopes shall be done along the stretch; if required.

8.6.5 Occupational Health and Safety Plan (OHSP)

OHSP provides a guidance document for identifying the potential risks involved in a project operation. This section provides the OHSP applicable to the proposed project, during operation phase of the proposed project. This section also covers the training requirements and safe work practices to be followed onsite to manage various risks involved during the operation phase of the project.

The occupational health and safety plan (OHSP) will address the following:

- Evaluation and Identification of hazards;
- Defining responsibilities to prevent risks;
- Elimination and removal of hazards;
- Control of Hazards which cannot be eliminated; and
- Recovery from accidents.

8.6.5.1 Risk Assessment

Risk assessment is an important step in protecting workers. FPEPL / Contractor shall ensure a risk assessment to be performed by a competent person before commencement of operations on site. Such an assessment shall as a minimum:

- identify the risks and hazards to which persons may be exposed to;
- analyze and evaluate the identified risks and hazards;
- document a plan of safe work procedures, including the use of any personal protective equipment or clothing and the undertaking of periodic “tool box talks” or inductions before undertaking hazardous work, to mitigate, reduce or control the risks and hazards that have been identified;
- provide a monitoring plan; and
- provide a review plan.

Risk assessment includes:

- Identification of hazards, discuss with workers and employees actually working at site, check manufacturer’s instructions or data sheets for chemicals and equipment, review accident and

ill-health records, long-term hazards to health (e.g. high levels of noise or exposure to harmful substances) as well as safety hazards etc.;

- Identify who may be harmed and what type of injury or ill health might occur;
- Evaluate the risks and decide on precautions to protect people from harm. Consider if the hazard can be eliminated and controlled so that harm is unlikely.

8.6.5.2 Control Measures

Operation of a solar power project involves many on job hazards which need to be identified and eliminated or minimized to an expectable level in order to achieve a safe and healthy work environment. Following control measures can be implemented to prevent risks identified on project site:

- Organize work to reduce exposure to the hazard;
- Identification of unsafe working conditions, e.g., falls, electrical hazards, heat/cold stress.
- Provide personal protective equipment (e.g. clothing, footwear, goggles etc.);
- Provide welfare facilities (e.g. First aid and washing facilities for removal of contamination);
- Implementation of LOTO; and
- Record the findings by writing down the findings of the risk assessment.
- Villages to be made aware of the movement of the trucks and transportation vehicles in the project area, well in advance.

8.6.5.3 Training Requirements

FPEPL to ensure that every employee / worker (direct or contractual) is aware of the EHS risks associated with the work being carried out at the site and is trained and competent in the relevant work practices and maintenance procedures. FPEPL shall also establish procedures to identify training needs and provide adequate safety training for all levels of employees including contractors. The safety training should provide staff with the knowledge and skills necessary for organising and managing occupational safety and health programmes; team leaders with leadership skills and knowledge to lead, implement and apply occupational safety and health activities; and workers with the knowledge, skills and right attitudes to enable them to work safely. Training proposed for the project includes but not limited to:

- Induction Training on Health and Safety covering
- HSE policy;
- Hazards and risks associated with operation and workplace;
- Control measure to eliminate or minimize HSE risks, including safe working systems and procedures; use of personal protective equipment; action to be carried out during emergency;
- Emergency response procedures, such as firefighting and evacuation procedure;
- Tool Box Training or pre-task briefings, highlighting hazards and the method of dealing with them;
- Special Job Hazard Training including entry into confined space and another hazardous environment; and
- Training on first aid

8.6.5.4 Documentation and Record Keeping

FPEPL should maintain data and records concerning the identification of hazards, assessment and control of risks of the ongoing activities. The document should establish and maintain procedures for controlling all relevant EHS documents and data. Such documents can include but not limited to:

- EHS Policy;
- Hazard Identification Records;

- Risk Register;
- Licenses, Certificates, Permits;
- Control Methods including process control and machine design, safe work procedures, in-house work rules;
- Design Drawings;
- Organization Structure;
- HSE group meeting records;
- Training Records;
- Drill Reports;
- Inspection and Audit Records;
- Incident/ Accident Records; and
- Medical and Health Surveillance Records

FPEPL should communicate and inform any person affected by risks about:

- The nature of risks involved; and
- The control measures or safe work procedures to be taken to address the risks involved.

The risk assessment should be reviewed and revised upon the occurrence of any injuries to any person as a result of exposure to a hazard in the workplace; or where there is a significant change in work practices or procedures.

8.6.6 Community Health and Safety Plan (CHSP)

Project activities, equipment, and infrastructure can increase community exposure to risks and impacts. Following measures needs to be taken in order to avoid any adverse impacts on the community as part of this Plan:

- Evaluate the risks and impacts to the health and safety to the communities during the project life-cycle and establish preventive and control measures consistent with good international industry practice (GIIP).
- Avoid or minimize the potential for community exposure to hazardous materials and substances that may be released by the project.
- Evaluate the risks and decide on precautions to protect people from harm.
- Exercise special care to avoid or minimize their exposure by modifying, substituting, or eliminating the condition or material causing the potential hazards.
- Assist and collaborate with the communities in preparations to respond effectively to emergency situations, especially when their participation and collaboration are necessary to respond to such emergency situations.
- Implement measures to avoid spills affecting communities, as defined in the Emergency Preparedness Plan.
- Conduct the offsite risk assessment and prepare the plan accordingly.
- Villages to be made aware of the movement of the trucks and transportation vehicles in the project area, well in advance.
- Develop a communication plan to inform them of any significant exercise performed during the construction or operation phase in a timely manner.
- Optimize road transport requirements including consideration for logistics management (minimisation of vehicle movements, etc.)

- Comprehensive traffic management plan should be prepared to avoid traffic congestion in the region.
- Efforts should be made to avoid heavy vehicle movement during peak traffic hours.
- Use of open ground, community properties, etc. for project activities or parking should not be done without proper permissions of concern authorities.
- The labour camps should be at sufficient distance from nearby habitations and labours should be instructed about not trespassing any other area.
- Efforts should be made to avoid dismantling / misfunctioning of any community infrastructure like road, gas, telecommunication, etc. without prior permission of concern authorities and due intimation to community which will be affected.
- If there is necessary, then contractor should provide other alternative options for locals.
- All community utilities likely to be impacted, such as sources of water, community centre etc. shall be relocated to nearby suitable places.
- The work scheduled should be arranged to avoid any nuisance to nearby communities.
- Use of agricultural land for storage of construction materials and equipment's should be avoided.
- Work area should be barricaded to ensure public safety and access to such area should be prohibited for locals and passers-by.
- Contractors should display appropriate signage in local language at the construction sites to make the travellers aware of the ongoing work.
- The segregation, storage and disposal of various solid and liquid wastes generated at site should be as per relevant applicable national regulations. Disposal of solid and liquid waste should be done at designated areas with proper permission from concern authorities.
- All construction machinery and equipment's should be operated and maintained regularly in such a way so that air emission, noise or vibration related impacts are minimal on nearby community.

8.6.7 Labour Management Plan

The Labor Management Plan (LMP) to be developed to manage labor risks during the implementation of the project.

- The LMP is to be in line with national requirements and ADB Safeguard Policy Statement as well as complying with the objectives and requirements of Environmental and Socials Standard 2: Labor and Working Conditions (PS2) and Standard 4: Community Health and Safety (PS4).
- The labour Management Plan will be complied by all employees, contractors, subcontractors and primary suppliers of the Projects.
- The Labour Management Plan to be communicated to all the relevant stakeholders in the language understandable them for further compliance and implementation.
- The Labour Management to give focus on but not limited to the following important aspects
    - Recruitment including local recruitment - . The preference for employment will be given to local people, in particular those have been directly affected by Project and those have required specific skills.
    - Working Conditions & Terms of Employment - A labour contract shall be concluded in writing. A labour contract to be mutually agreed by both the client and an employee on the basis of respect, voluntariness, equality, good faith, cooperation and honesty. Employees to be paid based on their performance and skills regardless of employees' characteristic such as gender, age, race, religion, disability, nationality, political beliefs, membership of unions, ethnic origin, religious beliefs, as well as sexual

orientation. The base monthly salary shall be determined according to wage scale and shall not be lower than the regional minimum wage.

- Non-Discrimination & Equal Opportunity - Employees must be treated equally with regard to gender, age, race, religion, disability, nationality, political beliefs, membership of unions, ethnic origin, religious beliefs, as well as sexual orientation. Equality in employment shall mean the absence of any form of discrimination, direct or indirect, for reasons specified
- Gender Equality - The Projects to provide equitable opportunities for male and female employees and maintains an organisational culture which supports gender equity. The client to provide adequate break rooms and toilets for both male and female employees with consideration of their privacy. During recruitment, utilization, development, promotion and retrenchment process, the client to provide equal opportunity for both male employees, female employees, and male and female employees regardless of sexual orientation.
- Workers' Organizations - Do not obstruct the employees from lawfully establishing, joining and participate in activities of a Trade Union/ Workers' organization and recognize and respect the rights of the lawfully established Trade Union/ Workers' organization of employees;
- Harassment and Abuse – client to prohibit harassment of any kind, including sexual harassment, and to take all appropriate measures to promote a harmonious work environment, and to protect personnel from exposure to any form of prohibited conduct through preventive measures and the provision of effective remedies when prevention has failed.
- Child Labour and Forced Labour - The Projects will not tolerate child labour under any circumstances. The employment of young workers, i.e. minors aged from full 15 years to under 18 years who have reached the minimum age of employment to be allowed under strict conditions and in compliance with requirements of internationally recognized standards and local relevant laws and regulations. The client to follow the requirements emphasized in the ILO conventions, IFC PS 2, EBRD Environmental and Social Policy, ADB Social Protection Strategy, and local relevant laws in terms of prohibition of forced labour in any form.
- Workers Engaged by Third Parties - Contractor/subcontractor/primary supplier to commit to adhere to the valid Labour Code and relevant under-law regulations
- Retrenchment - If the project working analysis does not identify viable alternatives to retrenchment, a labour utilization plan in accordance with local labour regulations will be developed and implemented to reduce the adverse impacts of retrenchment on employees. The alternatives may be explored.

8.6.8 Contract Worker Accommodation Plan

As indicated earlier, it was estimated that, during the peak construction phase, 200-230 workers will be employed during peak construction phase for a duration of 6 months. While most of the workers in the unskilled and semi-skilled categories will be hired from the neighbouring villages and from within the Sivaganga district, the manpower requirement in the skilled and highly skilled categories of about 130 workers will be sourced from outside the state based on their availability. It was reported by the FPEPL representatives that the migrant workers will be provided accommodation in the labour camps which is to setup during the construction phase. As reported no migrant women workers or family members are to be involved for the project and labour camp would be provided for only men. However, facilities including separate toilets, restrooms, would be provided for local women workers being employed. Labour camps are to be developed within the project site area with dimension of around 100 meters X 40 meters (Length X Width) to accommodate around 200 individuals. The proposed labour camp will be developed as per the Worker Accommodation Plan developed by FPEPL to comply with Indian legislation and IFC and EBRD requirements.

The guidelines/ principles to be followed while undertaking the various key activities during the construction and operations of the labour camp by the EPC Contractor are as follows: -

8.6.8.1 Design / Construction standard

- The height of the rooms should at least be 10 feet;
- The floor should be constructed from PCC Brick work in cement mortar and cement pointing with truss supporting roof or Prefabricated Insulated plastic-coated sheets;
- The minimum area of each room should be 22.5 square mtrs and the minimum area per person should be 3.5 square mtrs;
- Maximum 6 numbers of people should be provided accommodation in one room and all of them should belong to the same gender;
- Separate room should be provided to family members and for women workers along with security guards for women workers;
- There should be separate entry for Bachelors and workers living with their family members in order to ensure privacy of the family members of the workers;
- All rooms should be provided with at least one window for ventilation and adequate illumination;
- External lighting should be provided in the camp area to allow persons to move safely during the night time;
- Toilets/ drains should be connected to the septic tank and cleaning of the septic tank should be ensured regularly;
- Before construction of the Labour Camp, fire safety assessment should be done of the proposed site by qualified Fire Safety Personnel and all the suggests proposed therein should be incorporated while construction of the Labour Camp;
- Electrical safety norms should be adhered to ensure electrical safety in the Labour Camp e.g. earthing, MCBs, wiring as per electrical load etc.;
- Adequate drinking water should be provided as per generic standards and the same should be monitored on a monthly basis; and
- Sanitation and drainage should be ensured in order to maintain proper hygiene in the Labour Camp.
- Separate sanitation and bathing rooms to be provided for the women workers.

8.6.8.2 Drinking water

- All containers used for distribution of water shall be clearly marked ‘Drinking Water Only’ or equivalent and are not to be used for any other purpose;
- Portable containers used for dispensing of drinking water shall have right fitting lids and equipped with a tap. These containers should be kept clean and free from contamination;
- Tanker trucks used for transporting portable water shall be clearly identified and shall not be used for any other purpose;
- Outlets dispensing non-drinking water – for washing, bathing and toilets shall be marked ‘caution – water unfit for drinking and cooking’; and
- Drinking water should meet national/ local drinking water standards.

8.6.8.3 Toilet/ Washing/ Showering Facilities

- Adequate toilet/ washing/ showering facilities should be provided in the Labour Camp. The number of toilets and showering facilities will depend on the size of the Labour Camp and the number of workers being accommodated therein;

- Toilet/ Washing facilities should be provided as required to maintain healthy and sanitary conditions in the Labour Camp. Such facilities should be properly maintained and provided with potable water and drainage to prevent pooling of water; and
- The areas shall be checked and cleaned daily by a crew comprising of Sanitation workers. Disinfection of floors, sinks and toilet bowls should be carried out by the Contractor.

8.6.8.4 Hygiene and housekeeping

- High standard of hygiene and housekeeping shall always be maintained in the Labour Camp;
- The disposal of waste shall be done regularly as required and disposed of in accordance with the applicable local and national regulations;
- Containers for waste materials shall be placed in all areas and cleaned on a regular basis;
- Rubbish should not be dumped or disposed of indiscriminately but shall be stored in sealed rubbish bags at designated collection points for removal by the sanitary crew for disposal;
- No open fires shall be allowed within the Labour Camp; and
- Pest control measures should be in place to control insects and this should include flogging and spraying during the mosquito breeding season.

8.6.8.5 First aid/ Medical facilities

Access to adequate medical facilities is important to maintain workers' health and to provide adequate responses in case of health emergency situations. The availability or level of medical facilities provided in the Labour Camp/ Worker's accommodation is likely to depend on the number of workers living on site, the medical facilities already existing in the neighbouring communities and the availability of transport. However, first aid must always be available in the Labour Camp with an ambulance at place. Proper management plan on all the medical facilities at the workers accommodation need to be drafted which includes the disease management and COVID related protocols.

Audit and Inspection

- EPC Contractor and the caretaker of the Labour Camp shall make a weekly inspection and record the observations along with any required corrective actions.
- The EPC Contractor Site-in-Charge will inspect the Camp on a monthly basis along with the Site representative and the Project HR representative of FPEPL. The proposed inspection should use the points illustrated in this document as a guiding tool.
- Non-conformances identified must be corrected within the agreed timeline.
- Non compliances observed during the audit will attract penalty which will be decided by the Project Manager in line with the terms and conditions of the EPC Contract.

8.6.9 Community Development Plan

- Community Development paves way to promote local development and benefit stakeholders in their areas of operations and helps companies gain a social license to operate, access land, reduce project and reputational risks, boost productivity, meet government requirements or global standards.
- FPEPL shall develop a community development plan complying with the requirements of Sec. 135 of Companies Act 2013 and select eligible development programs as suggested in Schedule VII of Companies Act 2013.
- The Community Development Plan shall be formulated by using the following steps as suggested in "Strategic Community Investment" issued by International Finance Corporation.
- Community development will focus on:

- Assess the Business Context - The program planning and activities will be driven by community needs, priorities and concerns and a bottom up approach will be used to develop the implementation plan.
- Assess the Local Context - With active participation of the community, access need of community and capacity of community groups. This process will identify the prospective groups and partners in implementation and will further identify their key potential.
- Engage Communities - Focus on women and girls across all program interventions where equal opportunity will be provided in local socio-economic development. Socially excluded groups and various ethnic groups to be involved and prioritised in all key interventions.
- Invest in Capacity Building - Capacity building is one of the most effective and significant methods to empower the community with knowledge, information and skills
- Select Implementation Models and Set the parameters - The initial project phases will involve the implementation of community development activities through the service provider, which could be service provider or NGOs. The next phase will focus on institutionalizing the community development activities in the Project. Continuity of successful community development activities may be considered by the client.
- Measure and Communicate Results - The client team will regularly supervise the implementation of the programs to ensure the quality and effectiveness of the activities undertaken by them. They will collate qualitative and quantitative information to monitor progress with respect to the baseline.

8.6.10 Traffic Management Plan

Traffic of more than daily average is anticipated during project decommissioning phase. A Traffic Management Plan is however, required for the management of traffic due to movement of vehicles for transport of equipment and material. Additional traffic on the village road can be managed by measures mentioned below.

8.6.10.1 Management Measures

- Only trained drivers with valid license shall be recruited by FPEPL/ Contractor for transfer of material during decommission phase;
- Training program for all the drivers, regarding awareness about road safety and adopting best transport and traffic safety procedures shall be provided before initiation of the decommissioning activities;
- Mitigation measures such as emphasizing 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;
- Turning to the access road from the nearest arterial road to be maintained taking into consideration commuter's safety;
- Drivers will be adequately trained on the requirements of EHS Policy and national & local legal requirements to drive a vehicle.
- All heavy vehicles like JCB, cranes, battery operated trolleys etc. to be provided with reversing siren and locked.
- Vehicles will not be allowed to park anywhere else outside the dedicated parking area. Parking area will be provided with oil and fuel adsorbent materials or drip trays in case of any leakages.

- The villagers shall be made aware about the schedule prior to the movement of trucks and transportation in the project area.
- Appropriate speed limits (20-30km/hr) on community roads for various motor vehicles to be determined as part of the traffic management based on type of roads available en-route the location to and fro of the project component where construction material is to be transported project; and

8.6.11 Emergency Preparedness and Response Plan

The primary objective of formulating Emergency Preparedness and Response Plan (EPRP) is to undertake immediate rescue and relief operations and stabilize the mitigation process as quickly as possible. The main parameters of a response plan based on such mechanism include:

- Identification and declaration of potential emergencies;
- Signal/warning mechanism;
- Activities and their Levels;
- Command and control structure;
- Individual roles and responsibilities of each specified authority to achieve the activation as per response time;
- Emergency procedures;
- Alternate plans & contingency measures; and
- Co-ordination with external parties

8.6.11.1 Responsibilities

The Site EHS Coordinator will be responsible for implementing this procedure, which includes

- Ensuring that the emergency preparedness measures are in place;
- Providing training to the personnel at site regarding reporting of the emergencies, and to site office personnel regarding response to emergency calls from the site personnel,
- Direct action-and co-ordination at the time of an emergency

8.6.11.2 Identification of Emergencies

All the anticipated hazards and risks associated with each project activity, which may lead to an emergency are identified in the section, along with the required actions to be taken before or after the emergency arises. This section identifies the hazardous areas and activities in the operation phases. Probable emergencies that might arise due to these hazards for the duration of the project have been listed below.

Hazardous Areas

Following potentially hazardous areas and activities have been identified at the construction site:

- Fuel storage areas
- Electrical installations – improper laying of cables
- Switch Yard
- Transformer Area
- Hazardous waste storage area
- Broken/ defunct panel storage area

Emergency Situations

The possible emergency situations identified for the operation phases of the Project are as listed below:

Fire and Explosion

- Leakage of fuel from storage areas; and
- Short-circuit at project site.

Mechanical and Electrical Hazards

- Accidentally dropped object;
- Electrocution.

Occupational Hazards

- Handling of chemicals;
- Electrocution;
- Accidents due to vehicle movement; and
- Vandalism.

8.6.11.3 Declaration of Emergencies

Level 1 (Minor Emergency)

All events with no escalation potential and which can be controlled and contained by the action of Safety Officer at the site will be considered as Level 1. In such cases of local alert, Site EHS Manager will be notified. Some typical incidents are:

- Vehicle collision (involving no loss of life);
- Equipment damage;
- Medical Evacuation (not very serious cases);
- Minor fires.

Level 2 (Serious Emergency)

All events with escalation potential, depending on the effectiveness of the local response will be considered as Level 2. These incidents may impact the entire project operations or have cascading effect. For such type of incidents Site Manager will take the lead. Some typical incidents are:

- Substantial security incident / Vandalism;
- Structural collapse;
- Minor Flooding;
- Serious damage to structures;
- Substantial fire; and
- Cultural conflict.

Level 3 (Major Emergency)

The crisis that requires assistance from external resources in order to save lives, minimize damage and to bring the abnormal situation back under control are Level 3 emergencies. These incidents have the potential to impact beyond the project footprints and affect the community. In such cases appropriate government / regulatory authorities will be informed and involved. Some typical Level 3 incidents are:

- Major fire/explosion;
- Fatality;
- Severe flooding.

Personnel on site will know that a Major Emergency has been declared if the site fire alarm siren and /or the local fire alarm systems are activated. The Emergency Siren Modes will be demonstrated and shared with all workers to identify with them.

Level 2 and level 3 will be declared using emergency siren and evacuation shall be done.

8.6.11.4 Emergency Equipment

The following points should be implemented to tackle emergency situations:

- Onsite emergency equipment such as first aid boxes, firefighting equipment, PPEs etc. shall be maintained at project site;
- The adequacy and availability of emergency equipment shall be assessed at periodic intervals by the EHS Manager;
- Inventory and locations of respective emergency equipment shall be displayed at project office building and other work areas;
- It is to be ensured that the site staff is trained on usage of each type of emergency equipment.

First Aid Boxes

First aid boxes shall be provided at identified locations within the plant premises. A first aid box shall contain, but not limited to the following articles:

- Cotton wool
- Sterile gauze
- Antiseptic lotion
- Box of adhesive dressing (Plasters) for small wounds
- Blunt-ended scissors
- Tweezers for removing splinters
- Triangular bandages (for making a sling or emergency bandage)
- Safety pins
- Sterile eye dressings
- Crepe bandages
- Aspirin/ Paracetamol tablets
- Skin creams for treating burns
- Anti-histamine cream for insect bites and stings

Fire Fighting Equipment

During operation phase, fire extinguishers and sand buckets shall be provided at critical areas such as fuel storage area, waste storage area, areas with electrical installations and project office.

Other firefighting systems to be installed should include:

- Heavy-duty ABC powder type fire extinguishers kept at important electrical equipment areas;
- Portable CO2 extinguishers provided throughout the plant

Provision of Personal Protective Equipment (PPE)

Onsite workers and site staff should be provided with adequate number of personal protective equipment (PPEs) to deal with emergency situations. The PPEs shall be stored at the designated Emergency Control Centre (ECC) in the plant premises and will be easily accessible during times of

emergency. Training of proper use of PPEs shall be provided to all working personnel on periodic basis.

Assembly Area

Safe assembly area shall be identified and marked and employees to be instructed to gather at the assembly area during emergencies.

Codification of Sirens

The following codes of siren will be following during emergencies:

Table 8-5 Codification of Siren

S. No.	Siren	Indicate	Authority
1.	120 seconds Continuous Whelming Sound	On Site Emergency (Alert) For evacuation	Plant Head/ EHS Manager
2.	30 + 30 + 30 seconds Sound with an interval of 5 seconds each	Emergency controlled	Site Manager/ Site EHS Manager

Below points shall be noted during prevalence of emergency situation:

- Emergency siren to be sounded only if required.
- All staff shall be prior informed of use of emergency sirens during mock drills.
- No worker will leave the emergency spot unless 'all clear' siren blown.

8.6.11.5 Coordination with External Agencies

During emergency situations, Site Manager and Site EHS Manager shall form the Emergency Control Centre (ECC). Site EHS Manager shall coordinate with the following departments:

- Fire brigade;
- Police department;
- Hospitals/ Ambulance Services;
- Utility departments (electricity and water);
- Technical departments such as MPCB, Factory Inspectorate etc.
- Local Authorities and District Administration
- District Disaster Control Room, Sivaganaga

8.6.11.6 Emergency Response Team

- The Emergency Response Team (ERT) shall be set up immediately for the project;
- Each personnel identified as part of the ERT shall be designated specific roles and responsibilities for handling emergency situations.
- The ERT at the operating site under its control will have following role:
- Control the emergency and render the facility premises safe by the application of local resources; and
- Support the local response effort by coordinating additional equipment, personnel, and other external resources for the direct response effort.
- The ERT will comprise of the following personnel:
  - Site Manager;
  - Site EHS Manager;

- Safety Officer(s);
- Evacuation Officer;
- Employee/Workers

8.6.11.7 Emergency Response Procedure

Effective command and control start with a clear definition of the overall command and control structure, and description of the duties of key personnel with specific responsibilities for emergency response. The control of emergencies will consider the minimum number of persons required to provide an adequate response to emergencies.

All emergencies occurring as a result of project activities shall be managed according to the following order of priorities:

- Preservation of Life (self, team, community);
- Protection of the Environment;
- Protection or Property/assets; and,
- Preservation of Evidence.

8.6.11.8 Reporting and Documentation

The following aspects need to be communicated for the emergency reporting:

- While witnessing or receiving notification of an emergency, as much information as possible should be taken and/or conveyed to the relevant emergency activation authority;
- Where possible, all information should be logged in written form with time and date included and provided to EHS Manager;
- Personnel working on the site may, at any time, be exposed to an emergency which could take many forms, for example (but not limited to):
  - Injuries and/or fatalities
  - Fires and/or explosions
  - Extreme weather
- When an emergency occurs, an appropriate and prompt response is required, providing precise action to control, correct and return the site to a safe condition. Timely action will also be required to protect people, the environment and property from damage; and
- All near misses and unsafe acts will be written in logbooks / reported in the 'near miss, unsafe acts, hazards and sub-standard conditions report' and verbally communicated to the concerned Site Supervisor within a reasonable time

8.6.12Environment and Social Monitoring Plan

8.6.12.1 Environmental Monitoring Plan

Regular monitoring of environmental aspects during the project operations phase is important to assess the status of environment with respect to baseline conditions. The monitored data can serve as an indicator for any change in environmental quality due to the project activities, and further to take adequate mitigation measures to safeguard the environment.

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

Table 8-6: Environmental Monitoring Plan

S. No.	Environmental Attribute	Monitoring Parameters	Frequency of Monitoring	Responsibility
1.	Ambient Air Quality	Measurement of PM_{10}, $PM_{2.5}$, SO_x, NO_x, CO	Every Six Months	Site Manager
2.	Ambient Noise quality	Measurement of Noise Pressure Level in dB(A)	Every Six Months	Site Manager
3.	Soil Quality	Physico-chemical parameters monitored for baseline data collection	Every Six Months	Site Manager
4.	Water Resources	Physico-chemical parameters monitored for Surface and Ground water baseline data collection	Every Six Months	Site Manager
		Water meter readings to be maintained on daily basis	Monthly	Site Manager
5.	Waste	Waste inventory for both hazardous and non-hazardous waste, Waste Labelling, storage and disposal records Visual inspection for spilling/ leakages in the waste storage area	Weekly	Site Manager
		Agreements with vendors for waste collection and storage for both hazardous and non-hazardous waste	Every Six Months	Site Manager
6.	Ecological	• Monitoring of site clearance process for qualitative and quantitative documentation of natural vegetation loss to inform compensatory plantations • Monitoring of site clearance process for *Hemidactylus scabriceps* (Scaly Gecko IUCN Red List Status: EN) and appropriate rescue or rehabilitation in consultation with SME or reptile expert. • Monitor high bird use areas or critical avian habitats along the proposed TL alignment • Monitoring of the TL alignment for bird collision incidents and/or additional/different avian high use areas	Pre-construction Pre-construction and construction phase Pre construction phase Operation Phase (monthly)	Site Manager

8.6.12.2 Social and Health and Safety Monitoring Plan

Working conditions on site with respect to health and safety of the workers and concerns from the communities are required to be monitored regularly to ensure the positive impacts of the mitigation and management measures taken for the anticipated impacts.

Table 8-7: Social and Health and Safety Monitoring Plan

S. No.	Attribute	Monitoring Parameter	Monitoring Frequency	Responsibility
1	Health and Safety Risks	• Sanitation status of onsite office building • Potable nature of drinking water with respect to BIS drinking water standards 10500:2012; • Usage of adequate PPEs; • Electromagnetic field	Monthly	Site Manager

S. No.	Attribute	Monitoring Parameter	Monitoring Frequency	Responsibility
		• Adequate Health and Safety Training to workers • Fire Safety measures on site • Incident/ Accident Records • Permit to Work Records • LOTO records		

8.6.12.3 Monitoring Plan during Decommissioning Phase

Following aspects are required to be monitored throughout during the decommission phase, regularly by the Site Manager.

- Local community and workers shall be informed for the duration of works;
- All waste generated from decommissioning phase shall be collected and disposed of to the authorized vendor;
- All necessary PPEs shall be used by the workers during demolition work;
- Vehicle maintenance records, accident records
- Visual inspection of waste storage area;
- Broken/defunct solar panels shall be disposed of to authorized vendor through buy back agreements;
- It is to be ensured that dismantling is carried out during non-monsoon season and all the drainage channels will keep intact by creating bunds around them;

  FPEPL should ensure that retrenchment packages are provided for all staff who stand to lose their jobs when the plant is decommissioned.

8.6.13Land Access & Livelihoods Restoration Plan (LA & LRP)

The 'Land Access & Livelihoods Restoration Plan' (LA & LRP) is prepared to comply with the principles and objectives of the Asian Development Bank (ADB) Safeguard Policy Statement, Safeguard Requirement 2: Involuntary Resettlement (SR2). LA & LRP primarily to provide framework to measures and address the access rights arising through obtaining the Right of Ways (RoW) and vulnerability arising out of any potential displacement of people due to future land transactions and any change in proposed Transmission Line Corridor from the planned TL route. The LA&LRP report shall highlight the following aspects,

- Land Souring process
- Land Related specific issues and project status
- Details on Stakeholder Consultations
- Livelihood Restoration Plan
- Grievance Redressal Mechanism
- Project Disclosure
- Institutional Arrangements for implementing the LA&LRP

9. Conclusions

The Environmental and Social Assessment study for the proposed 75 (AC) MW solar power project to be developed by FPEPL in Sivaganga District of Tamil Nadu has been undertaken in accordance with International Finance Corporation (IFC) Sustainability Framework (Policy and Performance Standards on Environmental and Social Sustainability) 2012 and ADB Safeguard Policy Statement (SPS) (2009).

The ESIA study aimed to identify and evaluate potential environmental and social impacts associated with all aspects of the proposed project. The conclusion and recommendations of this study are result of on-site inspections, evaluation of impacts identified, and the process of stakeholder consultation. The proposed project is an opportunity to utilize the solar potential of the state for power generation. There are no fuel requirements or large quantities of water required for the operation of the plant. GHG emissions and other environmental pollution (stack emissions, ash management etc.) issues are also limited.

Categorisation of Project as per IFC Environment and Social Sustainability Standards and ADB Safeguard Policy Statement (SPS) (2009)

Based on the data available for the project at this stage and applying the criteria stipulated by the IFC Policy on Environmental and Social Sustainability for environmental and social categorization of projects and ADB Safeguard Policy Statement (SPS) (2009), FPEPL's proposed project may be assigned as '***Category B***' for SPS1 and 2 and ***Category C*** for SPS3

This is so basis the primary data available to date which indicates that the environmental and social risks and impacts of the proposed project activities are expected to be few in number, generally site-specific, largely reversible, and readily addressed through mitigation measures, which supports the above classification.

Additional rationale for the above categorization is as below:

- Solar power project is a clean technology project using solar energy for generation of electricity;
- No harmful emissions are expected from the project operations;
- The Project Site does not coincide or overlap with any Designated Area; and
- Available data suggests that the construction, operation and decommissioning of the proposed solar project are likely to have limited environmental and social impacts which can be readily addressed with mitigation measures.

Appendix A Participant List of Stakeholder Consultations

S.No	Stakeholder Type	Name & Address	Date of Consultation
1.	Client Representative	Mr. B. Thillai Narayanan- Land Team FPEPL	22nd June 2022
2.	Client Representative	Mr. Maynk Melvin – EHS, FPEPL	22nd June 2022
3.	Panchayat	Mr. Pon Arul – Ex-Vice President/ Panchayat Member	22nd June 2022
4.	Landowner	Mr. Neduncheliyan	22nd June 2022
5.	Landowner	Mr. Elamperuveluthi	22nd June 2022
6.	Landowner	Mr. John Brito	22nd June 2022
7.	Government	Dr. Nivek MBBS, Medical Officer, Maravamangalam PHC	23rd June 2022
8.	Government	Mr. Rajesh Kannan, Health Inspector, Kalayarkoil	23rd June 2022
9.	Government	Junior Assistant, Record Clerk- Sub-Registrar Office, Kalayarkoil	23rd June 2022
10.	Land Aggregator	Mr. Vijay Balaji- Land Aggregator	23rd June 2022
11.	Landowner	Ms. Ramya w/o Raghu	23rd June 2022
12.	Landowner	Ms. Vijayalakshmi	23rd June 2022
13.	Agriculture Labours	10 Members from Siramam Village	23rd June 2022
14.	Villagers	Mrs. Valliyamma w/o Chinnatham	24th June 2022
15.	Villagers	Mrs. Palaniamma w/o Thairiyam	24th June 2022
16.	Villagers	Mrs. Panju w/o Nagarajan	24th June 2022
17.	Landowner	Mr. Chelladurai	27th July 2022
18.	Landowner	Mr. Mallappa Thevar	27th July 2022
19.	Landowner	Mr. Muthuraku	27th July 2022
20.	Landowner	Mr. Utchaya	27th July 2022
21.	Landowner	Ms. Shamala	27th July 2022
22.	Landowner	Mr. Nagarajan	27th July 2022
23.	Landowner	Mr. Rakkappan	27th July 2022

Appendix B Mammals of the Study Area

SN	Scientific Name	Common Name	IUCN Status
1	*Anathana ellioti*	Madras Treeshrew	Least Concern
2	*Antilope cervicapra*	Blackbuck	Least Concern
3	*Axis axis*	Chital	Least Concern
4	*Bandicota bengalensis*	Lesser Bandicoot Rat	Least Concern
5	*Bandicota indica*	Greater Bandicoot Rat	Least Concern
6	*Canis aureus*	Golden Jackal	Least Concern
7	*Cynopterus brachyotis*	Lesser Dog-faced Fruit Bat	Least Concern
8	*Cynopterus sphinx*	Greater Shortnosed Fruit Bat	Least Concern
9	*Felis chaus*	Jungle Cat	Least Concern
10	*Funambulus palmarum*	Common Palm Squirrel	Least Concern
11	*Golunda ellioti*	Indian Bush-rat	Least Concern
12	*Herpestes edwardsii*	Indian Grey Mongoose	Least Concern
13	*Herpestes smithii*	Ruddy Mongoose	Least Concern
14	*Hipposideros ater*	Dusky Leaf-nosed Bat	Least Concern
15	*Hipposideros fulvus*	Fulvus Leaf-nosed Bat	Least Concern
16	*Hipposideros speoris*		Least Concern
17	*Hystrix indica*	Indian Crested Porcupine	Least Concern
18	*Lepus nigricollis*	Indian Hare	Least Concern
19	*Loris lydekkerianus*	Grey Slender Loris	Near Threatened
20	*Lutra lutra*	Eurasian Otter	Near Threatened
21	*Lutrogale perspicillata*	Smooth-coated Otter	Vulnerable
22	*Lyroderma lyra*	Greater False Vampire	Least Concern
23	*Macaca radiata*	Bonnet Macaque	Vulnerable
24	*Manis crassicaudata*	Indian Pangolin	Endangered
25	*Mellivora capensis*	Honey Badger	Least Concern
26	*Millardia meltada*	Soft-furred Metad	Least Concern
27	*Moschiola indica*	Indian Chevrotain	Least Concern
28	*Muntiacus vaginalis*	Northern Red Muntjac	Least Concern
29	*Mus booduga*		Least Concern
30	*Mus musculus*	House Mouse	Least Concern
31	*Mus saxicola*	Brown Spiny Mouse	Least Concern
32	*Mus terricolor*		Least Concern
33	*Paradoxurus hermaphroditus*	Common Palm Civet	Least Concern
34	*Pipistrellus ceylonicus*	Kelaart's Pipistrelle	Least Concern
35	*Pipistrellus coromandra*		Least Concern

SN	Scientific Name	Common Name	IUCN Status
36	*Prionailurus rubiginosus*	Rusty-spotted Cat	Near Threatened
37	*Pteropus giganteus*	Indian Flying Fox	Least Concern
38	*Rattus rattus*	House Rat	Least Concern
39	*Rhinolophus rouxii*	Rufous Horseshoe Bat	Least Concern
40	*Rhinopoma hardwickii*	Lesser Mouse-tailed Bat	Least Concern
41	*Rousettus leschenaultii*	Leschenaultâ€™s Rousette	Near Threatened
42	*Rusa unicolor*	Sambar	Vulnerable
43	*Scotophilus heathii*	Greater Asiatic Yellow House Bat	Least Concern
44	*Suncus murinus*	House Shrew	Least Concern
45	*Sus scrofa*	Wild Boar	Least Concern
46	*Taphozous longimanus*	Long-winged Tomb Bat	Least Concern
47	*Taphozous melanopogon*		Least Concern
48	*Tatera indica*	Indian Gerbil	Least Concern
49	*Vandeleuria oleracea*	Asiatic Long-tailed Climbing Mouse	Least Concern
50	*Viverricula indica*	Small Indian Civet	Least Concern
51	*Vulpes bengalensis*	Bengal Fox	Least Concern

Sources: IUCN 2022. The IUCN Red List of Threatened Species. Version 2021-3

Appendix C Birds of the Study Area

SN	Scientific Name	Common Name	IUCN Status	Migratory Status*
1	*Accipiter badius*	Shikra	Least Concern	R
2	*Acridotheres fuscus*	Jungle Myna	Least Concern	R
3	*Acridotheres tristis*	Common Myna	Least Concern	R
4	*Acrocephalus stentoreus*	Clamorous Reed-warbler	Least Concern	R
5	*Actitis hypoleucos*	Common Sandpiper	Least Concern	W
6	*Aegithina tiphia*	Common Iora	Least Concern	R
7	*Alauda gulgula*	Oriental Skylark	Least Concern	R
8	*Alcedo atthis*	Common Kingfisher	Least Concern	R
9	*Alexandrinus krameri*	Rose-ringed Parakeet	Least Concern	R
10	*Amaurornis phoenicurus*	White-breasted Waterhen	Least Concern	R
11	*Ammomanes phoenicura*	Rufous-tailed Lark	Least Concern	R
12	*Anas acuta*	Northern Pintail	Least Concern	W
13	*Anas crecca*	Common Teal	Least Concern	W
14	*Anas poecilorhyncha*	Indian Spot-billed Duck	Least Concern	R
15	*Anastomus oscitans*	Asian Openbill	Least Concern	W
16	*Anhinga melanogaster*	Oriental Darter	Near Threatened	W
17	*Anthus godlewskii*	Blyth's Pipit	Least Concern	W
18	*Anthus richardi*	Richard's Pipit	Least Concern	W
19	*Anthus rufulus*	Paddyfield Pipit	Least Concern	R
20	*Anthus similis*	Long-billed Pipit	Least Concern	R
21	*Anthus trivialis*	Tree Pipit	Least Concern	W
22	*Apus affinis*	Little Swift	Least Concern	R
23	*Aquila nipalensis*	Steppe Eagle	Endangered	W
24	*Ardea alba*	Great White Egret	Least Concern	R
25	*Ardea cinerea*	Grey Heron	Least Concern	R
26	*Ardea intermedia*	Intermediate Egret	Least Concern	R
27	*Ardea purpurea*	Purple Heron	Least Concern	R
28	*Ardeola grayii*	Indian Pond-heron	Least Concern	R
29	*Arenaria interpres*	Ruddy Turnstone	Least Concern	W
30	*Argya affinis*	Yellow-billed Babbler	Least Concern	R
31	*Argya caudata*	Common Babbler	Least Concern	R
32	*Argya striata*	Jungle Babbler	Least Concern	R
33	*Artamus fuscus*	Ashy Woodswallow	Least Concern	R
34	*Arundinax aedon*	Thick-billed Warbler	Least Concern	W
35	*Asio flammeus*	Short-eared Owl	Least Concern	W
36	*Athene brama*	Spotted Owlet	Least Concern	R

SN	Scientific Name	Common Name	IUCN Status	Migratory Status*
37	*Aythya fuligula*	Tufted Duck	Least Concern	W
38	*Botaurus stellaris*	Eurasian Bittern	Least Concern	W
39	*Bubo bengalensis*	Rock Eagle-owl	Least Concern	R
40	*Bubulcus ibis*	Cattle Egret	Least Concern	R
41	*Burhinus indicus*	Indian Thick-knee	Least Concern	R
42	*Butastur teesa*	White-eyed Buzzard	Least Concern	W
43	*Butorides striata*	Green-backed Heron	Least Concern	R
44	*Cacomantis passerinus*	Grey-bellied Cuckoo	Least Concern	P
45	*Cacomantis sonneratii*	Banded Bay Cuckoo	Least Concern	R
46	*Calandrella dukhunensis*	Mongolian Short-toed Lark	Least Concern	R
47	*Calidris alba*	Sanderling	Least Concern	W
48	*Calidris canutus*	Red Knot	Near Threatened	W
49	*Calidris falcinellus*	Broad-billed Sandpiper	Least Concern	W
50	*Calidris ferruginea*	Curlew Sandpiper	Near Threatened	W
51	*Calidris minuta*	Little Stint	Least Concern	W
52	*Calidris ruficollis*	Red-necked Stint	Near Threatened	W
53	*Calidris subminuta*	Long-toed Stint	Least Concern	W
54	*Calidris temminckii*	Temminck's Stint	Least Concern	W
55	*Caprimulgus affinis*	Savanna Nightjar	Least Concern	R
56	*Caprimulgus asiaticus*	Indian Nightjar	Least Concern	R
57	*Caprimulgus atripennis*	Jerdon's Nightjar	Least Concern	R
58	*Cecropis daurica*	Red-rumped Swallow	Least Concern	R
59	*Centropus sinensis*	Greater Coucal	Least Concern	R
60	*Ceryle rudis*	Pied Kingfisher	Least Concern	R
61	*Charadrius alexandrinus*	Kentish Plover	Least Concern	W
62	*Charadrius dubius*	Little Ringed Plover	Least Concern	R
63	*Charadrius leschenaultii*	Greater Sandplover	Least Concern	W
64	*Charadrius mongolus*	Lesser Sandplover	Least Concern	W
65	*Chlidonias hybrida*	Whiskered Tern	Least Concern	W
66	*Chloropsis aurifrons*	Golden-fronted Leafbird	Least Concern	R
67	*Chloropsis jerdoni*	Jerdon's Leafbird	Least Concern	R
68	*Chrysocolaptes festivus*	White-naped Woodpecker	Least Concern	R
69	*Chrysomma sinense*	Yellow-eyed Babbler	Least Concern	R
70	*Ciconia episcopus*	Asian Woollyneck	Near Threatened	R
71	*Ciconia nigra*	Black Stork	Least Concern	W
72	*Cinnyris asiaticus*	Purple Sunbird	Least Concern	R
73	*Cinnyris lotenius*	Loten's Sunbird	Least Concern	R
74	*Circus aeruginosus*	Western Marsh-harrier	Least Concern	W

SN	Scientific Name	Common Name	IUCN Status	Migratory Status*
75	*Circus macrourus*	Pallid Harrier	Near Threatened	W
76	*Cisticola juncidis*	Zitting Cisticola	Least Concern	R
77	*Clamator coromandus*	Chestnut-winged Cuckoo	Least Concern	W
78	*Clamator jacobinus*	Jacobin Cuckoo	Least Concern	R
79	*Clanga clanga*	Greater Spotted Eagle	Vulnerable	W
80	*Columba livia*	Rock Dove	Least Concern	R
81	*Copsychus saularis*	Oriental Magpie-robin	Least Concern	R
82	*Coracias benghalensis*	Indian Roller	Least Concern	R
83	*Coracina macei*	Indian Cuckooshrike	Least Concern	R
84	*Corvus macrorhynchos*	Large-billed Crow	Least Concern	R
85	*Corvus splendens*	House Crow	Least Concern	R
86	*Coturnix coromandelica*	Rain Quail	Least Concern	R
87	*Coturnix coturnix*	Common Quail	Least Concern	R
88	*Cuculus micropterus*	Indian Cuckoo	Least Concern	R
89	*Cuculus poliocephalus*	Lesser Cuckoo	Least Concern	R
90	*Curruca crassirostris*	Eastern Orphean Warbler	Least Concern	R
91	*Curruca curruca*	Lesser Whitethroat	Least Concern	R
92	*Cursorius coromandelicus*	Indian Courser	Least Concern	R
93	*Cyornis rubeculoides*	Blue-throated Blue-flycatcher	Least Concern	W
94	*Cyornis tickelliae*	Tickell's Blue-flycatcher	Least Concern	W
95	*Cypsiurus balasiensis*	Asian Palm-swift	Least Concern	R
96	*Dendrocitta vagabunda*	Rufous Treepie	Least Concern	R
97	*Dendrocygna bicolor*	Fulvous Whistling-duck	Least Concern	W
98	*Dendrocygna javanica*	Lesser Whistling-duck	Least Concern	W
99	*Dendronanthus indicus*	Forest Wagtail	Least Concern	R
100	*Dicaeum agile*	Thick-billed Flowerpecker	Least Concern	R
101	*Dicaeum erythrorhynchos*	Pale-billed Flowerpecker	Least Concern	R
102	*Dicrurus caerulescens*	White-bellied Drongo	Least Concern	R
103	*Dicrurus hottentottus*	Hair-crested Drongo	Least Concern	R
104	*Dicrurus leucophaeus*	Ashy Drongo	Least Concern	R
105	*Dicrurus macrocercus*	Black Drongo	Least Concern	R
106	*Dicrurus paradiseus*	Greater Racquet-tailed Drongo	Least Concern	R
107	*Dromas ardeola*	Crab-plover	Least Concern	W
108	*Dumetia hyperythra*	Tawny-bellied Babbler	Least Concern	R
109	*Egretta garzetta*	Little Egret	Least Concern	R
110	*Egretta gularis*	Western Reef-egret	Least Concern	R
111	*Elanus caeruleus*	Black-winged Kite	Least Concern	R
112	*Ephippiorhynchus asiaticus*	Black-necked Stork	Near Threatened	W

SN	Scientific Name	Common Name	IUCN Status	Migratory Status*
113	*Eremopterix griseus*	Ashy-crowned Sparrow-lark	Least Concern	R
114	*Esacus recurvirostris*	Great Thick-knee	Near Threatened	R
115	*Eudynamys scolopaceus*	Western Koel	Least Concern	R
116	*Euodice malabarica*	Indian Silverbill	Least Concern	R
117	*Falco amurensis*	Amur Falcon	Least Concern	W
118	*Falco peregrinus*	Peregrine Falcon	Least Concern	W
119	*Falco tinnunculus*	Common Kestrel	Least Concern	R
120	*Francolinus pondicerianus*	Grey Francolin	Least Concern	R
121	*Fulica atra*	Common Coot	Least Concern	R
122	*Gallicrex cinerea*	Watercock	Least Concern	R
123	*Gallinago megala*	Swinhoe's Snipe	Least Concern	R
124	*Gallinago stenura*	Pintail Snipe	Least Concern	R
125	*Gallinula chloropus*	Common Moorhen	Least Concern	R
126	*Gelochelidon nilotica*	Common Gull-billed Tern	Least Concern	W
127	*Glareola lactea*	Little Pratincole	Least Concern	W
128	*Glaucidium radiatum*	Jungle Owlet	Least Concern	R
129	*Gymnoris xanthocollis*	Chestnut-shouldered Bush-sparrow	Least Concern	R
130	*Haematopus ostralegus*	Eurasian Oystercatcher	Near Threatened	W
131	*Halcyon pileata*	Black-capped Kingfisher	Least Concern	R
132	*Halcyon smyrnensis*	White-breasted Kingfisher	Least Concern	R
133	*Haliaeetus leucogaster*	White-bellied Sea-eagle	Least Concern	R
134	*Haliastur indus*	Brahminy Kite	Least Concern	R
135	*Hieraaetus pennatus*	Booted Eagle	Least Concern	W
136	*Hierococcyx varius*	Common Hawk-cuckoo	Least Concern	R
137	*Himalayapsitta cyanocephala*	Plum-headed Parakeet	Least Concern	R
138	*Himantopus himantopus*	Black-winged Stilt	Least Concern	R
139	*Hirundo rustica*	Barn Swallow	Least Concern	R
140	*Hirundo smithii*	Wire-tailed Swallow	Least Concern	R
141	*Hydrophasianus chirurgus*	Pheasant-tailed Jacana	Least Concern	R
142	*Hydroprogne caspia*	Caspian Tern	Least Concern	W
143	*Hypothymis azurea*	Black-naped Monarch	Least Concern	W
144	*Iduna caligata*	Booted Warbler	Least Concern	W
145	*Iduna rama*	Sykes's Warbler	Least Concern	W
146	*Irena puella*	Asian Fairy-bluebird	Least Concern	R
147	*Ketupa zeylonensis*	Brown Fish-owl	Least Concern	R
148	*Kittacincla malabarica*	White-rumped Shama	Least Concern	R
149	*Lalage melanoptera*	Black-headed Cuckooshrike	Least Concern	P
150	*Lanius cristatus*	Brown Shrike	Least Concern	R

SN	Scientific Name	Common Name	IUCN Status	Migratory Status*
151	*Lanius schach*	Long-tailed Shrike	Least Concern	R
152	*Lanius vittatus*	Bay-backed Shrike	Least Concern	R
153	*Larus brunnicephalus*	Brown-headed Gull	Least Concern	R
154	*Larus fuscus*	Lesser Black-backed Gull	Least Concern	R
155	*Larus ichthyaetus*	Pallas's Gull	Least Concern	W
156	*Larvivora brunnea*	Indian Blue Robin	Least Concern	R
157	*Leiopicus mahrattensis*	Yellow-crowned Woodpecker	Least Concern	R
158	*Leptocoma zeylonica*	Purple-rumped Sunbird	Least Concern	R
159	*Limosa lapponica*	Bar-tailed Godwit	Near Threatened	W
160	*Lonchura punctulata*	Scaly-breasted Munia	Least Concern	R
161	*Lymnocryptes minimus*	Jack Snipe	Least Concern	R
162	*Merops leschenaulti*	Chestnut-headed Bee-eater	Least Concern	R
163	*Merops orientalis*	Asian Green Bee-eater	Least Concern	R
164	*Merops philippinus*	Blue-tailed Bee-eater	Least Concern	W
165	*Microcarbo niger*	Little Cormorant	Least Concern	W
166	*Micropternus brachyurus*	Rufous Woodpecker	Least Concern	R
167	*Milvus migrans*	Black Kite	Least Concern	R
168	*Mirafra affinis*	Jerdon's Bushlark	Least Concern	R
169	*Motacilla alba*	White Wagtail	Least Concern	W
170	*Motacilla cinerea*	Grey Wagtail	Least Concern	W
171	*Motacilla citreola*	Citrine Wagtail	Least Concern	W
172	*Motacilla flava*	Western Yellow Wagtail	Least Concern	W
173	*Motacilla maderaspatensis*	White-browed Wagtail	Least Concern	R
174	*Muscicapa dauurica*	Asian Brown Flycatcher	Least Concern	W
175	*Mycteria leucocephala*	Painted Stork	Near Threatened	R
176	*Nettapus coromandelianus*	Cotton Pygmy-goose	Least Concern	W
177	*Ninox scutulata*	Brown Boobook	Least Concern	R
178	*Numenius arquata*	Eurasian Curlew	Near Threatened	W
179	*Numenius phaeopus*	Whimbrel	Least Concern	W
180	*Nycticorax nycticorax*	Black-crowned Night-heron	Least Concern	R
181	*Ocyceros birostris*	Indian Grey Hornbill	Least Concern	R
182	*Oriolus kundoo*	Indian Golden Oriole	Least Concern	R
183	*Oriolus xanthornus*	Black-hooded Oriole	Least Concern	R
184	*Orthotomus sutorius*	Common Tailorbird	Least Concern	R
185	*Otus bakkamoena*	Indian Scops-owl	Least Concern	R
186	*Pandion haliaetus*	Osprey	Least Concern	W
187	*Parus major*	Great Tit	Least Concern	R
188	*Passer domesticus*	House Sparrow	Least Concern	R

SN	Scientific Name	Common Name	IUCN Status	Migratory Status*
189	*Pastor roseus*	Rosy Starling	Least Concern	W
190	*Pavo cristatus*	Indian Peafowl	Least Concern	R
191	*Pelecanus philippensis*	Spot-billed Pelican	Near Threatened	R
192	*Perdicula asiatica*	Jungle Bush-quail	Least Concern	R
193	*Pericrocotus cinnamomeus*	Small Minivet	Least Concern	R
194	*Pernis ptilorhynchus*	Oriental Honey-buzzard	Least Concern	R
195	*Phaenicophaeus viridirostris*	Blue-faced Malkoha	Least Concern	R
196	*Phalacrocorax carbo*	Great Cormorant	Least Concern	W
197	*Phoenicopterus roseus*	Greater Flamingo	Least Concern	W
198	*Phoenicurus ochruros*	Black Redstart	Least Concern	R
199	*Phylloscopus affinis*	Tickell's Leaf-warbler	Least Concern	W
200	*Phylloscopus nitidus*	Green Warbler	Least Concern	W
201	*Picoides nanus*	Indian Pygmy Woodpecker	Least Concern	R
202	*Pitta brachyura*	Indian Pitta	Least Concern	R
203	*Platalea leucorodia*	Eurasian Spoonbill	Least Concern	R
204	*Plegadis falcinellus*	Glossy Ibis	Least Concern	W
205	*Ploceus philippinus*	Baya Weaver	Least Concern	R
206	*Pluvialis fulva*	Pacific Golden Plover	Least Concern	W
207	*Pluvialis squatarola*	Grey Plover	Least Concern	W
208	*Porphyrio porphyrio*	Purple Swamphen	Least Concern	R
209	*Prinia hodgsonii*	Grey-breasted Prinia	Least Concern	R
210	*Prinia inornata*	Plain Prinia	Least Concern	R
211	*Prinia socialis*	Ashy Prinia	Least Concern	R
212	*Pseudibis papillosa*	Red-naped Ibis	Least Concern	R
213	*Psilopogon haemacephalus*	Coppersmith Barbet	Least Concern	R
214	*Psilopogon viridis*	White-cheeked Barbet	Least Concern	R
215	*Psilopogon zeylanicus*	Brown-headed Barbet	Least Concern	R
216	*Pterocles exustus*	Chestnut-bellied Sandgrouse	Least Concern	R
217	*Pycnonotus cafer*	Red-vented Bulbul	Least Concern	R
218	*Pycnonotus jocosus*	Red-whiskered Bulbul	Least Concern	R
219	*Pycnonotus luteolus*	White-browed Bulbul	Least Concern	R
220	*Recurvirostra avosetta*	Pied Avocet	Least Concern	W
221	*Rhipidura aureola*	White-browed Fantail	Least Concern	R
222	*Rostratula benghalensis*	Greater Painted-snipe	Least Concern	R
223	*Saxicola caprata*	Pied Bushchat	Least Concern	R
224	*Saxicoloides fulicatus*	Indian Robin	Least Concern	R
225	*Spatula clypeata*	Northern Shoveler	Least Concern	W
226	*Spatula querquedula*	Garganey	Least Concern	W

SN	Scientific Name	Common Name	IUCN Status	Migratory Status*
227	*Spilopelia senegalensis*	Laughing Dove	Least Concern	R
228	*Spilopelia suratensis*	Western Spotted Dove	Least Concern	R
229	*Sterna acuticauda*	Black-bellied Tern	Endangered	W
230	*Sterna aurantia*	River Tern	Vulnerable	R
231	*Sterna hirundo*	Common Tern	Least Concern	W
232	*Streptopelia decaocto*	Eurasian Collared-dove	Least Concern	R
233	*Strix ocellata*	Mottled Wood-owl	Least Concern	R
234	*Sturnia malabarica*	Chestnut-tailed Starling	Least Concern	R
235	*Sturnia pagodarum*	Brahminy Starling	Least Concern	R
236	*Synoicus chinensis*	Asian Blue Quail	Least Concern	R
237	*Taccocua leschenaultii*	Sirkeer Malkoha	Least Concern	R
238	*Tachybaptus ruficollis*	Little Grebe	Least Concern	R
239	*Tephrodornis pondicerianus*	Common Woodshrike	Least Concern	R
240	*Terpsiphone paradisi*	Indian Paradise-flycatcher	Least Concern	R
241	*Threskiornis melanocephalus*	Black-headed Ibis	Near Threatened	R
242	*Treron bicinctus*	Orange-breasted Green-pigeon	Least Concern	R
243	*Treron phoenicopterus*	Yellow-footed Green-pigeon	Least Concern	R
244	*Tringa erythropus*	Spotted Redshank	Least Concern	W
245	*Tringa glareola*	Wood Sandpiper	Least Concern	W
246	*Tringa nebularia*	Common Greenshank	Least Concern	W
247	*Tringa ochropus*	Green Sandpiper	Least Concern	W
248	*Tringa stagnatilis*	Marsh Sandpiper	Least Concern	W
249	*Tringa totanus*	Common Redshank	Least Concern	W
250	*Turdus simillimus*	Indian Blackbird	Least Concern	R
251	*Turnix suscitator*	Barred Buttonquail	Least Concern	R
252	*Turnix sylvaticus*	Common Buttonquail	Least Concern	R
253	*Turnix tanki*	Yellow-legged Buttonquail	Least Concern	R
254	*Tyto alba*	Common Barn-owl	Least Concern	R
255	*Tyto longimembris*	Eastern Grass-owl	Least Concern	R
256	*Upupa epops*	Common Hoopoe	Least Concern	R
257	*Vanellus indicus*	Red-wattled Lapwing	Least Concern	R
258	*Vanellus malabaricus*	Yellow-wattled Lapwing	Least Concern	R
259	*Xenus cinereus*	Terek Sandpiper	Least Concern	W
260	*Zapornia pusilla*	Baillon's Crake	Least Concern	R
261	*Zosterops palpebrosus*	Indian White-eye	Least Concern	R

*Migratory status of the species with respect to the Study Area, where – P- Passage, R- Resident and W-Winter

Sources: R. Grimmett, C. Inskipp & T. Inskipp (2011). Birds of the Indian Subcontinent. Oxford University Press, pp 1-528; IUCN 2022. The IUCN Red List of Threatened Species. Version 2021-3

Appendix D Reptiles of the Study Area

SN	Scientific Name	Common Name	IUCN Status
1	*Ahaetulla nasuta*	Long-nosed Tree Snake	Least Concern
2	*Amphiesma stolatum*	Buff Striped Keelback	Least Concern
3	*Argyrogena fasciolata*	Banded Racer	Least Concern
4	*Atretium schistosum*	Olive Keelback Water Snake	Least Concern
5	*Boiga flaviviridis*	Yellow-green Cat Snake	Least Concern
6	*Boiga forsteni*		Least Concern
7	*Boiga trigonata*	Indian Gamma Snake	Least Concern
8	*Bungarus caeruleus*	Common Krait	Least Concern
9	*Calliophis melanurus*	Slender Coral Snake	Least Concern
10	*Calotes versicolor*	Changeable Lizard	Least Concern
11	*Chamaeleo zeylanicus*	Asian Chameleon	Least Concern
12	*Coelognathus helenae*	Trinket Snake	Least Concern
13	*Crocodylus palustris*	Mugger	Vulnerable
14	*Daboia russelii*	Western Russelâ€™s Viper	Least Concern
15	*Dendrelaphis tristis*	Daudin's Bronzeback	Least Concern
16	*Echis carinatus*		Least Concern
17	*Eryx conicus*	Rough-tailed Sand Boa	Near Threatened
18	*Eryx johnii*	Red Sand Boa	Near Threatened
19	*Eutropis bibronii*	Bibron's Skink	Near Threatened
20	*Eutropis carinata*	Keeled Indian Mabuya	Least Concern
21	*Eutropis macularia*	Bronze Mabuya	Least Concern
22	*Fowlea piscator*	Chequered Keelback	Least Concern
23	*Grypotyphlops acutus*	Beaked Worm Snake	Least Concern
24	*Hemidactylus brookii*	Brooke's House Gecko	Least Concern
25	*Hemidactylus frenatus*	Common House Gecko	Least Concern
26	*Hemidactylus leschenaultii*	Leschenault's Leaf-toed Gecko	Least Concern
27	*Hemidactylus maculatus*	Spotted Leaf-toed Gecko	Least Concern
28	*Hemidactylus reticulatus*	Reticulate Leaf-toed Gecko	Least Concern
29	*Hemidactylus scabriceps*	Scaly Gecko	Endangered
30	*Indotyphlops braminus*	Brahminy Blindsnake	Least Concern
31	*Indotyphlops pammeces*	South India Worm Snake	Least Concern
32	*Indotyphlops porrectus*	Stoliczkaâ€™s Slender Blind Snake	Least Concern
33	*Lepidodactylus lugubris*	Mourning Gecko	Least Concern
34	*Liopeltis calamaria*	Calamaria Reed Snake	Least Concern
35	*Lissemys punctata*	Indian Flapshell Turtle	Vulnerable
36	*Lycodon anamallensis*	Colombo Wolf Snake	Least Concern

SN	Scientific Name	Common Name	IUCN Status
37	*Lycodon aulicus*	Common Wolf Snake	Least Concern
38	*Lycodon gracilis*	Scarce Bridal Snake	Data Deficient
39	*Lycodon nympha*	Vellore Bridal Snake	Least Concern
40	*Lycodon striatus*	Barred Wolf Snake	Least Concern
41	*Lycodon travancoricus*	Travancore Wolf Snake	Least Concern
42	*Lygosoma punctata*	Common Dotted Garden Skink	Least Concern
43	*Melanochelys trijuga*	Indian Black Turtle	Least Concern
44	*Naja naja*	Indian Cobra	Least Concern
45	*Oligodon arnensis*	Common Kukri Snake	Least Concern
46	*Oligodon taeniolatus*	Streaked Kukri Snake	Least Concern
47	*Pelochelys cantorii*	Asian Giant Softshell Turtle	Critically Endangered
48	*Psammophilus blanfordanus*	Blanford's Rock Agama	Least Concern
49	*Ptyas mucosa*		Least Concern
50	*Python molurus*	Indian Rock Python	Near Threatened
51	*Rhabdophis plumbicolor*	Green Keelback	Least Concern
52	*Sibynophis subpunctatus*	Dumeril's Black-headed Snake	Least Concern
53	*Sitana ponticeriana*	PondichÃ©ry Fan Throated Lizard	Least Concern
54	*Trimeresurus gramineus*	Common Bamboo Viper	Least Concern
55	*Varanus bengalensis*	Bengal Monitor Lizard	Near Threatened

Sources: IUCN 2022. The IUCN Red List of Threatened Species. Version 2021-3

Appendix E Amphibians of the Study Area

SN	Scientific Name	Common Name	IUCN Status
1	*Duttaphrynus melanostictus*	-	Least Concern
2	*Duttaphrynus scaber*	-	Least Concern
3	*Duttaphrynus stomaticus*	Marbled toad	Least Concern
4	*Euphlyctis cyanophlyctis*	-	Least Concern
5	*Euphlyctis hexadactylus*	-	Least Concern
6	*Fejervarya limnocharis*	-	Least Concern
7	*Hoplobatrachus crassus*	-	Least Concern
8	*Hoplobatrachus tigerinus*	Indian Bullfrog	Least Concern
9	*Hydrophylax malabaricus*	Malabar Fungoid Frog	Least Concern
10	*Microhyla ornata*	Ant Frog	Least Concern
11	*Microhyla rubra*	Guangdong Rice Frog	Least Concern
12	*Polypedates maculatus*	-	Least Concern
13	*Sphaerotheca breviceps*	-	Least Concern
14	*Sphaerotheca rolandae*	Roland's Burrowing Frog	Least Concern
15	*Uperodon globulosus*	Indian Globular Frog	Least Concern
16	*Uperodon systoma*	Marbled Globular Frog	Least Concern
17	*Uperodon taprobanicus*	Sri Lankan Bullfrog	Least Concern
18	*Uperodon variegatus*	Eluru Dot Frog	Least Concern

Sources: IUCN 2022. The IUCN Red List of Threatened Species. Version 2021-3

Appendix F Fishes of the Study Area

SN	Scientific Name	Common Name	IUCN Status
1	*Ambassis interrupta*	Long-spined Glassfish	Least Concern
2	*Ambassis nalua*	Scalloped Perchlet	Least Concern
3	*Amblypharyngodon microlepis*	Indian Carplet	Least Concern
4	*Anabas testudineus*	Climbing Perch	Least Concern
5	*Anguilla bengalensis*	Indian Mottled Eel	Near Threatened
6	*Anguilla bicolor*	Shortfin Eel	Near Threatened
7	*Anguilla marmorata*	Marbled Eel	Least Concern
8	*Aplocheilus lineatus*	Striped panchax	Least Concern
9	*Aplocheilus parvus*	Dwarf panchax	Least Concern
10	*Aurigequula fasciata*	Threadfin Ponyfish	Least Concern
11	*Awaous grammepomus*	-	Least Concern
12	*Bagarius yarrelli*	-	Vulnerable
13	*Bostrychus sinensis*	Four-eyed Sleeper	Least Concern
14	*Brachirus pan*	Pan Sole	Least Concern
15	*Bunaka gyrinoides*	Green-backed Gudgeon	Least Concern
16	*Caragobius urolepis*	Scaleless Worm Goby	Least Concern
17	*Channa gachua*	Dwarf Snakehead	Least Concern
18	*Channa marulius*	-	Least Concern
19	*Channa punctata*	Spotted Snakehead	Least Concern
20	*Channa striata*	Snakehead Murrel	Least Concern
21	*Chelon melinopterus*	Otomebora Mullet	Least Concern
22	*Chelonodon patoca*	Milkspotted Puffer	Least Concern
23	*Cirrhinus mrigala*	Mrigal	Least Concern
24	*Crenimugil seheli*	Bluespot Mullet	Least Concern
25	*Ehirava fluviatilis*	-	Data Deficient
26	*Eleotris fusca*	Brown Spinecheek Gudgeon	Least Concern
27	*Ellochelon vaigiensis*	Squaretail Mullet	Least Concern
28	*Equulites leuciscus*	-	Least Concern
29	*Esomus danrica*	Flying barb	Least Concern
30	*Etroplus suratensis*	Green Chromide	Least Concern
31	*Eubleekeria splendens*	Splendid Ponyfish	Least Concern
32	*Exyrias puntang*	Puntang Goby	Least Concern
33	*Favonigobius reichei*	Indo-pacific Tropical Sand Goby	Least Concern
34	*Gazza minuta*	Toothed Ponyfish	Least Concern
35	*Gymnostomus ariza*	Ariza Labeo	Least Concern
36	*Hippichthys cyanospilos*	Bluespeckled Pipefish	Least Concern

SN	Scientific Name	Common Name	IUCN Status
37	*Hippichthys heptagonus*	Reticulated Freshwater Pipefish	Least Concern
38	*Hippichthys penicillus*	Beady Pipefish	Least Concern
39	*Hippichthys spicifer*	Bellybarred Pipefish	Least Concern
40	*Ichthyocampus carce*	Indian Freshwater Pipefish	Least Concern
41	*Kuhlia mugil*	-	Least Concern
42	*Labeo bata*	Minor Carp	Least Concern
43	*Lamnostoma orientalis*	-	Least Concern
44	*Lamnostoma polyophthalma*	-	Least Concern
45	*Leiognathus equulus*	Common Ponyfish	Least Concern
46	*Lepidocephalichthys thermalis*	-	Least Concern
47	*Macrognathus aral*	-	Least Concern
48	*Megalops cyprinoides*	Indo-Pacific Tarpon	Data Deficient
49	*Microphis brachyurus*	Opossum Pipefish	Least Concern
50	*Monopterus albus*	Rice Swampeel	Least Concern
51	*Monopterus javanensis*	Oriental Swamp Eel	Least Concern
52	*Morone saxatilis*	Striped Bass	Least Concern
53	*Mugil cephalus*	Flathead Mullet	Least Concern
54	*Mystus gulio*	-	Least Concern
55	*Mystus keletius*	-	Least Concern
56	*Mystus montanus*	Wynaad mystus	Least Concern
57	*Mystus seengtee*	Shingtee	Least Concern
58	*Nandus nandus*	-	Least Concern
59	*Nemacheilus denisoni*	-	Least Concern
60	*Neopomacentrus taeniurus*	Freshwater Damsel	Data Deficient
61	*Neotropius atherinoides*	-	Least Concern
62	*Notopterus notopterus*	-	Least Concern
63	*Omobranchus ferox*	Gossamer Blenny	Least Concern
64	*Ompok bimaculatus*	-	Near Threatened
65	*Ophiocara porocephala*	Spangled Gudgeon	Least Concern
66	*Ophisternon bengalense*	Bengal Mud Eel	Least Concern
67	*Oreichthys cosuatis*	-	Least Concern
68	*Oryzias carnaticus*	Spotted Ricefish	Least Concern
69	*Oryzias dancena*	Indian Ricefish	Least Concern
70	*Parachiloglanis hodgarti*	-	Least Concern
71	*Pisodonophis boro*	-	Least Concern
72	*Planiliza macrolepis*	Largescale Mullet	Least Concern
73	*Planiliza planiceps*	Tade Gray Mullet	Least Concern
74	*Planiliza tade*	-	Data Deficient

SN	Scientific Name	Common Name	IUCN Status
75	*Platycephalus indicus*	Bartail Flathead	Data Deficient
76	*Plectorhinchus gibbosus*	Brown Sweetlips	Least Concern
77	*Plicofollis dussumieri*	Blacktip Sea Catfish	Least Concern
78	*Polynemus paradiseus*	-	Least Concern
79	*Pomadasys argenteus*	Silver Javelin	Least Concern
80	*Psammogobius biocellatus*	Sleepy Goby	Least Concern
81	*Pseudapocryptes elongatus*	-	Least Concern
82	*Pseudetroplus maculatus*	Orange Chromide	Least Concern
83	*Pseudogobius melanosticta*	Black-spotted Goby	Least Concern
84	*Pseudosphromenus cupanus*	Spiketail Paradise Fish	Least Concern
85	*Puntius vittatus*	-	Least Concern
86	*Rasbora caverii*	-	Least Concern
87	*Rasbora dandia*	-	Least Concern
88	*Rasbora daniconius*	Slender Barb	Least Concern
89	*Rasbora microcephalus*	-	Least Concern
90	*Salmophasia balookee*	Bloch Razorbelly Minnow	Least Concern
91	*Salmophasia boopis*	Boopis Razorbelly Minnow	Least Concern
92	*Scatophagus argus*	Spotted Scat	Least Concern
93	*Siganus vermiculatus*	Vermiculated Spinefoot	Least Concern
94	*Sperata aor*	Long-whiskered Catfish	Least Concern
95	*Stenogobius gymnopomus*	-	Data Deficient
96	*Taenioides cirratus*	Whiskered Eel Goby	Data Deficient
97	*Tenualosa ilisha*	Hilsa	Least Concern
98	*Terapon jarbua*	Tiger Perch	Least Concern
99	*Terapon theraps*	Largescaled Terapon	Least Concern
100	*Tetraroge nigra*	Freshwater waspfish	Least Concern
101	*Tor khudree*	Black Mahseer	Least Concern
102	*Toxotes jaculatrix*	Banded Archerfish	Least Concern
103	*Wallago attu*	-	Vulnerable
104	*Zenarchopterus dispar*	Feathered River-garfish	Least Concern
105	*Zenarchopterus ectuntio*	-	Least Concern
106	*Zenarchopterus gilli*	Shortnose River Garfish	Least Concern

Source: IUCN 2022. The IUCN Red List of Threatened Species. Version 2021-3

Appendix G Landowner Details and Occupation

S.No	Name of the landowner	Survey No	Extent of Land given for project	Extent leftover or Land holding elsewhere	Occupation
1	A Elamperuvaluthi	60	82.31	Sembar Village ~60 acres	Owner of Civil construction company in Singapore
2	Raghu	10	13.18	Aranthangi ~50 acres (Coconut Farm)	Farmer, expired (Currently his wife Ms. Ramya holding POA.
3	Ramya	27	36.39	Aranthangi ~50 acres (Coconut Farm)	Owner of Civil construction company in Singapore
4	Vijayalakshmai	58	55.8	Aranthangi ~50 acres (Coconut Farm)	Owner of Civil construction company in Singapore
5	Alagusunder	1	0.50	Sembar Village ~4 acres	Farmer
6	Chelladurai	1	2.31	Pulavanvayal & Sembar village ~8 acres	Farmer
7	Chinnakannu	1	1.04	Sembar ~5 acres	Farmer
8	Chitambaram	1	1.68	Maruthankudi ~10 acres	Farmer
9	J.James	3	0.81	Pulavanvayal & Sembar village ~10 acres	Real estate Business
10	Karuppasamy	1	2.03	Kallathi ~5 acres	Farmer
11	Karuppiah	2	0.98	Alpattaviduthi ~15 acres	Farmer
12	Malayappathevar	1	0.64	Sembar ~3acres	Farmer
13	Muthayee	2	4.45	Pulavanvayal ~5 acres	Business
14	Muthurakku	1	1.43	Sembar ~8 acres	Farmer
15	Nagarajan	1	0.72	Aranthangi ~5 acres	Farmer
16	Nirunjali	1	1.79	Kallur ~25	Busniess + Poilitician
17	Natarajan	1	0.49	Not available this information at this moment	Farmer
18	Palanisamy	1	1.56	Pulavanvayal & Sembar village ~5 acres	Business

S.No	Name of the landowner	Survey No	Extent of Land given for project	Extent leftover or Land holding elsewhere	Occupation
19	Pottu	1	1.46	Kallur ~10 acres	Farmer
20	Pushpavalli	1	0.72	Not available this information at this moment	Farmer
21	Rakappan	1	1.46	Pallathur ~8	Business
22	Seethalakshmi	1	2	Kallur ~4 acres	Farmer
23	Senthil	1	1.04	Pulavanvayal & Sembar village ~12 acres	Farmer
24	Venkatraman	5	2.47	Pulavanvayal & Sembar village ~6 acres	Business
25	Sundaram	1	1.93	Not available this information at this moment	Farmer
26	Uchimuthu	2	1.48	Not available this information at this moment	Farmer
27	Shymala	1	0.70	Sembar ~15 acres	Farmer
28	Uchiya	3	3.23	Sembar ~5 acres	Farmer
29	Thennila	1	1.38	Not available this information at this moment	Business
	Total		225.98		

Source: FPEPL Land Team

Appendix H PAF Socioeconomic Survey Form

Socio Economic Census Survey of PAFs

Name of the Site		**Nature of Impact**	Loss of Land	Loss of Structure	Loss of Access	Structure within RoW	Loss of CPR
			Cultural / Heritage Sites	Others specify			
Village		**Panchayat**				**Respondent No.**	

Name of the Respondent				**Age**		**Sex**		**Education**
Whether Head of HH		**If no Relation to HO-HH**		**Social Group**	GN	OBC	SC	ST
				House Type	Pakka	Semi-Pakka	Kutcha	
If ST Specify Tribe name		**Vulnerability**						
		WHH	BPL	Disabled	SC	ST	Elderly	Others
Religion	Hindu	Christian	Muslim	Others	**Family Type**	Joint	Nuclear	Extended
Family Size	Total		Children 0-7		Above 65 yrs	**Income Source**	Agri	Allied Agri	Business	Others, please specify

Family Profile

S.No	Name	Sex	Age	Relation	Education	Occupation	Monthly Income
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

1

Socio Economic Census Survey of PAFs

Land / Assets Lost							
Extent of Land Owned in Total (acre)	Extent Given	Extent Land Left over	Structure Lost (sq.ft)	Borewell Lost	Trees Lost	Crops lost	Others if any
Any other land owned, if yes, where and how much							

Land Procurement / Compensation						
Mode of Land Deal	Mutually Agreed	Involuntary	**Compensation Amount Utilization**	Purchased Land	Business	House
Others Specify			Others Specify			

Household Facilities	Electricity	Two-Wheeler	Four-wheeler	Toilet Facility	**Livestock**	Cow	Buffalo	Goat / Sheep	Others

Women Participation	Education Level		Economic Activity		Property Rights	

Perception about the project	
Is there are any grievances related to project	

Notes:

Appendix I Village Profiling Form

AECOM

Village Profiling

Date				**Village**	
Impact Category	Project Site ■	Core Zone ■	Buffer Zone ■	**Panchayat**	

Village Amenities							
Electrification %		Household Sanitation %		Public Toilets (Nos)		Streetlights Coverage %	
Drinking Water Source	Piped Drinking Water ■	Borewell ■	Tanker Supplied ■	If Piped Drinking Water Coverage %			
Transportation in Km	Bus@	Train@	Auto@	Bank @	Post Office @	Community Hall @	

Education Facilities					
School within Village	Primary School ■	Secondary ■	Hr. Sec. School ■	College ■	Vocational Training Institutes ■
If not nearest distance (Km)					
Status of Girl Child Education					
Perception of Girl Child Education			Average Education level of girls		
If education level is less compared to male, specify reason					
Do Girls encouraged to take higher studies		Age at Marriage for Girls		Does girls move out of town for higher studies/job	

Medical Facilities							
Facility Within village	Anganwadi ■	PHC / PHC-Sub ■	Private Clinics / Hospitals ■	Mobile Dispensary ■	Sidda / Ayurvedic ■	Ambulance ■	Veterinary Hospital ■
If not nearest facility (Km)							
People Preference in attaining medical aid	Allopathic Government ■	Allopathic Private ■	Ayurvedic / Siddha ■	Home Medicine ■	Others If any ■		
Predominant / Common Health Problems endemic to region			If any, specify if there are any reason				

Economic Activity						
Major Source of Economic Activity	Agriculture / Horticulture ■	Agri / Horti. & Allied ■	Labour ■	Fishing ■	Others ■	
Specify the % of population						
Source of Irrigation	Canal ■	River ■	Lake ■	Borewell ■	Rainfed ■	Others ■
Crops Cultivated						

Village Profiling

Any Industries nearby	Yes / No	Type of Industry		Population dependent	
Kind of Employment		Average Income / day /worker		Any Skill Development Centre within village	
Women Involvement in Economic activity	Type of Work				

Project Perception			
Have you heard about the upcoming project	Yes / No	How you came to know	
Does any people indirectly depend on the project site land	Yes / No	If yes, how	
Is, there culture important places within / adjacent to the project site	Yes / No	If yes, please specify in detail	
Is there are any tribal / Indigenous population in the village dependent on project site	Yes / No	If yes, please specify in detail	
What is the perception about the project			
How the project will benefit the village			
What are the felt needs			
Is, there any other industries doing CSR activities			

Notes: -