Draft Environmental and Social Impact Assessment 30MW Solar PV Project Mulkanoor

Project Number: 50195-001
July 2016

IND: ReNew Clean Energy Project

Prepared by Voyants Solutions Pvt. Ltd.

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

July 2016

IND: Environmental and Social Impact Assessment of 30 MW Solar PV Project at Vangara Village, Mulkanoor, District Karimnagar, Telangana

Prepared by **Voyants Solutions Pvt. Ltd.** for the Asian Development Bank.

CURRENCY EQUIVALENTS

(AS OF 08.08.2016 @ OANDA.COM)

{The date of the currency equivalents must be within 2 months from the date on the cover.}

CURRENCY UNIT	–	INR (₹)
$1.00	=	66.7033

Abbreviations

ADB	Asian Development Bank
BGL	Below Ground Level
BOD	Biological Oxygen Demand
BPA	Business Partnership Agreement
BPL	Below Poverty Line
CEA	Central Electricity Authority
CHC	Community Health Centre
CPCB	Central Pollution Control Board
CSR	Corporate Social Responsibility
CTE	Consent to Operate
CTO	Consent to Establish
DISH	Directorate of Industrial Safety And Health
EAC	Expert Appraisal Committee
EHS	Environment, Health and Safety
EPC	Engineering Procurement and Construction
ESIA	Environmental And Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESZ	Ecologically Sensitive Zone
FGD	Focus Group Discussions
GRM	Grievance Redressal Mechanism
IFC	International Finance Corporation
IMD	Indian Meteorological Department
IPP	Independent Power Producer
MOEF&CC	Ministry of Environment, Forests & Climate Change
MSL	Mean Sea Level
NAAQS	National Ambient Air Quality Standards
NABL	National Accreditation Board for Testing and Calibration Laboratories
NOC	No Objection Certificate
O&M	Operation and Maintenance
OBC	Other Backward Caste
PPA	Power Purchase Agreement
PHC	Primary Health Centre
PS	Performance Standard
RTFCTLARR	Right to Fair Compensation and Transparency in Land Acquisition and Rehabilitation & Resettlement
ROW	Right of Way

RSSPL	ReNew Saur Shakti Pvt. Ltd.
SC	Scheduled Caste
SCADA	Supervisory Control and Data Acquisition
SEIAA	State Environment Impact Assessment Authority
SEMS	Social and Environmental Management System
SPS	Safeguard Policy Statement
SPV	Special Purpose Vehicle
ST	Scheduled Tribe
TDS	Total Dissolved Solid
VSPL	Voyants Solutions Pvt. Ltd.
WB	World Bank
WPR	Work Participation Ratio

NOTES

i. The fiscal year 2016-17 of the Government of India ends on March 31, 2017.

ii. In this report, "$" refers to US dollars.

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0 EXECUTIVE SUMMARY

0.1 THE PROJECT

ReNew Saur Shakti Pvt. Ltd. (herein after referred as 'Client or Proponent or RSSPL'), a subsidiary of ReNew Power Ventures Pvt. Ltd. (RPVPL) is planning to set up a 30MW (AC) grid connected Solar PV Power Plant envisaged to sale with Northern Power Distribution Company of Telangana Limited. The project is being set-up near to village Vangara, Mulkanoor. A Power Purchase Agreement (PPA) has been signed on 3rd March, 2016. This PPA shall be in force for a period of 25 years from the date of commercial operation. Project is based on C-Si technology of solar PV modules with single axis tracking.

0.2 PROJECT PROPONENT

RPVPL, is an Independent Power Producer company backed by the Goldman Sachs Group Inc. ReNew Power is the first IPP in India to cross an installed capacity of 1000 MW from clean energy projects in the country. The company operates in the field of wind energy, utility scale solar and roof top solar. 1, 060 MW capacity is up and running, and another 1,400 MW in pipeline. This includes 286 MW in Telangana, 330 MW in Karnataka, 50 MW in Madhya Pradesh and 522 MW in Jharkhand. Further, ReNew Power's portfolio also comprises of wind 880 MW and solar 118 MW.

0.3 BACKGROUND OF STUDY

RSSPL intends to invest in the Solar projects with financial assistance from lenders / multilaterals etc. In this context, the project requires evaluating the environmental and social risks associated with the proposed project and to implement mitigation measures to avoid adverse impacts during the project lifecycle. In addition to ADB guidelines, the project need to comply with the applicable Asian Development Bank (ADB) Safeguard Policy Statement, International Finance Corporation (IFC)/World Bank (WB) guidelines, local laws and regulations relating to the environment, social issues and occupational health and safety matters. The aim of the study is to assess whether the project to comply with the requirements of the above mentioned guidelines as necessitated by financial investors. Voyants Solutions Pvt. Ltd. herein referred as "Consultant" was retained for carrying out Environmental and Social Impact Assessment.

Consultant's, Environment and Social Experts visited the site in Second-week of July, 2016. ADB Checklist approach and standard methodology was followed for project screening and categorization before starting of any construction activities. Project is categorized as 'Category B Project' based on site specific environmental and social impacts screening, the major observations of the proposed project are as follows.

- The project is a green field project. Land is being acquired on one to one negotiation approach and mutually agreed prices between Buyer and Seller.
- The land for the project is devoid of forest land or ecology/biodiversity of significant concern. Hence no significant impact on ecology of the area is expected. There is no ecologically sensitive areas like national parks, wildlife sanctuaries, scheduled areas and critically polluted areas within 10 km i.e. study area of the project.

- No specific / vulnerable group of community is likely to be affected by the project. No SC / ST land is being acquired for the project. No farmer will become marginal after acquiring the land for the project
- The construction phase of the project will witness various types of activities such as leveling and grading, increase in vehicular movement for material transportation, erection of solar module, etc. All the above mentioned tasks contribute to fugitive dust emission and noise due to construction activity in the vicinity. So there may be a temporary impact on neighboring agricultural plots, during construction phase.
- The site is devoid of any settlement. The nearest settlement is about 700m away from site periphery. Considering local nature of construction impacts, no impact on nearby settlement is expected due to project activities.

0.4 OBJECTIVES

The ESIA study has been undertaken with the following objectives:

- To establish the environmental baseline in the study area and to identify any significant environmental issue;
- To analyse, quantify the impacts, and design project activities keeping into mind environmental social impacts.
- To prepare an inventory of biodiversity (Flora and Fauna) in the region and those likely to be affected due to project activity.
- Prepare a PAP profile through survey using acceptable tool/s, as per the applicability
- Socio economic survey and need base assessment study on the basis of secondary/primary information
- Focused Group discussion to identify the needs, problems, if applicable
- Formulate and suggest suitable CSR plan for the specific project
- To identify and assess the project impact associated with proposed development
- To identify and design appropriate safeguards for associated risk & disasters with proposed management plan
- To integrate the environmental and Social issues in the project planning and design;
- To develop a project specific Environment and Social Management and Monitoring Plan (ESMMP) for implementation and monitoring of the mitigation measures along with proposed Budget

0.5 ESIA PROCESS AND METHODOLOGY

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

- Study and review of the Project Report including Justification, Technical Data and Implementation Schedule and Impact associated thereof
- A regulatory review was undertaken in order to understand the applicable, local and national legislation and regulatory frameworks
- Site visit, discussion with stakeholders, checklist preparation and project categorization as per standard practices

- A detailed social and environmental assessment of site and surrounding areas has been undertaken through:
  - Reconnaissance surveys to understand site specific issues;
  - Discussion with the local community and identification of key issues;
  - Review of land documents and land procurement/acquisition process;
  - Baseline environmental data collection of the site through primary monitoring and secondary details through publically available documents;
  - Ecological assessment on flora and fauna of the site and study area through primary surveys and secondary data (Forest Working Plan, Discussion with Local Peoples, etc.);
  - Assessment of ROW Impacts as associated with infrastructure facilities when the alignment is finalized.
- Social Assessment through consultation with the local community to understand community perception with regard to the project and its activities
- Assessment of impacts, including cumulative impacts, based on understanding of the project activities and existing baseline status
- Determination of risk and disaster for the proposed project and its management measures system in totality
- Preparation of project specific Environment & Social Management and Monitoring Plan (ESMMP)

0.6 SITE SETTING

Proposed project is to be located in Vangara Village, Mulkanoor, District Karimnagar, Sate of Telangana. Approximately 201 acres of land is being acquired for the project. The land identified for the project is the part of Vangara village revenue boundary. Mulkanoor is the nearest town located at a distance of approximately 3.5 km from the proposed site towards East. The site is connected by Siddipet-Husnabad Road running at a distance of 1.2km South from the proposed plant site. Uppal is the nearest Railway station located at a distance of approximately 18km from the project site.

0.7 CURRENT STATUS

Area for locating the solar project is generally based on the climatic conditions with preference given to solar radiation, optimum use of sunshine hours and fewer cloud cover hours etc. About 201 acres of land is being acquired/purchased for the project. The land is being acquired on one to one negotiation basis. The whole land is the part of Vangara Revenue Village. The land identified for the project is primarily single cropped agriculture land with patches of barren scrub land.

The total land requirement for the project is sourced from private land. There is no forest or government. land acquisition is proposed for the project. Most of land being acquired is left non-cropped by the choice of land owners as major portion of land owners are settled in other business. Therefore, project does not involve any resettlement in terms of physical and economical aspects hence do not attract Resettlement Action Plan as per applicable national/state legislation. Land is being procured on mutually agreed compensation which is on more than the existing circle rate. During consultation it was noted by the consultant that the land owners have sold their lands as per their own choice and got better compensation which is more than the existing circle and market rate. As informed by local community and client and that no SC and ST land involved in land procurement process and none of the land owner(s) have become marginal farmers.

A village Kutcha road is passing across the proposed plant boundary near to northern corner. Alternative route along the periphery of the plant boundary will be provided for diversion of this road.

0.8 POWER EVACUATION SCHEME

The power evacuation is proposed through a 132 kV transmission line to 132/33KV Malkanoor Substation at Malkanoor. Aerial distance of Mulkanoor Sub-station from plant switch yard is around 2.5km. Transmission line of length 2.5 km will be laid down to evacuate the power from plant site to Mulkanoor sub-station.

The route for transmission line should be finalised after considering following factors:

- Transmission line should not pass through from any habitations and thick vegetation
- No community structures should be affected by transmission line
- All environmentally sensitive sites, archaeologically significant sites, areas of ecological and cultural significance should be avoided while selecting the route

0.9 PROJECT DEVELOPMENT

The erection of PV panels requires development of site which will involve soil investigation, site survey, site levelling, construction of internal paths etc. The proposed site is a single crop agriculture land which is a plain land; it may not require extensive levelling.

0.10 CLIMATE CHANGE IMPACT ASSESSMENT

The comparison of the GHGs emission caused by solar power plant with the GHGs emission that would have been caused by fossil fuel burned to make the same amount of electricity has been made. Thus the purpose of the project activity is to generate power from zero emissions Solar PV based power generation technology and thereby reduce the emissions associated with the grid. The project activity will export the Electricity to Northern Power Distribution Company of Telangana Limited. The electricity generated by the plant will be monitored through energy meters connected to switchyard at project site. The calculation of the total GHGs emission reduction as 51805 tCO_2e/year. The technology of electricity generation from Solar PV Plant is environment friendly. It thereby reduces the greenhouse gas emissions associated with fossil fuel based electricity generation system. The availability and reliability of solar power depend largely on current and future climate conditions, which may vary in the context of climate change.

0.11 BASELINE SCENARIO, IMPACT AND MITIGATION MEASURES

0.11.1 Land Resources

The project site is primarily single cropped agriculture land with patches of scrub waste land. No forest land is involved at the project site as per revenue record. Also no settlement is likely to be affected by the project. Vangara is the nearest settlement located at a distance of approximately 700m North of the site. One village road (Kutcha Path) is passing through the north side of the proposed site. Two Second order streams (Nallah) passing through the southern side of the proposed site. Land for the project has been acquired in such fashion to avoid impacts on Pond /Lake located in mid-way of the site. Land is procured in almost two patches connected by a strip of 50m to avoid acquisition of water body for proposed plant setting. Site is devoid of any forest area, habitation, historical place, etc. Also

no protected areas like National Park, Wildlife Sanctuary or Bio-sphere Reserve is within 10 km radius from the project site.

0.11.1.1Impact and Mitigation Measures During Construction.

Impacts: Land use of the project site will get changed from single crop agriculture to industrial land. This will boost the price of land in the region. ROW shall be required for the transmission line. However, no significant impact on land use is expected as land shall acquisition shall only be limited for erection of towers.

Mitigation Measures: The width of the access road is sufficient enough to transport the project materials. Hence, there is no need to widened the existing road.

Alternative route along the periphery of the plant boundary will be provided for the Kutcha Road passing across the plant boundary near to northern corner.

All the site suitability and selection criteria were followed while selecting the site. Efforts should be made to limit the construction activities within the project site, so that, no alteration of nearby land use is impacted due to the project.

0.11.1.2 Impact and Mitigation Measures During Operation

Impacts: Considering that the land will be used for some industrial activity and will result in generation of revenue, the change in land use is considered to be minor positive impact.

Mitigation Measures: No industrial activities outside the plant area should be permitted.

0.11.2 Soil Quality and Characteristics

Two soil samples were collected to assess the soil characteristics and fertility potential of study area. The samples were collected by random sampling method and representative composite soil sample were collected up to 90-cm depth.

Sandy clay and silty clay are the major soil formation in the study area. pH value of 7.69 to 7.98 presents neutrality of the soil. Nutrient exchanges between organic matter, water and soil are essential to soil fertility. Percentage of organic matter was found varying from 2.65 to 4.23%, whereas level of Nitrogen varies from 2.68% to 3.58%. NPK value suggest that soil is moderate in terms of fertility potential.

0.11.2.1 Impact and Mitigation Measures During Construction

Impacts: The project site is single cropped agriculture land with some patches of scrub land. Clearing activities will boost the soil erosion activities. The storage and use of hazardous material like Paints for PV Module structure, Oil for vehicles and machineries, used oil from dg set or construction machineries can contaminate the nearby soil if doesn't handled safely.

Mitigation Measures: The project will utilize tracker system for PV installation, which in turn require minimum leveling activities. Also effort should be made to minimize the topographical disturbance. This will reduce the potential for compaction and disturbance to soil layers due to backfilling at site. The scale of construction being small will have limited heavy machineries at site and for a shorter duration, which will further diminish the potential for compaction. Regular water sprinkling should be carried out to settle down the excavated soil and protect from wind and water erosion. All

construction and hazardous material having potential to contaminate the soil should be stored in separate designated areas.

0.11.2.2 Impact and Mitigation Measures During Operation

Impacts: Operation of solar photovoltaic panels for power generation will not have any direct impact on soil. However, the hazardous waste like used oil, transformer oil, hydraulic oils, etc. may contaminate the soil if not handled properly.

Mitigation Plan: All hazardous waste should be stored in a separate designated area in scientific manner and disposed of to the registered vendor.

0.11.3 Waste Generation and Handling

Site clearance, excavation, labour camp and installation of PV modules and associated facilities will produce different kinds of waste during construction, whereas, Industrial wastes are generated during routine operations (dielectric fluids, cleaning agents, and solvents).

0.11.3.1 Impact and Mitigation Measures During Construction

Impacts: The debris generated due to construction activities may spread out in nearby areas with wind and run-off during rainy season. This may lead to the soil and water contamination. Improper disposal of solid waste from the labour camps at site and lack of proper sanitation facility for labour can lead to unhygienic conditions and spread of diseases in the area. It can lead to discontent of local community and result in conflicts with the labour engaged at site.

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

Mitigation Measures: Construction debris can be utilised for levelling of the land and unused debris shall be disposed-off to nearest TSDF/waste disposal site. Excess topsoil can be given to nearby farmers for use in their fields. Efforts should be made to use the locally available labour for unskilled work purpose.

Hazardous waste like paint empty tin, used oils should be stored in separate designated space and can be given to CPCB approved recyclers. Metals scrap should also be given to the approved recyclers. ReNew is in discussion with one Chennai based vendor for recycling of the defunct Solar Panel and accessories.

0.11.3.2 Impact and Mitigation Measures During Operation

Impacts: The defunct / damaged photo voltaic cells should be stored separately. Cables, wires, will be generated and storage/ disposal on unpaved ground can lead to contamination of soil. Hazardous waste such as transformer oil, hydraulic oil, etc. also has the potential of land and soil contamination.

Mitigation Measures: Separate designated area should be earmarked for storage of hazardous waste. These waste shall be given to the CPCB / SPCB approved recyclers. ReNew is in discussion with one Chennai based vendor for recycling of the defunct Solar Panel and accessories.

0.11.4 Hydrology and Water Quality

The depth to water levels in Karimnagar district during pre-monsoon range from 1.63 to 24.67 m bgl. Whereas, depth to water level during post-monsoon 2012 ranges from 1.22 to 13.82 m bgl. As per 'Ground Water Information Booklet Karimnagar District, Telangana- September 2013' prepared CGWB, entire district comes under safe category of Ground Water Development.

Project site has a rolling topography with elevation ranging from 310m amsl to 340m amsl. Two Second order streams (Nallah) passing through the southern side of the proposed site. One of this stream carry the run-off from mountainous structure located on the southern side of the proposed site. Water from this stream being utilized for irrigation and this stream also serves water for the Pond/Lake) located near to both the site land patches. No prominent natural drainage system in and around the project site was observed.

Ground water in the study area was found neutral in terms of pH ranging from 7.43 to 7.69. Turbidity and color was found well within the acceptable limits. Most of heavy metals was found below the detectable limit, whereas, slight concentration of Iron, Zinc and Copper were observed. However, concentration of these heavy metals were found well below the acceptable limits.

0.11.4.1 Impact and Mitigation Measures During Construction

Impacts: The construction at site can alter the natural drainage pattern of the area at a micro level. Also the levelling activities will hamper the run-off flow of the area as site is covered by Mountainous structures in two sides. There is potential of contamination of pond's water (located adjacent to the project site) due to sediment run-off from construction activities. Improper disposal of sewage and wastewater from labour camps and construction debris can contaminate the ground water resources in the area.

Mitigation Measures: Septic tank with soak pit should be provided so that no contamination due to discharge of sewage may take place. The natural slope of the site should be maintained to the extent possible in order to avoid any change in the drainage pattern. Path of Two Nallahs as passing through the site should be maintained as per present scenario. Adequate arrangement for storm water management during construction period should be made to avoid sediment runoff from the site. During construction it should be ensured that no run-off from construction area merges with these nallahs. Storm water flow should be directed to the existing channels after passing through the silt traps to avoid sedimentation of these channels.

0.11.4.2 Impact and Mitigation Measures During Operation

Impacts: The water requirements for cleaning of PV modules will be met through groundwater after requisite permission or by tankers from nearby areas. As per 'Ground Water Information Booklet Karimnagar District, Telangana- September 2013' prepared CGWB, entire district comes under safe category of Ground Water Development.

Mitigation Measures: Bore-wells should be established only after requisite permission from regulatory authority. Meters should be installed at the bore-wells to monitor the abstraction of water. Wastage of water during cleaning of panels should be avoided. Awareness campaign may be driven under project CSR activities for use of effective irrigation practices, scheduling of crops, change the crop pattern, awareness creation for effective use of water etc. No careless attitude in handling of

hazardous waste and oil should be tolerated during plant operation. If any oil spilled out accidentally, it should be cleaned and stored appropriately.

0.11.5 Ecological Environment

No National Park, Wildlife Sanctuary, Bio-sphere Reserve, Notified Wildlife Corridor, etc. is located within 10km from the project site. The proposed project doesn't involved diversion of any forests area for the project purpose.

According to India State of Forest Report, 2015, the recorded forest area of Telangana State is 21591 km^2 which constitute 18.8% of its total geographical area of 114865 km^2. Of the total forest area, 513 km^2 is classified as very dense forest while 12712 km^2 is moderately dense forest and 8366 $km^2$is open forest. The state is located in Deccan Plateau Geographic zone. The Deccan Plateau is characterised with open, thorny, scrub jungle is dominated by the Acacia, Albizia, Hardwickia and allied species.

As per the direct sighting records, indirect occurrence evidence records and records procured from secondary literature data there is more than 110 species of trees, 28 different species of shrubs and 7 different species of herbs are found in the study area. More than 47 different species of fauna are found in the study area while there are 44 different avifauna species.

0.11.5.1 Impact and Mitigation Measures During Construction

Impact: Removal of vegetation may result in loss of habitat for small mammals and birds. However, the ecological survey carried out at site established that the site is primarily agriculture land with patches of scrub land without any significant ground vegetation. The project may however involve removal of few shrubs and trees. Noise from construction and frequent movement of vehicles may disturb the faunal system living in vegetated areas as located in South and West of the proposed site.

Mitigation Measures: The site is primarily agriculture land and devoid of any dense natural vegetation. Therefore, the loss of vegetation at site is considered to be limited. Efforts are also made to retain some of the trees as presented at site. The noise generating activities shall be schedule during day time only. Movement of construction and transport vehicles should be restricted to dedicated paths to minimise any harm to small mammals within the site.

0.11.5.2 Impact and Mitigation Measures During Operation

Impact: Glare / Reflection from solar modules may distract the avian fauna flying over the solar panel land. The impact to flora from the operation should be limited to the routine clearance of vegetation near the solar plant to avoid shadows and hindrance to sunlight on solar panels. No other impacts are seen on local ecological system due to the project.

Mitigation Measures: Solar panels will absorb most of light falling on them which will be then converted to electricity. Thus there will be very less impact due to glare from the panels. The glare is reported to be similar to that of a small water body, which implies insignificant distraction for the avifauna. Clearing of vegetation should be limited to removal of undergrowth or shrubs at the plant site.

0.11.6 Traffic and Transport Issue

The site is connected by Siddipet-Husnabad Road running at a distance of 1.2km South from the proposed plant site. The density of vehicle at this road is quite low.

0.11.6.1 Impact and Mitigation Measures During Construction

Impacts: The construction activities will require transportation of construction material PV modules and mounting structures components to the site. The additional traffic movement on the road due to project will increase accident related injuries in locals. Break down of vehicles, and unplanned halt along the road can lead to traffic blockade and discomfort to community. Heavy vehicles may damage the roads during transportation of raw material during construction period.

Mitigation Measures: The increase in traffic due to the project is however going to be marginal as no village roads will be used. The traffic density on connecting road is low and has adequate carrying capacity to accommodate the additional traffic due to the construction activities.

No movement is proposed on village roads. The vehicles should be mandated to maintain a minimum speed limit in the area to avoid accidents to people and livestock. The traffic movement in settlement areas shall be limited for day time only. Only PUC certified vehicle shall be deployed for the project to keep the air pollution under check. Tool Box training should be arranged for the driver to create awareness about road safety.

0.11.6.2 Impact and Mitigation Measures During Operation

No significant increment in the traffic nos. is expected during operation phase of the project.

0.11.7 Air Environment

0.11.7.1 Baseline

Ambient air quality monitoring was carried at 4 locations in and around to the project site. No major traffic or Industrial growth was observed in the study region. Two stone crusher running in near vicinity of the project are the only source air pollution near to the site. Agricultural activities are other source of pollution in study area. Agriculture activities results in generation fugitive dust. The PM10 and PM2.5 concentrations in the region found varying from 28.3 to 47.5µg/m^3 and 14.2 to 25.0 µg/m^3 in respect to the prescribed standards of 100 and 60 µg/m^3 respectively. No significant concentration of gaseous pollution was observed. In general air pollution was found well below the prescribed standards at all the places.

0.11.7.2 Impact and Mitigation Measures During Construction

Impacts: Construction activities shall lead to fugitive dust pollution from excavation, leveling, mixing of materials, transportation of the construction material, etc. Also the gaseous pollution is likely from Vehicular Exhaust, Machineries Engines, DG Set Operation (In emergency), etc. Increment in the number of vehicles shall also boost up the fugitive dust emission from road side bared soil.

Mitigation Measures: Considering the scale of construction activities, only a limited number of construction machinery will be required for limited duration. Therefore, emissions from heavy machinery are considered to be insignificant. Open burning of solid waste or packaging material should be strictly prohibited. Regular water sprinkling should be carried out to reduce fugitive dust

emission from construction activities in identified dust prone areas. All machineries shall be properly maintained and should meet the pollution standards. Only PUC certified vehicle should be deployed for the construction purpose. The construction material shall be transported in covered trucks and tipplers.

0.11.7.3 Impact and Mitigation Measures During Operation

The project is based on the power generation through Solar PV Technology. The Solar PV technology is environment friendly in terms of GHGs emission. Solar energy is a Renewable resource available with great potential to significantly reduce GHG emissions.

0.11.8 Noise Environment

Noise monitoring was carried out at four locations including project site. At each location, noise monitoring has been carried out once during the study period (July 2016) over a period of twenty-four hours to obtain Leq values at uniform time intervals of 1 hour. Day time Leq has been computed from the hourly Leq values between 6.00 a.m. - 10.00 p.m. and night time Leq from the hourly Leq values between 10.00 p.m. - 6.00 a.m.

No major source of noise was observed in the region. No heavy traffic was found at the road side too. The noise levels recorded in the monitoring locations during daytime were found in the range of 45.2 to 48.2 dB(A) and during night time the Leq value was between 31.3 and 34.1 dB(A). In general noise level was found within the prescribed standards in absence of any major noise source.

0.11.8.1 Impact and Mitigation Measures During Construction

Impact: Noise and vibration will be caused by the operation of earth moving and excavation equipment, concrete mixers, and the transportation of equipment, materials and people. Movement of traffic during night hours can also disturb the local community. About 90 dB(A) of noise will be generated from construction activity, which will attenuate to less than 45dB(A) i.e. night time prescribed noise level at about 100m. The nearest habitation is located at a distance of over 700m and therefore the impact due to the noise will not be significant.

Mitigation Measures: Considering the capacity and nature of the project, the use of construction machineries will be very limited. Most of noise generating activities like excavation, use of heavy earth moving machineries, etc. shall be limited for the construction phase. Only limited construction activities shall be carried out during night-time. 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 should be well maintained and confirming the CPCB noise standards.

0.11.8.2 Impact and Mitigation Measures During Operation

No major noise generating activities is expected during operation phase of the project.

0.11.9 Social Environment

The proposed project covers 25 Census villages of Karimnagar district. The study area for the project has been considered 10 km peripheral from the project boundary. As per Census of India 2011, the total population of the study area is 83707 in which 49.81% are males and 50.19% are females. An

average gender ratio of the study area is approximately 1008 females per 1000 males, which indicate that there are a balanced composition of male and female population. The entire population of the study area has been grouped into 21807 households and the average size of household is approximately 4 persons/ household. During site visit it was observed and noted that most of the houses of the study area are made of bricks and of semi-pacca type with *khaprail* tiles roof.

About 201 acres of land from 9 families is being procured / acquired for the project. No SC and ST land is being acquired for the project.

0.11.9.1 Impact and Mitigation Measures During Construction

Impacts in this stage are mostly related to social aspects. Land for the project is being procured/acquired on one to one negotiation basis. The compensation is being paid on mutual agreed price. During the consultation with affected khata holders and Revenue Dept. officials it was concluded that compensation paid to affected khata holders is more than the circle rate

Grievance Redressed Mechanism as developed by ReNew Power shall be followed in this project too and should communicated to community to express their concerns associated with the project.

A village Kutcha road is passing across to the site near northern corner of the project site, is likely to be affected by the proposed development. This road is being utilized by farmers for their agricultural activities. As communicated by ReNew's officials, Alternative route along the periphery of the plant boundary will be provided to avoid any convenience to the villagers. The nearest settlement is at least 700m away from the proposed site. Therefore, no impact on this settlement is expected due to the project. Job opportunity for the locals will be generated during construction phase.

0.11.9.2 Impact and Mitigation Measures During Operation

Project is likely to have a positive impact on the local social system in terms of economy and area development project. Project will boost up local employment opportunities based on skill and education, increased taxation revenue, increased demand for materials and services through local contracting. These things will ultimately improve the revenue generation opportunities in the project region. Some financial support for community development will also be provided by the project developer in line with their CSR activities.

0.11.10Impact during Decommissioning

0.11.10.1 Impacts

Decommissioning of the project involves dismantling of the solar modules and trackers, and all associated electrical infrastructure and site buildings. Improper disposal of demolition waste and obsolete machineries will lead to contamination of soil and discontent of community.

0.11.10.2 Mitigation Measures

Dismantling activities should be taken care by experienced professionals under the guidance of plant EMS Head. All the dismantled infrastructures and debris shall be segregated and stored separately with cover facility to negotiate with contamination effects of such wastes. Water sprinkling would be the regular practice to reduce the dust generation from the plant decommissioning activities.

0.12 ANALYSIS OF ALTERNATIVES

Development of solar power in the project area will be based on green process of power generation. Project will help in reduction of CO_2 emission likely due to power generation of same capacity by conventional means.

Solar Power projects are non-polluting energy generation projects which are site specific and dependent on the availability of solar insolation. The bidding process for PPA is based on Tehsil Level. On the basis of initial discussion with Land aggregator active in the project Tehsil, 3-4 sites were identified. Shadow analysis and power potential assessment for the project was done by RSSPL, based on which potential areas are notified. The important meteorological parameter in the design of solar PV power plant are solar radiation, ambient temperature and wind speed which are represented in Table below. The average solar radiation, ambient temperature and wind speed of the study area is 5.25 kWh/m^2/day, 27.6^{o}C and 1.1 m/s respectively which are generally suitable for the reasonably good energy generation.

0.13 INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

Consultation programs (Focus Group Discussion, Community based) have been finalized after discussion with the officials of RSSPL and local community including questionnaire for the same. All the respondents, community of Vangara and Ramnagar were aware with the proposed solar power project. All the people expressed their full support for solar project and they do not have any problem due to proposed projects.

Economy of the study area is dependent on agriculture. The main occupation of the people of Vangara and Ramnagar village is agriculture, dairy milk and cattle rearing. During consultation with people it was found out that average land holding size of the farmer of the study area is 3 to 30 acre per family and with agriculture they may earn INR 15,000 to 20,000 per acre per year. Cotton, Paddy, and Maize are the main crops that grown in the region. Approximately 500 liters of milk are sold every day from Vangara village. Few people of Vangara village are working as Software Engineer in abroad.

Local people are also concern about employment opportunity through proposed solar power project. RSSPL should ensure that they will prefer local people for unskilled labour during project construction period on the basis of their skill and education. During project operation period employment opportunity will be limited to security staff only.

0.14 GRIEVANCE REDRESSAL MECHANISM

This Grievance Redressal Framework (GRM) has been developed by ReNew for managing grievances related to environmental and social performance arising from its operations in Solar / Wind Projects. The Corporate level ReNew's Grievance Redressal Mechanism shall also be applicable for this project.

This GRM shall serve as one of the component of ReNew's Environmental and Social Management for managing overall performance of its projects as well as providing more accountability to its stakeholders.

0.15 ENVIRONMENT AND SOCIAL MANAGEMENT PLAN

RSSPL is committed to execute all construction and operation related activities for the proposed Solar PV Project as per the best established environmental, health and safety standards and also it should

be aligned with upcoming project to be implemented at asset level. Mitigation measures are proposed for impacts which are identified and quantified. Some residual impact will however persist after the all mitigation measures are employed, the Environmental and Social Management Plan intends to delineate monitoring and management measures to minimize such impacts by allocating management responsibility and suggesting skill requirement for implementation of these measures during construction and operational phase.

0.16 CONCLUSION

The ESIA has assessed the overall impacts on Environmental and Social components as a result of construction and operation of proposed 30MW Solar PV Power Project at Vangara Village, Mulkanoor of Telangana State. Most of the impacts due to project is minimal, site specific and reversible in nature. Site selection was done in such a manner that minimum numbers of land owners should get affected by the project. Majority of site land portion is owned by persons who involved in other livelihood generation activities like job in abroad and business. Compensation paid for the land is more than market rate. Therefore, affected land owners may purchase more than the land sale. Impact associated with catchment area disturbance should be mitigated by minimum alteration of land topography by the use of tracking mounted structure. Regular water quality monitoring of the adjacent water body is proposed to have a regular check on project impacts.

Based on the ESIA study, as per ADB's Categorization of Projects the proposed Solar PV power project can be classified as a Category B, which specifies that the project can cause potential and limited adverse social or environmental impacts which are generally site-specific, largely reversible and readily addressed through mitigation measures.

The rationale for categorization being:

- Overall the project being a Solar PV Power Project is a green project and does not have significant adverse impacts associated with the construction or operation activities;
- The land required for the project is being procured / acquired on one to one negotiation basis;
- One village kutcha road is merging in proposed site. Alternative route is being provided along the plant periphery to avoid the inconvenience due to proposed developmental activities;
- No indigenous communities being affected in the project area;
- The project does not involve diversion of any forest land. Therefore, ensuring minimal impact on ecology during the construction and operation phase of the project

The project will throw opportunities to local people for both direct and indirect employment. The project will provide impetus to industrialization of the area. Ribbon development will increase the economy and revenue potential of the region. It is expected that project development will also be helpful in development of surrounding and State & Country at large.

1 INTRODUCTION

1.1 THE PROJECT

ReNew Saur Shakti Pvt. Ltd. (herein after referred as 'Client or Proponent or RSSPL') is planning to set up a 30MW (AC) grid connected Solar PV Power Plant envisaged to sale generated electricity with Northern Power Distribution Company of Telangana Limited. The project is being set-up near to village Vangara, Mulkanoor. A PPA has been signed on 3rd March, 2016. This PPA shall be in force for a period of 25 years from the date of commercial operation. C-Si technology based solar PV modules with single axis tracking are proposed for the project.

1.2 PROJECT PROPONENT

ReNew Power Ventures Pvt. Ltd., is an Independent Power Producer company backed by the Goldman Sachs Group Inc. ReNew Power is the first IPP in India to cross an installed capacity of 1000 MW from clean energy projects in the country. The company operates in the field of wind energy, utility scale solar and roof top solar. 1,060 MW capacity is up and running, and another 1,400 MW in pipeline. This includes 286 MW in Telangana, 330 MW in Karnataka, 50 MW in Madhya Pradesh and 522 MW in Jharkhand. ReNew Power's portfolio comprises wind at 880 MW and solar at 118 MW.

ReNew Power hopes to cross 2000 MW of capacity by the end of financial year 2016. Company intends to add 1,100 MW in solar and 300 MW in wind, and by the end of next year, company aims to achieve a balanced portfolio of 1,180 MW of wind and about 1,220 MW of solar. ReNew Power is also planning an initial public offering in near future thereby listing themselves in the stock market.

1.3 CONSULTANT

Voyants Solutions Pvt. Ltd. (herein after referred as The Consultant) has been retained by ReNew Saur Shakti Pvt. Ltd., Gurgaon to conduct an Environmental and Social Impact Assessment for their proposed Solar Plant in Telangana State. The detailed designing assessment for the project has been carried out by M/s. Arbutus Consultants Pvt. Ltd. (Arbutus).

1.4 PROJECT LOCATION

The project is proposed to be located in Vangara Village, Mulkanoor, District Karimnagar of Telangana State. The land identified for the project is the part of Vangara village revenue boundary. Mulkanoor is the nearest town located at a distance of approximately 3.5 km from the proposed site towards East. The site is connected by Siddipet-Husnabad Road running at a distance of 1.2km from the proposed plant site. Uppal is the nearest Railway station from the site.

1.5 PURPOSE AND SCOPE OF ESIA

This study is being undertaken as per the requirements of the ADB Safeguard Policies (In specific) to understand Environmental and Social impacts associated with proposed Solar Power Project. The study suggests appropriate mitigation measures and management plans to prevent and minimize adverse impacts identified. The environmental and social assessment has been carried out against the following reference framework.

- Applicable Indian national, state and local regulatory requirements;
- ADB Safeguard Policy Statement, 2009;

- IFC Performance Standards, 2012;
- Equator Principles III, 2013;
- IFC / World Bank General EHS Guidelines, 2007;
- IFC / World Bank EHS Guidelines for Electrical Power Transmission and Distribution, 2007.

1.6 BACKGROUND OF STUDY

RSSPL intends to developed Solar projects with financial assistance from lenders / multilaterals etc. In this context, the project requires evaluating the environmental and social risks associated with the proposed project and to implement mitigation measures to avoid adverse impacts during the project lifecycle. In addition to ADB guidelines, the project need to comply with the applicable International Finance Corporation (IFC) / World Bank (WB) guidelines, local laws and regulations relating to the environment, social issues and occupational health and safety matters. The aim of the study is to assess whether the project to comply with the requirements of the above mentioned guidelines as necessitated by financial investors.

Consultant's Environment and Social Experts had visited the site in Second-week of July, 2016. ADB Checklist approach was followed for project screening and categorization. Detailed checklist assessment is given in Chapter 2 of this report. Project is categorized as 'Category B Project' based on site specific environmental and social impacts screening, the major observations of the proposed project are as follows.

- The project is a greenfield project
- Land is being acquired on one to one negotiation approach and mutually agreed prices between Buyer and Seller.
- The land for the project is devoid of forest land or ecology of great concern. Hence no significant impact on ecological balance of the area is expected
- The project is away (10km surrounding of project boundary) from any ecologically sensitive areas like national parks, wildlife sanctuaries, scheduled areas and critically polluted areas.
- No specific / vulnerable group of community is likely to be affected by the project. No SC / ST land is being acquired for the project.
- The construction phase of the project will witness various types of activities such as slight leveling and grading, slight increase in vehicular movement for material transportation, erection of solar module, etc. All the above mentioned tasks contribute to fugitive dust emission and noise due to construction activity in the vicinity. So there may be a temporary impact on neighboring agricultural plots, during construction phase.
- The site is devoid of any settlement. The nearest settlement i.e. Vangara is about 700m away from site outer periphery. Considering local nature of construction impacts, no impact on nearby settlement is expected due to project activities.

1.7 OBJECTIVES

The ESIA study has been undertaken with the following objectives:

- To establish the environmental baseline in the study area and to identify any significant environmental issue;

- To analyse, quantify the impacts, and design project activities keeping into mind environmental & social impacts.
- To prepare an inventory of biodiversity (Flora and Fauna) in the region and those likely to be affected due to project activity.
- Prepare a PAP profile through survey using acceptable tool/s, as per the applicability
- Socio economic survey and need base assessment study on the basis of secondary / primary information
- Focused Group discussion to identify the needs, problems, if applicable
- Formulate and suggest suitable CSR plan for the specific project
- To identify and assess the project impact associated with proposed development
- To identify & design appropriate safeguards for associated risk & disasters with proposed management plan
- To integrate the environmental and Social issues in the project planning and design;
- To develop a project specific Environment and Social Management and Monitoring Plan (ESMMP) for implementation & monitoring of the mitigation measures along with proposed Budget

1.8 ESIA PROCESS AND METHODOLOGY

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

- Study and review of the Project Report including Justification, Technical Data and Implementation Schedule and Impact associated thereof
- A regulatory review was undertaken in order to understand the applicable, local and national legislation and regulatory frameworks
- Site visit, discussion with stakeholders, checklist preparation and project categorization as per standard practices
- A detailed social and environmental assessment of site and surrounding areas has been undertaken through:
  - Reconnaissance surveys to understand site specific issues;
  - Discussion with the local community and identification of key issues;
  - Review of land documents and land procurement / acquisition process;
  - Baseline environmental data collection of the site through primary monitoring and secondary details;
  - Ecological assessment on flora and fauna of the site and study area through primary surveys and secondary data (Forest Working Plan, Discussion with Local Peoples, etc.);
  - Assessment of ROW Impacts as associated with infrastructure facilities when the alignment is finalized.
- Social Assessment through consultation with the local community to understand community perception with regard to the project and its activities
- Assessment of impacts, including cumulative impacts, based on understanding of the project activities and existing baseline status
- Determination of risk & disaster for the proposed project and its management measures system in totality

- Recommendation on project specific Environment & Social Management and Monitoring Plan (ESMMP)

1.9 ESIA LIMITATION

The limitations of the ESIA study, pertaining to the availability of information regarding the project, the accessibility of villages and stakeholders and the secondary information for the project. The consultation undertaken during the site visit was based on the present understanding of the project and the project footprint area. This assessment may slightly change in case of a change in the site as finalized at the time of study. The documents like land records were limited for review at the time of visit.

The consultations undertaken as part of the impact assessment were restricted to the stakeholders who were available during the site visit. Also, due to the large number of the villages within the study area and the limited time in which the assessment had to be completed, the ESIA team undertook consultation in a sample of the villages with a focus for coverage of maximum number of stakeholder groups.

1.10 REPORT STRUCTURE

The full report presents the findings, analysis and recommendations for the proposed project which have been provided by environmental and social impact assessment (ESIA) team.

Chapter 0- Executive Summary: This section concisely describes the project critical facts, significant findings and recommended mitigate actions.

Chapter 1- Introduction: The chapter provides description of project background, objectives, scope and organization of the study and approach & methodology. Chapter also defines the structure of the full ESIA report.

Chapter 2- Policy, Legal and Administrative Framework: This chapter presents applicable legal provisions, National environmental and social (including labour) laws and policies as well as the relevant national and international standards and guidelines.

Chapter 3- Description of the project: This chapter deals with project details encompassing layout, land details, site settings, project components etc. Infrastructural development as a part of project during construction and operation phase and resources required are discussed in this chapter. This chapter also assess the climate change aspects related to project activities.

Chapter 4- Description of the Environmental and Social Baseline: This chapter presents an outline of Environmental, Ecological and Social baseline status of the study area and project site as well.

Chapter 5- Anticipated Environmental Impacts and Mitigation Measures: This chapter includes details of identified environmental impacts and associated risks due to the project activities, assessment and significance of impacts and presents mitigation measures to minimize adverse impacts identified.

Chapter 6- Analysis of Alternatives: This chapter presents the analysis of alternatives for the proposed solar project considering no project scenario, alternate methods for power generation and technology and alternate routes for transmission line.

Chapter 7- Information Disclosure, Consultation and Participation: This chapter addresses about the public consultation of the surrounding study area and elaborate the outcome result of public consultation. Also briefly discuss about the stakeholder profiling, mapping and analysis, methods for consultation and stakeholder engagement of project.

Chapter 8- Grievance Redress Mechanism: This chapter addresses the description of the grievance redress framework and mechanism for resolving the complaints.

Chapter 9- Environmental & Social Management and Monitoring Plan: This Section provides recommendation for environmental and social management plan aimed at minimizing the negative environmental and social impacts and monitoring requirements of the project.

Chapter 10- Conclusion and Recommendation: A brief conclusion drawn from the impact assessment study has been presented in this chapter.

2 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 INTRODUCTION

This section highlights the environmental and social regulations applicable to the proposed solar PV project. The section broadly focuses on the institutional framework, applicable environment, health & safety, social legislative requirements and ADB Safeguard Policy Statement relevant to the proposed Project. The administrative framework for the project will focus on:

- Applicable environmental and social regulations and policies in India and the State of Telangana;
- Institutional framework for the implementation of the regulations; and
- International Standards and conventions including:
  a. Applicable Indian National, State and Local regulatory requirements;
  b. ADB safeguard policy statement, 2009;
  c. ADB policy on Social Protection Strategy, 2001;
  d. ADB policy on Public Communication Policy, 2011;
  e. IFC Performance Standard, 2012;
  f. Equator Principles III, 2013;
  g. IFC and World Bank General EHS Guidelines, 2007;
  h. IFC and World Bank EHS Guidelines for Electric Power Transmission and Distribution, 2007; and
  i. Relevant ILO conventions rectified by Host country covering core labour standards and basic terms and conditions of employment (limited to operational phase of the proposed project).

2.2 NATIONAL REGULATIONS

The environmental regulations, legislations and policy guidelines in respect to the proposed project are governed by various regulatory agencies. The principal environmental regulatory agency in India is Ministry of Environment, Forest and Climate Change (MoEF&CC), Delhi supported by Central Pollution Control Board (CPCB).

The Solar Photovoltaic Power Projects are not covered under the ambit of EIA Notification, 2006. Hence, it does not require preparation of Environmental Impact Assessment Report and pursuing Environmental Clearance from MoEF&CC. Further, Ministry of Environment, Forest and Climate Change has included Solar PV Power Projects under “White category” for Consent to Establish / Operate. Newly-introduced White category contains 36 industrial sectors which are practically non-polluting. There shall be no necessity of obtaining the Consent to Operate’’ for White category of industries. An intimation to concerned SPCB / PCC shall suffice. The copy of guidelines is attached as **Annexure I** of this document.

Environmental and safety related national regulations that are applicable to the proposed Solar Project are discussed in **Table** below.

Table 2-1: National Regulation for Applicable in Solar Project

S. No.	Act/Law	Description/purpose	Responsible Authority	Applicability
A	**ENVIRONMENT & FOREST**			
A-1	Environmental (Protection) Act, 1986 and amendment.	To protect and improve overall environment, this umbrella act imposes certain restrictions and prohibitions on new projects or activities, or on the expansion or modernization of existing projects or activities based on their potential environmental impacts. It is a comprehensive act covering overall objective to improve environment by prevention and control of air, water, soil pollution etc. Clearances from different authorities are independently obtained. The Act is effective since 1986.	CPCB SPCB	Permissible limit for AAQ, Water Quality, Noise limits has been laid down by CPCB under EP Act 1986, which requires to be complied with.
A-2	Environmental Impact Assessment (EIA) Notification, 2006 and amendment.	Environmental Impact Notification S.O.1533 (E), dt. 14th September 2006, as amended in 2009, issued under Environment (Protection) Act 1986, has made it mandatory to obtain environmental clearance for scheduled development projects. The notification classifies projects under two categories 'A' and 'B'. Category A projects (including expansion and modernization of existing projects) require clearance from MoEF& CC, GoI and category B from State-level SEIAA, constituted by Government of India.	MoEF&CC and State Environmental Impact Assessment Authority (SEIAA)	Solar PV Power Plants are not in the ambit of EIA Notification, 2006.

S. No.	Act/Law	Description/purpose	Responsible Authority	Applicability
A-3	Forests (Conservation) Act, 1980 and Rules 1981 as amended 2004	The Forest Conservation Act (FCA) was adopted in 1980 to protect and conserve forests. The Act restricts the powers of the State in respect of de-reservation of forests and the use of forestlands for non-forest purposes. The FCA is relevant for the for the siting guidelines for Solar Plant, and for passage of transmission line, since it may involve use of forestland for "non-forest" purposes. According to Section 2 of the Act "notwithstanding anything contained in any other law for the time being in force in a State, no State Government, or other authority shall, except with the prior approval of the Central Government, make any order directing: • De-reservation of a reserved forest • Use any forest land for any non -forest purpose • Assign any forest land to any private person or entity not controlled by the Government • Clear any forest land of naturally grown trees for the purpose of using it for reforestation	State Forest Dept. / MoEF& CC	Project doesn't involve deforestation of any forest land for project or associated facilities like substation and transmission line.
A-4	Wildlife (Protection) Act 1972, Wildlife (protection) Amendment Act 2002 and 2003 amendment.	The Act provides for the protection of wild animals, birds and plants; and for matters connected therewith or ancillary or incidental thereto. The application of the Order of the Honorable Supreme Court in WP 460 of 2004 dated	Chief Conservator Wildlife, State Forest Department and MoEF&CC	No wildlife sanctuary or national park or eco-sensitive zone within 10 km radius from the project site. The nearest notified eco-sensitive area i.e. Vana Vignana Kendra Mini Zoo is about 27km from the proposed site.

S. No.	Act/Law	Description/purpose	Responsible Authority	Applicability
		04.12.2006 in the matter of Goa Foundation v. Union of India and other wherein the Honorable Supreme Court has directed that all projects which require environmental clearance and are located within the distance of 10Km of National Park and Sanctuaries must be placed before the standing Committee of the National Board for Wildlife constituted under the Wildlife (Protection) Act, 1972.		
A-5	Hazardous Waste (Management, Handling and Trans-Boundary Movement) Rules, 2008 as amended in 2009 and 2010 under EPA, 1986 (HWM Rules, 2008)	The Hazardous Wastes (Management, Handling and Tran's boundary Movement) Rules, 2008 are promulgated under Environment (Protection) Act 1986, which was further amended in July 2009, September 2009, March 2010 and August 2010. With the recent amendment, these rules have become quite comprehensive. The rules define responsibility of hazardous wastes generators, require safe handling practices and maintenance of manifest system during transport of hazardous waste and also describe technological aspects to be followed up by re-refiners and recyclers of hazardous wastes. The rules also cover liabilities of occupier, transporter and operator of a facility for any damages caused due to improper handling and disposal of hazardous wastes by reinstating or restoring environmental damages caused.	CPCB, SPCBs	Generation of waste oil & transformer oil at site attracts the provision of the rules and hazardous waste have to dispose as per directives of MoEF&CC and CPCB, SPCB. RSSPL should ensure authorization of deputed O&M contractor for collection, reception, storage, transportation and disposal of hazardous wastes.

S. No.	Act/Law	Description/purpose	Responsible Authority	Applicability
A-6	The Air (Prevention and Control of Pollution) Act, 1981 Including Rules 1982 and 1983 and amendment	The Act prohibits the construction and operation of any industrial plant without the consent of SPCBs. The Act assigns powers and functions to the CPCB and the SPCBs for prevention and control of air pollution and all other related matters. For the prevention and control of air pollution, the State Government, in consultation with the SPCB has the powers to set standards for emissions from automobiles, impose restrictions on use of certain industrial plants and prohibit emissions of air pollutants in excess of the standards laid down by the SPCB. The CPCB, as well as the SPCBs are eligible for contributions from the Central as well as the State Government, respectively, to perform their functions appropriately. The Act also allows for appropriate penalties and procedures for non-compliance.	SPCB	Ministry of Environment, Forest and Climate Change has included PV Projects under "White category" for Consent to Establish / Operate. Newly-introduced White category contains 36 industrial sectors which are practically non-polluting. "Consent to Operate'' is not necessary for White category of industries. An intimation to concerned SPCB / PCC shall suffice. The copy of guidelines is attached as **Annexure I** of this document.
A-7	The Noise Pollution (Regulation and Control) Rules, 2000 and the Noise Pollution (Regulation and Control) Amendment) Rules, 2010	As per the Noise Pollution (Regulation and Control) Rules 2000, every facility is required to take all possible steps to meet the ambient noise level standards prescribed in the Rules. The rules prescribe maximum permissible values of day and night time noise levels for zones A, B, C and D representing industrial, commercial, and residential and silence zone respectively.	SPCB	There will be generation of noise during construction activities. Operation phase noise generation activity shall be limited to the Transportation activities only. The project is required to maintain the noise limits prescribed for residential (55 dB(A) for daytime and 45 dB(A) for night-time) at project boundary. However, noise level of Industrial Area (75 dB(A) for daytime

S. No.	Act/Law	Description/purpose	Responsible Authority	Applicability
				and 70 dB(A) for night-time) shall be applicable inside the project boundary.
A-8	Water Prevention and Control of (Pollution) Act, 1974 including Rules, 1975 (as amended up to 1988)	This Act provides for the prevention and control of water pollution and maintaining or restoring good water quality for any establishment. The Act assigns functions and powers to the CPCB and SPCBs for prevention and control of water pollution and all related matters. Subject to the provisions of the Act, the functions and powers of CPCB as well as the SPCBs have been delineated individually and with respect to each other.	Center Pollution Control Board (CPCB), State Pollution Control Board (SPCBs)	MoEF&CC has included PV Projects under "White category" for Consent to Establish / Operate. Newly-introduced White category contains 36 industrial sectors which are practically non-polluting. There shall be no necessity of obtaining the "Consent to Operate'' for White category of industries. An intimation to concerned SPCB shall suffice. The copy of guidelines is attached as **Annexure I** of this document.
A-9	The Water Prevention and Control of Pollution), Cess Act, 1977 including Rules 1978 and 1991	This Act provides for levy and collection of Cess on water consumed and water pollution caused. It also covers specifications on affixing of meters, furnishing of returns, assessment of Cess, interest payable for delay in payment of Cess and penalties for non-payment of Cess within the specified time. Industries consuming water less than $10m^3$/day have been exempted from levy of Cess provided they are not generating hazardous wastes.	SPCB	The water demand for operation phase will be in the tune of about 343 m^3 water per wash. It is proposed to clean and wash the panels on twice in a month basis.
A-10	Electricity Act, 2003	The sections of the Electricity Act, 2003 that are relevant for laying (and repairs) of transmission lines for the supply of energy are described as following: Section 67 details the provisions (a) to open and break up the soil and pavement of any street,	State Electricity Regulation Committee	Client should obtain license under the electricity act and ensure compliance of Health and Safety requirements as per rule 29 and 46 under chapter 6.

S. No.	Act/Law	Description/purpose	Responsible Authority	Applicability
		railway or tramway; (b) to open and break up any sewer, drain or tunnel in or under any street, railway or tramway; (c) to alter the position of any line or works or pipes, other than a main sewer pipe; (d) to lay down and place electric lines, electrical plant and other works;(e) to repair, alter or remove the same; (f) to do all other acts necessary for transmission or supply of electricity. Section 159 describes that no person shall be engaged in the generation, transmission, distribution, supply or use of electricity, in any way injure any railway, highway, airports, tramway, canal or water-way or any dock, wharf or pier vested in or controlled by a local authority, or obstruct or interfere with the traffic on any railway, airway, tramway, canal or water-way. Section, 160(1) describes that every person generating, transmitting, distributing, supplying or using electricity (hereinafter in this section referred to as the "operator") shall take all reasonable precautions in constructing, laying down and placing his electric lines, electrical plant and other works and in working his system, so as not injuriously to affect, whether by induction or otherwise, the working of any wire or line used for the purpose of telegraphic, telephone or electric		

S. No.	Act/Law	Description/purpose	Responsible Authority	Applicability
		signaling communication, or the currents in such wire or line. Section 34 describes that every transmission licensee shall comply with such technical standards, of operation and maintenance of transmission lines, in accordance with the Grid Standards, as may be specified by the Authority. Section 53 (1) describes that the Authority may in consultation with the State Government, specify suitable measures for –(a) protecting the public (including the persons engaged in the generation, transmission or distribution or trading) from dangers arising from the generation, transmission or distribution or trading of electricity, or use of electricity supplied or installation, maintenance or use of any electric line or electrical plant; (b) eliminating or reducing the risks of personal injury to any person, or damage to property of any person or interference with use of such property ; (c) prohibiting the supply or transmission of electricity except by means of a system which conforms to the specification as may be specified; (d) giving notice in the specified form to the Appropriate Commission and the Electrical Inspector, of accidents and failures of supplies or transmissions of electricity; (e) keeping by a		

S. No.	Act/Law	Description/purpose	Responsible Authority	Applicability
		generating company or licensee the maps, plans and sections relating to supply or transmission of electricity; (f) inspection of maps, plans and sections by any person authorized by it or by Electrical Inspector or by any person on payment of specified fee; (g) specifying action to be taken in relation to any electric line or electrical plant, or any electrical appliance under the control of a consumer for the purpose of eliminating or reducing a risk of personal injury or damage to property or interference with its use; Section 165 (1) In section 40, sub-section (1) of clause (b) and section 41, subsection (5) of the Land Acquisition Act, 1894, the term "work" shall be deemed to include electricity supplied or to be supplied by means of the work to be constructed. (2) The Appropriate Government may, on recommendation of the Appropriate Commission in this behalf, if it thinks fit, on the application of any person, not being a company desirous of obtaining any land for its purposes, direct that he may acquire such land under the provisions of the Land Acquisition Act, 1894 in the same manner and on the same conditions as it might be acquired if the person were a company.		

S. No.	Act/Law	Description/purpose	Responsible Authority	Applicability
B. Land and Labour				
B-1	Land Acquisition Act 1894 (Amended in 1984) and The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013	Land Acquisition Act 1894 was passed with the purpose of enabling the procurement of land for the purpose of activities which are in the interests of the country. These include procedures for the acquisition of land, declaration of acquisition intent, hearing of objections, and final possession of the land amongst others. In last decade, the LA Act 1894 has been debated over for its archaic characters, which do not fit into the current realities. The current reality surrounding the process of land acquisition has changed tremendously, and therefore, the need was felt for the passing of a new law. A new Land Acquisition Resettlement and Rehabilitation Bill (LARR) 2011, which was renamed to The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act (RTFCTLARR Act), was passed by both the houses of Parliament and given the President's assent on 26th September 2013. The new law came into force in January 2014 and is applicable to the project. The new law stipulates mandatory consent of at least 70% of affected people for acquiring land for Public Private Partnership (PPP) projects and 80%	Local Administration District Collector Revenue Officer	Land for the project is being purchased / acquired on mutual agreement basis. Interactions are being made with Land Owners directly and registration of land is being carried on mutually agreed prices. Hence, It does not involve any involuntary displacement.

S. No.	Act/Law	Description/purpose	Responsible Authority	Applicability
		for acquiring land for private companies. It also requires that payment of compensation for the owners of the acquired land will be four times the market value in rural areas and twice in urban areas. It also stipulates that the land cannot be vacated until the entire compensation is awarded to the affected parties. The law has the provision that the companies can lease the land instead of purchasing it. Besides, the private companies will have to provide for rehabilitation and resettlement if land acquired through private negotiations is more than 50 acres and 100 acres in urban and rural areas, respectively.		
B-2	The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act 2006 & Rules 2007	The act basically vests the forest rights and occupation in forest land in forest dwellers (ST and other traditional forest dwellers) who have been residing in forests for generations but whose rights could not be recorded. The act provides a framework for recognizing the forest rights and the nature of evidence required for such recognition and vesting of forest land. Some of the key rights so vested are as follows • Right to hold and live in the forest land under the individual or common occupation for habitation or for self-cultivation for livelihood by	Ministry of Tribal Affairs Tribal Welfare Department	Not applicable as proposed project doesn't involve diversion of Forest Land.

S. No.	Act/Law	Description/purpose	Responsible Authority	Applicability
		a member or members of a forest dwelling Scheduled Tribe or other traditional forest dwellers; • Community rights such as NISTAR, by whatever name called, including those used in erstwhile Princely States, Zamindari or such intermediary regimes; • Right of ownership, access to collect, use, and dispose of minor forest produce which has been traditionally collected within or outside village boundaries; • Other community rights of uses or entitlements such as fish and other products of water bodies, grazing (both settled or transhumant) and traditional seasonal resource access of nomadic or pastoralist communities; • Rights including community tenures of habitat and habitation for primitive tribal groups and pre-agricultural communities; • Rights in or over disputed lands under any nomenclature in any State where claims are disputed; • Rights for conversion of Pattas or leases or grants issued by any local authority or any State Government on forest lands to titles;		

S. No.	Act/Law	Description/purpose	Responsible Authority	Applicability
		• Rights of settlement and conversion of all forest villages, old habitation, un-surveyed villages and other villages in forests, whether recorded, notified or not into revenue villages; • Right to protect, regenerate or conserve or manage any community forest resource which they have been traditionally protecting and conserving for sustainable use; • Rights which are recognized under any State law or laws of any Autonomous District Council or Autonomous Regional Council or which are accepted as rights of trial's under any traditional or customary law of the concerned tribes of any State;		
B-3	The Provision of the Panchayats (Extension to the Scheduled Areas) Act, 1996	The Act provides extension of the provisions of Part IX of the Constitution relating to the Panchayats to the Scheduled Areas. Scheduled Areas are defined as per the Clause (1) of Article 244 of the Constitution. The act gives special powers to the Panchayats in case it has been classified as Schedule V area by the constitution. The Panchayats are expected to have special powers given to them through the state Legislatures like:	Gram Panchayat	A NoC should be obtained from Gram Panchayat Vangara for proposed Solar PV Plant

S. No.	Act/Law	Description/purpose	Responsible Authority	Applicability
		• The power to enforce prohibition or to regulate or restrict the sale and consumption of any intoxicant; • The ownership of minor forest produce; • The power to prevent alienation of land in the Scheduled Areas and to take appropriate action to restore any unlawfully alienated land of a Scheduled Tribe; • The power to manage village markets by whatever name called; the power to exercise control over money lending to the Scheduled Tribes; • The power to exercise control over institutions and functionaries in all social sectors; • The power to control over local plans and resources for such plans including tribal sub-plans; • The administration and management of the Panchayat is similar to the non-schedule areas, but the Panchayat has immense powers in case of Scheduled Area.		
B-4	Panchayati Raj Act	The act gives powers to the Panchayats in case there is any grievance arises by the project. There is Provision for application of consent from the respective panchayat body/village administrative officer etc., during the project life cycle.	Panchayat Union	RSSPL should ensure that all grievances raised by locals related to the project are addressed through grievance redressal process. O&M contractor shall be responsible for Grievance Redressal, however, RSSPL should ensure regular compliance.

S. No.	Act/Law	Description/purpose	Responsible Authority	Applicability
B-5	The Indian Factories Act, 1948 and State Rules	The Indian Factories Act was promulgated in 1948, to ensure general welfare of the industrial workers. The Act is divided into nine chapters with three chapters exclusively on health and safety (H&S) issues. The Act in its preamble states that "it is the general duty of the occupier (defined in the act as person having the ultimate control over the affairs of the factory) to ensure as far as practicable health, safety and welfare of all workers while they are at work in the factory". A general policy with respect to H&S of the workers at work should be in the form of a written statement and brought to the notice of the workers per the provision of the Act. The Act in its Chapter 4 deals with the provisions relating to Safety. The specific areas of safety are those relating to the usage of machinery, handling of hazardous substances and the latest amendments include safety measures for hazardous processes. The Act also has regulations for working near machinery in motion; development of adequate safety measures during installation and various types of operation of the machinery. The Act also explains preventive and protective measures in safety including proper consideration	Directorate of Industrial Safety and Health (DISH) / Deputy Chief Inspector of Factories	Factory Act shall be applicable for the project. Compliance of Factory Act and other associated acts like Workman Compensation, Child Labour, Noise Rules, etc. should also be complied with.

S. No.	Act/Law	Description/purpose	Responsible Authority	Applicability
		of explosive or inflammable substances so that the workers are not exposed to hazards during operation. The factory occupier is responsible to maintain safety of the buildings and machinery per this legislation. The Act also gives power to States to make relevant rules to supplement the need of safety in the facility. An occupier is to develop a safety policy and form safety committees and provide power to the Central Government to appoint inquiry committee if some extraordinary situation had occurred in the factory which is engaged in the hazardous process.		
B-6	The Bonded Labour System (Abolition) Act 1976	The Bonded Labour System (Abolition) Act 1976: States that all forms of bonded labour stands abolished and every bonded labour stands freed and discharged from any obligations to render any bonded labour (Chapter 2)	Ministry of Labour & Employment	RSSPL should ensure compliance of the act conditions.
B-7	Minimum Wages Act, 1948	Minimum Wages Act, 1948 requires the Government to fix minimum rates of wages and reviews this at an interval of not more than 5 years. The minimum wage as prescribed for the industry by the government is required to be paid by the employers to the staff.	Ministry of Labour & Employment	RSSPL should ensure that all the contracted workers are provided with condition of services, rate of wages, holidays, hours of work as stipulated in the rules as per applicability and tenure of service, by the deputed contractor.

S. No.	Act/Law	Description/purpose	Responsible Authority	Applicability
B-8	The Workmen's Compensation Act, 1923	The Workmen's Compensation Act, 1923 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. Applicable to employees with less than or equal to a maximum of basic salary of INR 8000 per month	Ministry of Labour & Employment	RSSPL should ensure compliance, as per the applicability. This condition should be the part of contractor agreement.
B-9	The Contract Labour (Regulation & Abolition) Act, 1970 and Rules	As per the contract labour act, every principle employer is required to get the establishment registered before employing any contract labour. The contractors are also required to provide at minimum amenities like canteen, urinals, restrooms or alternate accommodation (if night halting labour), first aid, safe drinking water, etc. in case of contractor's failure to provide these amenities, the principle employer is liable to provide such amenities at its cost.	Ministry of Labour & Employment	RSSPL should ensure compliance of the act requirement as per agreement with O&M Contractor.
B-10	The Child Labour (Prohibition and Regulation) Act, 1986	A child is defined as a person who has not completed 14years of age. The Act prohibits employment of children in certain occupation and processes (part II, Section 3). The Act also specifies conditions of work for children, if permitted to work. These include a working day of maximum of 6 hours a day	Ministry of Labour & Employment	RSSPL should ensure compliance of the act conditions through deputed O&M Contractor.

S. No.	Act/Law	Description/purpose	Responsible Authority	Applicability
		(including rest), no work period exceeding 3 hours at a stretch, and no overtime (Section 7). The Act requires maintenance of a register for employed children (Section 11).		
B-11	ESI Act, 1948 (Employees State Insurance Act, 1948)	The ESI Act provides for certain benefits to employees in case of sickness, maternity and employment injury. These includes periodical payments to any insured person in case of his sickness certified by a duly appointed medical practitioner, periodical payments to an insured woman in case of confinement or miscarriage or sickness arising out of pregnancy, confinement, premature birth of child, periodical payments to an insured person suffering from disablement as a result of an employment injury sustained as an employee, or periodical payments to such dependents of an insured person who dies as a result of an employment injury sustained as an employee amongst others. Applicable to employees with less than or equal to a maximum of basic salary of INR 15000 per month	Ministry of Labour & Employment	Applicable to Proposed Solar PV Plant and RSSPL should ensure compliance through O&M Contractor as per the applicability.

2.3 INTERNATIONAL REGULATIONS

The Project is seeking financial support from ADB, hence ADB's environmental and social safeguards policies are applicable to this Project. Applicability analysis and compliance requirement for ADB SPs, EPs and IFC Performance standards are discussed in sections below.

2.3.1 ADB Safeguard Policies

Environmental and social safeguards are a cornerstone of ADBs support for sustainable economic growth. The Safeguard Policy Statement builds upon the three safeguard policies on the environment, involuntary resettlement, and indigenous peoples, and brings them into a consolidated policy framework to enhance effectiveness and relevance. The SPS lays out policy principles and outlines a set of specific safeguard requirements that ADB supported projects are expected to meet. The ADB Safeguard Policies cover the following aspects.

- Environmental assessment;
- Environmental planning, and management;
- Information disclosure;
- Consultation and participation;
- Grievance Redress mechanisms;
- Monitoring and Reporting;
- Unanticipated Environment Impacts;
- Biodiversity and sustainable natural resources management;
- Pollution prevention and abatement;
- Health and safety;
- Physical cultural resources; and
- Involuntary resettlement;
- Indigenous peoples

Applicability analysis of the ADBs in reference to proposed Solar PV Plant is Tabulated below.

Table 2-2: Application of ADB Safeguard Policies to the Project

ADB Safeguard Policy statement	Requirements	Project Information / Application
1. Environmental assessment	Environmental assessment term is used to identify potential direct, indirect, cumulative, and induced impacts and risks at an early stage of the project	The assessment is made in reference to the ADB standard checklist
2. Environmental planning and management	As per this requirement, borrower should prepare an environmental management plan (EMP) that addresses the potential impacts and risks identified by the environmental assessment. The EMP should include the proposed mitigation measures, environmental monitoring and reporting requirements,	Management and monitoring plan for the project is based on the Project's Impact Intensity on individual aspect. Performance Indicators are established for post project monitoring.

ADB Safeguard Policy statement	Requirements	Project Information / Application
	emergency response procedures, related institutional or organizational arrangements, capacity development and training measures, implementation schedule, cost estimates and performance indicators.	
3. Information Disclosure	Under this requirement borrower shall establish regular interaction with the affected populations and stakeholders from project planning to implementation to operation phases	Regular interaction with affected population and stakeholders are being made by the project proponent.
4. Consultation and Participation	The borrower / client should carry out meaningful consultation with affected people and other concerned stakeholders, including civil society, and facilitate their informed participation.	Consultation is a regular practice at the project site. RSSPL shall kept regular interaction with all the stakeholders.
5. Grievance Redress Mechanism	The borrower / client should establish a mechanism to receive and facilitate resolution of affected peoples' concerns, complaints and grievances about the project's environmental performance.	ReNew is in under process for development of Corporate Level Grievance Redressal Mechanism. Same will be followed for all projects once it got approval from ADB. Meanwhile, a Grievance Redressal Mechanism as prepared for the present project is discussed in this ESIA Report.
6. Monitoring and Reporting	The borrower / client should monitor and measure the progress of implementation of the EMP. The extent of monitoring activities should be commensurate with the project's risks and impacts. The borrower / client should prepare periodic monitoring reports that describe progress with implementation of the EMP and compliance issues and corrective actions, if any.	Monitoring plan is defined in this ESIA report and same shall be followed during erection and operation phase of the project.
7. Unanticipated Environmental Impacts	Where unanticipated environmental impacts become apparent during project implementation, the borrower / client should update the environmental	At this stage no such unanticipated impact is expected. However, If any unforeseen circumstance

ADB Safeguard Policy statement	Requirements	Project Information / Application
	assessment and EMP or prepare a new environmental assessment and EMP to assess the potential impacts, evaluate the alternatives, and outline mitigation measures and resources to address those impacts.	take place, RSSPL should take a corrective action.
8. Biodiversity and sustainable natural resources management;	Proponent should follow and need to identify measures to avoid, minimize, or mitigate potentially adverse impacts and risks and, as a last resort, propose compensatory measures, such as biodiversity offsets, to achieve no net loss or a net gain of the affected biodiversity.	The area is devoid of any notified ecologically sensitive areas viz. National park, wildlife sanctuary etc. The project site is devoid of any endangered or epidemic ecological habitat. Clearing of vegetation shall be limited as per necessity.
9. Pollution prevention and abatement;	During the design, construction, and operation of the project the borrower / client should apply pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environment, Health and Safety Guidelines.	Project is based on the Solar PV technology, which is in itself a clean technology of power generation. Project will reduce the carbon emission as expected from similar capacity of power generation through conventional approach. Most of the project's adverse impacts are limited for construction phase. Mitigation measures are discussed in Chapter 9.
10. Health and safety;	RSSPL should provide workers with a safe and healthy working environment, taking into account risks inherent to the particular sector and specific classes of hazards in the work areas, including physical, chemical, biological, and radiological hazards. Borrower / client should take steps to prevent accidents, injury, and disease arising from, associated with, or occurring during the course of work by (i) identifying and minimizing, so far as reasonably	RSSPL will abide with National and International Labour Safety Guidelines and Standards. Indian Labour laws should be followed religiously. Conditions of labour laws should be onus on O&M Contractor. Emergency preparedness plan is prepared for the

ADB Safeguard Policy statement	Requirements	Project Information / Application
	practicable, the causes of potential hazards to workers; (ii) providing preventive and protective measures, including modification, substitution, or elimination of hazardous conditions or substances; (iii) providing appropriate equipment to minimize risks and requiring and enforcing its use; (iv) training workers and providing them with appropriate incentives to use and comply with health and safety procedures and protective equipment; (v) documenting and reporting occupational accidents, diseases, and incidents; and (vi) having emergency prevention, preparedness, and response arrangements in place.	project and discussed in Chapter 9.
11. Physical cultural resources	The borrower / client is responsible for siting and designing the project to avoid significant damage to physical cultural resources (Defined as movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance.	No cultural resource is likely to be affected directly due to proposed project.
12. Involuntary resettlement;	Borrower / client should provide adequate and appropriate replacement land and structures or cash compensation at full replacement cost for lost land and structures, adequate compensation for partially damaged structures, and relocation assistance. The rate of compensation for acquired housing, land and other assets should be calculated at full replacement costs. The calculation of full replacement cost should be based on the following elements: (i) fair market value; (ii) transaction costs; (iii) interest accrued, (iv) transitional and restoration costs; and (v) other applicable payments.	Land for the project is being purchased / acquired on mutual agreement basis. Land is primarily agricultural land without any housing / commercial structure on it. Interactions are being made with Land Owners directly and registration of land is being carried on mutually agreed compensation. Hence, project does not involve any involuntary displacement. The compensation for land

ADB Safeguard Policy statement	Requirements	Project Information / Application
		being provided is more than the circle rate.
13. Indigenous peoples;	Borrower / client should explore to the maximum extent possible alternative project designs to avoid physical relocation of Indigenous Peoples that will result in adverse impacts on their identity, culture, and customary livelihoods. If avoidance is impossible, in consultation with ADB, a combined Indigenous Peoples plan and resettlement plan could be formulated to address both involuntary resettlement and Indigenous Peoples issues.	No vulnerable / indigenous population (SC and ST) land is being acquired or is likely to be affected by the project.

2.3.2 IFC Performance Standard

IFC applies the Performance Standards to manage social and environmental risks and impacts and to enhance development opportunities in private sector financing for its member countries eligible for financing. The Performance Standards may also be applied by other financial institutions choosing to support them in the proposed project. These performance standards and guideline provide ways and means to identify impact and affected stakeholders and lay down processes for management and mitigation of adverse impacts. The IFC Performance Standards stipulates that any proposed project shall meet the following requirements throughout the life of an investment by IFC or other relevant financial institution.

Table 2-3: Application of IFC Performance Standards to the Project

IFC Performance Standards	Requirements	Project Information/ Application
PS1: Social & Environmental Assessment and Management System	The project should have a social and environmental management system that incorporates the following: (i) policy; (ii) identification of risks and impacts; (iii) management programs; (iv) organizational capacity and competency; (v) emergency preparedness and response; (vi) stakeholder engagement; and (vii) monitoring and review.	The proposed project will have environmental and social impacts in project vicinity. PS1 is therefore applicable for the project and thus requires an Environmental and Social Impact Assessment (ESIA) study to be conducted before commencement of the project. RSSPL also needs to develop and implement a project specific Environmental and Social Management Plan to manage the impacts / risks associated with project's operations.

IFC Performance Standards	Requirements	Project Information/ Application
PS2: Labour and Working conditions	RSSPL requires to follow requirements on (i) working conditions and management of worker relationship (human resource Conditions policy, working conditions, terms of employment, worker's organizations, non-discrimination equal opportunity, retrenchment, grievance mechanism); (ii) protecting work force (not engaging child labor and forced labour); (iii) occupational health and safety; (iv) workers engaged by third parties; and (v) adverse impacts related to supply chain.	The applicability of PS2 will be more important during the construction phase as operation phase will only have limited number of staff. It not only covers the main plant employees, but all employees / workers, even those working through O&M contractors. Migrant workers be engaged for the project will stay in rented accommodation in nearby towns. Therefore, standards pertaining to camp sites may not be applicable. RSSPL should develop and implement procedures to manage and monitor performance of Contractors. These procedures should be integrated in day-to-day operations of the company and requirements should be clearly communicated to contractors, and if possible to workers engaged by contractors.
PS3: Pollution Prevention and Amendment	RSSPL requires to consider (i) sustainable resource utilization (water consumption); (ii) pollution prevention (wastes, hazardous materials management, pesticide use and management)	This Performance Standard is applicable to the Project. The proposed project is a clean energy project and no major pollution generation is associated with project activities. The construction works for the erection of project will entail generation of wastes like construction debris and defunct equipment or solar panels. The operation phase will result in generation of minor quantities of waste such as transformer oil and used oil and waste water administrative building. RSSPL should monitor emissions / pollutions level appropriate to

IFC Performance Standards	Requirements	Project Information/ Application
		ambient standards to ensure that the requirements of PS3 are being met.
PS4: Community Health, Safety and Security	RSSPL requires to follow requirements on i) infrastructure and equipment design and safety; (ii) hazardous materials management and safety; (iii) ecosystem services; (iv) community exposure to disease; (v) emergency preparedness and response; and (vi) security personnel.	The applicability of this PS has been established during the ESIA process, resulting in preparation of an Action Plan to be disclosed to the community. The Applicability will be limited to some extent of construction period with movement of heavy machinery / vehicles. Waste water generation from the module washing will get evaporated or absorbed by the soil underneath. Worker / Labour will be engaged from local community considering individual skill level. The Action Plan should be made available to influenced communities and relevant government agencies to understand these risks and impacts. The influenced communities and agencies should be engaged as and when required.
PS5: Land Acquisition and Involuntary Resettlement	Specifies requirements on (i) project design to avoid or minimize physical and/or economic displacement; (ii) compensation and benefits for displaced persons; (iii) community engagement; (iv) grievance mechanism; (v) resettlement and livelihood restoration planning and implementation; (vi) physical and economic displacement; (vii) private sector responsibilities under government-managed resettlement	Land for the project is being purchased / acquired on mutual agreement basis. Land is primarily rain-fed agricultural land without any structure on it. Interactions are being made with Land Owners directly and registration of land is being carried out on mutually agreed compensation packages. Hence, project does not involve any involuntary displacement. The compensation for land being

IFC Performance Standards	Requirements	Project Information/ Application
		provided is more than the circle rate.
PS6: Biodiversity Conservation and Sustainable Natural Resource Management	Specifies requirements on (i) protection and conservation of biodiversity (modified, natural, critical habitat, legally protected and internationally recognized areas, invasive alien species); (ii) management of ecosystem services; (iii) sustainable management of natural resources; and (iv) supply chain.	There is no notified ecologically sensitive areas viz. National park, wildlife sanctuary etc. within 10 km of project site. Baseline studies for ecological aspects have been described in Chapter 4 of the report. The study has been gathered through site survey, literature review and initial desktop analysis. The requirements of this PS shall be managed through the suggested mitigation measures. The operation phase of the proposed project shall ensure protection of fauna and flora of the site surroundings.
PS7: Indigenous Peoples	Specifies requirements on (i) Avoidance of adverse impacts; (ii) Participation and consent; (iii) circumstances requiring free, prior, and informed consent; (iv) mitigation and development benefits; and (v) private sector responsibilities where government is responsible for managing indigenous peoples issues	No indigenous population is likely to be affected by the proposed project. No material degradation or adverse impact is expected on land resources on which people are dependent. Hence, PS7 is not applicable for this project.
PS8: Cultural Heritage	Specifies requirements on (i) protection of cultural heritage in project design and execution (chance find procedures, consultation, community access, removal of replicable cultural heritage, removal of non-replicable cultural heritage, critical cultural heritage); and (ii) project's use of cultural heritage	As such the project does not impact any cultural property or structure of archaeological importance. This PS is applicable when tangible forms of cultural heritage, unique natural features or tangible objects that embody cultural values and certain instances of intangible forms of culture are impacted or are proposed to be used for commercial purposes. Hence,

IFC Performance Standards	Requirements	Project Information/ Application
		PS8 is not applicable for this project.

2.3.3 Equator Principles

The EPs, based on the IFC Performance Standards on social and environmental sustainability and on the World Bank Group Environmental, Health, and Safety Guidelines (EHS Guidelines), are intended to serve as a common baseline and framework for the implementation by each EPFI. The applicability of EP to the project has been outlined in Table below.

Table 2-4: Application of Equator Principles to the Project

Equator Principles	Requirements	Project Information/ Application
Principle 1: Review and Categorization	Project seeking financing from EPFIs, the project has to be categorized based on the magnitude of its potential impacts and risks in accordance with the environmental and social screening criteria of IFC.	Project is based on cleaner technology of power generation. Which will help in reduction of global carbon emission. Based on Section 2.4, project is identified as Category "B" project.
Principle 2: Social and Environmental Assessment	For each project assessed as being either Category A or Category B, the EPFI will require the borrower need to conduct an Environmental and Social Assessment process to address, to the EPFI's satisfaction, the relevant environmental and social risks and impacts of the proposed Project. The assessment should also propose measures to minimize, mitigate, and offset adverse impacts in a manner relevant and appropriate to the nature and scale of the proposed Project.	The social and environmental impacts and their mitigation measures are discussed in this ESIA Report.
Principle 3: Applicable Social and Environmental Standards	The principle requires the Environment and Social Assessment to refer to the applicable IFC performance standards and then applicable industry specific EHS guideline including the project's overall compliance with or justified deviation from, the respective Performance Standards and EHS Guidelines. The assessment process also needs to address compliance with relevant host country laws, regulation and permits	Applicability assessment of IFC Performance Standard is made in the earlier section. Compliance of the IFC standards shall be ensured by RSSPL.

Equator Principles	Requirements	Project Information/ Application
	that pertain to social and environmental matters.	
Principle 4: Action Plan and Management System	For all Category A and B projects, an Action Plan (AP) need to be prepared which addresses relevant findings, and draws on the conclusions of the Assessment. The AP will describe and prioritize actions needed to implement mitigation measures, corrective actions and monitoring measures necessary to manage the impacts and risks identified in the Assessment. In this regard, the borrower / proponent needs to maintain or establish a Social and Environmental Management System that addresses the management of these impacts, risks and corrective actions required to comply with applicable host country social and environmental laws and regulations, and requirements of the applicable Performance Standards and EHS Guidelines, as defined in the AP.	In accordance with the provision of this Principle, an Environmental and Social Management Plan has been drawn up as part of the ESIA study for the proposed project specifying appropriate plans and procedures which requires to be implemented during various phases in order to prevent, control and mitigate any potential environmental and social risks.
Principle 5: Consultation and Disclosure	According to this Principle, for all Category A and (as appropriate), Category B projects, the Government, borrower or third party expert to consult with project affected communities in a structured and culturally appropriate manner. For projects with significant adverse impacts on affected communities, the process will ensure their free, prior and informed consultation and facilitate their informed participation as a means to judge, vide EPFI norms, whether a project has adequately addressed the concerns of the affected communities.	Consultation with the stakeholders is a regular practice at the project site. RSSPL should continue regular interaction with all the stakeholders.
Principle 6: Grievance Mechanism	For all Category A and (as appropriate), Category B projects, it needs to be ensured by the proponent that consultation, disclosure and community engagement continues throughout construction and operation of the	RSSPL should ensure that all grievances raised by locals related to the project are addressed by contractor through grievance redressal process as discussed in this ESIA Report. Also ReNew is in

Equator Principles	Requirements	Project Information/ Application
	project and community concerns / grievances addressed through establishing a 'Grievance Redressal Mechanism'. In this regard, the proponent of the proposed solar PV project need to develop and implement a 'Grievance Redressal Mechanism (GRM)' to receive and facilitate resolution of any concern and grievance that may be raised by land loser groups and/or nearby village communities during both construction and operational phase of the project. As part of this Principle, it is also imperative that the proponent maintains regular dialogue with communities through implementation of focused CSR programmes / initiatives.	the process to develop a corporate level Grievance Redressal Mechanism and same should be implemented, once approved by ADB.
Principle 7: Independent Review	For all Category A projects and, as appropriate for Category B projects, an independent social or environmental expert not directly associated with the proponent will review the assessment, action plan and consultation process documentation in order to assist EPFI's due diligence, and assess Equator Principle Compliance.	As part of the loan approval for the project the respective EPFI may appoint an independent social or environmental expert for review of ESIA/ESMP report and its implementation.
Principle 8: Covenants	For Category A and B projects, the proponent will covenants in financing documentation: a) to comply with all relevant host country social and environmental laws, regulations and permits in all material respects; b) to comply with the action plans (where applicable) during the construction and operation of the project in all material respects; c) to provide periodic reports in a format agreed with EPFIs (with the frequency of these reports proportionate to the severity of impacts, or as required by law, but not less than annually), prepared by in-house staff or third party experts, that i) document compliance with the action plans (where	E&S Covenants shall be embedded within the contracts drawn between proponent and the contractors hired for construction activities and technology providers and waste handlers. Periodic environment and social review shall be carried out by the project proponent.

Equator Principles	Requirements	Project Information/ Application
	applicable), and ii) provide representation of compliance with relevant local, State and host country social and environmental laws, regulations and permits (where applicable) d) to decommission the facilities, where applicable and appropriate, in accordance with an agreed decommissioning plan.	
Principle 9: Independent Monitoring and Reporting	To ensure ongoing monitoring and reporting over the life of loan, EPFIs will, for all Category A projects and, as appropriate for Category B projects, require appointment of an independent environmental and/or social expert, or require that the proponent retain qualified and experienced external experts to verify its monitoring information which would be shared with EPFIs.	The project will fall under Category B and the periodic reporting mechanism will be done as may be agreed between EPFI and Project Proponent.

2.4 PROJECT CATEGORISATION

2.4.1 ADB Categorization Criteria

The project classification system of ADB is used to reflect the significance of potential environmental impacts understood as a result of the client's impact assessment and to establish ADB's safeguard requirements. The projects are screened on the following criteria:

Environment: Proposed project should be screened according to type, location, scale, sensitivity and the magnitude of their potential environmental impacts including direct, indirect, induced and cumulative impacts.

Involuntary Resettlement: The involuntary resettlement impacts of an ADB funded projects 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 should be 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.

Indigenous People: The impacts of an ADB funded project on indigenous people is determined by assessing the magnitude of impacts in terms of:

- Customary right of use and access to land and natural resources;
- The right of cultural and communal integrity;

- The level of vulnerability of the affected Indigenous people's community;
- Socio-economic status;
- Health, education, livelihood and social security status; and
- The recognition of indigenous people[1]

As per these criteria projects are classified into any of the four categories: A, B, C and F1. The categories used by ADB are:

Category A Projects: Projects which are likely to have significant adverse environmental and social impacts that are irreversible, diverse, or unprecedented.

Category B Projects: Projects with potential adverse environmental and social impacts that are less in number, generally site-specific, mostly reversible and readily addressed through mitigation measures;

Category C Projects: Projects with minimal or no adverse environmental and social impacts;

Category FI Projects: Projects which involve investment of ADB funds to or through a financial intermediary.

ADB Checklist approach was followed for project categorization. The REA checklist as filled for the project is as follows.

Rapid Environmental Assessment (REA) Checklist | **Solar Energy**

Country:	India
Project Title:	ReNew Saur Shakti Pvt. Ltd.'s 30 MW Solar PV Project at Vangara Village, Mulkanoor, District Karimnagar, Telangana
Date:	14th July, 2016

Screening Question	Yes	No	Remark
A. Project Siting			
Is the Project area adjacent to or within any of the following environmentally sensitive areas?		X	There is no notified ecologically sensitive protected area within 10km from the project site
Physical cultural heritage site		X	No cultural heritage in or nearby the project site
Located in or near to legally protected area		X	No legally protected area in or nearby the project site
Located in or near to special habitats for biodiversity (modified or natural habitats)		X	No special habitats of bio-diversity in and nearby the project site.

[1] As per Indian Regulatory Framework tribal population has been considered as Indigenous Population

Screening Question	Yes	No	Remark
Wetland		X	No notified wetland system is available in or nearby the project site. However, one pond is located near to North-Western side of the site. It was confirmed that pond area will not be acquired for the project requirement.
Mangrove		X	Project is located in Inland Area, no mangrove ecosystem in near vicinity of the project.
Estuarine		X	Project is located in Inland Area, no estuarine in near vicinity of the project.
Offshore (marine)		X	Not Applicable as project is an Inland Project
B. Potential Environmental Impacts			
Will the Project Cause			
large scale land disturbance and land use impacts specially due to diversion of productive lands?	X		About 201 acres of land shall be utilized for installation of proposed solar plant. Prima-facie, it is single agriculture land.
Involuntary resettlement of people? (physical displacement and/or economic displacement)		X	Land for the project is being purchased / acquired on mutual agreement basis. Land is primarily agricultural land without any residential or commercial structures. Interactions are being made with Land Owners directly and registration of land is being carried out on mutually agreed compensation. Hence, project does not involve any involuntary displacement. Also the compensation for land being provided is more than the circle rate.
Disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?		X	No such impact is anticipated.
Noise, vibration and dust from construction activities?	X		Fugitive dust emission is expected due to construction / erection activities. Regular water sprinkling is proposed to minimize the dust pollution during construction phase.
An increase in local traffic during construction?	X		Considering the project magnitude, increment in traffic nos. will not be significant.
Environmental disturbances such as soil erosion, land contamination, water	X		Air Pollution in terms of fugitive emission shall be controlled by regular sprinkling.

Screening Question	Yes	No	Remark
quality deterioration, air pollution, noise and vibrations during construction phase?			Noise level will be maintained by scheduling of construction activities. Hazardous material having potential to contaminate soil or land will be store at designated place.
Aesthetic degradation and property value loss due to establishment of plant and ancillary facilities?		X	No Aesthetic degradation is expected due to proposed project.
Changes in flow regimes of the water intake from surface water or underground wells due to abstraction for cooling purposes?		X	Project doesn't involve requirement of water for cooling purpose.
Pollution of water bodies and aquatic ecosystem from wastewater treatment plant, from cooling towers, and wash-water during operation?		X	Water for the project is required only for washing of the panels and officials at site. A septic tank with soak pit is proposed for office area.
A threat to bird or bat life from colliding with the project facilities and / or being burned by concentrated solar rays?		X	Project is based on Solar PV Power Generation Technology. Therefore, no such incidence is likely due to this project.
Industrial liquid (dielectric fluids, cleaning agents, and solvents) and solid wastes (lubricating oils, compressor oils, and hydraulic fluids) generated during construction and operations likely to pollute land and water resources?	X		Some amount of lubricating oils and hydraulic fluids will be utilized during construction. However, the quantity of utilization will be very less and not likely to create any hazard on land and water resources. Transformer oil shall be stored at separate designated space.
Soil / water contamination due to use of hazardous materials or disposal of broken or damaged solar cells (photovoltaic technologies contain small amounts of cadmium, selenium and arsenic) during installation, operation and decommissioning?		X	No land and soil contamination due to use of hazardous materials or disposal of broken or damaged solar cells (photovoltaic technologies contain small amounts of cadmium, selenium and arsenic) is expected during installation, operation and decommissioning as all such waste will be stored on separate designated place, properly labeled, possibly stored briefly and referred to the approved recyclers of waste handlers or manufacturer for Solar Panels as the case may be.
Noise disturbance during operation due to the proximity of settlements or other features?		X	No noise is expected due to power generation activities.

Screening Question	Yes	No	Remark
Visual impacts due to reflection from solar collector arrays resulting in glint or glare?	X		The project is based on the PV based Power Generation Technology. Therefore, reflection would be slightly on lower side in comparison to the Concentrating Solar Power Technology.
Large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		X	No such influx is expected as labour requirement for construction phase shall be met locally. The operation phase work-force requirement is limited for 15-20 nos., which is not likely to have any impact of local infrastructure.
Social conflicts between local labours and those from outside the area?		X	No such conflict is expected as effort will be made to meet the construction phase requirement locally.
Risks and vulnerabilities related to occupational health and safety due to physical, chemical, biological, and radiological hazards during construction, installation, operation and decommission?	X		Occupational health and safety risk shall be avoided with the help of best industrial practices.
Risks to community health and safety due to the transport, storage, and use and/or disposal of materials and wastes such as explosives, fuel and other chemicals during construction, and operation?		X	No incidence is expected
Community safety risks due to both accidental and natural causes, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?		X	Power generation is based on the PV technology of Power Generation. No industrial operation is involved for the project.

2.4.2 IFC Categorization Criteria

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

Category A Projects: Projects with potential significant adverse environmental and social impacts that are diverse, irreversible or unprecedented;

Category B Projects: Projects with potential limited adverse social or environmental impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures;

Category C Projects: Projects with minimal or no adverse social or environmental impacts, including certain financial intermediary (FI) projects with minimal or no adverse risks;

Category FI Projects: All Financial Intermediary (FI) projects excluding those that are Category C projects.

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

2.4.3 Project Categorization

Based on site specific environmental and social impacts assessment and checklist as stated in above section, the major observations of the proposed project are as follows.

Consultant's Environment and Social Experts had visited the site in Second-week of July, 2016. ADB Checklist approach was followed for project screening and categorization. Detailed checklist assessment is given in Chapter 2 of this report. Project is categorized as 'Category B Project' based on site specific environmental and social impacts screening, the major observations of the proposed project are as follows.

- The project is a greenfield project
- Land is being acquired on one to one negotiation approach and mutually agreed prices between Buyer and Seller.
- The land for the project is devoid of forest land or ecology of great concern. Hence no significant impact on ecological balance of the area is expected
- The project is away (10km surrounding of project boundary) from any ecologically sensitive areas like national parks, wildlife sanctuaries, scheduled areas and critically polluted areas.
- No specific / vulnerable group of community is likely to be affected by the project. No SC / ST land is being acquired for the project.
- The construction phase of the project will witness various types of activities such as slight leveling and grading, slight increase in vehicular movement for material transportation, erection of solar module, etc. All the above mentioned tasks contribute to fugitive dust emission and noise due to

construction activity in the vicinity. So there may be a temporary impact on neighboring agricultural plots, during construction phase.

- The site is devoid of any settlement. The nearest settlement i.e. Vangara is about 700m away from site outer periphery. Considering local nature of construction impacts, no impact on nearby settlement is expected due to project activities.

Most of the project impacts are associated with construction activities and shall be limited for shorter duration. Most of these impacts are reversible and will be limited for construction period of six months. On the basis of above observations project is categorized as 'Category B'.

2.5 APPLICABLE ENVIRONMENT STANDARDS

The central Pollution Control Board (CPCB) has stipulated different environmental standards w.r.t. Ambient Air Quality, Noise Quality, Water and Waste Water for the country as a whole under EP Act, 1986. IFC and WB EHS guidelines shall also be applicable for best international practices. Some of these standards shall only be applicable either during construction phase or in operation phase of the proposed plant. The applicable environmental standards for the proposed project have been discussed in the subsequent sections. The ambient air quality standards will be applicable only during the construction phase of the project and the wastewater discharges from the project during both construction and operation phases shall be as per the general discharge standards as sector specific standards are not available for solar power projects.

2.5.1 Ambient Air Quality Standards

Standards for Ambient Air Quality will only be applicable during construction phase only as no air major polluting process is expected during operation phase of the project.

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 2-5: National Ambient Air Quality Standards

Pollutant	Time Weighted Average	Concentration in Ambient Air	
		Industrial, Residential, Rural and other Areas	Ecologically Sensitive Area (notified by Central Government)
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 PM10, µg/m^3	Annual*	60	60
	24 Hours**	100	100
Particulate Matter (size less than 2.5 µm) or PM2.5, µg/m^3	Annual*	40	40
	24 Hours**	60	60
Ozone (O_3), µg/m^3	8 Hours**	100	100

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

No sector specific IFC guideline are in place for Solar Power Plant. Therefore, IFC general EHS guidelines are followed for comparison. As per IFC EHS guideline Emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards by applying national legislated standards, or in their absence, the current WHO Air Quality Guidelines or other internationally recognized sources. The WHO Ambient Air Quality Guidelines are presented in Table below.

Table 2-6: WHO Air Quality Guidelines

Pollutant	Averaging Period	Guideline Value in µg/m^3
Sulphur Dioxide (SO_2)	24 hour	125 (Interim target-1) 50 (Interim target-2) 20 (guideline)
	10 minute	500 (guideline)
Nitrogen dioxide (NO_2)	1 year	40 (guideline)
	1 hour	200 (guideline)
Particulate Matter PM10	1 year	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline)

Pollutant	Averaging Period	Guideline Value in µg/m³
	24 hour	150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)
Particulate Matter PM2.5	1 year	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (guideline)
	24 hour	75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)
Ozone	8 hour daily maximum	160 (Interim target-1) 100 (guideline)

2.5.2 Water Quality Standards

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

Table 2-7: Primary Water Quality Criteria for Designated-Best-Use-Classes

Designated-Best-Use	Class	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	Total Coliforms Organism MPN/100ml shall be 50 or Less pH between 6.5 and 8.5 Dissolved Oxygen 6mg/l or more Biochemical Oxygen Demand 5 days 20°C 2mg/l or less
Outdoor bathing (Organized)	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 20oC 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 20oC 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 25oC micro mhos/cm Max.2250 Sodium absorption Ratio Max. 26 Boron Max. 2mg/l

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

Source: Central Pollution Control Board

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

Table 2-8: Treated Sewage Discharge Guideline IFC

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

Notes: MPN = Most Probable Number

Table 2-9: Drinking Water Standard (IS 10500: 2012)

S. No.	Parameters	Unit	IS 10500:2012	
			Requirement (Acceptable Limit)	Permissible Limit in absence of alternative source
1	pH	--	6.5-8.5	No Relaxation
2	Turbidity	NTU	1	5
3	EC	µMho/cm	Not Specified	Not Specified
4	TSS	mg/l	Not Specified	Not Specified
5	TDS	mg/l	500	2000
6	Total Alkalinity as $CaCO_3$	mg/l	200	600
7	Chlorides as Cl^-	mg/l	250	1000
8	Sulphates as SO_4^-	mg/l	200	400
9	Nitrates as NO_3	mg/l	45	No Relaxation
10	Phosphates as PO_4	mg/l	Not Specified	Not Specified
11	Total Hardness as $CaCO_3$	mg/l	200	600
12	Calcium as Ca	mg/l	75	200
13	Magnesium as Mg	mg/l	30	100
14	Sodium as Na	mg/l	Not Specified	Not Specified
15	Potassium as K	mg/l	Not Specified	Not Specified
16	Flourides as F^-	mg/l	1.0	1.5
17	Iron as Fe	mg/l	0.3	No Relaxation
18	Phenolic Compounds	mg/l	0.001	0.002
19	Cyanide as CN-	mg/l	0.05	No Relaxation
20	Residual Chlorine as Cl^-	mg/l	0.2	1.0

S. No.	Parameters	Unit	IS 10500:2012	
			Requirement (Acceptable Limit)	Permissible Limit in absence of alternative source
21	Cadmium as Cd	mg/l	0.003	No Relaxation
22	Total Chromium as Cr	mg/l	0.05	No Relaxation
23	Lead as Pb	mg/l	0.01	No Relaxation
24	Zinc as Zn	mg/l	5	15
25	Manganese as Mn	mg/l	0.1	0.3
26	Copper as Cu	mg/l	0.05	1.5
27	Nickel as Ni	mg/l	0.02	No Relaxation
28	Colour	Hazen	5	15
29	Taste	-	Agreeable	Agreeable
30	Odor	-	Agreeable	Agreeable
31	Boron	mg/l	0.5	1.0
32	Anionic Detergents	mg/l	0.2	1.0
33	Mineral Oil	mg/l	0.5	No Relaxation
34	Aluminium as Al	mg/l	0.03	0.2
35	Mercury as Hg	mg/l	0.001	No Relaxation

Source: Indian Standard DRINKING WATER-SPECIFICATION (Second Revision), May 2012

2.5.3 Ambient Noise Standards

Noise standards notified by the MoEF vide gazette notification dated 14 February 2000 based on the A- weighted equivalent noise level (Leq) are as presented in Table below.

Table 2-10: Ambient Noise Standards

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

*Note: * Day time is from 6 am to 10 pm, Night time is 10 pm to 6.00 am;*

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

As per EHS guidelines of IFC, for residential, institutional and educational area, the one hourly equivalent noise level (Leq hourly) for day time is 55 dB(A) while the Leq hourly for night time is prescribed as 45 dB(A). Noise impacts should not exceed the prescribed levels in a maximum increase in background levels of 3 dB(A) at the nearest receptor location off-site.

Table 2-11: Ambient Noise Standards by IFC

Receptor	One Hour LAeq (dBA)	
	Day Time 07:00 – 22:00	Night Time 22:00 – 07:00
Residential, Educational, Institutional	55	45
Industrial and Commercial	70	70

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 2-12: Standards for Occupational Noise Exposure

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

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

3 PROJECT DESCRIPTION

3.1 INTRODUCTION

The project is based on Solar PV technology of power generation and will be established in Vangara Village, Mulkanoor. The ultimate capacity of the project is 30 MW and requires about 201 acres of land for establishment. This Chapter will discuss about technology portion related the Environment and Social aspects. Some of the project salient features are as follows.

Table 3-1: Salient Features of the Proposed Site

S. No.	Parameters	Details		
1	Name of the project	30 MW Solar PV Project at Vangara Village, Mulkanoor, District Karimnagar, State Telangana		
2	Nature of the project	Solar PV		
3	Project Proponent	ReNew Saur Shakti Pvt. Ltd.		
4	Village	Vangara		
5	Mandal	Bheemadevarpalle		
6	District	Karimnagar		
7	State	Telangana		
8	Latitude	18.107° N	Coordinate map is attached shown as Figure 3.1.	
9	Longitude	79.334° E		
10	Nearest Airport	Hyderabad Airport in SW about 120 km		
11	Nearest Town	Mulkanoor in East about 3.5 km		
12	Nearest Railway Station	Uppal in East about 18km		
13	Nearest major road	Siddipet-husnabad Road- 1.2km		
14	Land Requirement	201 acres		
15	Process Technology	Solar PV Power Generation Technology		
16	Annual global horizontal irradiation	1915.1 kWh/m^2/day		
17	Number of Modules	114324		
18	Total Module Area	221375 m^2		
19	No. of Inverters	30		
20	Capacity of Inverter	1000 KW		
21	First Year Energy Yield P50 (MWh/annum)	67050		
22	First Year Specific Yield (kWh/kWp)	1843		
23	Cost of the Project (Including land cost)	226.8 Crore		
24	Labour / Work-force Requirement	**Phase**	**Average**	**Peak**
		Construction	100 nos.	300 nos.
		Operation	15-20 nos.	

S. No.	Parameters	Details
25	Proposed date of commissioning	May 2017

A	18°06'56.15"N	79°19'43.37"E	E	18°06'20.97"N	79°19'56.85"E
B	18°06'40.45"N	79°19'03.12"E	F	18°06'29.93"N	79°19'49.65"E
C	18°06'39.52"N	79°19'10.15"E	G	18°06'28.48"N	79°19'08.83"E
D	18°06'19.62"N	79°19'08.30"E	H	18°06'37.89"N	79°19'46.14"E

Figure 3-1: Coordinate Map

3.2 PROJECT SITE

The project is proposed to be located in Vangara Village, Mulkanoor, District Karimnagar of Telangana State. Approximately 201 acres of land is being acquired for the project. The land identified for the project is the part of Vangara village revenue boundary. Mulkanoor is the nearest town located at a distance of about 3.5 km from the proposed site towards East. The site is connected by Siddipet-Husnabad Road running at a distance of 1.2km from the proposed plant site. Uppal is the nearest Railway station located at a distance of approximately 17km from the project site. The location of project site is presented in Figure 3.2.

Figure 3-2: Project Location Map

3.3 LAND REQUIREMENT & COST

Area for locating the solar project is generally based on the climatic conditions with preference given to solar radiation, optimum use of sunshine hours and fewer cloud cover hours etc. About 201 acres of land is being acquired / purchased for the project. The land is being acquired on one to one negotiation basis. The whole land is the part of Vangara Revenue Village. The land identified for the project is primarily single cropped agriculture land with patches of barren scrub land.

The total land being acquired for the project is private land. No forest or govt. land is being acquired for the project. Most of land being acquired is left non-cropped by the choice of land owners as major portion of land owners are settled in other business. Therefore, project does not involve any resettlement in terms of physical and economical aspects hence do not attract Resettlement plan as per applicable national/state legislation. Land is being procured on mutually agreed compensation which is on more than the existing circle rate. During consultation it was noted by the consultant that the land owner sale their land as per their own choice and got better compensation more than the existing circle and market rate. A village Kutcha road is passing through the northern part of the project site. Alternative route along the periphery of the plant boundary will be provided to avoid any inconvenience for this path users. As informed by local community and client that no SC and ST land involved in land procurement process and none of the land owner will become marginal. The major land requirement for the project is associated with installation of solar panel. The layout plan of the site is shown as Figure 3.3.

About 2.5km of transmission line will be laid down to connect the project from Mulkanoor Sub-station. Land for transmission line shall only be taken for RoW use. No land shall be acquired for laying the transmission line. The land requirement for Tower area will be in tune of 16 to 49 m^2, which shall be purchased on one to one negotiation basis. Tower shall be erected on every 250m interval.

3.4 WATER REQUIREMENT

Major water requirement during construction phase is limited for civil work and partly for domestic requirement of construction labour. An average 100 nos. of labour shall be required for construction activities with a peak of 300 nos. The water requirement for the construction phase shall be met through Tanker from authorized vendor.

For operation phase, the water requirement will be for domestic as well for cleaning of modules. The water requirement for cleaning of the whole plant is 0.12 m^3/MWh, depending on the option chosen. Module cleaning needs to be carried out periodically (Per module 2 times in one month) to remove dust, bird droppings etc. on the module and enhance the energy generation. Water requirement of 3 liters for each module has been considered while calculating total water requirement of the project. Modules likely to wash twice in a month.

The generated waste water from site office toilets should be disposed in septic tank followed by soak pit. The water for cleaning purpose of solar PV modules to remove dust, is likely to get evaporated or absorbed by the vegetation and soil underneath the solar panels.

3.5 POWER EVACUATION SYSTEM

The power evacuation shall be done through a 132 kV transmission line to 132/33KV Malkanoor Substation at Malkanoor. Aerial distance of Mulkanoor Sub-station from plant switch yard is around 2.5km.

Approximately 2.5km of transmission line will be laid down by to connect the project from Mulkanoor Sub-station. Land for transmission line shall only be taken for RoW use. No land shall be acquired for laying the transmission line. The land requirement for Tower area will be in tune of 16 to 49 m^2, which shall be purchased on one to one negotiation basis. Towers shall be erected at every 250m interval.

The route for transmission line should be finalised after considering following factors:

- Transmission line should not pass through from any habitations and thick vegetation
- No community structures should be affected by transmission line
- All environmentally sensitive sites, archaeologically significant sites, areas of ecological and cultural significance should be avoided while selecting the route

3.6 WORK-FORCE

Average 100 nos. labours will be employed for during construction / erection phase. Efforts should be made to utilize the local labours as per requirement based on their skills and expertise in the construction as well as operational phase. Skilled labored as required for the project will stay in nearby rented properties. Peak labour requirement during the construction phase is estimated to be 300.

The operation phase requirement shall be limited to 15-20 nos. The operation phase requirement is mainly for technician / skilled employees and Security Staff. One or two person shall also be required for module washing work.

3.7 CONSTRUCTION ACTIVITIES

3.7.1 Access Road

The proposed plant site is about 1.2 km from the Siddipet-Husnabad Road. Thereafter site is connected by a village kutcha road. This kutcha road will further be developed by RSSPL to use this as all-weather road by putting some murrum on it. The width of the road is sufficient enough to transport the project materials. Hence, there is no need to widened the existing road.

3.7.2 Site Development

The erection of PV panels requires development of site which will involve soil investigation, site survey, site levelling, construction of internal paths etc. The proposed site is a slightly undulating agriculture land; however, due to installation of tracking device it may not require extensive levelling. No big / Giant trees are observed at site. However, some shrubs of Babool (Acacia Spp.) and Calotropis gigantean are need to be cleared for setting-up the project.

3.7.3 Civil Work

RSSPL will sign EPC contracts with established contractors in this field. The project work shall involve the following activities:

- Erection of Solar PV Panels

- Erection of Inverters and SCADA Facility
- Construction of underground and/or overhead electrical collection lines to connect PV modules to the pooling substation
- Erection of other associated facilities

The major civil work involves PV Panel Foundation, erection, switch yard structure and equipment foundations including power transformer and control room cum administration building. Minor works involve security kiosks, collection substation, fencing and internal roads.

Construction of related structures will involve civil and steel work for installation of pooling stations, transformers, substation, and electric cables and signal wires.

3.7.4 Construction Waste

The main construction waste expected from the construction activities are packing and crafting material of solar panels, wires, inverters & other accessories, construction debris and defunct PV panels. The major construction activities associated with proposed plant are erection and cementing of the base structure for module installation. Waste out material like used oil, empty paint's tin, etc. should be stored at separate designated place and can be disposed of through approved recycler and dumping facility. As per the rules hazardous waste generated should be supplied to an authorized vendor. ReNew is in discussion with one Chennai based vendor for recycling of the defunct Solar Panel and accessories.

3.7.5 Implementation Schedule

It is expected that the project execution will commence from Mar 2016 and plant will be commissioned by May 17. The execution will be planned, monitored and controlled through project management techniques employing tools like MS-Project (PERT – CPM Charts). The construction schedule for the proposed plant is shown in Table below.

Table 3-2: Project Implementation Schedule

Activity	2016																				2017								
	03-Mar	18-Mar	02-Apr	17-Apr	02-May	17-May	01-Jun	16-Jun	01-Jul	16-Jul	31-Jul	15-Aug	30-Aug	14-Sep	29-Sep	14-Oct	29-Oct	13-Nov	28-Nov	13-Dec	28-Dec	12-Jan	27-Jan	11-Feb	26-Feb	12-Mar	27-Mar	11-Apr	26-Apr	11-May
PPA signing																													
Land acuqistion																													
Soli and counture surveys																													
Detail engineering																													
CEIG SLD and layout																													
BOM approval																													
Approach road construction																													
Land leveling																													
Boundary wall construction																													
Control room construction																													
Inverter room construction																													
MMS structure foundation																													
MMS Erection																													
Tracker system installation																													
PV module at site																													
PV module installation																													
SMU installation																													
Inverter installation																													
DC cabling																													
Transformer installation																													
Breaker panel																													
Plant evacuation yard																													
AC cabling																													
Transmission line																													
Substaion bay construction																													
CEIG Inspection																													
TSPCL Inspection & grid synchronisation																													
Plant commercial operation date																													

3.8 OPERATION ACTIVITIES

Operation of Solar PV Plant require very less amount of human resource. The human resource requirement for operation phase is required highly skilled expertise. Operation and Maintenance (O&M) facility shall be required for whole electrical system during operation phase. RSSPL will sign a O&M Agreement with established player in the field. RSSPL's EHS policy shall form the part of contract agreement. ReNew Power is in process for introducing and implementation of ESMS at corporate, strategic and policy level as well as in SPV level for implementation the same at assets level. Proposed Solar PV Power Plant will follow the same directives.

24 hourly onsite monitoring is proposed under the supervision of technically skilled and experienced staff to look after the O&M requirements of the entire Power Plant. There shall be a workshop facility

available at site to take care of regular maintenance requirement of the Power Plant. A tool room with sufficient stock of tools and spares as well as critical components will be maintained at the site.

There will be a remote O&M facility involving the supervisory control and data acquisition (SCADA) system. This system provides two-way communication with each PV Module. A SCADA system allows a central computer system to monitor and control each Module operation.

The typical maintenance and repair activity during operation phase involves preventive and breakdown maintenance of PV Module and/or the related equipment in accordance with the safety management plans and procedures as applicable and/or in accordance with accepted industry practices.

3.8.1 Preventive Maintenance

The O&M team will operate the solar facility in accordance with an Operations and Maintenance Agreement which shall provide for, at a minimum, the following services:

- Performing routine and non-routine maintenance on the solar facility during and after the EPC warranty period;
- Cleaning of Solar Modules;
- Operating the solar facility;
    - Providing all materials and services necessary for solar facility maintenance;
    - Monitoring the operations of the Project via the computer monitoring system;
    - Performing all duties to the standard mandated by the PPA;
    - Complying with all regulatory obligations;
    - Developing operating and safety plans;

Solar photovoltaic systems are highly reliable and require minimal maintenance. Several maintenance activities need to be completed at regular intervals during the lifetime of the system. In order to maintain a solar PV plant there are a number of requirements which are discussed below.

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. In addition to this, on-going maintenance of the plant may be required.

Typical activities are as described below.

Modules Maintenance: Visual inspection and replacement of damaged modules will be required. Cleaning of the module glass surface during long dry periods may be considered.

The water requirement for cleaning of modules is an important aspect to be kept in view. The water requirement for cleaning of the whole plant (84680 modules) is approximately 0.061 m^3/MWh, depending on the option chosen. Module cleaning needs to be carried out periodically (Per module 2 times in one month) to remove dust, bird droppings etc. on the module and enhance the energy generation. Along with the module cleaning, for the construction of various structures (like IR, MCR Rooms, Pile Foundation etc.) in the plant, water is required.

General maintenance: Vegetation will need to be cut back if it starts to cause a fire risk or introduce shading.

Module support structure: Frequent visual inspection for general integrity of the structure, corrosion, damage and fatigue. All frame connections should be checked for deflections or tears at the module and cross beams to assess the need for replacement.

Wiring and junction boxes: Visual inspection for corrosion, damage such as chafing, and damage by rodents and birds, and for overheating of cables and connections. This requires the skills of an electrical technician.

Inverters: Inverter maintenance requires the skills of an electrical technician. It involves: visual inspection of the fans, tightening leads and cleaning using a vacuum cleaner or brush.

3.8.2 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 need to be immediately corrected. Breakdowns can occur at any part of the system between solar PV modules to substation end. Staff should take care of routine or preventive maintenance at those parts of the system where chances of occurrence of breakdown are more.

3.8.3 Predictive Maintenance

This is undertaken with the help of FLIR camera, which identifies hot spots in solar modules and other electrical appliances. The pictures from the FLIR camera indicate components and fitments which are hotter than the surrounding fitments, clearly implying that the 'hotter' component is under electrical stress. A quick analysis of the feeding and off taking sub systems would help in preventing a breakdown in the coming future.

3.9 TECHNOLOGY

3.9.1 Module Technology

For optimum energy generation Crystalline Silicon 315Wp module of Hareon Solar has been chosen for this project. PV modules are selected based on the integration of modules, voltage and current rating with the inverter voltage and current rating. The modules are selected to match the desired operating voltage level through parallel and series combinations.

3.9.2 Module Mounting System

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

The mounting structure is designed for holding the designed number of modules in series. The frames and leg assemblies of the array structures are made of structural steel sections. The composition of steel shall conform to IS 2062, suitable for welding purposes. The structural sections shall conform to IS-800- 1984 and IS-801, for their chemical and mechanical properties. They shall be hot dip galvanized for a minimum of 86 microns to provide along life of 25 years in the field. All fasteners shall be of

stainless steel grade SS-304. The structure is designed in such a way that it will not only occupy minimum space but also be able to withstand extreme wind conditions like cyclones.

The structure shall be designed to allow easy replacement of any module. The structure shall be designed for simple mechanical and electrical installation. It shall support solar PV modules at a given orientation, absorb and transfer the mechanical loads to the ground properly. The design of module mounting structure will be suitable for East-West tracking system. The legs of the structures with appropriate strength will be fixed in the foundation columns as per design based on site soil condition. The minimum clearance between lower edge of the PV module and ground level shall be 700 mm. While designing the foundations, due consideration will be given to weight of module assembly. Seismic factors for the site will also be considered. The design of structure foundation shall be based on soil test report of the site. The support structure shall be optimized for easy handling, fitment and replacement of modules when necessary.

3.9.3 Module Tilt Angle

The angle between the horizontal plane and the solar panel is called the tilt angle. The tilt angle of a photovoltaic (PV) array affects the amount of incident solar radiation exposed on the array. Due to the motion of the earth round the Sun there are also seasonal variations. In winter, the Sun will not reach the same angle as in summer. Ideally, in summer, solar modules should be placed more horizontally, to benefit most from the sun high in the sky. However, these modules will then not be placed optimally for the winter sun. To achieve an optimum year-round performance, solar modules should be installed at a fixed angle, which lies somewhere between the optimum angle for summer and for winter. For each site there is an optimum tilt angle. Solar modules, located at the equator, may be placed horizontally. Following figure show the tilt angle of the array.

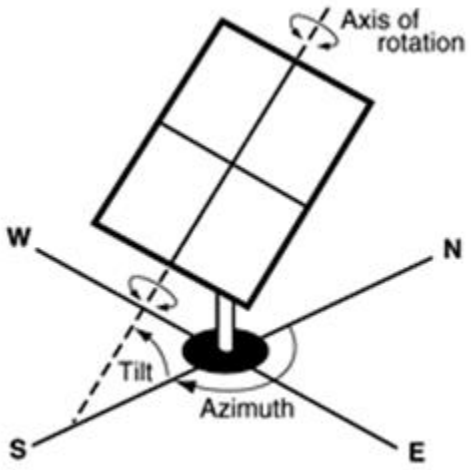


Figure 3-3: Array Tilt Angle

For the 30MW plant at Mulkanoor Village single axis tracker system is proposed, so tilt angle is adjusted automatically for maximum generation. Single Axis tracking, ground mounted structures are proposed to be used for this project. Each of this structure can support 21 modules. The structure is

made of galvanized steel profiles and is inclined -45 to +45 deg to horizontal. PV modules are directly mounted on the module support members.

3.9.4 Inverter Technology

The Power Conditioning Units (PCUs) used in grid-connected solar PV systems consist of an inverter and other electronics for MPPT, Synchronization and remote monitoring. They are generally referred to as PCU or inverter.

The inverter is the most complex part of the PV system. It has to act as the interface between the PV array and the Grid. As the PV array output varies with the solar radiation the inverter has to effectively interface with the grid to remain synchronized.

The main functions carried out by the PCU are:

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

Pulse width modulation is used to generate a waveform as near as possible to a sine wave. High speed switching device is used to generate pulses of the devices mainly used for Inverter circuitry. Inverter efficiencies are now reaching above 98% commercially, mainly by deploying new switching topologies.

Governing Standards: Inverter should conform to IEC 61683 and UL standards for safety.

For preliminary design and calculation purposes, a 1000 kW TMEIC make inverters have been selected. This gives an insight into energy generation possibilities and consequent revenue generation. These are three phase inverter with compact and weatherproof enclosures for indoor use. The company will choose inverter supplier like ABB or equivalent manufactures.

3.9.5 Transformer

Inverter transformer will be 3 phase, 50Hz, 4MVA capacity there will be 7 transformers of 4 MVA and 1 transformer of 2MVA to step up inverter voltage level from 400V to 33kV for 30MW power plant and there will be one power transformer for 30MW plant in the Switchyard section having of 3-phase, 50 Hz, 33/132kV 31.5MVA capacity transformer for stepping up inverter transformer output of 33KV to 132KV. This 132KV voltage level of 30MW power plant is transmitted to Utility substation through 132KV S/C Transmission Line. The Impedance, bushing rating, HV/LV termination and neutral earthing will also meet the system requirement and will also be in line with applicable standards. Suitable bushing CTs will be provided to meet the system protection requirement. Transformer will be in accordance to IS: 2026.

3.10 CLIMATE CHANGE ASSESSMENT

3.10.1 Effects of the Environment on the Project

This section considers the potential effects of environmental (climatic) conditions on the Project. The respective climate events and conditions are discussed below and the potential effects are discussed, along with a brief assessment of the potential impact and measures to minimize or mitigate the risk. At the end, the beneficial effects of the Project in addressing climate change are briefly summarized.

The Project is engineered and designed to integrate into its environmental surroundings and operate safely and reliably over the lifetime of the Project.

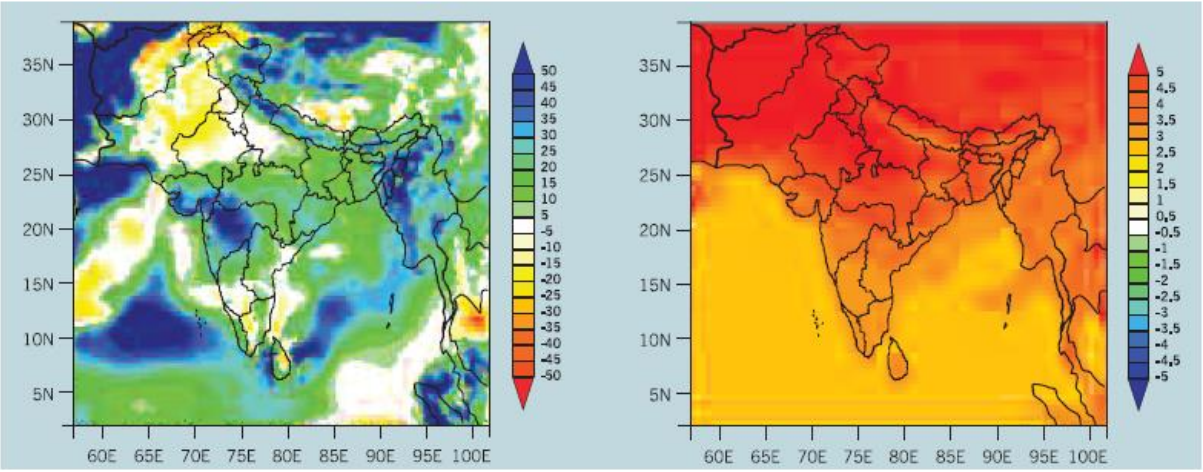
Solar photovoltaic panels have an operating lifetime of 25 and more years and photovoltaic systems are vulnerable to flood, wind and extreme temperatures (Patt et al. 2010). Solar cell output is usually rated at 25°C with output typically decreasing by about 0.25% (amorphous cells) to 0.5% (most crystalline cells) for each temperature rise of 1°C. Cell temperatures for mounted arrays in warm climates can easily reach 50°C–75°C. The module structure foundations should be designed to the current standards related to potential storm, and the risk is expected to be minimal based on the competent ground conditions and the modest potential for storm in project region. Absence of any major water body in the project region negates the flooding probability.

3.10.2 Climate Change Prediction

Climate change is predicted to impact India's natural resource base, including water resources, forestry and agriculture, through changes in precipitation, temperatures, monsoon timings, and extreme events. The Indian Institute of Tropical Meteorology (IITM) in collaboration with the Hadley Centre for Climate Prediction and Research, UK carried out an analysis of climate change scenarios for India. IITM used the Hadley Centre Regional Climate Models (RCMs) for the Indian subcontinent to model the potential impacts of climate change. Two different socioeconomic scenarios were incorporated into the model, both characterized by regionally focused development but with priority to economic issues in one (referred to as A2) and to environmental issues in the other (referred to as B2).

The RCMs have shown significant improvements over the global models in depicting the surface climate over the Indian region, enabling the development of climate change scenarios with substantially more regional detail. This project has generated high-resolution climate change scenarios not only for different states of India, but also for other South Asian nations. Some of the major results of this project are:

- Model simulations under scenarios of increasing greenhouse gas concentrations and sulphate aerosols indicate marked increase in both rainfall and temperature over India into the 21st century.
- The change in rainfall under the B2 scenario is relatively less than that under the A2 scenario.
- There are substantial spatial differences in the projected rain fall changes. The maximum expected increases in rainfall (10 to 30%) occur over central India.
- There is no clear evidence of any substantial change in the year-to-year variability of rainfall over the next century.
- Surface air temperature shows comparable increasing trends in A2 as well as B2 scenarios. The temperatures are projected to increase by as much as 3 to 4°C towards the end of the 21st century.
- The warming is widespread over the country, and relatively more pronounced over northern parts of India in comparison to south India.



Spatial patterns of the changes in (a) summer monsoon rainfall (%) and (b) annual mean surface air temperature (°C) for the period 2071-2100 with reference to the baseline of 1961-1990, under the A2 scenario.

South India is going to be affected moderately by the climate change aspects. The air temperature is likely to be increased by 1.5 – 2.5°C. As stated above Solar cell output is usually rated at 25°C with output typically decreasing by about 0.5% for each temperature rise of 1°C. Therefore, a reduction of 1%, in output of solar cells is expected due to proposed climate change as modeled. Futuristic Climate Change Effect

Climate change will make monsoons unpredictable. As a result, rain-fed wheat cultivation in South Asia will suffer in a big way. Total cereal production will go down. The crop yield per hectare will be hit badly, causing food insecurity and loss of livelihood. The rising levels of the sea in the coastal areas will damage nursery areas for fisheries, causing coastal erosion and flooding.

The Arctic regions, Sub-Saharan Africa, small islands and Asian mega deltas, including the Ganga and Brahmaputra, will be affected most.

Changes in climate around the globe are expected to trigger a steep fall in the production of cereals, Total agricultural land will shrink and the available land may not remain suitable for the present crops for too long. Farmers have to explore options of changing crops suitable to weather. He also pointed out that climatic changes could lead to major food security issues for a country like India.

India needs to sustain an 8 to 10 per cent economic growth rate, over the next 25 years, if it is to eradicate poverty and meet its human development goals, according to a 2006 report on an integrated energy policy prepared by an expert committee of the Planning Commission. Consequently, the country needed at the very least to increase its primary energy supply three or four-fold over the 2003-04 level.

3.10.3 GHG Emission Reduction

The comparison of the GHGs emission caused by solar power plant with the GHGs emission that would have been caused by fossil fuel burned to make the same amount of electricity has been made. Thus the purpose of the project activity is to generate power from zero emissions Solar PV based power project and thereby reduce the emissions associated with the grid. The project activity will export the Electricity to Northern Power Distribution Company of Telangana Limited. The electricity generated

by the plant will be monitored through energy meters connected to switchyard at project site. The calculation of the total GHGs emission reduction as 51805 tCO_2e/year. The technology of electricity generation from Solar PV Plant is environment friendly as it does not use any fossil fuel. It thereby reduces the greenhouse gas emissions associated with fossil fuel based electricity generation system. The availability and reliability of solar power depend largely on current and future climate conditions, which may vary in the context of climate change.

3.10.4 Conclusion

The Intergovernmental Panel on Climate Change (IPCC) Assessment Report (http://www.ipcc.ch/) concluded that climate changes are already occurring at a measurable scale and include warmer temperatures, increases in sea levels (from melting of snow and ice), and an increased frequency of extreme weather events. Most PV mounting structures are designed to withstand occasional extreme wind and temperatures and any long term changes to wind patterns and temperature averages, potentially resulting from climate change, are not expected to adversely affect the Project. It is considered to install more robust structures, tracking motors, and mountings for the project to avoid any thunderstorm calamity.

4 DESCRIPTION OF ENVIRONMENT AND SOCIAL BASELINE

Baseline data generation forms an integral part of the ESIA study and helps to evaluate the predicted impacts on the various environmental and social attributes in the study area by using scientifically developed and widely accepted environmental and social impact assessment methodologies.

4.1 STUDY AREA, PERIOD AND METHODOLOGY

Area of 10 km radius from the project site has been considered as study area for the project. The consultant team comprising Environment, Ecology and Social Experts undertaken site study in the month of July, 2016. The consultant undertook a reconnaissance survey of the proposed site and surroundings in order to understand the environmental and social setting of the proposed solar power project. The reconnaissance survey was followed by primary baseline data generation for environment and social aspects of the study area.

Primary environment monitoring and secondary data collection was undertaken as per process Tabulated below.

Table 4-1: Attributes of Environment Data

S. No.	Attributes	Parameters	Source and Frequency
1.	Ambient Air Quality	PM10, PM2.5, SO_2, NO_X and CO	Two sample per week at Four (4) locations for one week
2.	Meteorology	Wind speed and direction, temperature, relative humidity and rainfall	From secondary sources of IMD station, Hanamkonda
3.	Water quality	Physical, Chemical and Bacteriological parameters	Grab samples were collected at 3 ground water and 1 surface water locations once during study period.
4.	Ecology	Existing terrestrial and aquatic flora and fauna within 10-Km radius circle.	Primary inventory through site survey and secondary data from forest office
5.	Noise levels	Noise levels in dB(A)	Once at each location on 24 hourly basis at Four (4) locations
6.	Traffic Density	Traffic Nos.	Traffic Survey and Secondary Sources
7.	Soil Characteristics	Physical and Chemical parameters	Once at 2 locations during study period
8.	Land use	Existing land use for different categories	Based on Survey of India topographical sheet and satellite imagery
9.	Socio-Economic aspects	Socio-economic and demographic characteristics, worker characteristics	Primary consultation & survey and secondary sources data like primary census abstracts of Census of India 2011
10.	Hydrology	Drainage area and pattern, nature of streams, aquifer	Based on primary site visit and data collected from secondary sources

S. No.	Attributes	Parameters	Source and Frequency
		characteristics, recharge and discharge areas	

4.2 PHYSICAL ENVIRONMENT

4.2.1 Land use

4.2.1.1 Project Site

The project site is primarily single cropped agriculture land with patches of scrub waste land. No forest land diversion is involved at the project site as per revenue record. The project site is free from any residential or commercial structure. Vangara is the nearest settlement located at a distance of approximately 700m from the North-corner of the site. One village road (Kutcha Path) is passing through the north side of the proposed site. Two Second order streams (Nallah) passing through the southern side of the proposed site. Land for the project has been acquired in such fashion to avoid impacts on Pond located in mid-way of the site. Land is procured in almost two-three patches connected by a strip of 50m to avoid any land acquisition of this water body for proposed plant setting.

No protected areas like National Park, Wildlife Sanctuary or Bio-sphere Reserve is within 10 km radius from the project site. The nearest notified eco-sensitive area i.e. Vana Vignana Kendra Mini Zoo is about 27km from the proposed site. One transmission line is passing through from the eastern part of the project site. Snaps of project site are shown in Figure 4.1 below.

Figure 4-1: Project Site

4.2.1.2 Study Area

Agriculture activity is the dominant feature of the study area followed by scrub land and forest area. Agriculture land constitute approximately 59.1% of the study area. Scrub land and forest area together constitute 32.9% of the total study area. The distance of nearest forest patch is about 2.5km from the proposed site. The graphical presentation of land use break-up is shown as Figure 4.2 and land use for study area is presented under Figure 4.3.

Table 4-2: Land use / Land Cover Break-up

S. No.	Land use Type	Area (ha)	Area (%)
1.	Rocky Waste Land	707.1	2.0
2.	Water body	169.5	0.5
3.	Plantation	639.8	1.9
4.	Open Scrub	5910.1	17.1
5.	Mining Area	8.3	0.0
6.	Forest Area	5466.1	15.8
7.	Built-up	1228.5	3.6
8.	Agriculture Land	20443.8	59.1
Total		**34573.2**	**100.0**

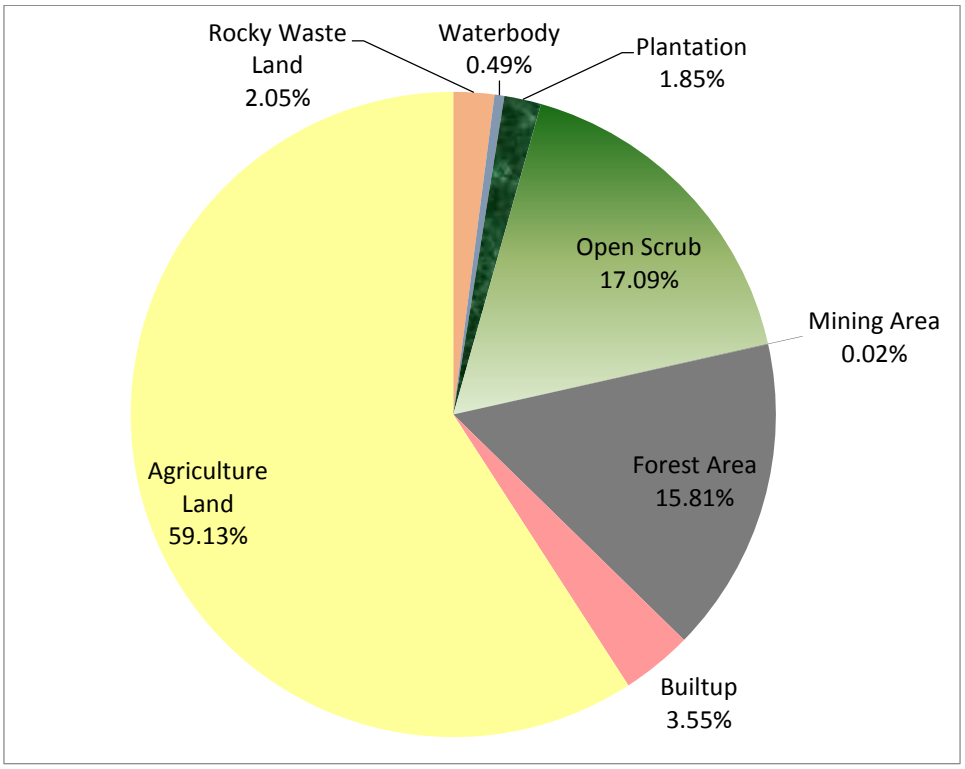


Figure 4-2: Land use / Land Cover Break-up of the Study Area

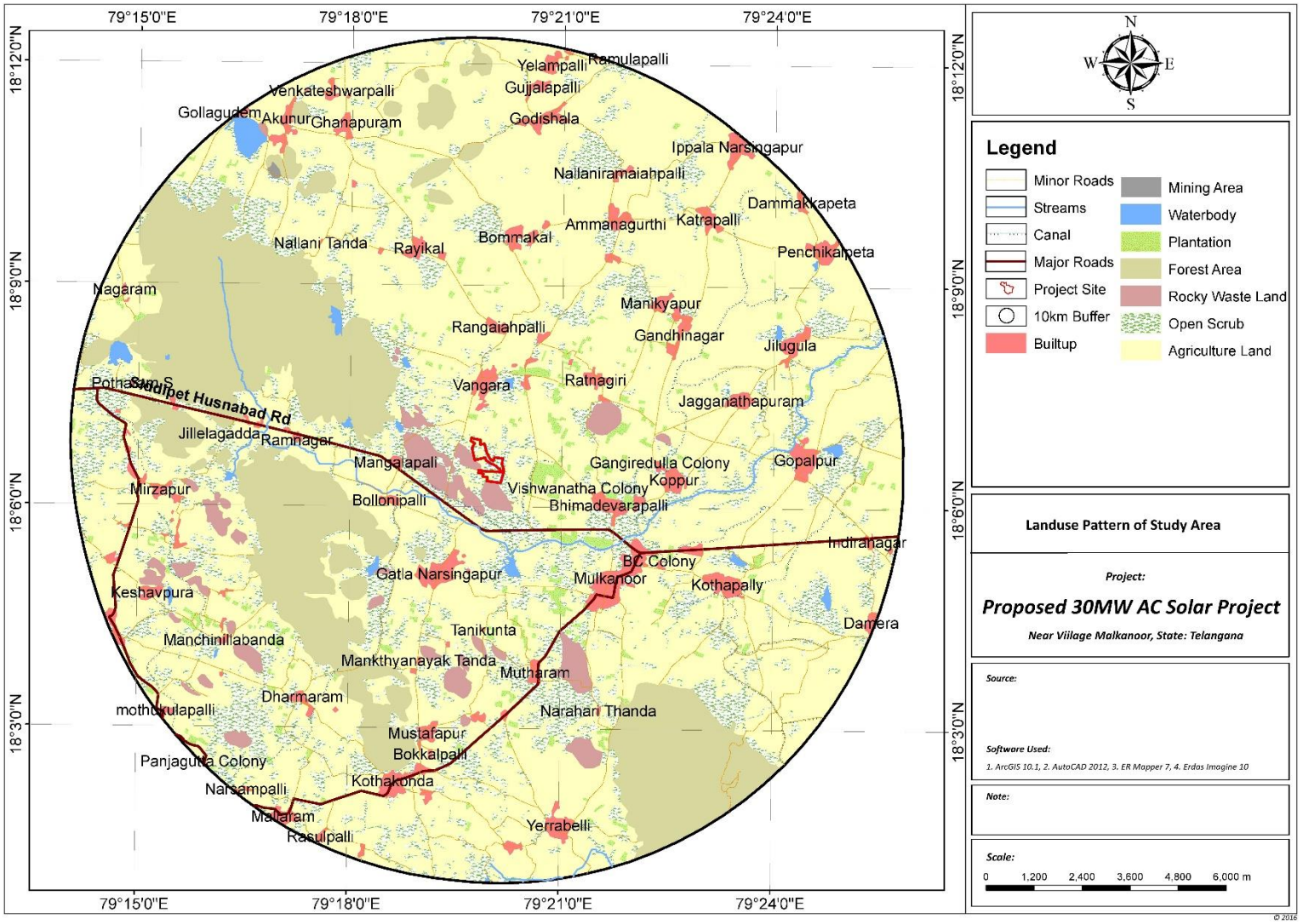


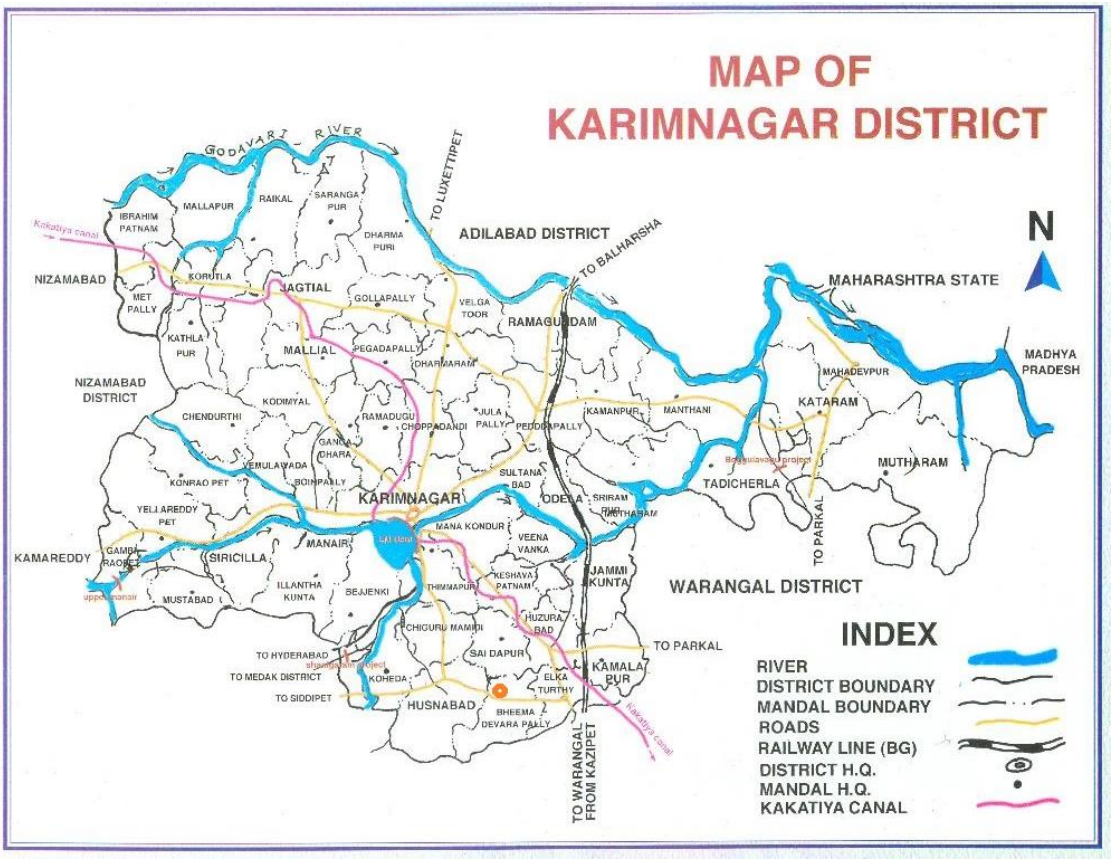
Figure 4-3: Land use / Land Cover of the Study Area

4.2.2 Topography and Drainage

Project site has a rolling topography with elevation ranging from 310m amsl to 340m amsl. Two Second order streams (Nallah) passing through the southern side of the proposed site. One of this stream carry the run-off from mountainous structure located on the southern side of the proposed site. Water from this stream being utilized for irrigation and this stream also serves water for the Pond (Lake) located near to project site.

The study area is mainly irrigated by network of canal and streams system. No prominent natural drainage system in and around the project site was observed. Peoples in the area normally creates big pond to serve the water requirement during lean season. The drainage Map of the district is shown as Figure 4.4 below.

Figure 4-4: Drainage Basin Map of Karimnagar District



4.2.3 Geomorphology and Geology

Karimnagar district with a total geographical area of 11,823 sq km is one of the ten Telangana districts. The district is mainly agrarian and agriculture activities are main stay of the population. Population density, which was 64 persons per sq km during 1901, has risen to 319 people per sq km as per 2011 census. This has led to stress on available land and the size of land holdings has decreased considerably. The district forms part of the Godavari river basin. The river Godavari, the largest river in the peninsular India enters the district at Kandukurthi village runs for a distance of 283 km forming the northern and eastern boundary of the district and leaves the district at Muknur village. Geological condition of Karimnagar District is shown in Figure below.

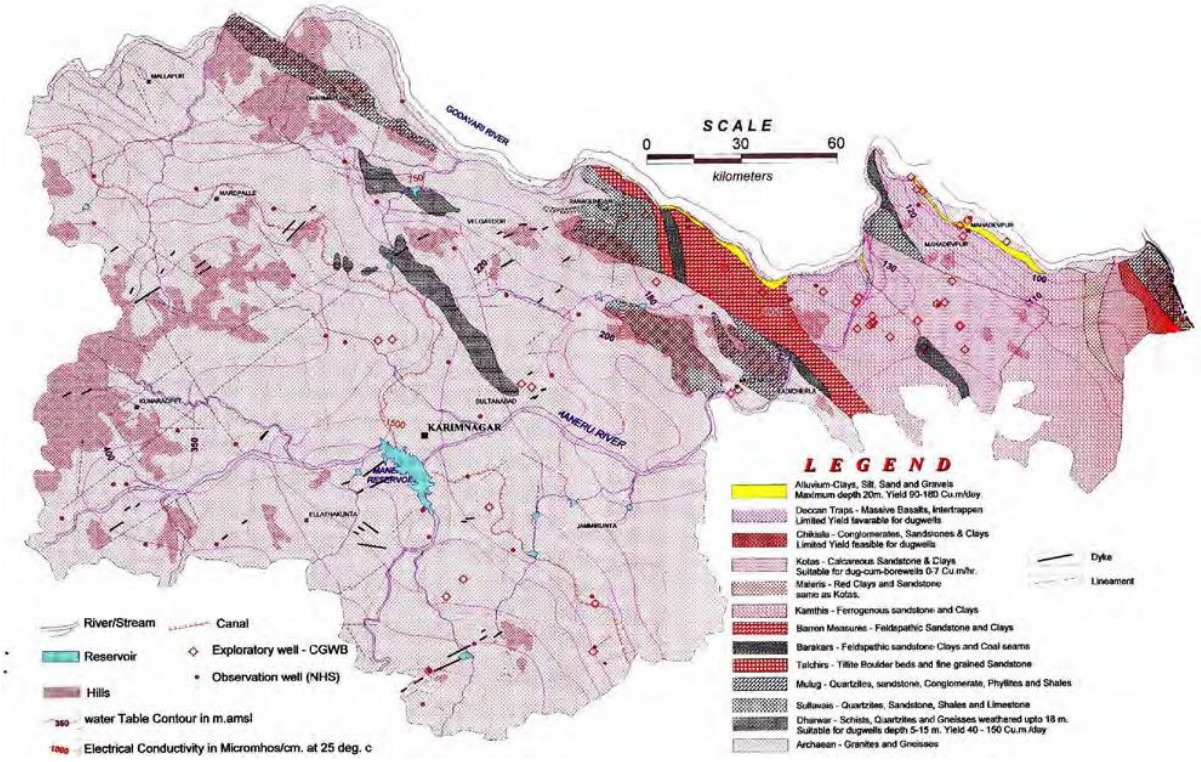


Figure 4-5: Geology and Soil Map

4.2.4 Hydrogeology

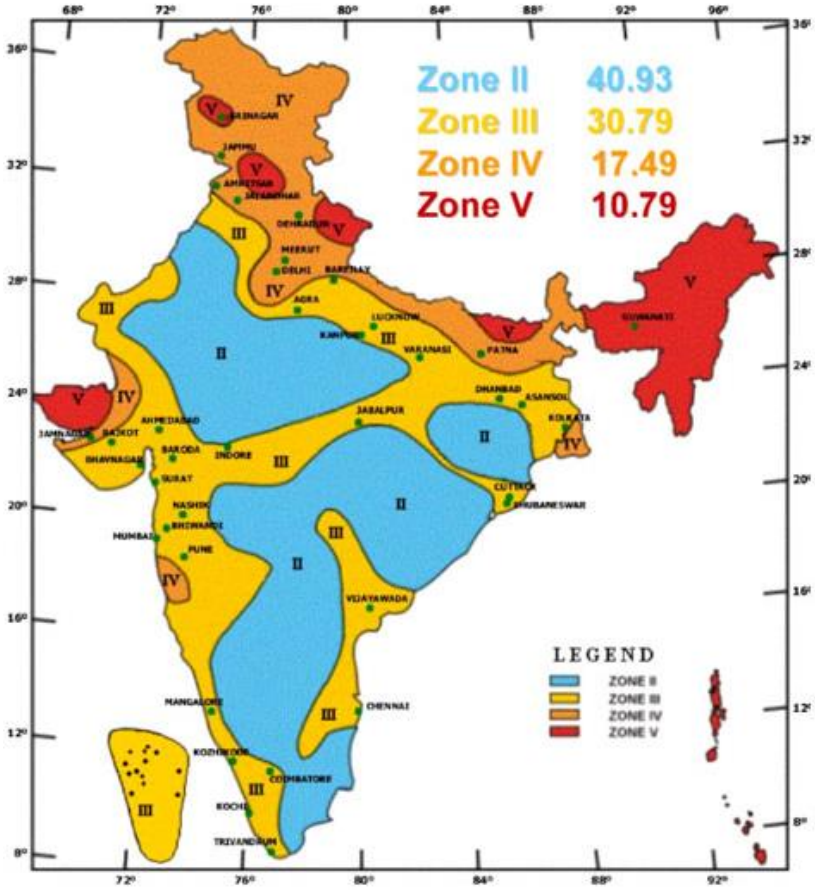
Ground water occurs in all the geological formations in the district. The major rock types occurring in the district are granites, gneisses, sandstone, limestone, shale, quartzite's etc. The occurrence and movement of the ground water is a consequence of a finite combination of topographical, climatological, hydrological, geological, and structural and pedagogical factors, which together form integrated dynamic system.

The depth to water levels during pre-monsoon range from 1.63 to 24.67 m bgl. The shallow water level of <2 m is observed as isolated patches in the central and eastern part of the district. The depth to water is shallow in the canal command area, varying from 5 to 10 m bgl in NE and SE part of the district and deeper water levels of more than 10 m bgl are observed in extreme eastern and south western part of the district where the level of ground water development is more and natural recharge is less. The depth to water level during post-monsoon 2012 ranges from 1.22 to 13.82 m bgl. The area under < 2 m bgl occurs in central, eastern and western part as isolated patches. The areas having water levels of 5 to 10 m bgl during pre-monsoon have come up to 2-5 m bgl with monsoon recharge.

4.2.5 Seismicity

As per seismic zoning map of India, project district falls under Seismic Zone II, which is a stable risk zone. Efforts will be made to design the structure according to intensity of the zone. The seismic zoning map of India is shown in Figure 4.6.

Figure 4-6: Seismicity Map of India



4.3 SOIL CHARACTERISTICS

4.3.1 Samples and Methodology

Assessment of soil quality is an important aspect with reference to tree plantations, percolation of water, ground-water impact, etc. Two soil samples were collected to assess the soil characteristics and fertility potential of study area. The samples were collected by ramming a core-cutter into the soil up to 90-cm depth. Two locations were selected for soil sampling on the basis of soil types, vegetative cover etc., which would accord an overall idea of the soil characteristics near project site. Soil samples were collected from three different depths viz. 30 cm, 60 cm and 90 cm below the surface and homogenized. The homogenized samples were analyzed for physical and chemical characteristics. The sealed samples were sent to laboratory for analysis. The locations of the monitoring sites are depicted in Table below and shown in Figure 4.7.

Table 4-3: Soil Sampling Locations

S. No.	Village	Distance / Direction	Station	Selection Criteria
1	Ramnagar	1.8 km - West	S1	Nearby Settlement
2	Project Site	-	S2	Project Site

Source: Sampling done by Vision Labs, Hyderabad

4.3.2 Analysis Results

The physical and chemical characteristics of the soil of the study area have been assessed by analyzing various parameters as per the methods described in "Soil Chemical Analysis" (M.L Jackson) and Department of Agriculture and Cooperation. The Physico-chemical characteristics of the soils are presented in Table on next page**.**

Sandy clay and silty clay are the major soil formation in the study area. pH value of 7.69 to 7.98 presents neutrality of the soil. Nutrient exchanges between organic matter, water and soil are essential to soil fertility. Percentage of organic matter was found varying from 2.65 to 4.23%, whereas level of Nitrogen varies from 2.68% to 3.58%. NPK value suggest that soil is moderate in terms of fertility potential.

Table 4-4: Soil Characteristics

S. No.	Parameters	Unit	S 1 (Ramnagar)	S 2 (Project Site)
1	Texture	-	Sandy Clay	Silty Clay
	Sand	%	36	16
	Silt	%	12	56
	Clay	%	52	28
2	pH (10% Slurry)	-	7.69	7.98
3	Conductivity	µmhos/cm	93	86
4	Moisture	%	15.6	18.2
5	Organic Matter	%	2.65	4.23
6	Bulk density	gram/cc	1.45	1.21
7	Porosity	% v/v	35	55
8	S.A.R	meq/kg	0.36	0.08
9	Infiltration capacity	mm/h	48	26
10	Carbonates	mg/kg	12	12
11	Sodium as Na	mg/kg	0.8	0.46
12	Potassium as K	%	0.9	0.082
13	Phosphorus as P	%	0.42	0.72
14	Chloride as Cl	mg/kg	2.1	1.68
15	Zinc as Zn	mg/kg	3.3	4.2
16	Copper as Cu	mg/kg	0.06	0.08
17	Iron as Fe	mg/kg	0.08	0.14
18	Nitrogen as N	%	3.58	2.68
19	Sulphate as SO4	mg/kg	0.14	0.64
20	Boron as B	mg/kg	0.11	0.15

Source: Sampling and Analysis done by Vision Labs, Hyderabad

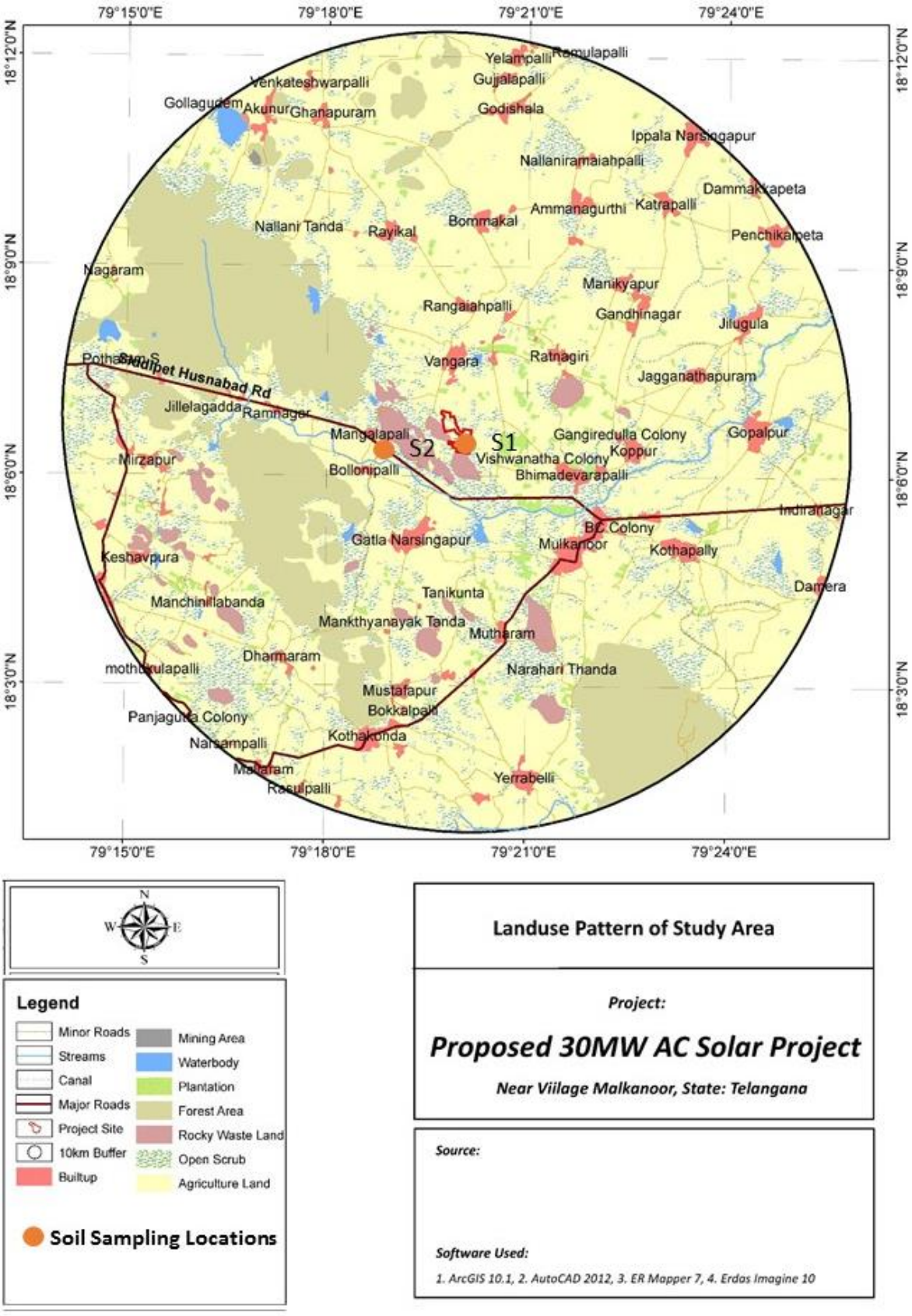


Figure 4-7: Soil Sampling Locations

4.4 CLIMATE AND AMBIENT AIR QUALITY

4.4.1 Climatology

Karimnagar experiences dry inland climatic conditions which give it hot summers and cool winters. The region gets much rainfall from the South West monsoon. Summer season is extremely hot. Temperatures decline with the onset of the monsoons and winter season is generally cool. Summer season starts in March and can continue through early June. The place gets most of its rainfall from June to September during the monsoon season. October and November also experiences increased rainfall from the North East Monsoon. The normal average annual rainfall of the region is 805mm (Hanamkonda IMD Station).

4.4.2 Long term Climate Scenario

Long term climate data from 1971-2000 was collected from Nearest IMD station i.e. Hanamkonda located at a distance of approximately 20km from the proposed plant site. The summary of long term meteorological data as collected are presented in Table below.

Table 4-5: Long-term Meteorological Data, IMD Hanamkonda

Month	Temperature (°C)		Wind		Humidity (%)		Average Rainfall (mm)
	Monthly Max	Monthly Min	Pre-dominant Direction (Angle)	Speed (kmph)	Morning	Evening	
Jan	32.8	12.8	S & SE	4.2	77	53	4.3
Feb	35.5	15.8	SE & S	6.3	73	48	10.7
Mar	39.6	18.8	S & SE	7.1	71	43	9.5
Apr	42.6	22.0	SE & S	9.0	67	40	10.4
May	44.2	22.9	SE & S	10.0	59	38	33.1
June	42.7	22.8	NW, S & W	8.9	68	54	132.4
July	36.3	22.4	W & NW	7.4	80	69	226.0
Aug	34.4	22.4	NW & W	5.8	81	72	173.1
Sep	35.1	21.8	NW & SE	5.6	80	71	106.1
Oct	34.7	19.1	N & S	4.1	78	65	72.3
Nov	33.2	15.3	N & S	4.0	74	62	23.6
Dec	31.5	13.1	N & S	3.3	74	57	3.4
Average	36.9	19.1	S & SE	6.3	73	56	804.9

Source: Climatological Tables 1971-2000, Indian Meteorological Dept., Govt. of India

The maximum average temperature was recorded in the month of May at 44.2°C and the minimum average temperature was 12.8°C in January. The Relative Humidity was maximum during the monsoon season with the month of August recording the highest average at 81%.

The average wind speed in the region is moderate with an annual average of 6.3 kmph. The maximum average wind speed in observed in the month of May. The annual predominant wind direction recorded at the IMD station was from South followed by South-East. The annual average wind-rose diagram as sketched for the IMD Station is shown as **Figure 4.8**.

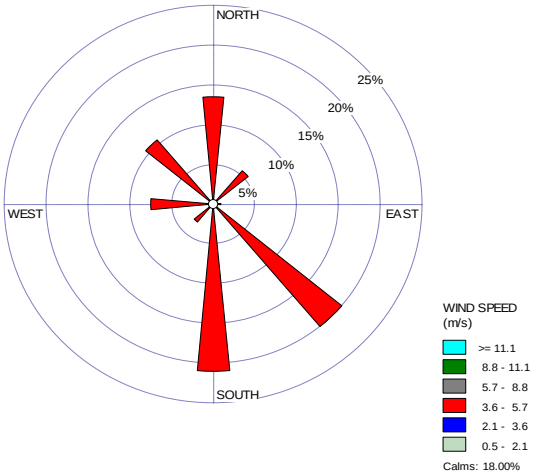


Figure 4-8: Wind-rose IMD Hanamkonda (1971-2000)

4.4.3 Ambient Air Quality

4.4.3.1 Monitoring Locations and Parameters

Air Quality monitoring of the project area is carried out by the Vision Labs, Hyderabad which is accredited by MoEF&CCC and NABL in accordance EPA Act, 1986 and ISO/IEC 17025:2005. Monitoring for the concentrations of the following parameters in the environment are measured:

- Particulate Matter 2.5 (PM2.5)
- Particulate Matter 10 (PM10)
- Sulphur Dioxide (SO_2)
- Oxides of Nitrogen (NO_X)
- Carbon Monoxide (CO)

Air pollution due to combustion of fossil fuels in vehicles, domestic cooking and other industrial activities is reflected in the level of SO_2, NO_X and CO, whereas Particulate Matter concentration is indicative of the amount of dust and other fine particles in the air.

Monitoring was carried out at four (4) locations for assessment of ambient air quality in study area. One station was set-up near to the project site, whereas other three stations were set-up in up-wind and down-wind direction respectively. Monitoring has been carried out twice in a week manner for one week at each location. Details of sampling location is presented in Table below.

Table 4-6: Ambient Air Quality Monitoring Stations

S. No.	Village	Distance / Direction	Station	Selection Criteria
1	Project Site	-	AAQ1	Project Site
2	Ramnagar	1.8 km - West	AAQ2	Nearby Settlement
3	Vanagara	1.4 km - North	AAQ3	Down-wind Station
4	Mulkanoor	3.5 km – South-East	AAQ4	Up-wind Station

Source: Onsite Monitoring done by Vision Labs, Hyderabad

Map for Ambient Air Quality Monitoring Locations is shown as **Figure 4.9**. Photographs presenting activities are shown in **Figure 4.10** below.

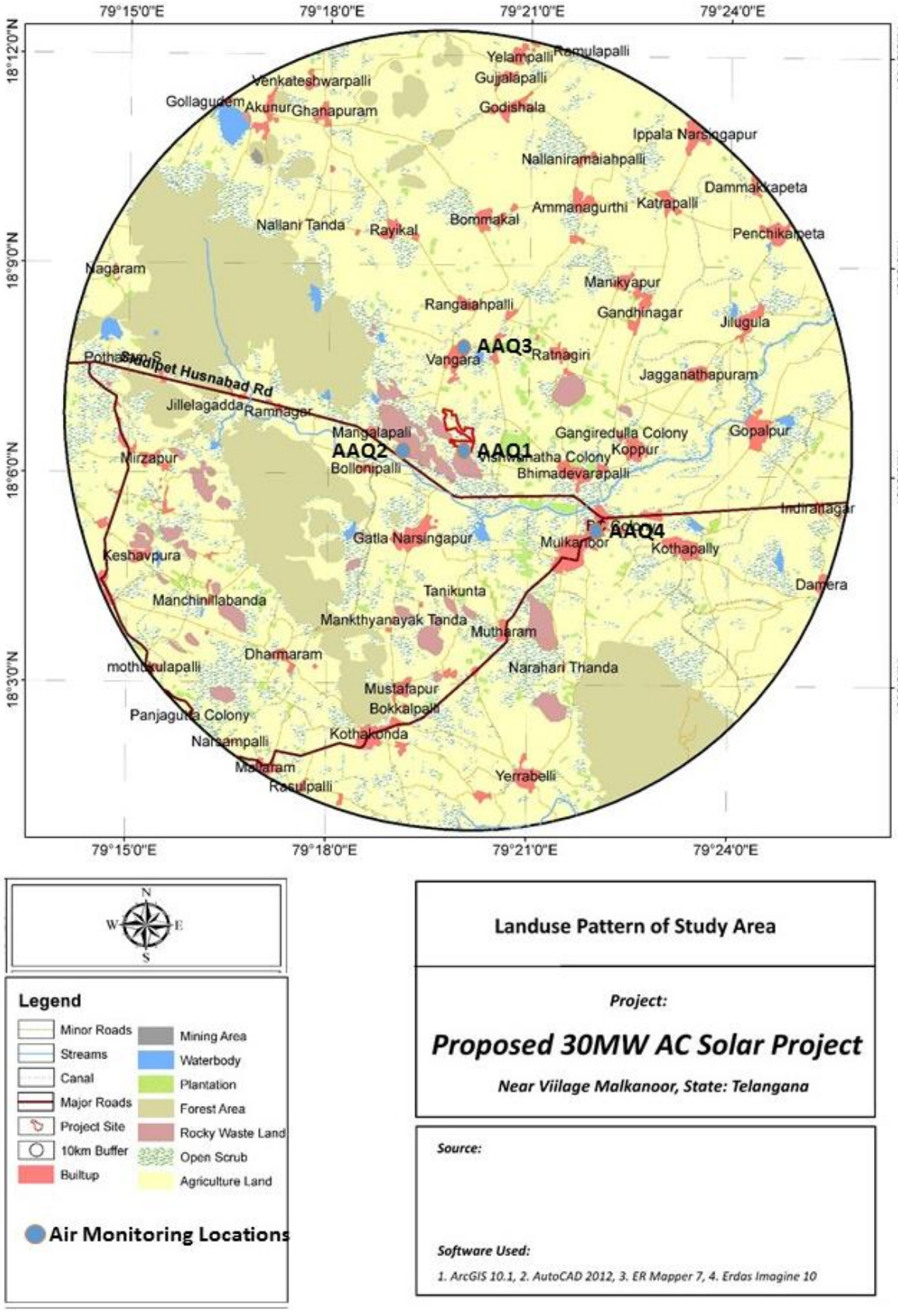


Figure 4-9: Air Monitoring Stations

Figure 4-10: Onsite Ambient Air Quality Monitoring Photographs

4.4.3.2 Analysis and Results

The ambient air quality samples as collected from the site was further analysed in laboratory for concentration analysis of pollutants. The analysis results further correlated mathematically and summarized below.

Table 4-7: Ambient Air Quality near Project Site (µg/m3)

Parameter	SO2	NOX	PM10	PM2.5	CO
Minimum	4.3	11.3	28.3	14.2	<1.0
Maximum	4.7	12.0	29.6	15.3	<1.0
Average	4.5	11.6	28.9	14.8	<1.0
10 Percentile	4.4	11.4	28.4	14.3	-
20 Percentile	4.4	11.4	28.6	14.4	-
30 Percentile	4.4	11.5	28.7	14.5	-
50 Percentile	4.5	11.6	28.9	14.8	-
80 Percentile	4.6	11.8	29.3	15.1	-
98 Percentile	4.7	11.9	29.5	15.3	-
Arithmetic Mean	4.5	11.6	28.9	14.8	-
Geometric Mean	4.5	11.6	28.9	14.7	-
Standard Deviation	0.3	0.5	0.9	0.8	-
95 Percentile	4.7	11.9	29.5	15.3	-
NAAQS (24 hourly)	80	80	100	60	2

Source: Monitoring and Analysis done by Vision Labs, Hyderabad

Table 4-8: Ambient Air Quality at Ramnagar (µg/m3)

Parameter	SO2	NOX	PM10	PM2.5	CO
Minimum	5.9	15.4	41.7	23.0	<1.0
Maximum	6.7	16.6	43.0	23.7	<1.0
Average	6.3	16.0	42.4	23.4	<1.0

Parameter	SO2	NOX	PM10	PM2.5	CO
10 Percentile	6.0	15.5	41.8	23.1	-
20 Percentile	6.1	15.7	42.0	23.2	-
30 Percentile	6.2	15.8	42.1	23.3	-
50 Percentile	6.3	16.0	42.4	23.4	-
80 Percentile	6.6	16.4	42.8	23.6	-
98 Percentile	6.7	16.6	43.0	23.7	-
Arithmetic Mean	6.3	16.0	42.4	23.4	-
Geometric Mean	6.3	16.0	42.4	23.4	-
Standard Deviation	0.5	0.9	1.0	0.5	-
95 Percentile	6.7	16.6	43.0	23.7	-
NAAQS (24 hourly)	80	80	100	60	2

Source: Monitoring and Analysis done by Vision Labs, Hyderabad

Table 4-9: Ambient Air Quality at Vangara (µg/m3)

Parameter	SO2	NOX	PM10	PM2.5	CO
Minimum	5.4	15.9	40.2	20.9	<1.0
Maximum	5.9	17.7	42.3	23.1	<1.0
Average	5.6	16.8	41.2	22.0	<1.0
10 Percentile	5.4	16.1	40.4	21.1	-
20 Percentile	5.5	16.3	40.6	21.3	-
30 Percentile	5.5	16.5	40.8	21.5	-
50 Percentile	5.6	16.8	41.2	22.0	-
80 Percentile	5.8	17.4	41.8	22.7	-
98 Percentile	5.8	17.7	42.2	23.0	-
Arithmetic Mean	5.6	16.8	41.2	22.0	-
Geometric Mean	5.6	16.8	41.2	22.0	-
Standard Deviation	0.4	1.3	1.4	1.6	-
95 Percentile	5.8	17.6	42.2	23.0	-
NAAQS (24 hourly)	80	80	100	60	2

Source: Monitoring and Analysis done by Vision Labs, Hyderabad

Table 4-10: Ambient Air Quality at Mulkanoor (µg/m3)

Parameter	SO2	NOX	PM10	PM2.5	CO
Minimum	6.4	18.4	45.1	23.4	<1.0
Maximum	6.6	19.9	47.5	25.0	<1.0
Average	6.5	19.2	46.3	24.2	<1.0
10 Percentile	6.4	18.6	45.3	23.5	-
20 Percentile	6.4	18.7	45.6	23.7	-
30 Percentile	6.4	18.9	45.8	23.9	-
50 Percentile	6.5	19.2	46.3	24.2	-

Parameter	SO2	NOX	PM10	PM2.5	CO
80 Percentile	6.5	19.6	47.0	24.7	-
98 Percentile	6.6	19.9	47.5	25.0	-
Arithmetic Mean	6.5	19.2	46.3	24.2	-
Geometric Mean	6.5	19.2	46.3	24.2	-
Standard Deviation	0.2	1.1	1.7	1.2	-
95 Percentile	6.6	19.8	47.4	24.9	-
NAAQS (24 hourly)	80	80	100	60	2

Source: Monitoring and Analysis done by Vision Labs, Hyderabad

No major traffic or Industrial growth was observed in the study region. Two stone crusher running in near vicinity of the project are the only source air pollution near to the site. Agricultural activities are other source of pollution in study area. Agriculture activities results in generation fugitive dust. The PM10 and PM2.5 concentrations in the region found varying from 28.3 to 47.5µg/m^3 and 14.2 to 25.0 µg/m^3 in respect to the prescribed standards of 100 and 60 µg/m^3 respectively. No significant concentration of gaseous pollution was observed. In general air pollution was found well below the prescribed standards at all the places.

4.5 AMBIENT NOISE LEVEL

4.5.1 Monitoring Station and Methodology

In the present study, sound pressure levels (SPL) have been measured by a sound level meter. Since loudness of sound is important for its effects on people, the dependence of loudness upon frequency must be taken into account in noise impact assessment. This has been achieved by the use of A-weighting filters in the noise measuring instrument which gives a direct reading of approximate loudness. A-weighted equivalent continuous sound pressure level (Leq) values have been computed from the values of A-weighted sound pressure level measured with the help of noise meter.

Noise monitoring was carried out at four locations including project site. These locations have been given in **Table** below and shown **Figure 4.11**.

Table 4-11: Noise Monitoring Stations

S. No.	Village	Direction	Station	Selection Criteria
1	Project Site	-	N1	Project Site
2	Ramnagar	1.8 km - West	N2	Nearby Settlement
3	Vanagara	1.4 km - North	N3	Project Affected Village
4	Mulkanoor	3.5 km – South-East	N4	Nearest major settlement

Source: Monitoring done by Vision Labs, Hyderabad

4.5.2 Frequency and Results

At each location, noise monitoring has been carried out once during the study period (July 2016) over a period of twenty-four hours to obtain Leq values at uniform time intervals of 1 hour. In each hourly time interval Leq values have been computed from SPL readings taken at uniform time intervals of 15 minutes. For each location, day and night time Leq values have then been computed from the hourly Leq values so that comparison could be made with the national ambient noise standards.

Day time Leq has been computed from the hourly Leq values between 6.00 a.m. - 10.00 p.m. and night time Leq from the hourly Leq values between 10.00 p.m. - 6.00 a.m. The results are presented in Table below.

Table 4-12: Noise Level in Study Area

Location	Noise Level in dB(A)		
	Leq (day)	Leq (night)	Leq (dn)
N1- Project Site	45.3	30.6	44.2
N2- Ramnagar Village	45.5	34.1	45.1
N3- Vangara Village	45.2	31.3	44.2
N4- Mulkanoor Village	48.2	33.0	47.0
Ambient Noise Standards for Rural and Residential Areas	55.0	45.0	-

Source: Monitoring done by Vision Labs, Hyderabad

No major source of noise was observed in the region. No heavy traffic was found at the road side too. The noise levels recorded in the monitoring locations during daytime were found in the range of 45.2 to 48.2 dB(A) and during night time the Leq value was between 31.3 and 34.1 dB(A). In general noise level was found within the prescribed standards in absence of any major noise source.

4.6 TRAFFIC COUNT

Project site is approachable by Siddipet-Husnabad Road, running at a distance of 1.2km from the plant site. Thereafter, site can be approached by Village Kachha Road. Traffic count was undertaken at Siddipet-Husnabad Road. This road is likely to be used for movement of construction vehicles during construction phase. Traffic density on this road was found quite low with traffic count of 50-100 vehicles per hour only.

4.7 WATER QUALITY

3 Ground water and 1 Surface water samples were collected and analyzed for assessment of water quality in and around the project site. The locations of the monitoring sites are depicted in Table below and shown in **Figure 4.12**.

Table 4-13: Water Sampling Stations

S. No.	Village	Direction	Station	Selection Criteria
Surface Water Sampling Location				
1	Pond (Near Vangars)	-	SW1	Surface Water nearest to Project SIte
Ground Water Sampling Location				
1	Mulkanoor Village	3.5 km – South-East	GW1	Nearest Major Settlement
2	Vanagara Village	1.4 km - North	GW2	Nearest settlement
3	Ramnagar Village	1.8 km - West	GW3	Nearest settlement in the direction

Source: Sampling done by Vision Labs, Hyderabad

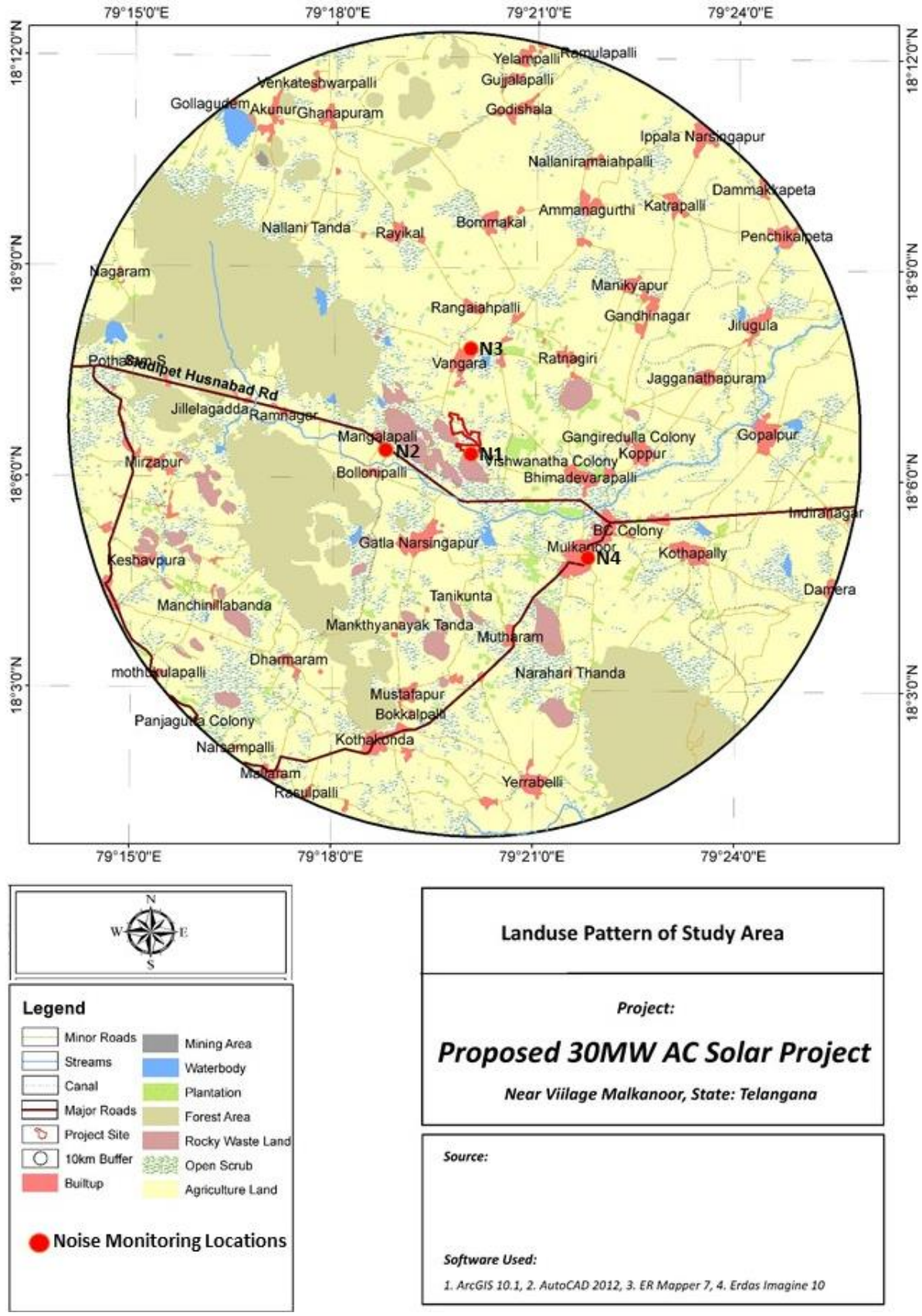


Figure 4-11: Noise Monitoring Stations

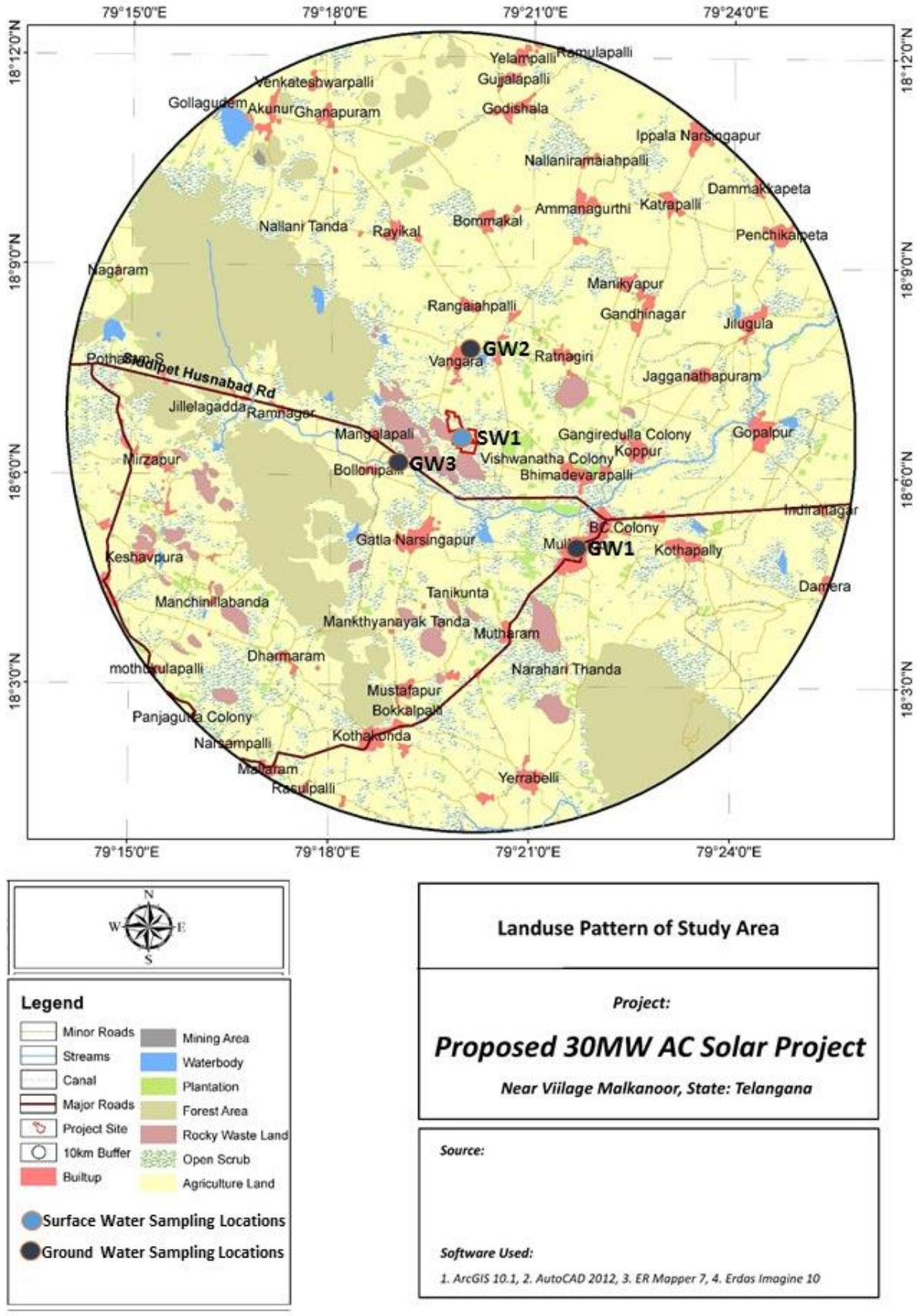


Figure 4-12: Water Sampling Locations

4.7.1 Surface Water Quality

Surface water sample was collected from the Pond located near to the project site. Analysis of the sample was carried out as per established standard methods and procedures prescribed by CPCB, IS3025, IS10500 and APHA 22nd edition, 2012.

The quality of water is determined with respect to the standard values provided by the Central Pollution Control Board (CPCB). The detail of the water quality is mentioned in Table below.

Table 4-14: Surface Water Quality

S. No.	Parameter	Units	IS:2296 Class C Limits	SW 1 (Pond adjacent to Site)
1	pH	-	6.5 – 8.5	7.71
2	Color	Hazen units	300	Four
3	Conductivity	mS/cm	$	148
4	Dissolved Oxygen	mg/l	4 minimum	5.2
5	BOD (3 days at 27°C)	mg/l	3	4
6	Total Dissolved Solids	mg/l	1500	95
7	Total Hardness	mg/l	$	40
8	Chloride as Cl	mg/l	600	20
9	Fluorides as F-	mg/l	1.5	0.1
10	Sulphate as SO_4^{--}	mg/l	400	<0.02
11	Alkalinity	mg/l	$	40
12	Nitrates as NO_3	mg/l	$	1.2
13	Cyanides as CN	mg/l	0.05	<0.001
14	Calcium as Ca	mg/l	$	8
15	Magnesium as Mg	mg/l	$	4.8
16	Sodium as Na	mg/l	$	13.8
17	Potassium as K	mg/l	$	0.4
18	Iron as Fe	mg/l	50	<0.001
19	Chromium as Cr	mg/l	0.05	<0.001
20	Cadmium as Cd	mg/l	0.01	<0.001
21	Lead as Pb	mg/l	0.1	<0.001
22	Copper as Cu	mg/l	1.5	<0.001
23	Arsenic as	mg/l	0.2	<0.02
24	Selenium as Se	mg/l	0.05	<0.001
25	Phenolics as C_6H_5Oh	mg/l	0.005	<0.001
26	Zinc as Zn	mg/l	5	0.03
27	Mercury as Hg	mg/l	$	<0.001
28	Aluminum as Al	mg/l	$	<0.001
29	Anionic detergents as MBAS	mg/l	0.12	<0.001

S. No.	Parameter	Units	IS:2296 Class C Limits	SW 1 (Pond adjacent to Site)
30	Oil and grease	mg/l	0.3	<0.001
31	Sodium Absorption Ratio	meq/L	-	<0.001
32	Insecticides	mg/l	Absent	<0.001
33	Coliform Organisms	MPN/100 ml	Should not exceed 5000	22

Source: Sampling and Analysis done by Vision Labs, Hyderabad

The water of the pond was found with prescribed limits of IS 2296 Class C water. No contaminant was observed in water.

4.7.2 Ground Water Quality

The ground water selected for analysis was source from Tube-wells. Since the ground-water is used without treatment by a large portion of population. The ground water analysis results were compared with BIS standards and presented in Table below.

Table 4-15: Ground Water Quality

S. No.	Parameter	Unit	GW 1 (Mulkanoor)	GW2 (Vangara)	GW3 (Ramnagar)	10500:2012	
						Acceptable	Permissible
1	pH	--	7.67	7.43	7.69	6.5-8.5	NR
2	Turbidity	NTU	1.2	1.6	1.3	1	5
3	EC	µMho/cm	1002	674	926	-	-
4	TDS	mg/l	648	428	592	500	2000
5	Colour	mg/l	<01	<01	<01	5	15
6	Taste	mg/l	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
7	Odor	mg/l	Unobjectionable	Unobjectionable	Unobjectionable	Agreeable	Agreeable
8	Total Alkalinity as CaCO3	mg/l	210	160	220	200	600
9	Chlorides as Cl-	mg/l	145.1	95	130.1	250	1000
10	Sulphates as SO4-2	mg/l	71.7	34.7	48.8	200	400
11	Nitrates as NO3	mg/l	6.9	3.7	5	45	NR
12	Phosphates as PO4	mg/l	<0.02	<0.02	<0.02	-	-
13	Total Hardness as CaCO3	mg/l	320	230	320	200	600
14	Calcium as Ca	mg/l	72	52	76	75	200
15	Magnesium as Mg	mg/l	33.6	24	31.2	30	100

S. No.	Parameter	Unit	GW 1 (Mulkanoor)	GW2 (Vangara)	GW3 (Ramnagar)	10500:2012	
						Acceptable	Permissible
16	Sodium as Na	mg/l	57.5	45.5	61.6	-	-
17	Potassium as K	mg/l	3.1	1.9	2.3	-	-
18	Flourides as F-	mg/l	1	0.6	0.8	1.0	1.5
19	Iron as Fe	mg/l	0.12	0.08	0.12	0.3	NR
20	Phenolic Compounds	mg/l	<0.001	<0.001	<0.001	0.001	0.002
21	Cyanide as CN-	mg/l	<0.001	<0.001	<0.001	0.05	NR
22	Residual Chlorine as Cl-	mg/l	<0.001	<0.001	<0.001	0.2	1.0
23	Cadmium as Cd	mg/l	<0.001	<0.001	<0.001	0.003	NR
24	Total Chromium as Cr	mg/l	<0.001	<0.001	<0.001	0.05	NR
25	Lead as Pb	mg/l	<0.02	<0.02	<0.02	0.01	NR
26	Zinc as Zn	mg/l	0.09	0.06	0.06	5	15
27	Manganese as Mn	Hazen	<0.001	<0.001	<0.001	0.1	0.3
28	Copper as Cu	-	0.023	0.013	0.031	0.05	1.5
29	Nickel as Ni	-	<0.001	<0.001	<0.001	0.02	NR
30	Boron	mg/l	<0.001	<0.001	<0.001	0.5	1.0
31	Anionic Detergents	mg/l	<0.001	<0.001	<0.001	0.2	1.0
32	Mineral Oil	mg/l	<0.001	<0.001	<0.001	0.5	NR
33	Aluminium as Al	mg/l	<0.001	<0.001	<0.001	0.03	0.2
34	Mercury as Hg	mg/l	<0.0002	<0.0002	<0.0002	0.001	NR
35	Pesticides	mg/l	absent	absent	absent	Absent	NR

Source: Sampling and Analysis done by Vision Labs, Hyderabad

Water in the study area was found neutral in terms of pH ranging from 7.43 to 7.69. Turbidity and color was found well within the acceptable limits. Most of heavy metals was found below the detectable limit, whereas, slight concentration of Iron, Zinc and Copper were observed. However, concentration of these heavy metals were found well below the acceptable limits. In general water is suitable for drinking, after necessary disinfection.

4.8 ECOLOGICAL STATUS

4.8.1 Objective of Study

The study was undertaken with a view to understand the status of ecosystem along the following line:

- To assess nature and distribution of the vegetation in the area
- Determination of type of forests
- Preparation of checklist of flora and fauna

- Listing of Trees, shrubs, climbers and herbs and other existing habit forms
- To recognize the plant community
- To identify the rare and endangered species in the project area
- To determine ecologically sensitive areas like national parks or wildlife sanctuaries
- Existing status of flora and fauna
- Disturbance due to human utilization and livestock

4.8.2 Ecology Survey

The survey for ecology and biodiversity assessment was conducted in and around the proposed Solar PV Project site at Vangara village, Mulkanoor, District Karimnagar, Telengana. Team of ecology experts visited the site on 13th July, 2016 to 16th July, 2016 for floral and faunal survey. Secondary available information was also reviewed while finalizing the list of floral and faunal species.

To achieve the above objectives, floristic and ecological survey covering 10 km radius around the proposed site was carried out. The survey included:

- Reconnaissance Survey
- Generation of primary data to understand baseline ecological status of floral and faunal diversity, sensitive habitats and rare species
- Importance and status of flora and fauna

4.8.3 Ecological Sensitive Area

No National Park, Wildlife Sanctuary, Bio-spehere Reserve, Notified Wildlife Corridor, etc. is located within 10km from the project site. The proposed project doesn't involved diversion of any forests area for the project purpose. The nearest notified eco-sensitive area i.e. Vana Vignana Kendra Mini Zoo is about 27km from the proposed site. As per discussion with forest dept. no migratory bird incidence was reported in Karimnagar District.

4.8.4 Forest Area

According to India State of Forest Report, 2015, the recorded forest area of Telangana State is 21591 km^2 which constitute 18.8% of its total geographical area of 114865 km^2. Of the total forest area, 513 km^2 is classified as very dense forest while 12712 km^2 is moderately dense forest and 8366 km^2 is open forest. Figure 4.13 presents the Forest Cover Map of Telangana state.

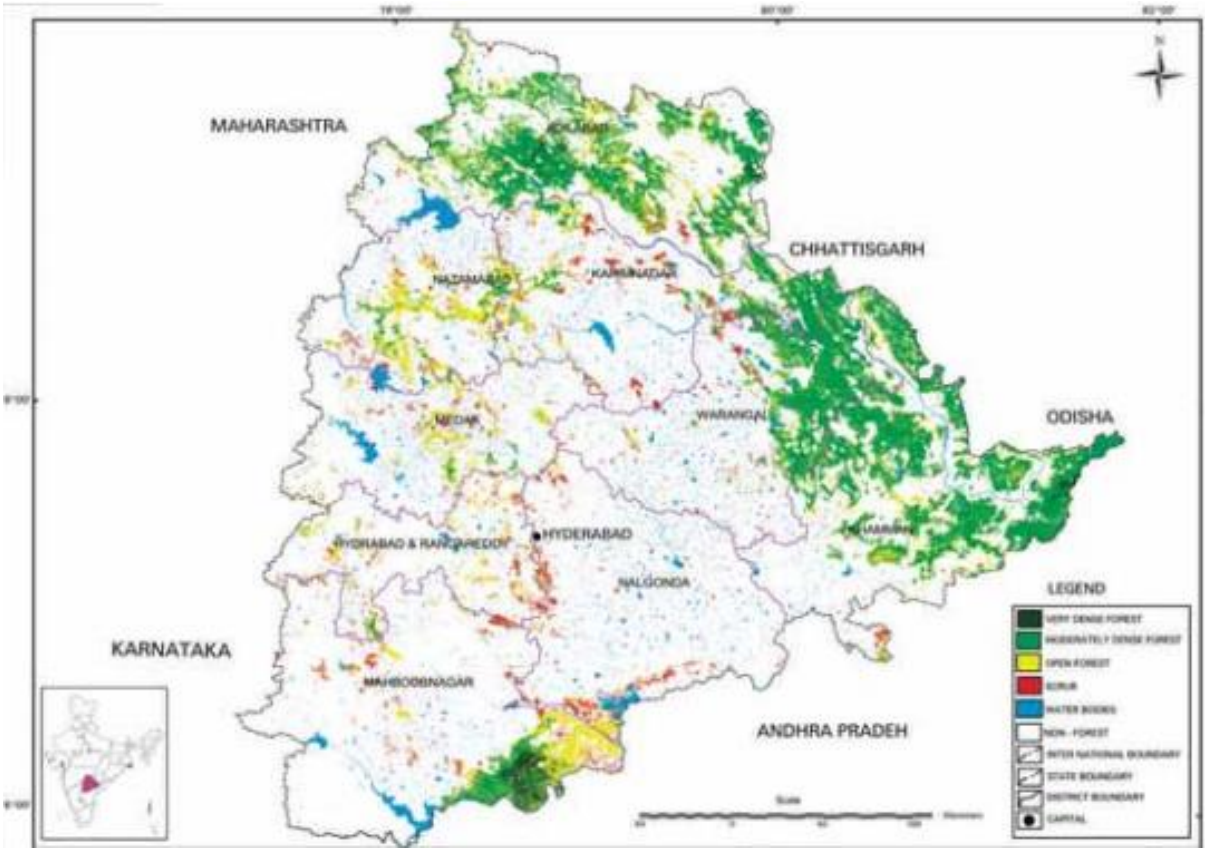


Figure 4-13: Forest Map of Telangana State

Forest area percentage in Karimnagar District is 14.2%, which is in series with Telanagana State forest area percentage of 18.8%. No dense forest is reported in project district. Comparative details between the Project Districts & State forest Cover have been presented in below table.

Table 4-16: Forest Cover in Project District and State as per Density

District / State	Area in Km^2					% of Geographical Area
	Geographical Area	Very Dense Forest	Moderately Dense Forest	Open Forest	Total	
Karimnagar	11823	0	973	696	1669	14.12
Telangana	114865	513	12712	8366	21591	18.8

Source: India State of Forest Report, 2015

Project site primarily consist the agriculture land with patches of scrub land. No forest area is being affected due to proposed project. Characteristics of forest was closely observed during site survey and presented in Table below.

Particulars	Characteristics
Forest Block in North-West at 2.1 km	
Gradient	Steep
Aspect	South
Major Soil Type	Morram Soil
Soil Erosion Status	Moderate

Particulars	Characteristics
Soil Compaction	High
Soil Permeability	Low
Drainage Availability	Good
Major Over wood Species	Albizia *amara,* Cleistanthus *collinus, etc.*
Major Under wood Species	Wrightia *tinctoria,* Zizyphus *oenoplia, etc.*
Major Under growth Species	Canthium *parviflorum,* Randia *dumetorum, etc.*
Wildlife Presence	Sloth Bears, Wild Bores, Peacocks, Rabbits
Forest Block in South-West at 3.4 km	
Gradient	Steep
Aspect	North-East
Major Soil Type	Morram Soil
Soil Erosion Status	Moderate
Soil Compaction	High
Soil Permeability	Low
Drainage Availability	Good
Major Over wood Species	Albizia *amara,* Cleistanthus *collinus, etc.*
Major Under wood Species	Wrightia *tinctoria,* Zizyphus *oenoplia, etc.*
Major Under growth Species	Butea *superba,* Randia *dumetorum, etc.*
Wildlife Presence	Fox, Sloth Bears, Wild Bores, Peacocks

Source: Visual Observation supported by Forest History

4.8.5 Floral Composition

The floristic studies were based on exploration of the study area. The field surveys involve the preparation of an inventory of different species of plants including trees, shrubs, economic plants in the plant community of the area. All plant species were identified correctly with the help of expert taxonomist and literature published by BSI. The observations were also made on the agricultural patterns, agricultural weeds and cultivated and introduced plant species. The documentation of the plant communities was done by random walk through the study area and visual observations.

4.8.5.1 Observations and Results

Broadly the state is located in Deccan Plateau Geographic zone. The Deccan Plateau is characterised with open, thorny, scrub jungle is dominated by the Acacia, Albizia, Hardwickia and allied species. Telangana state has rich flora and fauna with its varied geographic features, has diverse habitats, harboring several and unique flora and fauna. The Main Forest types found in Telangana are.

- Tropical Moist Deciduous
- Tropical Dry Deciduous
- Littoral and Swamp
- Tropical Thorn
- Dry Evergreen.

The forest type in study area is Tropical Dry Deciduous. The forest is the part of Akunur Forest Block. Some of the glimpses of ecology near to plant site are shown as Figure 4.14 below.

Figure 4-14: Glimpses of Vegetation near to Site

Floral diversity was observed under three categories namely; Over-wood, Under-wood and undergrowth vegetation. Over-wood categories involved trees, whereas shrubs are covered Under-wood category and Climbers, Weeds & Grasses are covered in undergrowth category.

4.8.5.2 Over-wood Species

Albizia *amara,* Azadirachta *indica,* Bridelia *retusa,* Cleistanthus *collinus,* Wrightia *tinctoriam,* Zizyphus *mauritiana,* Terminalia *alata,* Trevia *nudiflora, etc.* are the major over-wood species observed in the region and nearby forest areas. One tree of Azadirachta *indica* was also observed at site. The inventory of the Floral Species as observed and presence suggested by villagers and forest dept. in Study area is presented in Tables below.

Table 4-17: Trees in Study Area

S. No.	Local Name	Scientific Name
1	Nallatumma	Acacia *nilotica*
2	Sundra	Acacia *chundra*
3	Val-sandra	Acacia *ferruginea*
4	Tella tumma	Acacia *leucophloea*
5	Bandaru	Adina *cordifolla*
6	Maredu	Aegle *marmelos*
7	Peddamanu	Ailanthus *excelsa*
8	Udugu	Alangium *salvifolium*
9	Narlingi*	Albizia *amara*
10	Dirisanam	Albizia *lebbeck*
11	Chindugu	Albizia *odoratissima*
12	Pasarganni (Tella chintha)	Albizia *procera*
13	Pasi	Anogeissus *accuminata*
14	Tirman	Anogeissus *latifolia*
15	Sitaphal	Annona *squamosa*

S. No.	Local Name	Scientific Name
16	Tella pulseru	Antidesma *shaesemhilla*
17	Vepa (Neem)*	Azadirachta *indica*
18	Gari	Balanites *roxburghii*
19	Kadmini	Baringtonia *acutangula*
20	Mohwa	Madhuca *indica*
21	Pedda are	Bauhinia *malabarica*
22	Are	Bauhinia *racemosa*
23	Tadi	Borassus *flabellifer*
24	Anduk	Boswellia *serrata*
25	Korra maddi*	Bridelia *retusa*
26	Tella yegisa	Bridelia *hamiltoniana*
27	Pedda morri	Buchanania *angustifolia*
28	Morri	Buchanania *latifolia*
29	Moduga	Butea *monosperma*
30	Nakkareni	Canthium *didymum*
31	Budareni	Capparis *divaricata*
32	Budda dharmi	Careya *arborea*
33	Tangedu	Cassia *auriculata*
34	Rela	Cassia *fistula*
35	Nela tangedu	Cassia *siamea*
36	Billudu	Chloroxylon *swietenia*
37	Kodisha*	Cleistanthus *collinus*
38	Kondagogu	Cochlospermum *religiosum*
39	Iriki	Cordia *myxa*
40	Uskiaman	Crataeva *religiosa*
41	Jitregi	Dalbergia *latifolia*
42	Soppera	Dalbergia *paniculata*
43	Yeltur	Dichrostachys *cinerea*
44	Kalinga	Dillenia *pentagyna*
45	Illinta	Diosphyros *chrloroxylon*
46	Tunki	Diospyros *melanoxylon*
47	Muchituniki	Diospyros *montana*
48	Voddi	Dolichandrone *falcata*
49	Paladanti	Ehretia *laevis*
50	Butankus	Elaeodendron *roxburghii*
51	Mullumodaga	Erythrina *suberosa*
52	Devadaru	Erythroxylum *monogynum*
53	Neredu	Eugenia *jambolana*

S. No.	Local Name	Scientific Name
54	Pedda jamudu	Euphoriba *antiquorum*
55	Moddu jamudu	Euphorbia *neriifolia*
56	Velaga	Feronia *elephantum*
57	Marri	Ficus *benghalensis*
58	Bandajuvvi	Ficus *infectoria*
59	Muli-elka	Flacourtia *ramontchi*
60	Chit-mut	Gardenia *gummifera*
61	Palakodisha*	Wrightia *tinctoria*
62	Regu*	Zizyphus *mauritiana*
63	Nallamaddi*	Terminalia *alata*
64	Botku*	Trevia *nudiflora*

**- Major Species observed during primary ecology survey*

Source: Onsite field Survey, Botanical Survey of India, Forest Working Plan and Local Consultation

Varieties of Shrubs, herbs and Climbers were also observed in study area. However, no economical cropping of these hers or shrubs was observed in study area. Some of the dominant shrubs, herbs and climbers as observed during site visit, is giving in Table below.

Table 4-18: Shrubs, Herbs, Climbers and Grasses in Study Area

S. No.	Family	Scientific Name
Shrubs		
1	Addasaram	Adhatoda *vasica*
2	Panchotkam	Bridelia *hamiltniana*
3	Jilledu	Calotropis *gigantea*
4	Jilledu	Calotropis *procera*
5	Balusu*	Canthium *parviflorum*
6	Adonda	Capparis *horrida*
7	Danti	Celastrus *emarginatus*
8	Tangedu	Cassia *auriculata*
9	Chakunda	Cassia *tora*
10	Pulivayili	Dodonaea *viscosa*
11	Bommamadi	Ficus *hispida*
12	China karinga	Gardenia *lucida*
13	Jana	Grewia *populifolia*
14	Nultada	Helecteres *isora*
15	Iataripala	Holarrhena *antidysentercia*
16	Karkandi	Indigofera *pulchella*
17	Neeli	Indigofera *arborea*
18	Advi amudam	Jatropha *glanduli-fera*
19	Advi amudam	Jatropha *curcas*

S. No.	Family	Scientific Name
20	Wajinika	Loranthus *longiflorus*
21	Undrugu	Mimosa *rubicaulis*
22	Parijatak	Nyctanthes *arbortristis*
23	Jangji khajur	Phoenix *acaulis*
24	Manga*	Randia *dumetorum*
25	Barrinia	Strebulus *asper*
26	Vavili	Vitex-*negundo*
27	Kommi	Webera *corymbosa*
28	Jaju	Woodfordia *floribunda*
Herbs		
1	Nalladoggati	Amaranthus *spinosus*
2	Nelavemu	Andrographis *paniculata*
3	Manchi-jamudu	Euphorbia *tirucalli*
4	Sugandhipala	Hemidesmus *indicus*
5	Malla vavili	Justicia *gendarussa*
6	Touch – me – not	Mimosa *pudica*
7	Pedda palleru	Pedalium *murex*
Climbers		
1	Erra – gurija	Abrus *precatorius*
2	Korintha	Acacia *intia*
3	Musalidani tiga	Asparagus *racemosus*
4	Addatiga	Bauhinia *vahlii*
5	Tiga modugu*	Butea *superba*
6	Gachakai	Caesalpinia *bonducella*
7	Teegadhari	Calycopteris *floribunda*
8	Maner tiga	Celastrus *paniculata*
9	Yadatiga	Combretum *decandrum*
10	Bondku tiga	Combretum *extensum*
11	Aretiga	Combretum *ovalifolium*
12	Chakalitiga	Derris *scandens*
13	Nallatiga	Ichnocarpus *frutescens*
14	Duladundi	Mucuna *pruriens*
15	Kumurika	Smilax *macrophylla*
16	Pariki*	Zizyphus *oenoplia*
Grasses		
1	Adavi korray – gaddi	Apluda *mutica*
2	Cheepuru – gaddi	Aristida *adscensionis*
3	Kashy- gaddi	Chionachna *koenigii*

S. No.	Family	Scientific Name
4	Kanthirigaddi	Chloris *incompleta*
5	Peddapale	Chrysopogon *montanus*
6	Kashay – gaddi	Cymbopogon *martinii*
7	Garika – gaddi	Cynodon *dactylon*
8	Kaproda – gaddi	Echinochloa *colona*
9	Kesari – gaddi	Heteropogon *contortus*
10	Kundara – gaddi	Ischaemum *pilosum*

**- Major Species observed during primary ecology survey*

Source: Onsite field Survey, Botanical Survey of India, Forest Working Plan and Local Consultation

4.8.6 Faunal Characteristics

4.8.6.1 Faunal Elements

Faunal studies help to understand the wellbeing of a nature and functioning of ecosystems. It helps to monitor biological richness or heritage quality, habitat change and quantifying threatening species. Animals and birds in the study area were documented using following means:

- Secondary sources and published literature
- By interviewing local people
- Actual sighting
- Indirect evidence (pallets, dung, droppings, scat, mould, marking on the trunks etc.)
- Nesting (birds, burrows for small mammals)

The records for the birds, mammals and other faunal groups were made at the same site where vegetation observation was carried out.

4.8.6.2 Terrestrial Faunal Elements

Most of the records of the mammalian and reptilian fauna are opportunistic, nonetheless very useful to understand habitat specificity and interrelationship between certain floral and faunal elements and also between certain geological and faunal features. Some of the faunal Species found in the Study area is presented in Tables below.

Table 4-19: Terrestrial Faunal Species Diversity in Study Area

S. No.	Common Name	Scientific Name	Local Name	Wildlife Schedule	IUCN Category
1	Baned Crait	Bungarus *fasciatus*	Katlapamu	-	LC
2	Barking Deer*	Muntiacus *muntjak*	Kondagorre	III	LC
3	Chamelleon	Chemelean *calcaratus*	Usaravelli	II	LC
4	Chinkara	Gazella *gazellabennetti*	Gaddimeka	I	LC
5	Common Crait	Bungarus *caeruleus*	Katlapamu	-	LC
6	Common Langur	Presbytis *entellus*	Kondamutchu	II	-
7	Common Lizard	Calotes *vercicular*	Thonda	-	-
8	Common skink	Nabuya *carinta*	Nallikesu	-	-

S. No.	Common Name	Scientific Name	Local Name	Wildlife Schedule	IUCN Category
9	Dhole or wild dog	Cuon *alpinus*	Rechu Kukka	II	E
10	Fanthroated Lizard	Sitena *sps*	Thonda	-	LC
11	Forest Lizard	Calotes *rouxibughii*	Adavi thonda	-	LC
12	Hare	Lepus *nigricollis*	Chevulapilli	-	LC
13	Indian cobra	Naja	Nagupamu	II	LC
14	Indian Pond Terapin	Melanochelys *injuga*	Neeti Tabelu	I	NT
15	Indian Porcupine	Hystrix *indica*	Mullapandi	IV	LC
16	Indian python	Python *molurus*	Kondachiluva	I	V
17	Indian Wolf	Canis lupus *pallipes*	Thodelu	I	LC
18	Indian Fox*	Vulpes *bengalensis*	Nakka	II	LC
19	Jackal	Canis *aureus*	Gunta Nakka	II	LC
20	Jungle Cat	Felis *Chaus*	Jangupilli	II	LC
21	Keelback	Exnochrophis *piscater*	Neetipamu	II	-
22	Nilgai	Boselaphus *tragocamelus*	Manubothu	III	LC
23	Oliveceous Keelback	Artactium *schistosum*	Neerukatta	II	LC
24	Palm Civet	Paradoxurus *hermophroditus*	Msnupilli	-	LC
25	Palm Squirrel	Funamberlus *palmarum*	Udatha	IV	LC
26	Rat Snake	Pytyas *mucosus*	Jerripothu	II	-
27	Rattle	Mellivora *capensis*	Puridu Banti	-	LC
28	Rhesus Macaque	Macaca *mulatta*	Kothi	II	LC
29	Russels viper	Vipera *russeli*	Popamu	II	-
30	Sambar	Cervus *unicolour*	Kasnuju	III	V
31	Sloth Bear*	Melursus *ursinus*	Yelugugoddu	II	V
32	Smooth Indian Otter	Lutra *perspicillata*	Neeru Kukka	II	V
33	Snake skink	Ryopa *panketa*	Nallikesu	IV	-
35	Spotted Deer	Axis *axis*	Duppi	-	LC
36	Wild Boar*	Sus *cxistatu*	Adavipandi	-	LC
37	Indian Rabbit*	Lepus *nigricollis*	-	-	LC

LC- Least Concern, NT- Near Threatened, V- Vulnerable, E- Endangered

Source: *Actual sightings, Forest Working Plan, interactions with local people and Publication of ZSI, Kolkata*

4.8.6.3 Avi-fauna

Detailed inventory of the avifauna is presented in Table below.

Table 4-20: Avi-fauna in Study Area

S. No.	Common Name	Scientific Name	Wildlife Schedule	IUCN Category
1	Large Cormorant	Phalacrocorax *carbo sinensis*	IV	-
2	Little cormorant	Phalacrocorax *niger*	IV	LC
3	Darter	Anhinga *rufa melanogaster*	-	NT
4	Grey heron	Ardea *cinerea rectirostris*	-	LC
5	Pond heron	Ardeola *grayii*	-	LC
6	Cattle egret	Bubulcus *ibis coromandus*	IV	LC
7	Night heron	Nycticorax	-	LC
8	White stork	Ciconia	I	LC
9	White ibis	Threskiornis *aethiopica melanocephala*	IV	LC
10	Black ibis	Pseudibis *papillosa*	IV	LC
11	Brahminy duck	Tadorna *ferruginea*	IV	LC
12	Common teal	Anas *crecca acrecca*	-	LC
13	Red crested pochard	Netta *rufina*	-	LC
14	South indian grey partridge	Francolinus *pondicerianus*	-	LC
15	Jungle bush quail	Perdicula *asiatica*	-	LC
16	Grey jungle fowl	Gallus *sonneratii*	II	LC
17	Indian peafowl *	Pavo *cristatus*	I	LC
18	Indian moorhen	Gallinula *chloropus indica*	-	LC
19	Indian purple moorhen	Porphyrio *poliocephalus*	-	LC
20	Red wattled lapwing	Vanellus *indicus*	-	LC
21	Yellow-wattled lapwing	Vanellus *malabaricus*	-	LC
22	Indian ring dove	Streptopelia *decaocto*	-	LC
23	Indian spotted dove	Streptopelia *chinensis suratensis*	-	-
24	Rose ringed parakeet	Pasittacula *krameri manillensis*	IV	LC
25	Common hawk-cuckoo	Cuculus *varius*	IV	LC
26	Indian cuckoo	Cuculus *micropterus*	IV	LC
27	Koel	Eudynamys *scolopacea*	-	LC
28	Peninsular scops owl	Otus *scops rufipennis*	-	-
29	Blue tailed bee-eater	Merops *pphilippinus philippinus*	-	LC
30	Common grey hornbill	Tockus *birostris*	I	LC
31	Indian pitta	Pitta *brachyura*	-	LC
32	South indian black drongo	Dicrurus *adsimilis macricercys*	IV	-
33	Indian myna	Acridotheres *tristis*	IV	LC

S. No.	Common Name	Scientific Name	Wildlife Schedule	IUCN Category
35	Indian house crow	Corvuus *splendens*	V	LC
36	Common babbler	Turdoides *caudatus*	IV	LC
37	Indian magpie robin	Copsychus *saularis*	-	LC
38	Indian robin	Saxicoloides *fulicata*	-	LC
39	Large pied wagtail	Motacilla *maderaspatensis*	-	LC
40	Indian house sparrow	Passer *domesticus indicus*	-	LC
41	Indian yellow throated sparrow	Petronia *xanthocollis*	-	LC
42	Red munia	Estrilda *amandava*	IV	V

LC- Least Concern, NT- Near Threatened, V- Vulnerable, E- Endangered

Source: *Actual sightings, Forest Working Plan, interactions with local people and Publication of ZSI, Kolkata*

4.8.6.4 Findings Summary

The Site and Study areas near Vangara Village, Mulkanoor is predominantly dominated by agroecosystem on plains. No protected areas like National Park, Wildlife Sanctuary/ Reserve within the 10 km radius. As per the direct sighting records, indirect occurrence evidence records and records procured from secondary literature data there is more than 64 species of trees, 28 different species of shrubs and 7 different species of herbs are found in the study area. More than 37 different species of fauna are found in the study area while there are 44 different avifauna species.

4.9 SOCIAL ENVIRONMENT

This section provides an understanding of the administrative setup of the district, the demographic profile of the villages/towns in the project area, the social groups present, the land use pattern in the area, the livelihood profile of the community, the common property resources, the social and physical infrastructure available in terms of the education and health infrastructure, the water supply for irrigation and drinking purposes, sanitation facilities and connectivity. The purpose of this section is to allow for an increased understanding of the key issues identified as well as identify areas of intervention in future scenarios.

4.9.1 Methodology

The key objective of the socio-economic study is to assess possible impact of the project on socio-economic life of the people in the neighborhood of the project.

A mixture of both quantitative and qualitative approach has been adopted in the current socio-economic study. The study has been conducted based on primary and secondary data. While primary data has been collected through a stratified sampling method of selected households located in the nearby village, the secondary data has been collected from the administrative records of the Government of Telangana, Census of India 2011, district statistical hand book, state and district portal.

The details regarding population composition, number of literates, workers, etc. have been collected from secondary sources and analyzed. Data on amenities available in the study area have been

collected from secondary sources like District Annual Statistical Handbook, *http://www.telangana.gov.in*, Census of India 2011, and analyzed.

Two stage sampling design has been adopted to select the sampling units. The first stage units are census villages in the rural areas and towns/cities in urban areas. The ultimate stage units are households in the selected villages. Stratified Sampling Method has been adopted to select the sampling units. Estimation of various parameters has been made based on sample data and bottom top approach has been adopted.

On the basis of a preliminary reconnaissance survey, questionnaire was developed to make it suitable to fulfill the objectives of the study. The questionnaires contained both open ended and close ended questions.

The data collected during the above survey was analyzed to evaluate the prevailing socio-economic profile of the area. Based on that, impacts due to project operation on the community have been assessed and recommendations for improvement have been made. The impact from the solar power project will be very minimal and will be limited to maximum within project boundary. But the study area has been considered as 10 km radius of project boundary.

4.9.2 Baseline of the Study Area

4.9.2.1 State Profile: Telangana

Telangana became the 29th state of India on 2nd June 2014. The State is richly endowed with natural and human resources with competitive socio-economic advantages. It's geographical spread of 1,14,840 Sq. Km makes it the 12th largest State in the country. A projected population of 3.52 Crores as per 2011 census makes it the 12th most populous State. It consists of the ten north-western districts of Andhra Pradesh with Hyderabad as its capital. Most of it was part of the princely state of Hyderabad (Medak and Warangal Divisions), which was ruled by the Nizams during the British Raj until 1947 and later until 1948, when it joined the Union of India. In 1956, Hyderabad state was dissolved and Andhra State was merged with the Telangana region of the state of Hyderabad to form the state of Andhra Pradesh. The city of Hyderabad will continue to serve as the joint capital for Andhra Pradesh and the successor state of Telangana for a period of ten years. Hyderabad, Warangal, Karimnagar and Nizamabad are the major cities in the state. The commonly spoken languages are Telugu, Hindi, Urdu and English. **Table** below describes salient features of the State of Telangana.

Table 4-21: Salient Features of Telangana State

S. No.	Particular	Unit
1	Capital City	Hyderabad
2	Area	114,840 Sq. Kms.
3	Districts	10
4	Revenue Divisions	42
5	Towns (as per Census, 2011)	158
6	Municipal Corporations	6
7	Municipalities	38
8	Nagara Panchayaths	25

S. No.	Particular	Unit
9	Zilla Praja Parishads	9
10	Mandal Praja Parishads	443
11	Gram Panchayaths	8778
12	Revenue Mandals	464
13	Revenue Villages	10,761
14	Inhabited Villages	10,128
15	Un-inhabited Villages	633
16	Households	83.58 Lakhs
17	Household size	4
18	Population	351.94 Lakhs
19	Male	177.04 Lakhs
20	Female	174.90 Lakhs
21	Sex Ratio (Female per 1000 Males)	988
22	Density of Population	307 per Sq. Km
23	Decadal Growth Rate (2001-2011)	13.58 Rate
24	Rural Population	215.85 Lakhs
25	Rural Population Male	107.97 Lakhs
26	Rural Population Female	107.88 Lakhs
27	Rural Population Sex Ratio (Female per 1000 Males)	999 Ratio
28	Rural to Total Population	61.33%
29	Urban Population	136.09 Lakhs
30	Urban Population Male	69.07 Lakhs
31	Urban Population Female	67.02 Lakhs
32	Urban Population Sex Ratio (Female per 1000 Males)	970 Ratio
33	Urban to Total Population	38.64%
34	SC Population	54.33 Lakhs
35	SC Population Male	27.05 Lakhs
36	SC Population Female	27.28 Lakhs
37	ST Population	32.87 Lakhs
38	ST Population Male	16.60 Lakhs
39	ST Population Female	16.27
40	Child Population (0-6 years)	39.20 Lakhs
41	Child Population (0-6 years) Male	20.28 Lakhs
42	Child Population (0-6 years) Female	18.92 Lakhs
43	Child to Total Population	11.14%
44	Child Sex Ratio (Female per 1000 Males)	933 Ratio
45	Literates	207.84 Lakhs
46	Literates Male	117.49 Lakhs

S. No.	Particular	Unit
47	Literates Female	90.35 Lakhs
48	Literacy Rate	66.46%
49	Literacy Rate Male	74.95%
50	Literacy Rate Female	57.92%
51	Total Workers	164.53 Lakhs
52	Main Workers	138.06 Lakhs
53	Marginal Workers	26.47 Lakhs
54	Members of Parliament (MPs)	17
55	Members of Legislative Assembly (MLAs)	119
56	Zilla Parishad Territorial Constituency Members (ZPTCs)	443
57	Mandal Parishad Territorial Constituency Members (MPTCs)	6497

Source: http://www.telangana.gov.in

4.9.2.2 District Profile: Karimnagar

Karimnagar district lies approximately between the latitudes 17° 50' and 19° 05'N and longitudes 78° 29' and 80° 22'E. It is located in middle of North-eastern side of the State and is bounded on the North by Adilabad, West by Nizamabad, South by Medak and Warangal districts and on the East by Godavari River and Chhattisgarh State.

The district has population of 37,76,269 as per the 2011 census which accounts for 10.73% of the total population of the State with 8.15% decadal growth. Many large scale companies like NTPC, Kesoram Cements, Ramagundam-singareni collieries etc. are located in and around Karimnagar. Salient feature of the district has been summarised in **Table** below.

Table 4-22: Salient Features of Karimnagar District

S. No.	Particular	Units	Figure
1	Area	In '000 Sq. Km	11.8
2	Population	In Persons	37,76,269
3	Male	In Persons	18,80,800
4	Female	In Persons	18,95,469
5	Urban	In Persons	9,51,225
6	Rural	In Persons	28,25,044
7	Population Growth (decadal)	%	8.15
8	Population Density (Person/Km^2)	Ratio	319
9	Literacy	%	64.15
10	Male	%	73.65
11	Female	%	54.79
12	Urbanization	%	25.19
13	% of Workers with respect to total population	%	49.70

S. No.	Particular	Units	Figure
14	% of Main workers with respect to total worker	%	84.74
15	% of Marginal workers with respect to total workers	%	15.26
16	Area under Food & Non-Food crops	Area in Hectares	7,56,959
17	Mining & Quarrying (Coal - Top)	Qty in tonnes	1,76,24,611
18	Forest Area under the control of Forest Department	Area in Sq. Km	2544.83
19	Gross irrigated area as % of gross cropped area	%	70.15
20	Road Length per 100 sq.km	In Sq.km	103.64179
21	Post offices per 100,000 persons	Ratio	19.649024
22	Bank branches per 100,000 persons	Ratio	8.2886044
23	Population per bank	In Thousands	12.26
24	Per capita bank deposits	INR In Crores	22965.525
25	Per capita bank credit	INR	16542.783
26	Per capita bank credit to agriculture	INR	39.107521
27	Per ha. bank credit to agriculture	INR	19.509712
28	Per capita bank credit to Industries	INR	12.305577

Source: http://www.telangana.gov.in/about/districts/karimnagar

4.9.2.3 Project Influence Area

The proposed, 30 MW Solar Power Project site is located at Vangara Village, Bheemadevarpalle Mandal, Karimnagar District, approximately 42 km SSE from Karimnagar District Headquarter, 30 km NW from Warangal district Headquarter and 120 km NE from State Capital, Hyderabad. Nearest Railway Station is Uppal Railway Station (18 km E) and nearest Airport is Rajiv Gandhi International Airport Hyderabad (136 km SE). The proposed project covers 25 Census villages of Karimnagar district. The study area for the project has been considered 10 km peripheral from the project boundary. Further, to achieve an informative result the total area has been segregated into two different zones.

Zone -1 : Core Zone village

Zone -2 : Buffer Zone (Villages falling within 10 km radius from Core Zone)

On the basis of available census data, 2011 different aspects of socio economic condition of all villages in these two different zones have been analyzed which is presented in sections and tables below.

Table 4-23: Demographic Profile of the Study Area

S. No.	Name of Villages	HH	Population			Literates			Main Workers			Marginal Workers			Non Workers		
			Total	M	F	Total	M	F	Total	M	F	Total	M	F	Total	M	F
Zone I (Core Zone)																	
1.	Vangara	1484	6081	2973	3108	3396	1886	1510	2029	1229	800	769	315	454	3283	1429	1854
Zone II (Buffer Zone 10 km. Radius)																	
2.	Akunur	1528	6058	2999	3059	3242	1852	1390	2711	1439	1272	557	287	270	2790	1273	1517
3.	Ammanagurthi	603	2223	1121	1102	1270	764	506	1231	641	590	20	17	3	972	463	509
4.	Bheemadevarpalle	699	2579	1282	1297	1559	887	672	1235	666	569	59	33	26	1285	583	702
5.	Bommakal	714	2657	1331	1326	1412	839	573	1135	693	442	161	30	131	1361	608	753
6.	Dharmaram	190	746	370	376	534	291	243	399	205	194	3	1	2	344	164	180
7.	Gatlanarsingapur	1224	4626	2327	2299	2686	1563	1123	1559	924	635	841	332	509	2226	1071	1155
8.	Ghanpur	609	2259	1122	1137	1197	687	510	1007	576	431	188	35	153	1064	511	553
9.	Godisala	1355	5013	2492	2521	2777	1592	1185	2195	1173	1022	531	216	315	2287	1103	1184
10.	Gopalpur	830	2997	1520	1477	1753	1062	691	1482	839	643	206	56	150	1309	625	684
11.	Jeelgul	905	3334	1680	1654	1874	1112	762	1470	778	692	343	156	187	1521	746	775
12.	Katrepalle	512	1892	950	942	1125	638	487	698	490	208	275	32	243	919	428	491
13.	Kesavapur	558	2184	1103	1081	1139	667	472	1092	578	514	137	75	62	955	450	505
14.	Koppur	789	3055	1523	1532	1496	883	613	1286	676	610	264	83	181	1505	764	741
15.	Kothakonda	1192	4610	2334	2276	2746	1604	1142	1982	1192	790	310	58	252	2318	1084	1234
16.	Kothapalle	1092	4199	2019	2180	2323	1286	1037	1772	968	804	354	132	222	2073	919	1154
17.	Mallaram	1134	3986	2034	1952	2170	1293	877	1825	954	871	261	131	130	1900	949	951
18.	Manikyapur	804	3183	1592	1591	1816	1035	781	1531	829	702	190	81	109	1462	682	780
19.	Mirzapur	777	3121	1456	1665	1520	784	736	1474	723	751	124	52	72	1523	681	842
20.	Mulkanoor	2225	9075	4524	4551	5710	3280	2430	3880	2318	1562	369	142	227	4826	2064	2762
21.	Mustafapur	667	2511	1273	1238	1450	834	616	1276	675	601	147	79	68	1088	519	569

S. No.	Name of Villages	HH	Population			Literates			Main Workers			Marginal Workers			Non Workers		
			Total	M	F	Total	M	F	Total	M	F	Total	M	F	Total	M	F
22.	Mutharam	501	1970	1003	967	1093	634	459	632	446	186	294	96	198	1044	461	583
23.	Penchakalpeta	572	2123	1046	1077	1205	697	508	1084	559	525	19	5	14	1020	482	538
24.	Ratnagiri	460	1811	917	894	1081	623	458	1050	522	528	11	2	9	750	393	357
25.	Ummapur	383	1414	704	710	683	399	284	777	395	382	11	6	5	626	303	323
Total		20323	77626	38722	38904	43861	25306	18555	34783	19259	15524	5675	2137	3538	37168	17326	19842
Grand Total		21807	83707	41695	42012	47257	27192	20065	36812	20488	16324	6444	2452	3992	40451	18755	21696

Source: Census of India, 2011

4.9.3 Demographic Profile of the Study Area

4.9.3.1 Data Collection & Survey

The study area comprises of 25 villages including core zone and buffer zone as explained in the table above. Consultation and socio-economic survey was mainly conducted in Vangara and Ramnagar villages, located close proximity and approachable distance from the site in order to assess the impact of the upcoming solar power project. However, the secondary baseline data has been collected from Census of India 2011, for all the villages within the study area as per the zones as described in the **Table** above.

4.9.3.2 Concept and Definition of Terms Used

QoL: The Quality of Life (QoL) refers to degree to which a person enjoys the important possibilities of his/her life. The 'Possibilities' result from the opportunities and limitations, each person has in his/her life and reflect the interaction of personal and environmental factors. Enjoyment has two components: the experience of satisfaction and the possession or achievement of some characteristic.

Household: A group of persons who normally live together and take their meals from a common kitchen are called a household. Persons living in a household may be related or unrelated or a mix of both. However, if a group of related or unrelated persons live in a house but do not take their meals from the common kitchen, then they are not part of a common household. Each such person is treated as a separate household. There may be one member households, two member households or multi-member households.

Sex Ratio: Sex ratio is the ratio of females to males in a given population. It is expressed as 'number of females per 1000 males'.

Literates: All persons aged 7 years and above who can both read and write with understanding in any language are taken as literate. It is not necessary for a person to have received any formal education or passed any minimum educational standard for being treated as literate. People who are blind but can read in Braille are also treated as literates.

Literacy Rate: Literacy rate of population is defined as the percentage of literates to the total population aged 7 years and above.

Labour Force: The labour force is the number of people employed and unemployed in a geographical entity. The size of the labour force is the sum total of persons employed and unemployed. An unemployed person is defined as a person not employed but actively seeking work. Normally, the labour force of a country consists of everyone of working age (commencing from 14 years and below retirement (around 65 years) that are participating workers, that is people actively employed or seeking employment. People not counted under labour force are students, retired persons, stay at home people, people in prisons, permanently disabled persons and discouraged workers.

Work: Work is defined as participation in any economically productive activity with or without compensation, wages or profit. Such participation may be physical and/or mental in nature. Work involves not only actual work but also includes effective supervision and direction of work. The work may be part time or full time or unpaid work in a farm, family enterprise or in any other economic activity.

Worker: All persons engaged in 'work' are defined as workers. Persons who are engaged in cultivation of land or milk production even solely for domestic consumption are also treated as workers.

Main Workers: Those workers who had worked for the major part of the reference period (i.e. 6 months or more in the case of a year) are termed as Main Workers.

Marginal Workers: Those workers who did not work for the major part of the reference period (i.e. less than 6 months) are termed as Marginal Workers**.**

Work Participation rate (WPR): The work participation rate is the ratio between the labour force and the overall size of their cohort (national population of the same age range). In the present study the work participation rate is defined as the percentage of total workers (main and marginal) to total population.

Below Poverty Line (BPL) family: As per Press Information Bureau, Govt. of India, 2011-12, Poverty Line Estimation for rural areas (as per Tendulkar Committee Report) is at INR 816 per capita per month and INR 1,000 per capita per month in urban areas. Thus, for a family of five, the all India poverty line in terms of consumption expenditure would amount to about INR 4,080 per month in rural areas and INR 5,000 per month in urban areas.

Pacca House: A pucca house is one, which has walls and roof made of the following material: (i) *Wall material:* Burnt bricks, stones (packed with lime or cement), cement concrete, timber, ekra etc. (ii) *Roof Material:* Tiles, GCI (Galvanised Corrugated Iron) sheets, asbestos cement sheet, RBC, (Reinforced Brick Concrete), RCC (Reinforced Cement Concrete) and timber etc.

Kutcha House: The walls and/or roof of which are made of material other than those mentioned above, such as unburnt bricks, bamboos, mud, grass, reeds, thatch, loosely packed stones, etc. are treated as kutcha house.

Semi-pucca House: A house that has fixed walls made up of pucca material but roof is made up of the material other than those used for pucca house *(roof of khaprail tiles*).

4.9.4 Baseline Data of the Study Area

Table below is an attempt to provide salient features of socio-economic features of the study area.

Table 4-24: Demography, Literacy and Occupational details of people living in Study Area

S. No.	Description	Number	% to total
1	**Total Population - Gender wise**	**83,707**	**100**
	Male	41,695	49.81
	Female	42,012	50.19
	Sex ratio (No. of females per 1000 males)	1008	
2	**Total Population (0-6 years) - Gender wise**	**6,955**	**8.31**
	Male	3561	51.20
	Female	3394	48.80
	Sex ratio (No. of females per 1000 males)	953	-
3	**Total Population (Sector Wise)**	**83,707**	**100**
	Rural	83,707	100
	Urban	0	0
4	**Total No. of Households**	**21,807**	**-**
	Average House hold size	3.84	-
	Lowest Household size (Village: Mallaram)	3.51	-
	Highest Household size (Village: Vangara)	4.10	-
5	**Total SC & ST Population**	**23346**	**27.89**
	Total Population (SC)	18240	21.79
	Total Population (ST)	5106	6.10
6	**Total Literates – Gender wise**	**47257**	**61.57**
	Male Literacy (with respect to the male population)	27192	71.31
	Female Literacy (with respect to the female population)	20065	51.96
	Literacy gap between male and female	-	19.35
7	**Total Workers & Work Participation Rate**	**43256**	**51.68**
	Male (Number and % with respect to the male population)	22940	55.02
	Female (Number and % with respect to the female population)	20316	48.36
	Gender gap in workforce (in percentage)	-	6.66
8	**Total Main Workers & percentage to total worker**	**36812**	**85.10**
	Male (Number and % with respect to the male working population)	20488	89.31

S. No.	Description	Number	% to total
	Female (Number and % with respect to the female working population)	16324	80.35
a)	Main Worker as Cultivator (Number and Percentage)	11478	31.18
b)	Main Worker as Agricultural Labour (Number and Percentage)	19096	51.87
c)	Main Worker as Household Industry Worker (Number and Percentage)	710	1.93
d)	Main Worker as Other workers (Number and Percentage)	5528	15.02
9	**Total Marginal Workers & percentage to total worker**	**6444**	**14.90**
	Male (Number and % with respect to the male working population)	2452	10.69
	Female (Number and % with respect to the female working population)	3992	19.65
a)	Marginal Worker as Cultivator (Number and Percentage)	317	4.92
b)	Marginal Worker as Agricultural Labour (Number and Percentage)	5163	80.12
c)	Marginal Worker as Household Industry Worker (Number and Percentage)	96	1.49
d)	Marginal Worker as Other workers (Number and Percentage)	868	13.47
10	**Number and Percentage of Marginal Worker (3-6 Months)**	**6063**	**94.09**
11	**Number and Percentage of Marginal Worker (0-3 Months)**	**381**	**5.91**

Source: Census of India, 2011

4.9.5 Demographic Composition

4.9.5.1 Population

As per Census of India 2011, the total population of the study area is **83707** in which 49.81% are males and 50.19% are females. An average gender ratio of the study area is approximately 1008 females per 1000 males, which indicate that there are a balanced composition of male and female population. The study area comes under rural settlement. Approx. 8.31% of the total population belongs to 0-6 age group. The sex ratio of this age group is 953 female children per 1000 male children, which is lower than the average sex ratio of the study area. The break-up of population data for the study area zone-wise is given in **Table** below.

4.9.5.2 Households and Household Size

The entire population of the study area has been grouped into 21807 households and the average size of household is approximately 4 persons/ household. During site visit it was observed and noted that most of the houses of the study area are made of bricks and of semi-pacca type with *khaprail* tiles roof.

Table 4-25: Zone-wise Break up of Population in Study Area

S. No.	Core/ Buffer Zone	House-holds	Household Size	Population				Population (06 years)			
				Total	M	F	Gender Ratio	Total	M	F	Gender Ratio
1	Core (Vangara)	1484	4.10	6081	2973	3108	1045	538	265	273	1030
2	Buffer	20323	3.82	77626	38722	38904	1005	6417	3296	3121	947
Total		21807	3.84	83707	41695	42012	1008	6955	3561	3394	953

Source: Census of India, 2011

Gender Ratio of the study area with district, state and national average is compared and is shown in Figure 4.15.

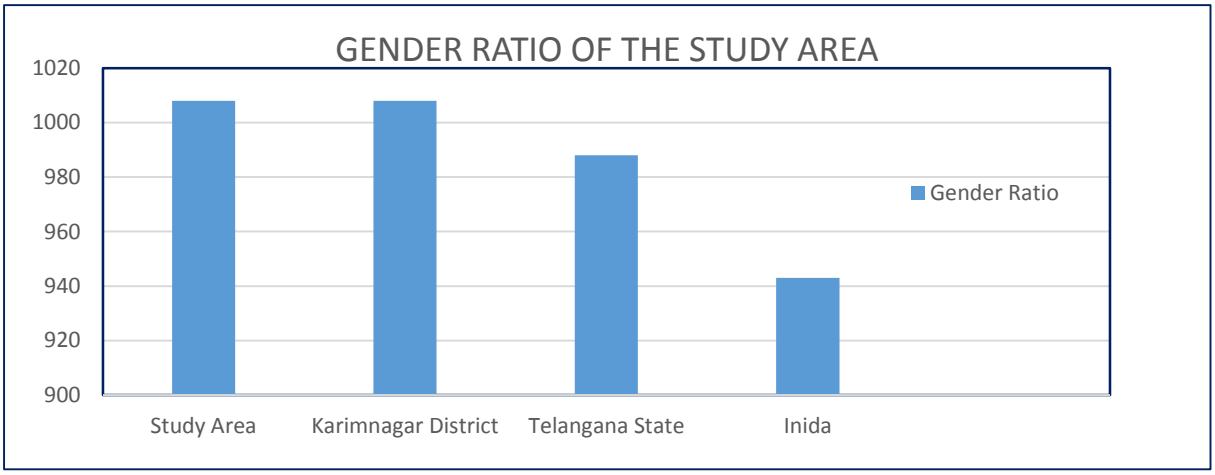


Figure 4-15: Gender ratio in the study area in reference to District, State and Nation

4.9.5.3 Social Stratification

With reference to the **Table** below, approx. 28.11% of the total population of the study area belongs to Schedule Castes (SC) and Schedule Tribes (ST), rest are general and other backward castes. The population of Scheduled Castes in core zone (Vangara village) is 19.09% while Schedule Tribes is 6%. In buffer zone the population of SC is 22% while ST is 6.11%.

The break up distribution of scheduled caste and scheduled tribe population in the project area is shown in **Table** below.

Table 4-26: Zone-wise Distribution of SC and ST Population in Study Area

S. No.	Village	Schedule Caste Population				Schedule Tribe Population			
		Total	M	F	Percentage	Total	M	F	Percentage
Core Zone									
1.	Vangara	1161	588	573	19.09	365	202	163	06
Sub-Total		**5240**	**2767**	**2473**	**30.06**	**0**	**0**	**0**	**0**
Buffer Zone									
2	Sub-Total	33958	17848	16110	33.80	0	0	0	0
Total		**39198**	**20615**	**18583**	**33.24**	**0**	**0**	**0**	**0**

Source: Census of India, 2011

4.9.5.4 Literacy and Literacy Rate

The average literacy rate of the study area is 61.57% (47257) in which male's literacy is 71.31% with respect to the male population as against 51.96**%** for females with respect to the female population, creating a gender gap of 19.35%. The average literacy rate of core zone is 61.27% while it is 61.59% in buffer zone of the study area. The break up distribution of literate population in the project area is shown in Table below.

Table 4-27: Zone-wise Distribution of Literacy in the Study area

S. No.	Zone	Number of Literates			Literacy Rate			
		Total	M	F	Total	M	F	Gender Gap
1	Core	3396	1886	1510	61.27	69.65	53.26	16.38
2	Buffer	43861	25306	18555	61.59	71.43	51.85	19.58
Total		**47257**	**27192**	**20065**	**61.57**	**71.31**	**51.96**	**19.35**

Source: Census of India, 2011

The literacy rate of the project area has been compared with the literacy rate of district, state and national level which shows that literacy rate of the study area is below than the literacy rate of the district, state and national level. Details of comparison are given in Figure 4.16 below.

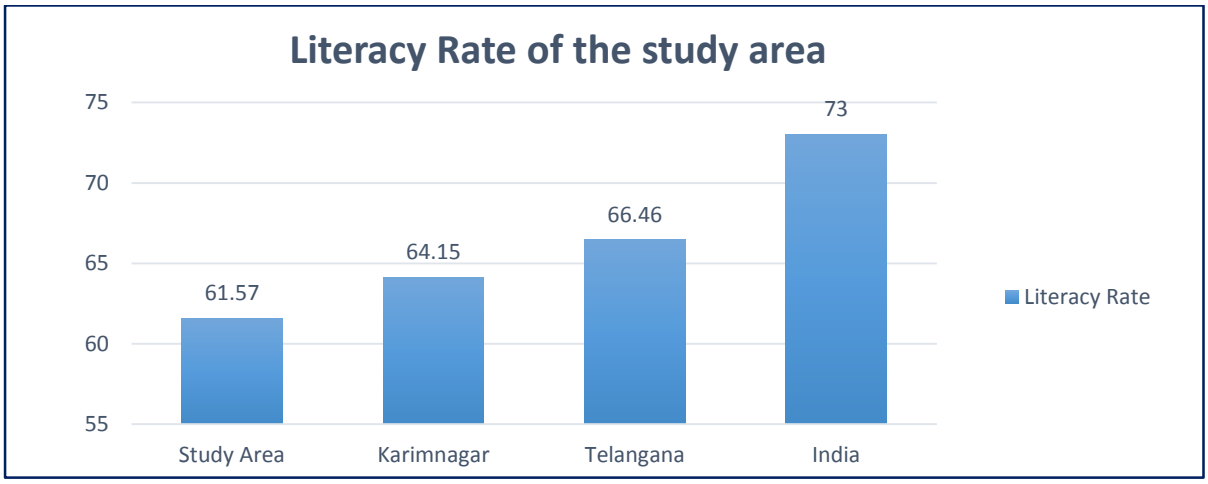


Figure 4-16: Literacy Rate in the study area when compared with district, state and national level

4.9.5.5 Workers and Work Participation Rate

The total number of workers in the study area is 43,256 and the WPR is 51.68% in which males are 55.02% with respect to the male population and females are 48.36% with respect to female population. Among the total workers 85.10% are main workers and the remaining 14.90% are marginal workers.

4.9.5.6 Categorization of Main Workers on the basis of Occupation

Following tables reflects that 51.87% of main worker are involved in agricultural labourers followed by cultivator with 31.18%, other workers with 15.02% and only 1.93% workers are involved in household industry. In core zone of the study area most of the workers are involved in agricultural labourers and cultivation.

Table 4-28: Categorization of Main Workers on the basis of Occupation

S. No.	Zone	Types of Main Workers							
		Cultivators		Agricultural Labours		Household Industrial Workers		Other Workers	
		Nos.	%	Nos.	%	Nos.	%	Nos.	%
1	Core	771	38.00	925	45.59	33	1.63	300	14.79
2	Buffer	10707	30.78	18171	52.24	677	1.95	5228	15.03
Total		**11478**	**31.18**	**19096**	**51.87**	**710**	**1.93**	**5528**	**15.02**

Source: Census of India, 2011

4.9.5.7 Categorization of Marginal Workers on the basis of Occupation

Following tables reflects that most of the marginal workers are involved in agricultural labourers (80.12%) followed by other workers (13.47%) and cultivators (4.92%).

Table 4-29: Categorization of Marginal Workers on the basis of Occupation

S. No.	Zone	Types of Marginal Workers							
		Cultivators		Agricultural Labours		Household Industrial Workers		Other Workers	
		Nos.	%	Nos.	%	Nos.	%	Nos.	%
1.	Core	38	4.94	664	86.35	9	1.17	58	7.54
2.	Buffer	279	4.92	4499	79.28	87	1.53	810	14.27
Total		**317**	**4.92**	**5163**	**80.12**	**96**	**1.49**	**868**	**13.47**

Source: Census of India, 2011

Considering the work culture of the study area, it appears that most of the workers in core zone (Vangara village) as well as in buffer zone villages are involved in agricultural labourers.

4.9.5.8 Culture and Religion

The field survey has revealed that majority of the persons living in the villages are Hindus with approximately 10% of population in the study area are Muslim. Most part of the study area has been occupied by Hindus and they play a vital role in making cultural and religious activities. Out of total population in the study area, approximately 72% population are general and Backward Caste category, 28% are SC and ST. *Reddy, Rao, Vaishya, Chaudhari, Lingabaleja* etc. are comes under general category (O.C.); *Kurma, Valamiki, Boya, Pinjari, Dudekula, Yadaya, Kurva, Kumbari, Golla, Dukula, Chakali, Mangala, Wadde, Uppare* etc. comes under Backward Caste (B.C.); *Madiga, Mala, Harizana, Dasari* etc. comes under Schedule Caste (SC) and N*ayak* are come under Scheduled Tribes of social group. Men of the study area generally wear Lungi and kamiz/shirt, pant and shirt and women wear saries and suits.

Yugadi, Dashahara, Deepawali, Sankranti, Vinayak Festival, Muharram, Eid ul Fiter, Chrismasday are the main festivals celebrated by the people of the study area. They worship Lord Shiva, Anjaney Swami, Rama, Durga and Shiva.

4.9.5.9 Economy and Occupation

The main occupation of the study area is agriculture and more than 75% people depend on agriculture or as agricultural labourers. Main crops grown in the region are cotton, ground nut, onion, makka, Jwar etc. which depends on rain water. During consultation, it was revealed by villagers that few persons of the Vangara village adopted cattle rearing as other source of income. Average land holding size of the study area is 3 to 30 acre per family. But few families (approximately 5 to 8 families) have more than 250 acres of land. In Vangara village most of the people depend on agriculture and their average income is INR 4000 to INR 20000 per month. On the same time few families (approximately 5%) depends on business and job and their average monthly income are INR 1,00,000 to 10,00,000.

4.9.5.10 Infrastructure Facilities

Roads: The site of the proposed solar power project is located near Mulkanoor-Husnabad road which are further well connected with SH-7 (Warangal-Karimnagar) Road. Village road of the study area are also well connected with main road and are in good conditions.

Education: Considering the educational facilities of the study area, Govt. Primary School and *Anganwadi* Center are available in most of the villages of the study area. Vangara village, being the native village of former Prime Minister P.V. Narasimha Rao is enriched with government schools such as 3 numbers of Anganwadi center, 3 numbers of Government Primary School, Government Secondary School and Govt. Girls Residential School. Govt. Senior Secondary School and Degree colleges are available in Mulkanoor, 5 km SE from the village Vangara.

In addition, government facilitate in Govt. Primary and Upper Primary School with scholarship, mid-day meal, free text-book and uniform to every student to encourage the students and improve the educational quality of the region. In spite of all these efforts the literacy rate (as per Census of India, 2011) of the study area is 61.57% in which males are 71.31% and females are 51.96% with 19.35% of gender gap.

Health: Vangara is endowed with 30 bedded Government Primary Health Center with all basic infrastructure facility. Govt. Veterinary Hospital is also available in the village. There are no any chronic or epidemic disease has been reported in the study area except general cases of fever and cough.

Drinking Water Facility: Hand-pumps, bore-well and tap water are the main source of water for drinking and other domestic use in the study area. In Vangara, water for drinking and domestic use are supplied through pipe line with the help of village Panchyat.

Communication: The study area is well connected via mobile, telephone and internet. Government post office is available in Vangara Mulkanoor and Husnabad villages. Means of communications such as internet, telephone and television has made a vital role in changing the conservative thoughts of the people of the study area and brought awareness for development in both men and women.

Electricity Facility: The study area is good in terms of electricity supply. Generally, 20 hours' electricity is available in Vangara and most of the villages of the study area. Proposed 30 MW Solar power project may reduce demand-supply gap of the state. Thus in future, power cut will be reduced and people

may utilize power in establishing household industry as well as in irrigation etc. Thus proposed project will improve socio-economic status of the study area.

4.9.6 Social Impact Assessment

4.9.6.1 Impact on Land

Approximately 201 acres of private land has been procured for proposed 30 MW Solar Power Project from village Vangara, Mandal Bheemadevarpalle, District Karimnagar under 'The Telangana Solar Power Policy 2015'. The Land identified for the proposed project site is primarily undulating and mix of single cropped agricultural and uncultivated land. The crops grown here, depends on rain water. It does not involve any physical / economical displacement.

4.9.6.2 Rehabilitation and Resettlement

The land purchased for the proposed project is under one to one negotiation basis. The land price was decided after considering mutual negotiation and best of the market value with respect to circle rate, defined by government of Telangana. Based on discussions with village serpent, village administrative officer and land seller during site visit, it was recorded that the land sold to M/S. ReNew Saur Shakti Private Limited (RSSPL) by the land sellers are open land and mix of un-cultivated and single cropped, rain-fed agricultural land. It does not involve any physical/economical displacement.

Hence, this project does not involve any resettlement in terms of physical and economical aspects therefore, it does not attract Resettlement Plan as per applicable national / state legislation.

4.9.6.3 Impact on Indigenous People

In land procurement process of RSSPL, there is no any SC or ST land involved. Therefore, there is no any negative impact on indigenous people.

4.9.6.4 Community Development Activity

ReNew India Initiative is focussed on empowering communities by educating and giving them means of livelihood in alignment with ReNew's Vision and Mission. As per its CSR Policy, RSSPL will propose community developmental programme on need based and with consultation to stakeholders.

4.9.7 Conclusion

On the basis of interpretation made above, primary survey (interaction with stakeholders, FGD, community consultation and discussion with influential person of the study area) and secondary sources, the major outcomes specify the following observations and gap in the study area:

- Average literacy rate of the study area is approximately 61.57% whether as male literacy is 71.31% and female literacy rate is 51.96% with 19.35% of gender gap. The literacy rate of the study area is below than the literacy rate of the district, the State and National level;
- Work Participation Rate of the study area is 51.68% in which males are 55.02% and females are 48.36%. There are 6.66% of gender gap between male and female in WPR;
- Livelihood of the most of the people of the study area depends on agriculture, cultivation and cattle rearing;
- Women are generally depending on their male counterparts;
- Hand-pumps, bore-well and tap water are the main source of drinking water in the study area;

- Vangara village is well endowed with educational and medical infrastructure; and
- There are no any chronic or epidemic disease has been reported in the study area except general cases of cough and fever.

5 ANTICIPATED ENVIRONMENT IMPACTS AND MITIGATION MEASURES

5.1 INTRODUCTION

The proposed project may have impact on the environment during construction and operation phases. This chapter describes the various environmental and social impacts identified and assessed for the construction and operation phases of the proposed Project. The identification of impacts has been done based on the review of available project information, discussions with the local community and representatives of the project proponents and other sector specific professionals.

During the construction phase, the impacts may be regarded as temporary or short-term; while long term impacts may be observed during the operation stage. The impact during operation phase are very limited and associated with transmission of electricity, washing of PV Modules, local transportation activities only. Spatially the impacts have been assessed over the study area of 10 km radius of the project site. The project has overall positive impacts by providing a competitive, cost-effective, pollution free reliable mode of power. It will certainly meet the ever increasing demand of power and to bridge the gap between demand and supply of power.

5.2 IMPACT APPRAISAL CRITERIA

The Criterion which has been employed to appraise impacts on various social and environmental components is as presented as **Table** below.

Table 5-1: Impact Appraisal Criteria

Criteria	Sub-Classification	Defining Limit	Remarks
Spread: refers to area of direct influence from the impact of a particular project activity.	Insignificant / Local spread	Impact is restricted within the foot prints of the Project boundary. For transmission line it will be within the right of way.	Except for ecology (which is defined as loss of vegetation only at site) or within the base of tower area
	Medium Spread	Impact is spread from up to 2 km from the boundary of the Project. Within 500m on either side of transmission line	Except for ecology (which is defined as loss of vegetation at site including large trees with limited disturbance to adjoining flora & fauna)
	High Spread	Impact is spread up to 2 km to 5 km from footprint boundary of the Project Beyond 500m on either side of transmission line	Except for ecology (which is defined as loss of vegetation at site and / or damage to adjoining flora and fauna).

Criteria	Sub-Classification	Defining Limit	Remarks
Duration: based on duration of impact and the time taken by an environmental component to recover back to current state	Insignificant / Short Duration	When impact is likely to be restricted for duration of less than 1 year;	The anticipated recovery of the effected environmental component within 2 years
	Medium Duration	When impact extends up to 3 years	With an anticipated recovery of the effected environmental component within 6 years
	Long Duration	When impact extends beyond 3 years	With anticipated recovery of prevailing condition to happen within 6 years or beyond or upon completion of the project life
Intensity: defines the magnitude of Impact	Insignificant intensity	When resulting in changes in the environmental baseline conditions is up to 10%	However, it shall be reconsidered where the baseline values are already high.
	Low intensity	When resulting in changes in the baseline conditions up to 20%	For ecology it refers to minimal changes in the existing ecology in terms of their reproductive capacity, survival or habitat change
	Moderate intensity	When resulting in changes in the baseline conditions for up to 30%	For ecology, it refers to changes that are expected to be recoverable
	High intensity	When change resulting in the baseline conditions beyond 30%	While for ecology, high intensity refers to changes that result in serious destruction to species destruction to species, productivity or their habitat

Criteria	Sub-Classification	Defining Limit	Remarks
Nature: refers to whether the effect is considered beneficial or adverse	Beneficial		Useful to Environment and Community
	Adverse		Harmful to Environment and Community

A significance assessment matrix was developed to assess the impacts based on the appraisal criteria developed above, which is as given in Table below.

Table 5-2: Impact Significance Criteria

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

The Impacts for the proposed project are covered under the following subsections:

- Construction Phase
- Operational phase
- Decommissioning Phase

5.3 IMPACTS DURING CONSTRUCTION PHASE

The construction activity will comprise of following activities which will impact the environment and social aspects, as described in sections below:

- Site Preparation
- Labour Engagement
- Material Handling and Storage
- Concrete work, Erection and Installation Activities
- Construction Demobilization

Based on activities involved, an impact interaction matrix for construction phase was prepared for the project. The impact identification matrix is presented in Table below

Table 5-3: Impact Identification Matrix for Construction Phase

S. No.	Main Activities	Environmental and Social Components									
		Land	Ecology	Water Resources	Ambient Air Quality	Soil Resources	Ambient Noise Quality	Water Quality	Traffic/ Transport	Social/ Livelihood	Occupational Health and Safety
1	**Site Preparation**										
a	Procurement of Land										
b	Site Clearing Grading										
c	Vegetation clearance										
2	**Labour Engagement**										
a	Employment of workers										
b	Water requirement										
c	Power requirement										
d	Waste handling and disposal										
e	Sewage disposal										
3	**Material Handling and Storage**										

S. No.	Main Activities	Environmental and Social Components									
		Land	Ecology	Water Resources	Ambient Air Quality	Soil Resources	Ambient Noise Quality	Water Quality	Traffic/ Transport	Social/ Livelihood	Occupational Health and Safety
a	Transportation and Unloading of construction material										
b	Transportation of plant components										
c	Storage and Handling of plant components										
d	Storage and Handling of construction material, hazardous materials, etc.										
4	**Construction activities**										
a	Preparation/Mixing of construction material										
b	Supply of water, power, sanitation etc.										
c	Operation of construction machinery, foundation, access road, offices etc.										
d	Handling and Disposal of construction wastes										
e	Construction of new access roads and widening of existing roads										
5	**De-mobilisation of Construction Equipment**										
a	Dismantling of temporary support construction structures / equipment's										

S. No.	Main Activities	Environmental and Social Components									
		Land	Ecology	Water Resources	Ambient Air Quality	Soil Resources	Ambient Noise Quality	Water Quality	Traffic/ Transport	Social/ Livelihood	Occupational Health and Safety
b	Removal of construction machinery										
c	Transportation of Construction / Dismantled wastes										

Impacts associated with construction are discussed and mitigation measures are also suggested for different segment of environment in sections below.

5.3.1 Land Resource

5.3.1.1 Impacts

Project involves acquisition of about 201 acres of agriculture and scrub land. Land use of the project site will get changed from agriculture to industrial land. This will boost price and economy of the region. ROW shall be required for the transmission line. However, no significant impact on land use is expected as land shall only be required for erection of towers.

The proposed plant site is about 1.2 km from the Siddipet-Husnabad Road. Thereafter site is connected by a village kutcha road. This kutcha road will further be developed by RSSPL to use this as all-weather road with the help of Murram. A village Kutcha road is passing through the northern part of the project site, is likely to be affected by the proposed development.

5.3.1.2 Mitigation Measures

The width of the access road is sufficient enough to transport the project materials. Hence, there is no need to widened the existing road.

Alternative route along the periphery of the plant boundary will be provided for the Kutcha Road passing across the plant boundary near to northern corner.

Site suitability and selection criteria were followed while selecting the site. Efforts should be made to contained the construction activities within the project site, so that, no alteration of nearby land use is expected due to the project.

5.3.1.3 Impact Significance

Impact on land use is moderate, however, it may get reduce to minor level with proper mitigation measures. The impact significance for Land use is tabulated below.

Table 5-4: Impact Significance on Land Use

Aspect	Scenario	Spread	Duration	Intensity	Overall
Land Resource	Without Mitigation	Local	Long	Medium	Minor
	With Mitigation	Local	Long	Low	Minor

5.3.2 Impact on Soil Quality

5.3.2.1 Impacts

Site clearing and leveling activities for installation for PV Module and Other facilities involve excavation and compaction of the soil. The waste handling area and transportation of hazardous material may have an impact on the soil quality. Also the movement of vehicle and construction machineries will further lead to the compaction of soil. The excavated soil may risk for the Wind and Water induced soil erosion if didn't covered or compacted. The refilling of the excavated soil may alter the original layer of the soil formation.

The project site is agriculture land with some patches of scrub land. Clearing activities will boost the soil erosion activities. The storage and use of hazardous material like Paints for PV Module structure, Oil for vehicles and machineries, used oil from dg set or construction machineries can contaminate the nearby soil if doesn't handled safely.

5.3.2.2 Mitigation Measures

The project will utilize tracker system for PV installation, which in turn require minimum leveling activities. Also effort should be made to keep the topography untouched. This will reduce the potential for compaction and disturbance to soil layers due to backfilling at site. Considering scale of construction activities limited heavy machineries will be utilized at site and for a shorter duration, which will further diminish the potential for compaction. Movement of trucks and other vehicles should be maintained along dedicated paths to avoid disturbance to land and soil.

Regular water sprinkling should be carried out to settle down the excavated soil and protect from wind and water erosion. All construction and hazardous material having potential to contaminate the site should be stored in separate designated areas. During painting of structures for panels and switchyard, it should be ensured that the land beneath is covered with a sheet of impervious material in order to prevent contamination of soil.

5.3.2.3 Impact Significance

The impact on soil quality will be limited for shorter duration and contend within the project site. However, the mitigation measures may further reduce the impact upto insignificant level. The Impact significance as assessed for the project is tabulated below.

Table 5-5: Impact Significance for Soil Quality

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

Aspect	Scenario	Spread	Duration	Intensity	Overall
Soil Degradation due to construction activities	With Mitigation	Local	Short	Low	Insignificant

5.3.3 Impact due to Waste Handling

5.3.3.1 Impacts

Site clearance, excavation, labour camp and installation of PV modules and associated facilities will produce different categories of waste. The construction demobilisation which will entail removal of machinery, workers, campsite and other temporary structures will also result in generation of waste. The major waste generating areas are as follows.

- Construction Debris
- Domestic solid waste from labour camp
- Packaging material of the plant parts
- Waste oil from generator and other construction machinery
- Metal scraps, Paint containers, etc.

The debris generated due to construction activities may spread out in nearby areas with wind and run-off during rainy season. This may lead to the soil and water contamination.

Improper disposal of solid waste from the labour camps at site and lack of proper sanitation facility for labour can lead to unhygienic conditions and spread of diseases in the area. It can lead to discontent of local community and result in conflicts with the labour engaged at site.

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

5.3.3.2 Mitigation Measures

Construction debris may be utilised for levelling of the land and unused debris should be disposed-off to nearest TSDF / waste disposal site. Excess topsoil shall be given to nearby farmers for use in their fields. Efforts should be made to use the locally available labour for unskilled work purpose. Considering the plant capacity and labour requirement, quantity of waste generation will be small and limited. Proper sanitation and sewage facility in terms of septic tank with soak pit should be provided. Nearby municipality may also be contacted for regular disposal of the labour camp waste.

Hazardous waste like paint empty tin, used oils should be stored in separate designated space and should be given to CPCB / SPCB approved recyclers only. Metals scrap should also be given to the approved recyclers. ReNew is in discussion with one Chennai based vendor for recycling of the defunct Solar Panel and accessories.

5.3.3.3 Impact Significance

The overall impact due to solid waste are minor and can further be reduced to insignificant level after implementation of proper mitigation measure.

Table 5-6: Impact Significance due to Solid Waste Disposal

Aspect	Scenario	Spread	Duration	Intensity	Overall
Waste Disposal	Without Mitigation	Local	Short	Moderate	Minor
	With Mitigation	Local	Short	Low	Insignificant

5.3.4 Impact on Water Quality and Resources

The water for the construction works shall be sourced from authorised tankers. No usage of groundwater is proposed for the construction phase of the Project.

The construction at site can alter the natural drainage pattern of the area at a micro level. Also the levelling activities will hamper the run-off flow of the area as site is surrounded by Muntaneous structures in two sides. There is potential of contamination of pond's water (located adjacent to the project site) due to sediment run-off from construction activities. Improper disposal of sewage and wastewater from labour camps and construction debris can contaminate the ground water resources in the area.

5.3.4.1 Mitigation Measures

Water for the labour camp will be sourced from bore-well or nearby villages, whereas, construction water requirement shall be met through authorized water tankers. Drinking water in the labour camps will be supplied through packaged water cans. Septic tank with soak pit should be provided so that no contamination due to discharge of sewage may take place.

The natural slope of the site should be maintained to the extent possible in order to avoid any change in the drainage pattern. Path of Two Nallahs as passing through the site should be maintained as per present scenario. Adequate arrangement for storm water management during construction period should be made to avoid sediment runoff from the site. During construction it should be ensured that no run-off from construction area merges with these nallahs. Storm water flow should be directed to the existing channels with silt traps to avoid sedimentation of the channels or the receiving water body.

5.3.4.2 Significance of Impact

Overall the impact on water resources will be moderate without mitigation, whereas, it can be minor with implementation of mitigation measures.

Table 5-7: Impact Significance for Water Resources

Aspect	Scenario	Spread	Duration	Intensity	Overall
Water Resources	Without Mitigation	Medium	Short	Moderate	Moderate
	With Mitigation	Local	Short	Moderate	Minor

5.3.5 Impact on Ecological Impact

5.3.5.1 Impacts

Removal of vegetation may result in loss of habitat for small mammals and birds. However, the ecological survey carried out at site established that the site is primarily agriculture land with patches of scrub land without any significant ground vegetation. The project may however involve removal of few shrubs and trees. Distance of nearest forest area is about 2.1 km from the project site. No significant impact on these forest patches is expected due to noise from the construction activities. Considering duration and size of construction activities impact on ecological environment is assessed to be minor.

5.3.5.2 Mitigation Measures

The site is primarily agriculture land and devoid of any dense natural vegetation. Therefore, the loss of vegetation at site is considered to be limited. Efforts should also be made to retain some of the trees and shrubs patches as presented at site. No labour should be allowed to clearing of nearby vegetation for fuel purpose. Hunting and Poaching should be a non-forgiving activity. The noise generating activities sould be schedule during day time only. Movement of construction and transport vehicles should be restricted to dedicated paths to minimise any harm to small mammals near to proposed site.

5.3.5.3 Impact Significance

The overall impact on ecological aspect during construction shall be moderate in nature and can further be reduced to minor level after putting all mitigation measures in place.

Table 5-8: Impact Significance on Ecological Aspects

Aspect	Scenario	Spread	Duration	Intensity	Overall
Ecology	Without Mitigation	Medium	Short	Moderate	Moderate
	With Mitigation	Local	Short	Moderate	Minor

5.3.6 Impact due Traffic and Transport

5.3.6.1 Impacts

The construction activities will require transportation of construction material PV modules and mounting structures components to the site. The additional traffic movement on the road due to project will increase accident related injuries in locals. Such impacts arise almost entirely during the construction period. Break down of vehicles and unplanned halt along the road can lead to traffic blockade and discomfort to community. Transportation of construction material in open trucks / tippers can also lead to dust generation along the route. Excess traffic on the road will create discomfort for locals due to increment in noise level and fugitive dust and gaseous pollution expected to exhaust from the vehicles.

5.3.6.2 Mitigation Measures

The increase in traffic due to the project is however going to be marginal. The traffic density on the Siddipet-Husnabad Road is low and has adequate carrying capacity to accommodate the additional traffic due to the construction activities.

The traffic movement should be away from most of the settlement reaches. Movement of the project traffic should be limited for planned route only. The vehicles should be mandated to maintain a speed limit in the area to avoid accidents to people and livestock. The traffic movement in settlement areas should be limited for day time only. Only PUC certified vehicle should be deployed for the project to keep the air pollution under check. Tool Box training should be arranged for the driver to create awareness about road safety.

5.3.6.3 Impact Significance

Without mitigation measures, the impact shall be moderate overall. However, mitigation measures should be implemented to keep it on minor level.

Table 5-9: Impact Significance due to Traffic and Transport

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact due to traffic	Without Mitigation	Medium	Short	Moderate	Moderate
	With Mitigation	Medium	Short	Low	Minor

5.3.7 Impact on Ambient Air Quality

5.3.7.1 Impacts

Construction activities shall lead to fugitive dust pollution from excavation, leveling, mixing of materials, transportation of the construction material, etc. Also the gaseous pollution is likely from Vehicular Exhaust, Machineries Engines, DG Set Operation (In operation), etc. Increment in the number of vehicles shall also boost up the fugitive dust emission from road side bared soil.

5.3.7.2 Mitigation Measures

The scale of construction being small, will require only a limited number of construction machinery and for limited duration, therefore emissions from heavy machinery are considered to be insignificant. Open burning of solid waste or packaging material should be strictly prohibited.

Regular water sprinkling should be a regular practice to reduce fugitive dust emission from construction activities in identified dust prone areas. All machineries should be properly maintained and complying pollution standards. Only PUC certified vehicle should be deployed for the construction purpose. The construction material should be transported in covered trucks and tipplers.

5.3.7.3 Impact Significance

Considering the size of the project, impact intensity on air quality part is minor and can further be reduce to insignificant level by implementation of above discussed mitigation measures.

Table 5-10: Impact Significance on Air Quality

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

5.3.8 Impact on Noise Level

5.3.8.1 Impacts

Noise and vibration will be caused by the operation of earth moving and excavation equipment, concrete mixers and transportation of equipment, materials and people. Movement of traffic during night hours can also disturb the local community. About 90 dB(A) of noise will be generated from construction activity which will attenuate to less than 45dB(A) i.e. night time prescribed noise level at about 100m. The nearest habitation is located at a distance of over 800m, whereas the distance of nearest notified forest area is 2.0km. Therefore, the impact due to the noise will not be significant.

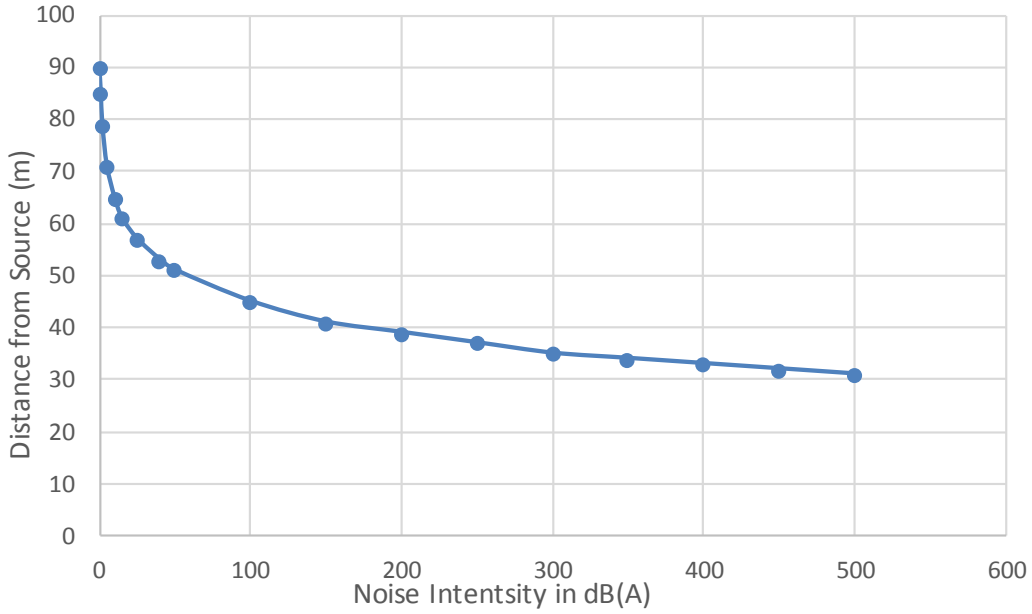


Figure 5-1: Noise Intensity in respect to Distance from Noise Source

5.3.8.2 Mitigation Measures

Considering the capacity and nature of the project, the use of construction machineries will be very limited. Most of noise generating activities like excavation, use of heavy earth moving machineries, etc. shall be limited for the construction phase.

Only limited construction activities should be carried out during night-time. Temporary noise barriers should be provided surrounding the high noise generating construction equipment. The personnel involved in high noise generating activities should be provided with personal protective devices to minimize their exposure to high noise levels. Construction vehicles and machinery should be well maintained and confirming the CPCB noise standards.

5.3.8.3 Impact Significance

The impact due to construction activities on noise level shall be very minor as no sensitive receptor is located within 500m from the construction site. Significance of impact on noise level with and without mitigation is presented in table below.

Table 5-11: Impact Significance on Noise Level

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact on Nosie Level	Without Mitigation	Local	Short	Moderate	Minor
	With Mitigation	Local	Short	Low	Insignificant

5.3.9 Health and Safety Hazards

5.3.9.1 Impacts

Loading and unloading operation of the construction material may cause an injury if not handled properly. During construction works, physical injury can result due to road accidents, construction accidents and other occupational hazards. Overexertion injuries and illness are potentially the most common health hazards associated with construction activities. Further there is potential for slips and fall on the same elevation associated with poor housekeeping, such as excessive waste debris, loose construction material, liquid spills and uncontrolled use of electrical cords and ropes on ground, which results in injuries and time loss during construction.

Hazards associated with fall of construction material or tools, as well as collapse of constructed slabs, walls and roofs can result in injury to head, eyes and extremities. Transportation and movement of vehicles are associated with road accidents and related hazards, which can lead to injuries and fatalities.

5.3.9.2 Mitigation Measures

Operation of loading–unloading equipment should be undertaken under the guidance / supervision of trained professional. The contractor should ensure that no person is engaged in driving or operating construction machineries unless he / she is sufficiently competent and reliable, possess the knowledge of risks involved in the operation and is medically examined periodically.

As per Section 23 of the Factories Act, 1948, as amended, young persons (below 18 years of age) must not be allowed to work at any dangerous machine unless they have been fully instructed about the dangers arising pertaining to the machine and the precautions to be observed, and have received sufficient training in work at the machine, or are under adequate supervision by a person who has a thorough knowledge and experience of the machine.

ReNew Power has formulated a site Emergency Preparedness and Response Procedure, which should be followed for the subjected project. The On-Site emergency procedure provide details of the anticipated emergencies, the emergency organisation, facilities, emergency procedures and roles and responsibilities. Adequate training should be provided to staff about raising awareness about use of Personal Protection Equipment (PPE) and emergency response measures. Job responsibility and shifting chart should be prepared so that no person shall be over exhausted, which will ultimately lead to the accident or injuries. Safety sign should also be marked at appropriate places. ReNew Power's Standard Emergency Response and Preparedness Plan is given as **Annexure II**.

Excessive waste debris and liquid spills should be cleaned up regularly, while electrical cords and ropes should be placed along identified corridors marked for attention of everyone at site. Use of personal

fall arrest system, such as full body harnesses as well as fall rescue procedures to deal with workers whose fall has been successfully arrested should also been carried out.

Good housekeeping should be ensured at the construction site to avoid slips and falls. PPEs such as safety glasses with side shields, face shields, hard hats and safety shoes should be mandatory at construction site. Ear plugs should be provided for workers placed at high noise areas.

5.3.9.3 Impact Significance

The project will have moderate impact on Health and Safety aspect during construction phase. However, this can be reduced to the insignificant level by successful implementation of mitigation measures.

Table 5-12: Impact Significance on Health and Safety Aspect

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact on Health and Safety Aspect	Without Mitigation	Local	Short	High	Moderate
	With Mitigation	Local	Short	Low	Insignificant

5.3.10 Impact on Social Aspect

The impacts on social aspect are discussed under following sections.

5.3.10.1 Impact due to Land Acquisition and Mitigation Measures

Impacts in this stage are mostly related to social aspects. Land for the project is being taken procured / acquired on one to one negotiation basis. The compensation is being paid on mutual agreed price. During the consultation with affected khata holders and Revenue Dept. officials it was concluded that compensation paid to affected khata holders is more than the circle rate.

Grievance Redressed Mechanism as developed by ReNew Power shall be followed for this project too and communicated to community to express their concerns associated with the project.

5.3.10.2 Access Issue and Job Opportunities

A village Kutcha road is passing through the northern part of the project site, is likely to be affected by the proposed development. This road is being utilized by farmers for their agricultural activities. As communicated by ReNew's officials, Alternative route along the periphery of the plant boundary will be provided to avoid any inconvenience to nearby farmers. The nearest settlement is at least 700m away from the proposed site. Therefore, no impact on this settlement is expected due to the project. Job opportunity for the locals shall be generated during construction phase.

5.3.10.3 Labour Related Issues and Mitigation Measures

In the construction phase, skilled workers might be engaged in the project to perform technical work and they might come from outside the area. The contractor should take care all the arrangements for the accommodation of these workers. The labour from the outside will be stayed in nearby rented properties. Considering the project size an influx of EPC Engineers Staff will not create any significant pressure on available resources.

The potential impacts that might arise in reference to labour related issues have been mentioned below.

- Once the construction activity for the project gets underway, there is a possibility that there will be an inflow of migrant workers. However, for unskilled work in the construction phase, the local population and its surrounding areas should be given first preference.
- The influx of migrant workers might put pressure on the existing resources like water supply, supply of fuel, provision of basic facilities, waste handling and sewage disposal of the project influenced population which might create frictions between them and the resident population of the area. However, chance of this scenario are rather low considering the project capacity and nature of work.
- With the inflow of migrant workers and their interaction with the local population, health issues among the local community might emerge. Health problems like STD's and HIV Aids might spread in the area because of this floating population. Regular medical camps can be conducted amongst the labours and the local population to make them aware about diseases like STD's and HIV Aids.

5.3.10.4 Impact of Cultural, Archaeological and Historical Place

No such place was found getting affected by the proposed development.

5.3.10.5 Impact Significance

Overall impact on the social aspect was found moderate in nature. However, efforts should be made to keep it on minor level through implementation of mitigation measures.

Table 5-13: Impact Significance on Social Aspect

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

5.4 OPERATION PHASE IMPACT

Being a Renewable energy project, the operation phase impacts of the project are very low. The major issues of concern during operation of plant are Tabulated below:

Table 5-14: Impact Identification Matrix for Operation Phase

S. No.	Main Activities	Environmental and Social Components							
		Land and Visual Aesthetic	Waste Generation	Ecology	Water Resources and Quality	Soil Resources	Social / Livelihood	Occupational Health and Safety	Air Quality
1	Power Generation Process								
2	Maintenance Activities								
3	Corporate Social Activities								

The impacts are discussed in detailed under headings below.

5.4.1 Land and Visual Aesthetics

5.4.1.1 Impacts

Considering that land will be used for industrial activity, this will result in generation of revenue. Therefore, change in land use is considered to be minor positive. No aesthetic degradation is expected due to proposed development.

5.4.1.2 Mitigation Measures

Efforts should be made to confined the industrial activities within the acquired area only.

5.4.1.3 Impact Significance

Overall minor impacts are expected due to proposed project.

Table 5-15: Impact Significance on Land use and Aesthetic Value

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact on Land Use and Aesthetic Value	Without Mitigation	Local	Long	Low	Minor
	With Mitigation	Local	Long	Low	Minor

5.4.2 Impact on Soil Quality

5.4.2.1 Impacts

Operation of solar photovoltaic panels for power generation will not have any direct impact on soil. However, the water as may use for washing activities may contaminate the soil if chemical is used for washing. The hazardous waste like used oil, hydraulic oils, etc. may contaminate the soil if not handled properly.

5.4.2.2 Mitigation

The water for cleaning purpose of solar PV modules to remove dust from it, is likely to get evaporate or absorbed by the vegetation and soil underneath the solar panels. Electro-mechanical system is being used in tracking devices, therefore, no hydraulic oil shall be required for the purpose. All hazardous waste should be stored in a separate designated paved space.

5.4.2.3 Impact Significance

Impact on soil quality is moderate in nature and can further be reduced to minor after implementation of Management Plan.

Table 5-16: Impact Significance on Soil Characteristics

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact on Soil Characteristics	Without Mitigation	Local	Long	Moderate	Moderate
	With Mitigation	Local	Long	Low	Minor

5.4.3 Waste Generation

5.4.3.1 Impacts

Industrial wastes likely to be generated during routine operations are dielectric fluids, cleaning agents, and solvents, etc. These wastes typically would be put in containers, characterized and labeled, possibly stored briefly, and transported by a licensed hauler to an appropriate permitted off-site disposal facility as a standard practice.

Once the plant is commissioned there will be limited waste generation, however repair and maintenance of underground cables and associated utilities will lead to generation of hazardous wastes such as used oils. The defunct / damaged photo voltaic cells will also be generated and storage/ disposal on unpaved ground can lead to contamination of soil.

5.4.3.2 Mitigation Measures

Separate designated area should be earmarked for storage of hazardous waste. These waste shall be given to the CPCB / SPCB approved recyclers. ReNew is in discussion with one Chennai based vendor for recycling of the defunct Solar Panel and accessories.

5.4.3.3 Impact Significance

The impact significance for the aspect considered to be minor and detailed out in Table below.

Table 5-17: Impact Significance due to Waste Generation

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact due to Waste Generation	Without Mitigation	Local	Long	Moderate	Moderate
	With Mitigation	Local	Long	Low	Minor

5.4.4 Impact on Water Resource and Quality

5.4.4.1 Impacts

For operation phase, the water requirement will be for domestic as well for cleaning of modules. The operation phase water requirement of the project shall be in tune of 0.12 m^3/MWh for module cleaning. Module cleaning needs to be carried out periodically (Per module 2 times in one month) to remove dust, bird droppings etc. The water requirements for the project will be met through groundwater. As per 'Ground Water Information Booklet Karimnagar District, Telangana- September 2013' prepared CGWB, entire district comes under safe category of Ground Water Development. The domestic & drinking water requirement for the plant officials shall be met through tankers or bore-well as per the requisite permission from regulatory authority. Run-off from the plant site may carry waste oil from plant area to the nearest drainage system. This may affect the water quality of the drainage passing through the site and ultimately pond located adjacent to the project site.

5.4.4.2 Mitigation Measures

Bore-wells should be established after requisite permission from regulatory authority. Meters should be installed at the bore-wells to monitor the abstraction of water. The plant site should be provided with adequate drainage facility to drain-off the rainy water and prevent any waterlogging at site or in

the surroundings. Wastage of water during cleaning of panels should be avoided. No careless attitude in handling of hazardous waste and oil should be tolerated during plant operation. If any oil spilled out accidentally, it should be cleaned and stored appropriately.

Awareness campaign should be driven under project CSR activities for use of effective irrigation practices, scheduling of crops, change the crop pattern, awareness creation for effective use of water etc. as suggested by CGWB in above referenced Booklet.

5.4.4.3 Impact Significance

Impact on water resources are moderate in nature and impact intensity can further be reduced with proper implementation of mitigation measures.

Table 5-18: Impact Significance on Water Resource and Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact on Water Resource and Quality	Without Mitigation	Local	Long	Medium	Moderate
	With Mitigation	Local	Long	Low	Minor

5.4.5 Ecological Impact

5.4.5.1 Impacts

Glare / Reflection from solar modules may distract the avian fauna flying over the solar panel area. The impact to flora from the operation will be limited to the routine clearance of vegetation near the solar plant to avoid shadows and hindrance to sunlight on solar panels. No other impacts are seen on local ecological system due to the operation of proposed project.

5.4.5.2 Mitigation

Solar panels will absorb most of light falling on them which will be then converted to electricity. Thus there will be very less impact due to glare from the panels. The glare is reported to be similar to that of a small water body, which implies insignificant distraction for the avifauna. Clearing of vegetation should be limited to removal of undergrowth or shrubs at the plant site. It should have no significant impact on the flora of the area.

5.4.5.3 Impact Significance

Impact due to operation of proposed solar found minor in overall aspect.

Table 5-19: Impact Significance on Ecology

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact on Ecology	Without Mitigation	Local	Long	Low	Minor
	With Mitigation	Local	Long	Low	Minor

5.4.6 Impact on Air Quality / Climate Change

The project is based on the power generation through Solar PV Technology. The Solar PV technology is environment friendly in terms of GHGs emission. Levels of carbon dioxide (CO2) and other

greenhouse gases (GHG) in the atmosphere have increased dramatically in the past few decades. Solar energy is a Renewable resource available with great potential to significantly reduce GHG emissions. The technology of electricity generation from Solar PV Plant is environment friendly as it does not use any fossil fuel. It thereby reduces the greenhouse gas emissions associated with fossil fuel based electricity generation system. The availability and reliability of solar power depend largely on current and future climate conditions, which may vary in the context of climate change.

The comparison of the GHGs emission caused by solar power plant with the GHGs emission that would have been caused by fossil fuel burned to make the same amount of electricity has been made. Thus the purpose of the project activity is to generate power from zero emissions Solar PV based power project and thereby reduce the emissions associated with the grid. ACM0002 Version 17.0 Methodology is followed to assess the Carbon Reduction Potential of the proposed project. The calculation of the total GHGs emission reduction as 51805 tCO_2e/year.

The proposed solar farm is based on Photovoltaic technology which generates electricity using solar energy from the sun through photo-electric effect, which depends upon solar flux of the area. It is defined by the Global Horizontal Irradiance (GHI) of the area, wherein shortwave radiations received by the surface at a high temperature get absorbed and individual electrons in bonds moves into a higher energy level. This absorption of energy does not cause any change in temperature of the area. It is also very well understood that there can be an increase in temperature, which will be confined only to the site.

5.4.6.1 Impact Significance

Climate change is a burning issue now a day. Project will help in reduction of GHG emission with the use of environment friendly technology of power generation. Though the significance level is minor due to capacity / size of the project but it would be a long term beneficial impact of the project.

Table 5-20: Impact Significance on Climate Change

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact on Climate Change	Without Mitigation	Local	Long	Low	Minor
	With Mitigation	Local	Long	Low	Minor

5.4.7 Health and Safety Risk

5.4.7.1 Impacts

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.

5.4.7.2 Mitigation

The lists of exposure limits for general public / occupational exposure to electric and magnetic fields published by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) is as given in Tables below.

Table 5-21: ICNIRP exposure limits for general public exposure

Frequency	Electric Field (V/ m)	Magnetic Field (µT)
50 Hz	5,000	100
60 Hz	4,150	83

Table 5-22: ICNIRP exposure limits for occupational exposure

Frequency	Electric Field (V/ m)	Magnetic Field (µT)
50 Hz	10,000	500
60 Hz	8,300	415

There are no specific standards or guidance on EMF in India however the Indian Electricity Act and Rules clearly stipulate the minimum clearances required. Hence the ICNIRP standards and guidelines have been considered. For the general public (up to 24 hours a day) an exposure level of 1,000mG or 100µT is suggested. The EMF generated by 33 KV unit will be lesser than the suggested value.

Workers handling electricity and related components should be provided with shock resistant gloves, shoes and other protective gears. Adequate training regarding health and safety should be provided to the workers. The switchyard building should be provided with fire extinguishers and sand buckets at all strategic locations to deal with any incident of fire. Safety incidents should be recorded and monitored with an aim that numbers are never significant, and gradually reduce.

5.4.7.3 Impact Significance

Overall impact significance is moderate, which can further be reduced to the minor level after EMP implementation.

Table 5-23: Impact Significance on Health and Safety

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

5.4.8 Impact on Social Aspects

5.4.8.1 Impacts

Project is likely to have a positive impact on the local social system in terms of economy and area development project. Availability of electricity will boost up the commercial potential of the area. Project will boost up local employment opportunities based on skill and education, increased taxation revenue, increased demand for materials and services through local contracting. These things will ultimately improve the revenue generation opportunities in the project region. Some financial support for infrastructure development should also be provided by the project developer in line with their CSR activities.

5.4.8.2 Mitigation

Community should be engaged on each aspect of CSR activities.

5.4.8.3 Impact Significance

The impact intensity will be low as most of the impact shall be limited for local area only.

Table 5-24: Impact Significance on Social Aspects

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact on Social Aspects	Without Mitigation	Local	Long	Low	Minor
	With Mitigation	Local	Long	Low	Minor

5.5 IMPACT DURING DECOMISSIONING

5.5.1 Impacts

Decommissioning of the project involves dismantling of the solar modules and trackers, and all associated electrical infrastructure and site buildings. The impacts associated with decommissioning activities are:

- Improper disposal of demolition waste and obsolete machineries will lead to contamination of soil and discontent of community
- Demolition activity will lead to generation of dust which can be carried downwind to habitations

5.5.2 Mitigation Measures

Dismantling activities should be taken care by experienced professionals under the guidance of plant EMS Head. All the dismantled infrastructures and debris should be segregated and stored separately with cover facility to negotiate with contamination effects of such wastes. Water sprinkling should be a regular practice to reduce the dust generation from the plant decommissioning activities.

5.5.3 Impact Significance

Decommissioning phase impact shall be limited to the site and minor in nature. However, impact can further be mitigated to the insignificant level.

Table 5-25: Impact Significance for Decommissioning

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact of Decommissioning	Without Mitigation	Local	Short	Moderate	Minor
	With Mitigation	Local	Short	Low	Insignificant

5.6 CUMMULATIVE IMPACT

RSSPL has signed a Power Purchase Agreement with Northern Power Distribution Company of Telangana Limited for 30 MW_{AC} Solar Project. No other proposed industrial activities in study area was noted by the consultant team during the site visit, also the proponent confirmed that no other new industrial activity is being proposed in the project region. The impact of proposed Mulkanoor Solar Project is discussed in above sections of this chapter.

6 ANALYSIS OF ALTERNATIVES

6.1 INTRODUCTION

ReNew Saur Shakti Pvt. Ltd. is being set-up 30 MW_{AC} Solar Power Project near to village Vangara, Mulkanoor. The PPA for the project shall be in force for a period of 25 years from the date of commercial operation. C-Si technology based solar PV modules with single axis tracking are proposed for the project.

Development of solar power in the project area will be based on green process of power generation. Project will help in reduction of CO2 emission likely due to power generation of same capacity by conventional means. Analysis of alternatives involves a thorough study of the possible future conditions in the project study area in response to a set of alternatives with and without project scenario. Alternative methods of power generation and comparison with the following one are discussed in this chapter.

6.2 ALTERNATIVE METHODS OF POWER GENERATION

Harnessing solar energy is an eco-friendly process, inexhaustible and processes a minimal environmental footprint. There are neither fuel requirements nor large quantities of water for operation of the plant. Solar energy scores over other forms of energy generation as it has a low gestation time. Table below elaborates upon the advantages and disadvantages of various power generation systems.

Greenhouse gas Emission: As per the estimation of International Atomic Energy (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. Table below highlights the advantages and disadvantages along with GHG emission that each technology possesses.

Considering various factor such as solar resources potential in the project districts; favorable environmental and social settings, low GHG emission in the project life cycle, land availability, governmental assistance, and local community's acceptance of solar energy project in the region, solar energy based power generation is the most suitable alternative in for power generation in India.

Table 6-1: Advantage and Disadvantage of Conventional Technology

Mode	Disadvantage	Advantage
Thermal Power Plant	• High fossil fuel consumption • Large quantities of water requirement for cooling • High volume of emission from operation • Accumulation of fly ash (in case of coal powered installations) • GHG emission estimated as 960 gCeq/kWh	• Large scale production potential • Moderate gestation period • Relative inexpensive • Wider distribution potential

Mode	Disadvantage	Advantage
Nuclear Power	• Availability of fuel and power source • Hazard associated with radioactive material • High cost of project • Long gestation period • Risk of fallout and melt down scenarios and its impacts on the local populace and environment. • GHG emission estimated as 66 gCeq/kWh	• Capable of producing huge amounts of energy with little or no carbon
Wind Power	• Overall land requirement is large • Site specific (associated to wind pattern) • High Noise and Shadow Flicking Effect	• Pollution level are insignificant • Inexpensive power generation • Inexhaustible source • GHG emission as low as 10 gCeq/kWh
Solar Power	• Large land requirement • Site specific to solar installation • Concrete foundation on large area	• Pollution level are insignificant • Inexhaustible source • GHG emission as low as 32 gCeq/kWh

Source: Nature Reports Climate Change

Published online: 24 September 2008 |doi:10.1038/climate.2008.99

Table 6-2: CO_2 Equivalent Emissions for full Energy Chain

Technology	Maximum Value	Minimum Value
Coal	1290	860
Oil	890	689
Gas	1234	460
Hydro	410	16
Nuclear	30	9
Wind	75	11
Solar PV	279	30
Biomass	116	37

Source: IAEA Bulletin

6.3 WATER REQUIREMENT

The interdependency between water and energy, sometimes called the water-energy nexus, is growing in importance as demand for both water and energy increases. Energy is required for water treatment and supply, while virtually all processes for energy production require significant amount of water. Many areas are already under water and energy constraints and yet water and energy are

both indispensable for modern economics. Moreover, the population is expected to grow, which should boost the water and energy demand substantially in the coming years.

Solar power project has been known to use almost insignificant water, in comparison to nuclear and coal based power projects. Solar plant requires small amount of water are used to clean photovoltaic panels.

6.4 CARBON OFFSETING

According to American Wind Energy Association (AWEA), water consumption (technology gallons/MWh) is as follows; Nuclear- 620; Coal- 490; Oil- 430; Wind- 1; Solar- 30.

6.5 ALTERNATIVE SITE LOCATION

Solar Power projects are non-polluting energy generation projects which are site specific and dependent on the availability of solar insolation. The bidding process for PPA is based on Tehsil Level. On the basis of initial discussion with Land aggregator active in the project Tehsil, 3-4 sites were identified. Shadow analysis and power potential assessment for the project was done by RSSPL, based on which potential areas are notified. The important meteorological parameter in the design of solar PV power plant are solar radiation, ambient temperature and wind speed which are represented in Table below. The average solar radiation, ambient temperature and wind speed of the study area is 5.25 kWh/m^2/day, 27.6^oC and 1.1 m/s respectively which are generally suitable for the reasonably good energy generation.

Table 6-3: Metrological Data of the Site

S. No.	Month	Global Horizontal Irradiance on a Horizontal Plane (kWh/m2/day)	Ambient Temperature (^oC)	Wind Speed (m/s)
1	Jan	4.63	22.5	0.89
2	Feb	5.57	25.6	1.20
3	Mar	6.05	29.2	1.30
4	Apr	6.48	32.2	1.40
5	May	6.48	34.6	1.60
6	Jun	5.23	31.1	1.70
7	Jul	4.42	28.5	1.40
8	Aug	4.46	27.4	1.29
9	Sep	5.21	27.7	0.99
10	Oct	5.18	26.8	0.68
11	Nov	4.75	23.7	0.59
12	Dec	4.56	21.8	0.59
Average		5.25	27.6	1.1

Source: Detailed Project Report, 30 MW Solar Power Project, Mulkanoor

Further, before selecting the site RSSPL has assessed the site which are suitable for solar power plant and presented in the table below.

Table 6-4: Assessment of the Site

S. No.	Parameters of Assessment	Utility in Design and Construction	Characteristics of Site Assessed
1.	Access	Easy access to site or connectivity with main road or highways help in transportation of materials, man and machinery required during construction.	Site is easily accessible by Siddipet-Husnabad Road
2.	Water Availability	For module cleaning purpose and for construction purpose water is required in large quantity. Availability of water (non-saline) on site in form of bore-well, pond, lake or river saves the time and cost of buying this water from outside.	Area is in safe category of water development as per CGWB district ground water brochure
3.	Electrical Infrastructure	Availability of Grid sub-station at distance of not more than 10 km is considered to be good choice of land as it will allow minimum transmission losses and also saves transmission cost of project.	Mulkanoor sub-station is about 2.5km from the proposed site.
4.	Climate	Site with moderate rainfall, solar irradiation in range between 4-6 kW/m2/day, wind speed not more than 45 m/s, low relative humidity is a good choice for setting a solar power plant	As per the PV System data, the solar irradiation available at the site are 5.25 kWh/m2/day and the average wind speed is 1.1 m/s.
5.	Topography	Minimum undulation of land with minimum vegetation is good for Solar power plant. Site with gentle slopes provide natural drainage thus reducing water logging problem. It also serves as economic benefit as requirement of digging drains is minimized. It reduces construction time as well. Site under Zone 1-3 of Seismic zone is good for construction. Sand, gravel medium and hard clay type of soil is good for construction purpose.	Site falls under seismic zone II, which is a stable zone for construction. Silty-Clayey soil is observed at the site.

A checklist approach was followed and checklist as prepared for the Mulkanoor Site is attached as **Annexure III.**

6.6 ALTERNATIVE TECHNOLOGY

In designing any power generation system that incorporates photovoltaic (PV) there is a basic requirement to accurately estimate the output from the proposed PV modules under operating conditions. A comparison of the characteristics of the most popular cell technologies are given in the Table below.

Table 6-5: Characteristics of Some PV Technology Classes

Technology	Crystalline Silicon	Amorphous Silicon	Cadmium Telluride	Copper Indium Gallium Di-Selenide
Percentage of global installed capacity	78%	22%	22%	22%
Current Commercial Efficiency	14-19%	11-12%	13-17%	7-16%
Temperature Co-efficient of Power (Typical)	-0.45%/°C	-0.21%/°C	-0.25%/°C	-0.36%/°C

Source: Detailed Project Report, 30 MW Solar Power Project, Mulkanoor

Poly-crystalline Silicon Solar Modules: Poly-crystalline panels are made up from silicon offcuts, molded to form blocks and create a cell made up of several bits of pure crystal. Because the individual crystals are not necessarily all perfectly aligned together and there are losses at the joints between them, they are not quite as efficient. However, this mis-alignment can help in some circumstances, because the cells work better from light at all angles, in low light, etc. Due to random crystal arrangement the panels look a little bluer as they reflect some of the light. Conversion efficiency of the cell in large scale mass production is between 16% to 19%. Poly-crystalline modules are less expensive than mono crystalline. They have a better temperature coefficient. For reasons cited above, poly-crystalline modules are preferred for this project.

6.7 ALTERNATIVE PV MODULE MOUNTING SYSTEM

The Sun's intensity is at its maximum on a PV module when it is striking it perpendicularly—the incident angle is 0°. The mounting structure plays an important role in supporting and securing the module. It also deals with the module alignment with the sun at a particular angle at a certain time to maximize the solar power generation. Mainly there are two modes of installation:

- Fixed installation Technology; and
- Installation with Sun tracking Technology.

Fixed mounting systems keep the rows of modules at a fixed tilt angle while facing a fixed direction of orientation. The tilt angle is important for maximizing the energy incident on the collector plane. The tilt angle and orientation are generally optimized for each PV power plant according to location. This helps to maximize the total annual incident irradiation and total annual energy yield. Fixed tilt mounting systems are simpler, cheaper and have lower maintenance requirements than tracking systems.

Tracking systems follow the Sun as it moves across the sky. They are generally the only moving parts employed in a PV power plant. Single-axis or horizontal-axis trackers alter either the orientation or tilt angle. Depending on the site and characteristics of the solar irradiation, trackers may increase the annual energy yield by up to 25% for single-axis trackers. Dual-axis tracking systems alter both orientation and tilt angle and are able to track the Sun more precisely than single-axis systems. Depending on the site and characteristics of the solar irradiation, dual-axis trackers may increase the annual energy yield by up to 35%.

Solar tracking systems are utilized to continually orient photovoltaic panels to the sun and can help make best use of the investment in PV system. They are useful as the sun's position in the sky will alter gradually during a day and over the seasons throughout the year. Therefore, single axis solar tracking system has been selected for Mulkanoor site.

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

The mounting structure is designed for holding the designed number of modules in series. The frames and leg assemblies of the array structures are made of structural steel sections. The composition of steel shall conform to IS 2062, suitable for welding purposes. The structural sections shall conform to IS-800- 1984 and IS-801, for their chemical and mechanical properties. They shall be hot dip galvanized for a minimum of 86 microns to provide along life of 25 years in the field. All fasteners shall be of stainless steel grade SS-304. The structure is designed in such a way that it will not only occupy minimum space but also be able to withstand extreme wind conditions like cyclones.

6.8 WITH AND WITHOUT PROJECT SCENARIO

Keeping in view the site conditions and the scope of development of the area, 'with' or 'without' project scenarios have been compared as shown in Table 6.6. By looking at the table it can be concluded that 'with' project scenario with positive/ beneficial impacts will vastly improve the environment and enhance social and economic development of the region when compared to the 'without' project scenario, which will further deteriorate the present environmental setup and quality of life. Hence 'with project scenario' alongside minor reversible impacts is an acceptable option than the 'without project scenario'.

Table 6-6: With and Without Project Scenario

Component	With Project Scenario	Without Project Scenario
Siting	The present project is of establishing a new solar power plant. Solar power is a green energy and requires adequate amount of solar heat/ energy for which siting is a pre-requisite. The site is well connected and is having good number of solar radiation days. With Project land owners will get compensation better than the market rate. One kutcha road is passing through project site will be re-routed for the proposed development. Availability of electrical supply will boost the region economy.	Without the project this condition people may face power cut problem. Without the project, the project land would single crop per annum. Even some of the land will remain vacant as most of land owners are busy with other livelihood generation areas.
Power Generation	The proposed project would improve in power generation in the area through a green power	Without project scenario, demand-supply gap will increase

Component	With Project Scenario	Without Project Scenario
	within zero consumption of fossil fuel thereby minimizing the resource consumption.	and people may face power cut in future.
Environmental Quality	Setting up of proposed solar power plant has very low environmental degradation.	Without the project, possibilities of setting up of thermal power plant in near future would have increased. The setting up of conventional power plants would have more environmental degradation than solar power plant.
Economic Development and Employment Opportunity	There will be increased power generation in the surrounding areas and this will minimize the gap between the demand and supply of power. Such activities would increase various economical activities including the various local based industries and agricultural activities (including water pumping etc.). This on other hand will reduce the dependence on DG set for pumping of water for agriculture activity by villagers and thereby would reduce the consumption of fossil fuel (e.g. diesel).	Without the project the dependence on DG set for power generation for carrying out small industrial and agricultural activities would further increase.

7 INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

7.1 CONSULTATION

Public consultation and participation has been viewed as a continuous two ways process involving, promoting of public understanding of the processes and mechanisms through which developmental problems and needs are investigated and solved. The public consultation, as an integral part of environmental and social assessment process throughout the project preparation stage not only to minimizes the risks and unwanted hurdle against the project implementation but also abridges the gap between the community and the project formulators which leads to successful and timely completion of the project and making the project people friendly.

Therefore, keeping in mind the above objective public consultation with the people of different section of the society, i.e., local administrative officials, some related social agencies, business groups, community representatives, village heads, Panchayat members and respectable and influential persons of the project area were made. Moreover, potential vulnerable people were also consulted with the aim to make people aware and minimize adverse impacts of the solar project. The option of alternative design was also discussed to achieve accelerate the implementation of proposed solar project with people's involvement.

As per the Safeguard Policy Statement (SPS) of ADB, Public Consultation and participation plan needs to be included in the EIA/ESIA Report for all stages of the project (project design, construction and operations phase) for categories "A" and "B". Also, a documentation of meaningful consultation with affected local communities especially project affected persons needs to be carried out.

7.2 OBJECTIVES

Following are the main objectives of the consultation:

- Promote public awareness and improve understanding of the local people about the proposed project;
- Assessment of possible requirement of improvements;
- Solicit the views of affected communities/individuals on environmental and social problems;
- Improve environmental and social soundness;
- To settle problems with mutual consent; and
- Create accountability and sense of local ownership during project implementation.

7.3 CONSULTATION DURING PROJECT PRE-CONSTRUCTION STAGE BY ESIA TEAM

Within the study area a total 3 consultation programs (Focus Group Discussion, Community based) have been finalized after discussion with the officials of RSSPL and local community including questionnaire for the same. The details of consultation location, dates of consultation are shown in Table below.

Table 7-1: Details of Public Consultation

S. No	Location of consultation	Community being consulted	Dates of Consultation	Target group
1	Project Site	Project Developer	Date: 14/07/2016 (02.00 PM to 04.00 PM)	Project developer and local Villagers
2.	At P. Narayan Reddy's House	Local people of Vangara	Date: 15/07/2016 (01.35 PM to 03.00 PM)	Land Seller, Village Sarpanch, Village Panchayat Member and Respectable and Influential Person of the village
3.	Near village Panchayat Bhawan, Ramnagar	Local villagers of Ramnagar	Date: 17/07/2016 (01.30 PM to 02.50 PM)	Local villagers and labourers

7.4 CONSULTATION PROCESS

The process of stakeholder consultation included:

- Identification of the relevant stakeholders including all those individuals, groups and organizations potentially affected by or interested in the project;
- Imparting information about the project and its potential impacts on their lives in local and simple language;
- During the consultation process the project plan was clearly explained;
- Recording of their concerns and aspirations through survey and discussions;
- Responding to their queries in a neutral manner.

In the primary survey a list of open-ended questionnaire is used in both the focus group discussions and the individual interviews. A three-person survey team carried out the discussions and the interviews. The list of persons involved in the public consultation is limited to those who were willing to allow their name to be added in the document. Project proponent, land sellers, village *Sarpanch* and *panchayat* members, members of the Vangara and Ramnagar villages, government officials of revenue and rural development department, local labours, contractors were our stakeholders to whom we consulted.

7.5 PROJECT DISCLOSURE: AWARENESS ANOUT THE PROJECT

A focused group discussion and public consultations were conducted in Vangara and Ramnagar village. All the people expressed their full support for solar project as they see that there is an opportunity of employment and power generation. They do not have any problem due to proposed projects and they are already aware with the projects. In the consultation approximately 15-20 people at each location were participated. Consultant team has also consulted/discussed informally with youths, women and daily wages workers in and around the project site. At the very beginning of the public consultation/discussions the participants were introduced about the details of a solar power plant. It was also explained to them that solar power is an environment friendly system which reduces the environmental impacts of combustion of fossil fuel based power generation, such as impacts from

greenhouse gases and other air pollution emissions. It was also explained to that unlike fossil fuel power generating facilities, solar facilities have no air emissions of air pollutants such as Sulphur dioxide, Nitrogen oxides, Carbon monoxide, Volatile Organic Compounds, and the greenhouse gas carbon dioxide during operations.

7.6 CONSULTATION WITH DIFFERENT GROUP OF PERSONS

Focused group discussions were held with the randomly selected villagers and land owners. These groups encompass a wide age range, as well as both genders, and people from the entire communal spectrum. The FGD included people who had given their land for the proposed project.

Natural group discussions were also conducted, where ever possible. Natural group discussions are interviews conducted with 'naturally' occurring groups. The method has the advantage of being interviewed at a time and place of their convenience, and is suitable from the point of view of the interviewee. The result is honest and open discussion in a more relaxed and informal manner.

7.6.1 Consultation with The Site Staffs

During the study period, ESIA team consulted with RSSPL staff at project site to understand about the project and other environmental and social features around the project site.

Figure 7-1: Consultation with RSSPL Officials and Site Inspection at Project Site

7.6.2 Consultation with Project Affected Families

The team has consulted with project affected families (land sellers) and discussed about their socio-economic conditions. The team talked their willingness of selling the land, discussed about their land holding types, total land they own, land left after sale, their source of income, total income by agriculture and others sources, their expenditure, household size, literacy, socio-economic status of women etc.

7.6.3 Consultation with the Local Labours

Daily wage labourers, mostly in and around project site and Ramnagar village have been observed during site visit and tried to consult them. Consultation with the labourers highlights that as the proposed Solar Power Project supported their employment during construction period and helped them tackle the seasonal unemployment in the area so they are very positive and glad about the project.

Consultation with village *Sarpanch*, Project Affected Family and other members of Vangara Village

Consultation with People in Ramnagar village

Consultation with people near Project Site

Figure 7-2: Consultation and Group Discussion with People at Vangara and Ramnagar

7.6.4 Consultation with Youth of the Study area

We have also consulted with youth of the study area and tried to know their opinion about the project. We discussed with developmental issues and employment opportunity in the region. They are very hopeful with the project in the region. They are much conscious with their education, career and are seeking employment opportunity in metropolitan cities like Hyderabad, Bangalore, Mumbai and abroad. Few people of Project Affected Families are working as Software Engineer in USA, UK, Singapore, and Germany. They are much ambitious.

7.7 ISSUES / CONCERNS / CONCERNS RAISED / ADDRESSED DURING CONSULTATION

Following issues have been discussed with the people of Project Impact Area:

7.7.1 Awareness About the Project

All the respondents, community of Vangara and Ramnagar were aware with the proposed solar power project. All the people expressed their full support for solar project and they do not have any problem due to proposed projects.

7.7.2 Occupation and Livelihood

Economy of the study area is dependent on agriculture. The main occupation of the people of Vangara and Ramnagar village is agriculture, dairy milk and cattle rearing. During consultation with people it was found out that average land holding size of the farmer of the study area is 3 to 30 acre per family and with agriculture they may earn INR 15,000 to 20,000 per acre per year. Cotton, Paddy, and Maize are the main crops that grown in the region. Approximately 500 liters of milk are sold every day from Vangara village. Few people of Vangara village are working as Software Engineer in abroad.

7.7.3 Health

There is no any epidemic or chronic disease have been reported in the study area during consultation with local people of Vangara and Ramnagar village except general fever, cough and cold. People of the study area are well aware with HIV/AIDS/STP. Government Primary Health Center and Veterinary Hospital are available in Vangara village.

7.7.4 Education

In spite of government infrastructure facility and support for mid-day meal, free text books, scholarship and uniform distribution to every student at Primary and Upper Primary level, the literacy rate of the study area is not so good. There are about 19.35% of gender gap in literacy rate of male and female. But youth and people of new generation are much conscious and firm to provide better education to their male and female children without any discrimination.

7.7.5 Use of Land Being Procured

The land identified for the proposed project are undulating, mix of agricultural and uncultivated scrub land. It is one crop yielding, rain-fed agricultural land. Identified land has been procured on one to one negotiation basis and direct from land owners.

7.7.6 Rates offered for the Land

The land owners agreed with the fact that the rate being offered by the project proponent is better than the circle rate of land decided by government and what they would have received if there was no project. The land owners have sold their land as per their own choice and willingness. There is no family rendered landless by procurement of land as all of the land owners have more land besides it.

7.7.7 Employment Opportunity

Local people are also concern about employment opportunity through proposed solar power project. RSSPL assured that they will prefer local people for unskilled labour during project construction period on the basis of their skill and education. During project operation period employment opportunity will be limited to security staff only.

The outcome of the public consultation with the villagers is given in Table below.

Table 7-2: Outcome of Public Consultation

S. No.	Concerns & Expectations	Addressal of Issues/ Concerns by RSSPL
1.	Capacity and Technology adopted for the proposed project	A brief introduction about the proposed project has been given to local community by Consultant team and RSSPL personnel. It has been told that it is a Solar PV Technology based 30 MW Solar Power Plant proposed at Vangara village.
2.	Requirement of land and process of land procurement	Approximately 201 acres of land have been procured on one to one negotiation basis to establish the project. The sale deed has been done on the basis of direct negotiation between land owner and land purchaser through land aggregator.
3.	Will the upcoming solar power plant create employment opportunities for the local people?	During construction period, the proposed project will provide an employment opportunity to semi-skilled and unskilled worker. The priority of employment will be provided to local villagers / residents on the basis of their skill and qualification.
4.	Will there be any influx of people due to upcoming solar power plant? Will it disrupt public services?	The chances of influx of people from outer area for this project are limited to the plant persons which are very nominal and will be accommodated within the project site itself. This will not as such disturb the public services.
5.	Will the proposed solar power plant disturb existing land uses?	The land use pattern of the identified land will be changed from agricultural and scrub land to industrial land use.
6.	Will the solar power plant project pose a risk to human health and the environment?	No. It is considered safe to human health and the environment. It does not present any risks to public health and the environment.
7.	Will the power plant will provide regular electricity to the villagers	Electricity will be supplied to grid, thus reduce the power deficit of the state and help in improving the power supply in the area.
8.	What will the benefits be of the project to local people?	The proposed project will reduce demand supply gap of electricity to the state as well as to local region. It will provide employment opportunity to local community during construction period. Monetary gains, education, health, sanitation, water conservation, plantation and improvement in general environment through CSR / community development plan will lead to positive growth to local community.

Thus on the basis of above consultation / group discussion with local community / villagers / village sarpanch / village panchayat members / influential person of the region/ government officials and various stake holders, we may conclude that proposed project will prove beneficial not only to local region but also up to state and national level for a long term. There is a big support of local community in favour of the project.

8 GRIEVANCE REDRESSAL MECHANISM

8.1 INTRODUCTION

This Grievance Redressal Framework (GRM) has been developed by ReNew Power Ventures Pvt. Ltd. (RPVPL) for managing grievances related to environmental and social performance arising from its operations in Solar/Wind Projects. The Corporate level RPVPL's Grievance Redressal Framework shall also be applicable for ReNew Saur Shakti Private Limited (RSSPL).

This GRM shall serve as one of the component of RSSPL's Environmental and Social Management for managing overall performance of its projects as well as providing more accountability to its stakeholders. The GRM is based on four guiding principles of the company which include:

- Transparency
- Fairness
- Respect
- Accountability

8.2 TYPES OF GRIEVANCES

If any internal or external stakeholder believes that the company's business practices or activities are having an adverse impact on their quality of life, livelihood or environment, which they want the appropriate management to address, such a concern can be classified as a complaint or grievances. From the purpose of classifying the various kinds of grievances that can arise, they are mostly categorized under two headings.

8.2.1 Internal Grievances

Employee Grievance- Separate procedure in place as part of the Human Resources (HR) of RSSPL. These include the employees hired specifically for the site.

8.2.2 External Grievances

Contractor and Labour related Grievances- Directly / indirectly controlled by RSSPL

Community Grievances including those on land and resettlement issues, project activities, CSR intervention, employee / worker-community conflicts, and other project related issues (Directly/Indirectly controlled by RSSPL)

8.2.2.1 Internal Grievances- Employees Grievance

The likely grievances of direct employees of RSSPL may include but not limited to:

- Complaints pertaining to amount of wage, salary, other remuneration or benefits, as per company's centralized HR Policy
- Timely disbursement of remuneration;
- Working condition, health and safety of the employees;
- Unethical behavior between senior and subordinate employees;
- Discrimination on the basis of caste, creed, language, religion etc.;
- Gender discrimination; and
- Workplace harassment

8.2.2.2 External Grievances

External grievances are those grievances received from the external stakeholders such as labour and workforce, contractors, communities, local administrative setup, community groups / NGOs, and media groups.

Contractors and Labour Related Grievance

The workers include the local and interstate migrant workers are likely to have the grievance related to the following issues:

- Risk to health and safety of the labours or workers hired by the Contractors;
- Working condition of the labour;
- Wage discrimination among the labour;
- Timing of the payments;
- Adequate facilities in the labour camps (during construction stages) including water supply and sanitation;
- PF, ESIC, Workmen's compensation, adequate health facility related issues;
- Unjustified deduction from the wages;
- Minimum wage rates for the labour;
- Extended working hours;
- Prevention and protection of child labour from hazardous work condition;
- Issue of forced labour;
- Gender discrimination.

Note: RSSPL has limited control on labour & workforce deputed through contractor/subcontractor as per business model. However, as a principle employee, RSSPL should monitor the overall process as & when required as a part of its own Environmental & Social Management system

8.2.2.3 Community Grievance

The surrounding community of the project is considered as important stakeholder by the Project. The possible grievances of the community could be:

- Land and compensation related issues
- Damage to, crops, infrastructure;
- Eligibility issues and payment of compensation;
- Improper/ inadequate valuation of the compensation;
- Compensation and employment entitlement against losses;
- Delay in the payment of the compensation;
- Livelihood restoration issues and associated benefits;
- Adverse impacts on community, common property resources (CPR);

Community development, employment and other issues

- Risks to community, health & safety (e.g. traffic);
- Accidents (e.g. involving livestock);
- Unethical Behavior by RSSPL personnel or its sub-contractors;

- Noise/dust/air emissions or any other impact on environment caused by project or sub-contractors;
- Demand for development interventions in the community;
- Issues owing to behavior of the security personnel and general attitude of the local community;
- Issues related to cultural conflicts or opportunity conflict owing to presence of migrant workers in the community or in the nearby areas;
- Any attempts to conceal the above

Note: RSSPL has limited control in case of Trunkey contract for the project /OEM. However, as a principle employee, RSSPL should monitor the overall process as & when required as a part of its own Environmental & Social Management system

8.3 REDRESSAL PROCESS

8.3.1 Redressal Process for Internal / Employee Grievances

RSSPL as part of its Human Resources system has developed grievance addressing policy with detailed scope and coverage considering registration and addressal of internal grievances raised by the employees, which display Grievance procedures transparently in its SAP Net Weaver Portal with following objectives:

- Grievances of the employees in the shortest possible time
- At the lowest possible management level
- With appellate stages so that it is fair, transparent and reasonable

The grievance policy is intended as the tool by which a member of staff may formally have a grievance, regarding any condition of their employment, which he/ she wants to be heard by the management of the Company.

The following stages outline the grievance redressal process likely to be established by RSSPL with stipulated time period to resolve the issues for its employees.

8.3.1.1 Stage 1: First level of grievance addressal

The aggrieved employee may take up the grievance in writing with his/her reporting officer. If the matter itself concerns the employee's line manager or program manager, then the grievance should be escalated to the Head of the Department.

8.3.1.2 Stage 2: Second level of grievance addressal

In case employee is not satisfied with the decision communicated to him/her at Stage-I, or if she/he fails to receive the reply within stipulated period, he/she may submit the grievance in the prescribed form to Head- HR

8.3.1.3 Stage 3: Third level of grievance addressal

If the employee remains aggrieved and not satisfied with the decision of the Head-HR, should have an option to appeal to the President

8.3.2 Redressal Process for External Grievances

Mainly deputed Pretty contractor should be responsible for grievances redressal system as they are responsible from land purchasing to Plant erection and OEM. In those cases, as a principle employee, RSSPL should monitor the overall process as & when required as a part of its own Environmental & Social Management system. However, in case of self-developed project and OEM, RSSPL should implement a robust Grievance Redressal & Management system with a defined process.

8.3.2.1 Step 1: Publicizing Grievance Management Procedures

For any project, RSSPL / deputed Contractor is required to ensure suitable public disclosure of its grievance handling and redressal process to its external stakeholders such as the community or the local administration. The company should establish a grievance body at the plant site comprising of designated personnel and disclosure of such a body to be displayed at suitable location in the plant premises so that any member of the community can easily access such information.

Looking at the scale of the project and the duration of the construction stage wherein maximum numbers of contract workers, migrant workers or workers from the local community are supposed to be working at the site for a duration ranging from six months to nine months tentatively, the Grievance Redressal Mechanism for the community can simultaneously be used for the workers. The process of disclosure of information and the GRM process itself should be disclosed to the workers considering the duration i.e. six months to nine Months. Should the contractors have their own GRM, RSSPL should ensure that it is functioning effectively and even review the grievance records as and when required.

For the grievance mechanism to be in line with the cultural and socio- economic characteristics, based on its understanding of the ground situation in the project area, the company/deputed contractor should strive to provide the following information to the stakeholders (primarily community) from time to time with suitable communication media, at least some of the following:

- Project-level mechanisms capable of delivering outputs against grievances and benefits complainants can receive from using the company grievance mechanism, as opposed to other resolution mechanisms;
- Information on who can raise complaints (affected communities);
- Where, when, and how community members can file complaints;
- Company personnel responsible for receiving and responding to complaints, and
- Type of response complainants can expect from the company/contractor, including proposed timing of response, based on the gravity;

Designated personnel shall be responsible for publicizing the procedure through appropriate methods.

8.3.2.2 Step 2: Receiving and Keeping Track of Grievances

This receipt and tracking of grievances primarily involves the following stages:

- Collecting and recording grievances;
- Registering them in a suitable manner; and
- Tracking them to reflect their status

Grievance Receipt and Recording

Designated personnel from the grievance body with collection of grievances writes down complaints at group or individual meetings, during field visits, or at designated locations. These grievances are to include:

- Complaints received through third parties such as Sarpanch, community persons, contractors, contract workers, etc.;
- Complaints received by project staff directly/indirectly involved in handling grievances;
- Tracking of grievances can be undertaken with keeping of records in the registrar

Designated grievance personnel of respective sites should be responsible to intimate the Grievance status at regular interval to appropriate authority e.g. Project Head, OEM Head, HR&FMS-Head and EHS Head so that it should be reflected in appropriate forum like ESMS committee. The designated Grievance personnel may also do a case to case grievance status reporting to the Top management in case of critical grievances or grievances that may require immediate attention of the Top management or ESMS committee.

8.3.2.3 Step 3: Reviewing and Investigating Grievances

The designated personal from the grievance body responsible for grievance handling should organize the process to validate the complaint's legitimacy and arrange for investigation of details as per the applicability. All grievances shall undergo some degree of review and investigation, depending on the type of grievance and clarity of circumstances.

RSSPL should communicate clearly to all concerns about the role, responsibilities, and limitations of a company grievance mechanism and the limitations of the same in handling grievances, if any to ensure transparent dealing of any grievance.

8.3.2.4 Step 4: Developing Resolution Options and Preparing a Response

Rationale for Grievance Closure

- The requirements / need specified in the form of grievance by the aggrieved have been effectively addressed to the satisfaction of the complainant;
- Applicable Grievance to be duly addressed and closed by RSSPL in stipulated time based on the merit

Process of the Grievance Redressal

- The person having grievance should come on the scheduled time and lodge the complaint in person or through other recognized person/forum identified by the company
- The grievance should be processed and concerned person should be informed through a suitable communication by person or through company recognized person/forum within mutually agreed stipulated period
- On hearing from the designated grievance personnel they have to come for further processing to the grievance redressal, if required.

8.3.2.5 Step 5: Monitoring, Reporting, and Evaluating a Grievance Mechanism

Monitoring and reporting can be tools for measuring the effectiveness of the grievance mechanism and the efficient use of resources, and for determining broad trends and recurring problems so they can be resolved proactively before they become points of contention. Monitoring helps identify common or recurrent claims that may require structural solutions or a policy change, and it enables the company to capture any lessons learned in addressing grievances. Periodic review of internal and external grievances has to be carried out at the appropriate forum of RSSPL like ESMS committee meetings.

Monitoring Indicators

Grievance records should provide the background information for regular monitoring, both informal and formal.

8.3.2.6 Step 6: Reporting and Recording

Based on all grievances received, registered, documented and tracked through database reports shall be prepared for reporting to the appropriate Forum. This shall assist in tracking overall trends and patterns in concerns allowing emerging issues to be flagged and understood at an early stage. Monitoring and reporting also create a base level of information that can be used by the company to report back to communities as per the applicability and requirement.

8.4 DISCLOSURE OF GRM

The disclosure for GRM should be done with the appropriate community, employees and stakeholders to fulfil the specific purpose based on the requirement through suitable communication.

8.5 PERSONNEL: ROLES AND RESPONSIBILITIES

8.5.1 Corporate Level

At the corporate level, handling of grievances is required to be directly handled by the HR&FMS department under the responsibility of the designated officer, declared in the SAP Net Weaver Portal for resolution of internal grievances.

8.5.2 Project & O&M Level

A grievance Body, leaded by designated Grievance officer is proposed for effective implementation of GRM and coordinating day to day functions. The grievance Body would be reporting back to the appropriate authority including functional areas such as HR, Project, O&M, BD/Land, CSR, EHS etc. as per requirement. The mandate of this cell would be managed as part of the ESMS forum.

8.6 FINANCIAL

RSSPL should ensure appropriate budget allocation to deal with grievance tracking and handling with consent of appropriate authority.

8.7 TRAINING

Awareness shall be provided in the company's policy and practices for both employee and appropriate stakeholder grievance mechanisms, relevant to their exposure and responsibilities.

9 ENVIRONMENT AND SOCIAL MANAGEMENT PLAN

9.1 INTRODUCTION

ADB Environmental Safeguards requires the project proponent to prepare an environmental management plan which addresses the identified potential impacts and risks. The importance of managing social and environmental performance throughout the life of a project is also highlighted by the IFC Performance Standard-1.

An effective environmental management system is a dynamic, continuous process initiated by management and involving communication between the project proponent, the workers, and the local communities directly affected by the project. The EMP includes proposed mitigation measures, environmental monitoring and reporting requirements, training measures, implementation schedule and cost estimates.

RSSPL is committed to execute all construction and operation related activities for the proposed Solar PV Project as per the best established environmental, health and safety (**Annexure IV- ReNew Power 'EHS Policy'**) standards and also it should be aligned with upcoming project to be implemented at asset level. Mitigation measures are proposed for impacts which are identified and quantified. Some residual impact will however persist after the all mitigation measures are employed, the Environmental and Social Management Plan intends to delineate monitoring and management measures to minimize such impacts by allocating management responsibility and suggesting skill requirement for implementation of these measures during construction and operational phase.

9.2 REGULATORY AGENCIES

The authorities / agencies to be coordinated for ESMP implementation include the following:

- District Administration of Karimnagar District;
- District Forest Department, Karimnagar West;
- Telangana State Pollution Control Board;
- Telangana State Electricity Board;
- Central Electricity Authority;
- Factory Inspectorate, etc.

9.3 ENVIRONMENT & SOCIAL MANAGEMENT SYSTEM (ESMS)

ReNew power is already in process to develop a standard Environment & Social Management System (ESMS) for all his subsidiaries. This corporate Level ESMS standard process should guide project level decision making taking into account overall risk and environmental impacts and ensure that appropriate plans, implementation methods and monitoring frameworks are in place to prevent, mitigate and reduce risks / impacts that may arise from project activities. The Environment and Social Management Plan (ESMP) provided in the subsequent sections should be operationalized within the framework of the corporate level ESMS system.

9.3.1 Organization, Roles and Responsibilities

The corporate ESMS of ReNew is responsive to the overall structure and culture that exists in the organization. The organizational structure shown below provides a framework to foster communication and effective working relation between corporate and project level.

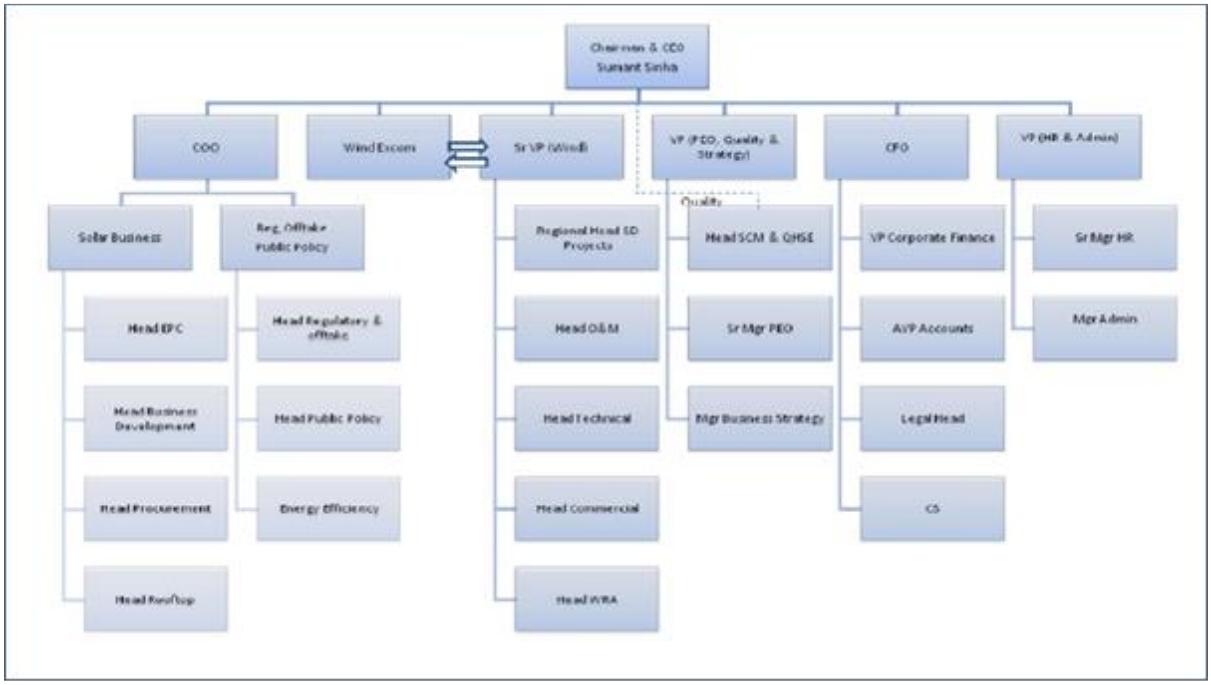


Figure 9-1: Corporate Level Organizational Structure

Regional EHS reporting to Corporate QHSE and Project Manager should look after the compliance of the ESMMP at site level. The proposed organizational structure to implement the project and ESMP is as follows.

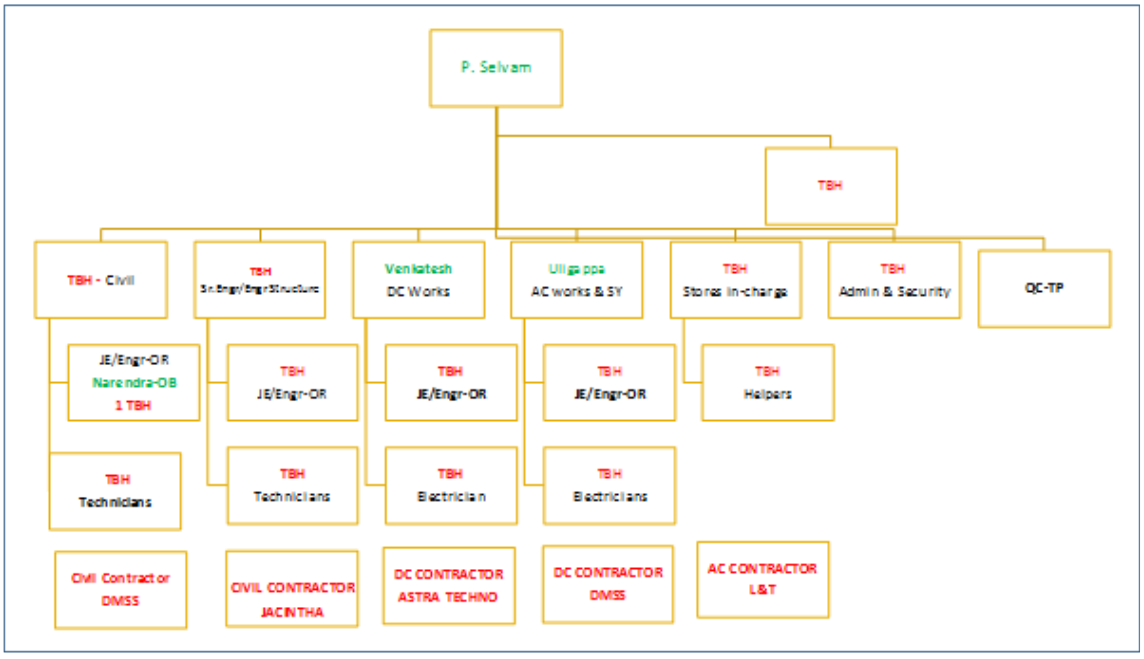


Figure 9-2: Organizational Structure for Project Management

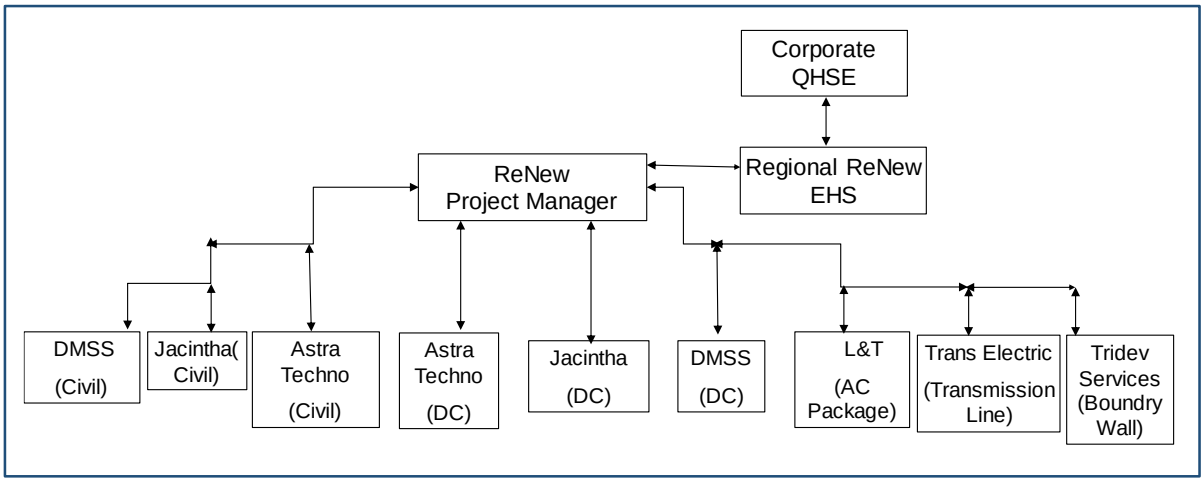


Figure 9-3: Organizational Structure for ESMS Management

The usual activities of the EHS manager and his team should be as following:

- Ensuring availability resources and appropriate institutional arrangements for implementation of ESMP;
- Compliance of legislative requirements and ADB safeguards;
- Carryout audits, and inspection of all the project activities through site engineer;
- Preparation of necessary documents and record keeping system through site engineer;
- Review and updating of ESMP for effective implementation.

9.3.2 ESMS Committee

ESMS committee is formed at corporate level to review the performance of project on environmental, health, safety and social aspects. Regular updation of ESMS is the responsibility of ESMS committee in addition to support the top management system to achieve the goal as committed in the Policy. ESMS committee is formed of one member from HR, Finance, Project and QHSE departments. The QHSE Head is the ESMS Coordinator for implementing this ESMS and will need to interface with several other departments to ensure smooth and efficient functioning of the ESMS.

9.3.3 Contractors Management

Prior to assigning any contract, RSSPL pre-qualify each contractor according to commercial, technical, quality assurance and its past performance on EHS standards so as to satisfy RSSPL's requirements.

RSSPL should ensure that the job specific training and EHS Induction Training needs are identified based on the specific requirements of ESMP and existing capacity of site and project personnel (including the Contractors and Sub-contractors) to undertake the required actions and monitoring activities.

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

An environmental and social management training programme should be conducted to ensure effective implementation of the management and control measures during construction and operation of the project. The training programme should 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; etc.

A basic occupational training program and specialty courses should be provided, as needed, to ensure that workers are oriented to the specific hazards of individual work assignments.

Training should be provided to management, supervisors, workers, and occasional visitors to areas of risks and hazards. Workers with rescue and first-aid duties should receive dedicated training so as not to inadvertently aggravate exposures and health hazards to themselves or their coworkers.

Through appropriate contract specifications and monitoring, the employer should ensure that service providers, as well as contracted and subcontracted labour, are trained adequately before assignments begin. Turnkey Contractor shall ensure that the sub-contractors provide the basic facilities and infrastructure to their worker as per Contract Labour regulation and abolition act 1970 Chapter V-Health and Welfare of Contract Labour.

- Principal employer should have labour registration certificates for 500 people working at site and shall issue form V to the principal contractor
- Principal Contractor should have the labour license for the number of labours as mentioned in the labour registration certificate of principal employer.
- All Main, Sub and Sub Sub-contractor employing more than 20 needs to have labour License
- All the contractors irrespective of no. of employee needs to have PF, ESI registration and monthly compliance and other labour law related matter. The necessary list of compliance and documentation should be the part of contract.
- Every sub-contractor should be responsible for payment of minimum wages ax per prevailing rule to each worker employed by him as contract labour and such wages should be paid before the expiry of such period as may be prescribed.
- Labour camps to be set up for construction workers outside the plant boundary.
- Sub-Contractor has to sign leasing / rental agreement with respective land owners and submit the copy of the contract agreement to the main contractor for records.
- Rest Rooms (Urinals / Latrines) sufficiently ventilated, lighted with water facility for male and female should be provided separately.
- Proper drainage / soak pit arrangement should be made.
- Storm water drain as per approved design of the project shall be provided at site.
- Adequate drinking water should be arranged.
- Canteen facilities wherein contract labour numbering one hundred or more is ordinarily employed by a contractor.

- Temporary sheds should be arranged for labours to take food during working hours at different locations inside the site.
- First aid box with prescribed contents should be made available at distinguished places.
- Tie up with nearby hospitals having ambulance facility and anti-venom injections should be made by Principal Contractor and site Safety officer shall be responsible to organize as when needed.
- Safety Induction Training should be imparted for all the workers
- Attendance register (IN/OUT) for all main contractor and sub-contractor's employees / workers should be maintained at Security Post.
- There is no hot work involved in setting up of solar power plant and it comes under C class fire hazard, required fire extinguishers should be maintained at the work place.
- Personal Protective equipment (PPE) should be made available and mandatory to use at site.

9.3.4 ESMP Review and Amendments

The ESMP provided with this report is an environment management tool which needs to be reviewed periodically to address changes in the organization, process or regulatory requirements.

9.3.5 Inspection, Monitoring & Audit

In order to implement the ESMP effectively, the on-site team should develop a time-bound and action oriented Environmental and Social Action Plan to implement the mitigation measures provided for each of the identified environmental and social impacts. ESMP compliance should be monitored on a half-yearly and all outcomes would need to be audited in accordance with existing EHS commitments as per **Annexure V**. Environment and Social Action Plan should be in line with ReNew Power's Integrated ESMS Plan. The action plan should also be aligned with integrated ESMS as being developed to have a common approach for all the projects.

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

9.3.6 Reporting and Review

RSSPL should develop and implement a programme of reporting through all stages of the project - construction and commissioning, operation and decommissioning. Contractors required to fully comply with the reporting requirements in terms of timely report submission with acceptable level of details. Reporting should be done in form of environmental, health, safety and social check list, incident record register, environmental, health, safety and social performance reports (Six Monthly basis).

9.3.7 External Reporting and Communication

All complaints and enquiries should be appropriately dealt with and records be maintained in Complaint / Enquiry Register by Site Officers / Regional EHS Office or other delegated staff. RSSPL should also submit annual monitoring reports to financial institutions on the progress of implementation of the ESMP. RSSPL should undertake annual inspections in order to verify compliance with the ESMP and progress towards the expected outcomes. Necessary corrective actions should be identified based on the verifications and a corrective action plan should be formulated. RSSPL should ensure effective implementation of these corrective actions and submit periodic monitoring reports to ADB.

9.3.8 Internal Reporting and Communication

Inspection and audit observations along with their improvement program should be regularly reported to the senior management for their consideration. The same should also to be communicated within the staff working on the project. To maintain open communication between the staff and management on EHS&S issues the following can be used:

- Team Briefings,
- On-site work group meetings;
- Work Specific Instructions; and
- Meeting with stakeholders.

9.3.9 Documentation and Record Keeping

Documentation and record keeping system should be established by RSSPL through turnkey contractor to ensure updating and recording of requirements specified in ESMP. Responsibilities have to be assigned to relevant personnel for ensuring that the ESMP documentation system is maintained and document control is ensured through access by and distribution to identified personnel in form of the following:

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

9.3.10 Proposed Environment and Social Management Plan

An Environment and Social Management Plan has been developed following the delineation of impacts and mitigation measures. These measures should be adopted by the project proponent and imposed as conditions of contract of the sub-contractor employed for respective phases of this solar power project. The mitigation measures suggested during operation should be made part of the regular maintenance and monitoring schedule. Environment and Social Management & Monitoring Plan as developed for the proposed project is Tabulated at next page.

9.3.11 Feedback Mechanism

The key indicators from various monitoring should be helpful in refining the mitigation measures suggested and also for introduction of new measures as required. The key indicators on the status of project during the various stages of the project are:

9.3.11.1 Construction

Grievance redressal should be the key indicator to assess community concerns, concerns of women and behavioral issues of workers. The EHS supervisor should assess the basic behavior of workers at site towards local community, women and other workers. The inputs from EHS supervisor can determine the need for extent and frequency of briefing and training on local customs, respect for women and code of conduct to be imparted to the workers. The liaison officer should continuously interact with the community and land aggregators to address the key concerns.

Incident reporting mechanism should be a key indicator for the Health and Safety aspects of the site. The safety Officer either directly or through EHS supervisor should verify the capability of the contractors / sub-contractors to implement the EHS requirement. The need for training and scope for improvement shall be charted internally and implemented. RSSPL should focus on incident reduction and follow up measures.

Internal Audits of the site should be carried out on periodic basis. Internal Audit on bi-annually basis should be undertaken after the construction work is fully initiated. The Audit reports and the corrective actions submitted should be implemented in a time bound manner by RSSPL under the guidance of the corporate EHS head.

Debris removal of site: Restoration of site post construction is a key indicator for the lenders and RSSPL to assess the commitment to environment. Removal of debris and vegetation in open or unutilized areas should be undertaken in a time bound manner.

9.3.11.2 Operation

Grievance Redressal should be a key indicator for community concerns and to understand the effectiveness of CSR programs planned/implemented. It should also provide an assessment of behavior of security staff with the local community, especially women.

Table 9-1: Environment and Social Management & Monitoring Plan

Impact Identified	Suggested Mitigation	Monitoring / Training	Management Responsibility	Cost Estimate and Timeline
Construction Phase				
Land Resources				
• Land use Change • Aesthetic Change • Contamination	• Tracking system of solar mounting require minimum leveling • Hazardous material / waste should be stored in a separate designated space • No significant change in land use is expected due to proposed development	• Workers handling hazardous material to be briefed about the need to prevent contamination	• Should be implemented with EPC contractor	Normal Practice for complete erection stage
Soil Characteristics				
• Erosion and compaction • Contamination	• Loose soil should be protected from wind and runoff by covering / watering / other means of covering • Unutilized / Open area should be suitably re-vegetated at the earliest • Use of existing track for transport of man and material to the extent possible	• RSSPL representative should observe all the activities closely as and when on storage and handling of construction material is proposed • Vehicles should be mandated to use of dedicated tracks within the site • Workers should be trained on handling and storage of fuel and hazardous waste by contractor	• Should be implemented with EPC contractor Site supervisor / Engineer to make observations and convey it to the contractors and Project Head. • Deputed regional EHS / site engineer of RSSPL should monitor the implementation of	Normal Practice for complete implementation stage

Impact Identified	Suggested Mitigation	Monitoring / Training	Management Responsibility	Cost Estimate and Timeline
	• All construction material should be kept within the footprint of the proposed site area • Painting of switchyard structures should be undertaken after covering the land beneath with a sheet of impervious material as per the requirement. • Re-fueling of machinery at site should be undertaken over paved / suitable surface • In case of any accidental spill the soil should be cut and stored securely for disposal with hazardous waste	• Workers handling painting activity should be briefed about the need to prevent contamination	ESMMP and report to RSSPL on half yearly.	
Waste Disposal				
• Accumulation of construction waste • Unhygienic condition for labours • Hazardous waste from machinery, generators etc. (lube oil, hydraulic oil, waste oil etc.) • Defunct solar panels	• Construction debris should be utilised for levelling of the land and unused debris shall be disposed-off to nearest TSDF / waste disposal site. • Renew is in discussion with one Chennai based vendor for recycling of defunct solar panels and accessories	• RSSPL should brief the specific needs as per Host Country's requirement for further execution, as and when required. • Workers should be instructed to maintain neat, clean & hygiene at the use of facilities • Contractors should be briefed about the need for proper storage and disposal of construction waste	• Contractors should be abided with Hazardous Waste (Management, Handling and Trans boundary Movement) Rules, 2008 and amendments thereof • Site Engineer should make observations	• Should be incorporated as part of project budget, no additional cost is envisaged. • During Construction phase

Impact Identified	Suggested Mitigation	Monitoring / Training	Management Responsibility	Cost Estimate and Timeline
• Soil and land contamination due to accidental leakage • Run off into rainwater channels	• Proper sanitation and sewage facility in terms of septic tank with soak pit should be provided. • Nearby municipality should also be contacted for regular disposal of the labour camp waste. • Other wastes like wood packaging material, metal, jute, etc. can be sold to scrap dealers/ buyers. • Random stocking of raw material, storage of debris, piling of loose soil etc. should be strictly controlled. • Portable toilets / suitable arrangements with septic tank-soak pit arrangement should be provided for workers • Hazardous waste (like used oil, paint tins, etc.) should be stored at designated place and only be sold to CPCB authorized vendors.		and convey it to the contractors. • Half Yearly report of EHS supervisor to include the compliance and observations if any.	
Water Resource and Quality				

Impact Identified	Suggested Mitigation	Monitoring / Training	Management Responsibility	Cost Estimate and Timeline
• Water resource depletion due use of water for construction activities • Change in micro level drainage pattern • Run off into rainwater channels and drains passing through the site and ultimately into nearby surface water body • Wastage of water and sewage discharge from labour camp	• Water for construction and consumption to be arranged by the suitable local contractors through authorized tanker water suppliers. • Adequate arrangement for storm water management in identified area during construction period should be made to avoid sediment run off from the site. • Storm water flow during monsoons should be directed to the existing suitable channels. • Natural flow and topography of the drains as flowing inside the project boundary should be maintained • Tracking system based solar panel erection requires very minimum leveling. Therefore, natural run-flow will remain intact. • Septic tank with soak pits should be provided at site to facilitate	• Daily consumption of water should be recorded. • Storm water arrangements should be monitored for clogging as and when required • Water quality monitoring of the drainage located inside plant boundary and one adjacent to plant site should be conducted for any mishap observed on six monthly basis • Performance parameters are EC, TSS, TDS, Oil & Grease, Total Coliforms, BOD, etc. • Workers should be instructed about optimal use of water	• Conditions should be the part of contract with the EPC contractor • Site Engineer or regional HSE manager should make observations and convey it to the contractors • Report of Site Engineer / EHS regional engineer should be sent to EHS head	• Water quality monitoring cost– INR 12,000 per sample • During Construction phase

Impact Identified	Suggested Mitigation	Monitoring / Training	Management Responsibility	Cost Estimate and Timeline
	the sewage generated from labour area.			
Ecology				
• Clearing of vegetation • Cutting of trees • Disturbance to avifauna, small mammals	• Tree cutting or shrub clearance should be limited to those directly affecting solar panel exposure • Workforce should be instructed to avoid any other activity likely to affect the local flora & fauna • Movement of construction and transport vehicles should be restricted to dedicated paths to minimise any harm to small mammals	• Visual damage loss inspection should be undertaken by Site Engineer • Construction contractor should instruct and inform workers about need to refrain from activities that may adversely affect the ecology	• Site supervisor / Engineer should take care of this aspect • Should be the part of EPC Contract	• Precautions need to be taken care for full construction phase
Traffic and Transport				
• Movement of additional vehicles leading to congestion and accidents • Break-down and Improper halt of vehicles • Discomfort due to air and noise pollution	• Vehicle movement and parking within the project premises should be managed properly to avoid accidents • Routes for use by construction traffic should be planned to minimize impact on adjoining activities.	• No village road should be utilized for the project. If any such condition arises proper NoC from Panchayat shall be taken. • Necessary training to the driver of construction vehicles for speed restrictions	• Site supervisor/ Engineer should provide the training • Should be mentioned in the contract with the construction contractor	• Per Training Cost- INR 25,000/- • Regular maintenance of vehicle and up keep of roads should be included in O&M budget • For all construction related activities

Impact Identified	Suggested Mitigation	Monitoring / Training	Management Responsibility	Cost Estimate and Timeline
due to raw materials transportation • Damage to road and related structure from heavy vehicles	• Dedicated path within the site for exclusive entry and exit of the construction vehicles should be provided. • Only PUC certified vehicle should be deployed • Construction material should be transported in covered trucks • Transportation should be undertaken along pre-identified paths. • High noise generating activities should be restricted to day time (07:00 to 22:00 hours) with proper mitigation measures.	• Drivers should be assessed for their knowledge on traffic rules before engagement. • During the construction phase number of vehicles as well as any incidents and accidents need to be reported and their outcomes should be monitored.		during construction and operation phases.
Air Quality				
• Fugitive dust • Emissions from diesel engines / vehicles	• Regular water sprinkling while undertaking dust generation activities • Work should be avoided during high wind speed time • Construction material should be covered to prevent any fugitive dust from these areas	• Awareness should be developed among the site workers for fugitive dust management	• Site supervisor / Engineer should regularly coordinate and super-wise the work • Monitoring agency should take out the monitoring work • Should be incorporated in the	• Water tankers would cost INR 1200-1600 per tanker (15,000-20,000 liters) • Throughout construction phase

Impact Identified	Suggested Mitigation	Monitoring / Training	Management Responsibility	Cost Estimate and Timeline
	• Regular maintenance of construction machineries • Deployment of only PUC certified vehicles • Flyable Construction material should be transported in covered trucks only • Vehicle speed should be restricted to 30km/hour at site to minimize potential for dust emission in the surroundings		contract with contractor	
Noise and Vibration				
• Disturbance to habitations • Disturbance to fauna • Occupational Hazard	• Only well maintained equipment (Compliant to CPCB noise standards) should be operated on site • DG sets should only be used for emergency power / backup • Temporary noise barriers should be provided surrounding the high noise generating construction machineries • Scheduling of the construction activities	• Arrangements / facilities for noise reduction should be monitored as and when required • Schedule of activities should be discussed and finalized between site manager and the contractor	• Site Engineer should take care of the compliance of ESMMP • Third party monitoring agency can be engaged for Noise Monitoring • External training on use of PPE should be the responsibility of EPC Contractor	• Throughout construction phase

Impact Identified	Suggested Mitigation	Monitoring / Training	Management Responsibility	Cost Estimate and Timeline
	• Loud, sudden noise emissions to be avoided wherever possible. • Personal protective devices for site workers working near high noise equipment			
Cultural				
• Cultural differences amongst workers	• To the extent possible sourcing of construction labour should be done from local region by contractor for unskilled activities	• Workers should be briefed about need for cooperation and harmony with the community	• EPC Contractor	Normal Practice
Health and Safety				
• Working at height • Operation of heavy machinery • Accidents leading to injuries fatalities • Occupational health hazards	• Operation of loading–unloading equipment should be undertaken under the guidance / supervision of trained professional • Sufficiently competent person should be engaged in driving or operating construction machineries • Should ensure effective work permit system for hot-work, electrical work, working at	• Proper training of the workers regarding health and safety procedures • Workers should be trained through sub-contractors regarding use of Personal protection equipment and its importance. • Operation of Cranes shall normally be limited for transmission line as per requirement. Crane (If required) should be operated as per contractor's Crane Safety Plan only.	• Site Manager / Engineer should ensure compliance of safety guidelines • Safety Officer of contractor should be responsible for implementation of safety guidelines • To form part of the contractor's contract	• Training of workers will be mostly given by internal resources. INR-25,000/- has been kept for each training • Throughout Construction phase

Impact Identified	Suggested Mitigation	Monitoring / Training	Management Responsibility	Cost Estimate and Timeline
	height, working in confined space etc. • Should ensure personal protective equipment for all personnel present at site are made available • Arrangement for fire control measures • Display of Emergency phone numbers at site. • Should ensure good house-keeping at the construction site to avoid slips and falls.			
Social				
• Expectations for infrastructure development benefits	• RSSPL's officials should communicate and discuss with the community in a transparent manner on a regular basis and demonstrate their concerns. • Consultation with women's groups should also be held during construction and operation phases to listen to their issues and concerns regarding labour, health and safety etc. as well as to solicit	• RSSPL should hold regular consultations with appropriate stakeholders. • All concerns must be addressed through systematic process.	• RSSPL Site Engineer	Normal Practice

Impact Identified	Suggested Mitigation	Monitoring / Training	Management Responsibility	Cost Estimate and Timeline
	their ideas on various community initiatives.			
• Local Employment	• Assess the exact number of workers should be required at each stage through contractor / own resource in the construction period. • Should ensure priority is given to local people for short term / long term employment opportunities, based on required skill and education level.	• Explore possibilities of training and capacity building to enable the community to be able to secure the available jobs and contracts, as per the applicability and requirement of the business. • RSSPL should explore possibility to engage women in appropriate work as per the applicability during construction phase.	• EPC contractor in discussion with RSSPL regional HSE Manager should assess potential for engagement of local community and for women.	Normal Practice
• Demands for materials	• Should ensure local contracting and vendor opportunities aligned with the scope and demand as far as possible		• RSSPL / Contractor	Normal Practice
• Livelihood loss due to acquisition of land for the project	• Site is selected in such a manner that majority of land portion is owned by persons who involved in other livelihood generation activities like job in abroad and business. • Compensation paid for the land is more than market rate. Therefore, affected land owners	• Fair Compensation Policy	• Deputed Executive	Normal Practice

Impact Identified	Suggested Mitigation	Monitoring / Training	Management Responsibility	Cost Estimate and Timeline
	may purchase more than the land sale. That too be in better vicinity.			
• Access Issues due to merger of one Kutcha Road in proposed plant site	• Alternative road along the periphery of the plant site shall be provided for village road passing through the northern side of site to avoid any inconvenience to nearby farmers.	• Alternate route should be constructed before closing the existing route	• Deputed Executive	-
• Influx of migrant labour • Excess load on existing resources • Spread of communicable disease	• Local labour should be preferred for unskilled work • Awareness camp for communicable disease understanding • Medical camp as part of CSR activities	• Awareness training for applicable regulatory regulations	• RSSPL's Site In-charge through EPC Contractor	INR 25,000/- Per training camp INR 1,50,000/- Per Medical Camp
Operation Phase				
Waste Generation				
• Used Oil • Dielectric fluids, cleaning agents, and solvents • Defunct / damaged photo voltaic cells	• Should earmarked designated areas for storage of waste separately • Waste should be given to approved recyclers in a systematic approach	• Training and briefing of the staff involved in waste management	• Plant manager and Safety Engineer	• Normal Process • Training budget of INR 25,000/- Annum

Impact Identified	Suggested Mitigation	Monitoring / Training	Management Responsibility	Cost Estimate and Timeline
	• ReNew is in discussion with one Chennai based vendor for recycling of the defunct Solar Panel and accessories.			
Ecological Impact				
• Distraction due to Glare / Visual intrusion • Routine clearance of vegetation	• Clearing should be limited for affected area only	-	• Plant EHS or Safety Officer	-
Water Resources				
• Depletion of water quality due to oily run-off from plant area to drainage passing through and ultimately to the water body locates adjacent to the project site • Catchment area disturbance of surface water body located adjacent to plant site • Ground water extraction	• Natural slope of the site shall remain maintained as tracking mounting structures require very less topographical correction • Used oil and Waste should be stored in separate designated areas to avoid any contamination due to run-off • Avoidance of water wastage to the maximum extent • Proper storm water facility	• Regular water quality monitoring of adjacent water body • Extraction after requisite permission • Regular check on water use quantity • Awareness campaign for effective use of water	• Plant EHS or Safety Officer	-

Impact Identified	Suggested Mitigation	Monitoring / Training	Management Responsibility	Cost Estimate and Timeline
• Water Logging • Water Discharge				
Soil Quality Degradation				
• Accidental spillage of oils	• Storage of hazardous materials or waste in separate designated areas • Adequate drainage facility to drain out run-off	• Regular upkeep and record management of hazardous materials	• Plant EHS or Safety Officer	-
Health and Safety				
• Electromagnetic field • Accidents leading to Injury / fatality • Fire Risk	• Workers handling electricity and related components should be provided with shock resistant gloves and shoes • Fire extinguisher in accident prone areas	• Health and safety awareness training on regular interval • Safety incidents should be recorded and monitored with an aim that numbers are never significant, and gradually reduce.	• Plant EHS or Safety Officer	-
Social Aspects				
• Local Economy • Upgradation of infrastructure	• Should boost the local economy though local contracting up to the maximum extent • Infrastructure upgradation as part of CSR	-	• Environment and Social Team	Continuous improvement
Decommissioning Phase				
• Impacts due to disposal of panels,	• Dismantling activities should be taken care by experienced professionals	-	• Plant EHS or Safety Officer	-

Impact Identified	Suggested Mitigation	Monitoring / Training	Management Responsibility	Cost Estimate and Timeline
• Contamination of soil, • Generation of wastes and associated health and safety risks	• All the dismantled infrastructures and debris should be segregated and stored separately			

10 CONCLUSION AND RECOMMNEDATION

The ESIA has assessed the overall impacts on Environmental and Social components as a result of construction and operation of proposed 30MW Solar PV Power Project at Vangara Village, Mulkanoor of Telangana State. Most of the impacts due to project is minimal, site specific and reversible in nature. Site selection was done in a such a manner that minimum numbers of land owners will get affected by the project. Majority of site land portion is owned by persons who involved in other livelihood generation activities like job in abroad and business. Compensation paid for the land is more than market rate. Therefore, affected land owners may purchase more than the land sale. Impact associated with catchment area disturbance will mitigated by minimum alteration of land topography by the use of tracking mounted structure. Regular water quality monitoring of the adjacent water body is proposed to have a regular check on project impacts.

The proposed Environmental and Social Management Plan describes implementation mechanism for recommended mitigation measures together with monitoring to verify overall project performance. Mitigation measures for potential impacts on physical, social and biological aspects of the environment have been specified through:

- Adequate arrangements for construction safety, stakeholder engagement and grievance redress mechanism;
- Stringent adherence to Health and Safety requirements; and
- Obtaining requisite permits for the proposed project.

Based on the ESIA study, as per ADB's Environment Categorization of Projects the proposed Solar PV power project can be classified as a Category B for Environment as the project will have adverse environmental impacts that are less in number, generally site specific and readily addressed through mitigation measures. In addition, the project is also classified as Category B for Involuntary Resettlement and Indigenous People as no involuntary resettlement and indigenous people are anticipated to be affected by the project activities. In reference to IFCs categorization of projects. Over all proposed project can be categorized as Category B, which specifies that the project can cause potential and limited adverse social or environmental impacts which are generally site-specific, largely reversible and readily addressed through mitigation measures.

The rationale for categorization being:

- Overall the project being a Solar PV Power Project is a green project and does not have significant adverse impacts associated with the construction or operation activities;
- The land required for the project is being procured / acquired on one to one negotiation basis;
- One village kutcha road is merging in proposed site. This route being altered in discussion with the community to avoid any inconvenience to the users;
- There are no indigenous communities being affected in the project area;
- The project does not involve diversion of any forest land. Therefore, ensuring minimal impact on ecology during the construction and operation phase of the project

The project will throw opportunities to local people for both direct and indirect employment. The project will provide impetus to industrialization of the area. Ribbon development will increase the

economy and revenue potential of the region. It is expected that project development will also be helpful in development of surrounding and State & Country at large.