Initial Environmental Examination

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India: Rajasthan Renewable Energy Transmission Investment Program (Tranche -1)

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Abbreviations

ADB	:	Asian Development Bank
ASEI	:	Asia Solar Energy Initiative
ASI	:	Archaeological Survey of India
CAZRI	:	Central Arid Zone Research Institute
DC or D/C	:	Double Circuit
DPR	:	Detailed Project Report
EA	:	Executing Agency
EHV	:	Extra High Voltage
EIA	:	Environmental Impact Assessment
EMoP	:	Environmental Monitoring Plan
EMP	:	Environmental Management Plan
GoI	:	Government of India
GoR	:	Government of Rajasthan
GRM	:	Grievance Redress Mechanism
GSS	:	Grid Sub Station
IA	:	Implementing Agency
IEE	:	Initial Environmental Examination
IGNP	:	Indira Gandhi Nahar Pariyojna (Indira Gandhi Canal Project)
IIT-R	:	Indian Institute of Technology Rajasthan, Jodhpur
IMD	:	India Metrological Department
JNNSM	:	Jawaharlal Nehru National Solar Mission
MOEF	:	Ministry of Environment and Forests
MOP	:	Ministry of Power
MSL	:	Mean Sea Level
NIT	:	Notice of Inviting Tender
PGCIL	:	Power Grid Corporation of India Limited
PLF	:	Plant Load Factor
PTCC	:	Power Telecom Co-ordination Committee
R & D	:	Research and Development
Ramgarh GTPS	:	Ramgarh Gas Thermal Power Station
RE	:	Rural Electrification
RIICO	:	Rajasthan State Industrial Development and Investment Corporation
ROW	:	Right of Way
RRECL	:	Rajasthan Renewable Energy Corporation Limited
RRVPNL	:	Rajasthan Rajya Vidyut Prasaran Nigam Limited
RSPCB	:	Rajasthan State Pollution Control Board
SEZ	:	Special Economic Zone

Weights and Measures

Bigha	:	Measurement of land area (1 Bigha =1618 sq m in western Rajasthan)
Cusec	:	Measure of flow rate (28.317 litres per second)
ha. (hectare)	:	10,000 sq m
GW	:	Giga watt
km (kilometre)	:	1,000 m
kV	:	kilovolt (1,000 volts)
kW	:	kilowatt (1,000 watts)
kWh	:	kilowatt-hour
MW	:	Mega Watt
Ppm	:	Parts per million

EXECUTIVE SUMMARY

1. ADB is proposing to extend a multi-tranche financing facility to the Government of Rajasthan under the Rajasthan Renewable Energy Transmission Investment Program. The project will support evacuation of power from Western Rajasthan including the facilities coming up at the 250 MW Phase 1 of the Bhadla solar park, Jodhpur district, Rajasthan for which Rajasthan Renewable Energy Corporation (RREC) is the nodal agency.

2. The project activities would support cost-effective development of renewable energy resources in Rajasthan. The project will develop the transmission infrastructure to evacuate renewable energy in a reliable manner from private solar and wind power plants to be located in western Rajasthan to the national grid. It is expected that western Rajasthan could site over 4,200 megawatts (MW) of solar and wind power plants including at the Bhadla solar park over the next five years. Table below gives the list of project Tranche 1 components and summary of environmental issues.

Tranche 1 Components and Summary Environmental Issues

No	Subproject	Environmental Issues
Component A - New Transmission Lines – 400/220/132 kV lines		
I	400 kV double circuit 160 km long transmission line from 400/220/132/33 kV GSS Bhadla to LILO point at 400 kV S/C Jodhpur-Merta line.	Line has no land issue, no sanctuary/reserve forest within 10 km vicinity of the line alignment. No Land acquisition required
II.	400 kV double circuit 180 km long transmission line from 400/220/132/33 kV Ramgarh GSS to 400/220/132/ 33 kV Bhadla GSS.	Line has no land issue, no sanctuary/reserve forest within 10 km vicinity of the line alignment. No land acquisition required.
III.	400 kV double circuit 100 km long transmission line from 400/220/132 kV Akal GSS to 400/220/132/33 kV Ramgarh GSS.	Line has no land issue, no sanctuary/reserve forest within 10 km vicinity of the line alignment. No land acquisition required.
Component B - New Grid sub-stations - 400/220/132 kV		
IV	New 400/220/132 kV GSS at Bhadla.	25.89 ha. land already allotted to RRVPNL by state government. No wildlife sanctuary or ecological sensitive area within the 10 km vicinity of the substation.
V.	New 400/220/132 kV GSS at Ramgarh.	23.46 ha. land already given on lease to RRVPNL by state government. No wildlife sanctuary or ecological sensitive area within the 10 km vicinity of the substation.
VI	Existing and under construction 220 kV GSS at Bap (District Jodhpur) and associated 220 kV and 132 kV lines	Line corridor for proposed 400 kV Bhadla – Merta (Jodhpur) line used for the LILO and 220 kV line. Line has no land issue, no sanctuary/reserve forest within 10 km vicinity of the line alignment. GSS under construction, no land acquisition required.
VII	220 kV GSS at Kanasar (District Jodhpur) and associated 220 kV and 132 kV lines.	Line corridor for proposed 400 kV Bhadla – Merta (Jodhpur) line used for these LILO and 220 kV lines. Line has no land issue, no sanctuary/reserve forest within 10 km vicinity of the line alignment. Government land used for GSS land, no land acquisition required.
COMPONENT C - Augmentation of Grid Sub-stations – 400 kV/220/132/33 kV		
VIII	Augmentation of 400/220/132 kV Akal GSS.	Civil work within existing Akal grid substation. No associated environment and social impacts.
IX	Augmentation at 400 kV Bikaner GSS.	Civil work within existing Bikaner grid substation. No associated environment and social impacts.
COMPONENT D - Transformer package – 400/220/132 kV at GSS		
X	Transformer package for Ramgarh, Bhadla and Akal GSS.	No associated social and environment impact as no civil work required.
COMPONENT E - Shunt Reactor packages – 400/220/132 kV at GSS		
XI	Shunt Reactors package for Ramgarh, Bhadla, Bikaner and Akal.	No associated social and environment impact as no civil work required.
COMPONENT F - New conductors for new Transmission lines in COMPONENT I above.		
XII	400 kV Conductor for 400 kV lines in Component A - I, II and III.	No social and environment impact as no civil work required.
COMPONENT G - Up-gradation of 132 kV GSS		
XIII	Upgradation to 132 kV grid substation with 132/33 kV, 2x20/25 MVA Transformers with associated 132 kV line	No associated social and environment impact as no civil work required.
COMPONENT H - Charging of 132 kV lines at existing sub-stations		
XIV	Charging of 132 kV transmission lines	No associated social and environment impact as no civil work required.

Source: Revised power evacuation system of new solar & wind power plants in Jaisalmer, Barmer and Jodhpur Districts, RRVPNL

3. The two new GSS's are proposed to be set up on government land and therefore acquisition of land will not be required from the surrounding communities. Since the proposed Bhadla and Ramgarh GSS land is barren with some scrubs and weed plants, there is no need for removal of trees. Larger extent of proposed 400 kV transmission lines from Jodhpur to Bhadla, Bhadla to Ramgarh and Ramgarh to Akal and 20 kV lines from Bhadla to Bap, Bhadla to Kanasar and other LILO lines runs through single season cultivated lands, uncultivated lands and lesser extend runs through human settlements and parallel to the existing transmission lines.

4. Project benefits outweigh negative impacts. The negative environmental impacts are likely to be associated with land acquisition for sub-stations, construction activities of the sub-stations and power lines and disposal of soil at the solar park land development activities. The location impacts will be comparatively low due to the small forest coverage of the state and ample space available for buffer zones from wildlife habitats (in this case Desert National Park). The main project activities will be construction of GSSs, erection of transmission lines spread over to a large geographical area, and power evacuation scheme in the Jaisalmer and Jodhpur areas from Bhadla solar park and other solar plants in its vicinity. These negative impacts can be mitigated in a cost-effective manner and will not be cumulative.

5. No endangered or protected species of flora or fauna are reported at any of the subproject sites. Adequate provisions have been made for the environmental mitigation and monitoring of predicted impacts, along with their associated costs. Adverse impacts if noticed during implementation will be mitigated using appropriate design and management measures and through the provision of compensation for the temporary loss of crops/trees.

6. According to the MoEF regulation, solar PV and solar thermal plants do not require development of an Environment Impact Assessment (EIA). The Asian Development Bank is assisting REC in development of a Detailed Project Report (DPR). According to Government of India's (GoI) EIA Notification 2009, Power transmission projects are not listed as environmental sensitive projects and hence no clearance is required from Rajasthan State Pollution Control Board (RSPCB) or Ministry of Environment and Forests (MoEF), GoI. Clearance from Rajasthan Forest Department is required only in cases where subproject is constructed on forest land or requires cutting of forest trees.

7. Since the project does not involve activities that have no significant adverse impact, an IEE has been developed an environment impact matrix and environmental management plan as per ADB's Safeguard Policy Statement (SPS) 2009. The IEE report conforms to regional and national environmental regulations and is also consistent with ADB Operations Manual F1/BP and F1/OP (2003), Environment Policy, and Environmental Assessment Guidelines (2003)[1]. Accordingly, the environmental classification for the project is "Category B" as per ADB SPS 2009.

[1] ADB 2003: *Operations Manual, Environment Policy, Environmental Guidelines for Selected Industrial and Power Projects, and Environmental Assessment Guidelines*, Manila.

1.0 INTRODUCTION

1. In May 2010, ADB announced its Asia Solar Energy Initiative (ASEI) to catalyze 3,000 megawatts (MW) of solar power generation projects from 2010 to 2013 with the broad objectives to (i) keep the region abreast with technological developments in solar energy, (ii) identify and develop large capacity solar projects, and (iii) design incentive mechanisms and innovative financing mechanisms for rapid diffusion of solar technology, both grid connected systems as well as distributed stand-alone power generation. Out of the 3,000 megawatts (MW), at least 500 MW is expected to be developed by India with ADB's support.

2. India is bestowed with solar irradiation ranging from 4-7 kWh/square meter/day across the country and certain regions namely the western and southern have high solar incidence. With rapidly growing electricity demand, availability of land and increasing reliance on imported sources of fossil fuel, India has initiated steps to tap into the large potential for solar energy development. In 2010, the Government of India (GOI) launched the Jawaharlal Nehru National Solar Mission (JNNSM) to (i) create an enabling policy framework for deployment of 20,000 MW of solar power by 2022; (ii) ramp up capacity of grid-connected solar power generation to 1,000 MW within three years in the first phase i.e. by 2013 and an additional 3,000 MW by 2017 in the second phase through the mandatory use of the renewable purchase obligation by utilities backed with a preferential tariff; (iii) deploy 20 million solar lighting systems for rural areas by 2022; and (iv) create favourable conditions to enhance solar manufacturing capability, particularly solar thermal for indigenous production and market leadership. Achieving the ambitious target for 2022 of 20,000 MW will be dependent on the lessons learnt during the implementation of the first two phases, which could lead to conditions of grid-competitive solar power. The transition could be appropriately scaled up through capacity development of all the stakeholders related to issues of technology, finance, project management and policy development.

3. JNNSM envisages setting up utility scale solar power generation plants through the promotion and establishment of solar parks with dedicated infrastructure by state governments, among others, the governments of Gujarat (GoG) and Rajasthan (GoR). The development of solar parks will streamline the project development timeline by letting government agencies undertake land acquisition and necessary permits, and provide dedicated common infrastructure for setting up solar power generation plants, that is expected to reduce the project development cost. This approach will facilitate the accelerated installation of solar power generation capacity while reducing costs by addressing issues faced by stand-alone projects. Common infrastructure for the solar park includes site preparation, power evacuation, availability of water, access roads, and security services etc.

4. The Government of Rajasthan (GoR) through the Government of India (GoI), has requested the Asian Development Bank (ADB) for a Multi-Tranche Financing Facility (MFF) to finance the power sector investment program in the state. The investment program covers investments for transmission of clean energy to national grid of India by construction of grid sub-stations and Extra High Voltage (EHV) transmission lines.

5. GoR and Rajasthan Rajya Vidyut Prasaran Nigam Limited (RRVPNL), the state power transmission utility licensed to operate in the state of Rajasthan, will be the executing agency (EA) for the project. RRVPNL will also be responsible for supervising project implementation and monitoring of project operational performance. The RRVPNL will establish a Project Management Unit (PMU) for implementing the ADB loan. A Committee will be constituted by the Department of Energy, GoR to promote and facilitate overall coordination between RRVPNL and Rajasthan Renewable Energy Corporation (RREC), the State Nodal Agency for promotion and development of renewable energy sources, for smooth implementation of the project and review the progress and achievement of the

project.

1.1 Background

6. The project activities would support solar power development in a cost-effective manner in Rajasthan. The project outcome is the development of a reliable evacuation system for power from various renewable energy projects coming up in western Rajasthan including at the Bhadla solar park.

7. Physical outputs under the Investment Program include the construction of three grid substations (400/220/132 kilo Volt) and associated facilities at Bhadla, Ramgarh and Jaisalmer; the construction of associated automation and control infrastructure, the construction of nine grid substations (9 220/132 kV) and associated facilities at Bap, Kanasar, Chhatrail, Pokaran, Kolayat, Ramdev Nagar, Badisid, Aau and Bajju; the augmentation of four 400 kilo Volt (kV) grid substations at Akal, Jodhpur, Barmer, Bikaner; the upgradation of 3 substations to 132 kV in Bhadla; and the construction of nearly 1850 km. of 400 kV, 220 kV and 132 kV of transmission lines in Western Rajasthan by RRVPNL. Non-physical outputs include improving institutional capacity and effectiveness, including planning, project management, community involvement, financial management and improved monitoring and reporting.

8. The first project under the Program (Tranche 1 project) will include physical and nonphysical investments. Physical investments the construction of the transmission system, including two grid substations (400/220/132kV) and associated facilities at Bhadla and Ramgarh; two substations (220/132 kV) and associated facilities at Bap and Kanasar; and associated automation and control infrastructure. The investments also include the augmentation of two 400 kV grid substations at Akal and Bikaner, the upgradation of 3 substations to 132 kV in Bhadla, and the construction of nearly 600 km. of 400 kV, 220 kV, 132 kV transmission lines in Bhadla and Ramgarh. The non-physical outputs include project management, training and community outreach work.

9. As per Government of India's (GoI) Environment Impact Assessment (EIA) Notification 2009, Power transmission projects are not listed as environmental sensitive projects and hence no clearance is required from Rajasthan State Pollution Control Board (RSPCB) or Ministry of Environment and Forests (MoEF), GoI. Clearance from Rajasthan Forest Department is required only in cases where subproject is constructed on forest land or requires cutting of forest trees. The National Environmental Policy 2006 of Government of India (GoI) and Safeguard Policy Statement 2009 of ADB and other state level guidelines that apply to all subprojects funded by ADB are listed in **Appendix 1**.

10. The Environmental Categorization for the ADB funded project on transmission lines and sub-stations is Category B. The IEE report conforms to regional and national environmental regulations and the ADB Safeguard Policy 2009.

1.2 Scope of Work and Methodology Adopted

11. The broad scope of the Environmental Assessment study is:

i) To conduct field visits to collect data relevant to the study area and also collect secondary data so as to establish the baseline environmental status of the study area;
ii) To assess the impacts on environmental attributes due to the location, design, construction and operation of the proposed project;
iii) To prepare a mitigation plan outlining the measures for protecting the environment including institutional arrangement and environmental monitoring;

iv) To identify critical environmental attributes required to be monitored subsequent to the implementation of the proposed project;
v) To carry out consultation with local people to identify the public perception of the project; and
vi) To establish the Environment Monitoring Plan (EMoP) for the RRVPNL to submit environmental monitoring reports to ADB at regular intervals.

12. The alignment of transmission lines may slightly vary after the exact demarcation of tower locations. Accordingly, transect walks and field surveys were undertaken to assess physical and biological environment. Detailed assessment of the baseline environment has been conducted along with line route alignment and data collection from secondary source has been done to support the findings of the field survey. This report is prepared on the basis of survey, field study and consultation with the help of available secondary data of different sites, books, articles and report. The field studies were supported by data collected from secondary sources such as internet, forest atlas, published data from GoI documents, 2001 population census statistics data, as well as documents from RRVPNL, Rajasthan State Pollution Control Board (RSPCB), RREC etc.

13. The IEE report comprises baseline data on existing condition of physical, ecological, economic, and social information, together with the anticipated environmental impacts and proposed mitigation measures. Observations were made through transect walk along the proposed transmission line locations, and the proposed premises for new sub-stations from November 1, 2011 to January 31, 2012. Public consultations were held with the project affected communities, stakeholders, and government officers of the project area. Annexure 9C gives details of places and persons who attended these consultations.

1.3 Applicable Environmental Policies and other Legislations

14. The Ministry of Environment and Forests, Government of India, vide its Notification No. S.O. 1533 dated 14-09-2006, reengineered the EIA process in India and also decentralized some powers and made provision to constitute the State Level Environment Impact Assessment Authority (SEIAA) and the State Level Expert Appraisal Committee (SEAC) for performing functions under the said notification. For the Rajasthan State, the SEIAA and SEAC were constituted in year 2008. In addition, the Rajasthan State Pollution Control Board's guidelines for project proponents apply to all state projects.

15. Rajasthan Renewable Energy Corporation (RREC) acts as nodal agency for single window clearance of projects for following activities (as per Rajasthan Solar Energy Policy, 2011):

a. Registration of projects.
b. Approval of capacity of projects under Clause 5.1.6 & 5.1.8.
c. Selection of projects under clause 5.1.3, 5.1.5, 5.1.7 (ii) & 5.1.9 by process of tariff based bidding.
d. Loans from IREDA/PFC/REC/Financial Institutions/Commercial Banks.
e. Allotment of revenue land.
f. For solar thermal power plants, water allocation from concerned department.
g. Approval of power evacuation plan and allocation of bays etc.
h. Arranging other statutory clearances/approvals.
i. Execution of PPA/WBA with RRVPNL/DISCOMS of Rajasthan/NTPC Vidyut Vyapara Nigam Ltd. (NVVN) (as applicable)
j. Co-ordination with MNRE/NVVN/DISCOMS of Rajasthan/RRVPNL and other State Agencies.
k. Accreditation and recommending the solar power project for registration with central agency under REC mechanism.

16. The sub-projects included under this program should comply with the requirements of the acts, rules, notifications and standards of GoI and policies as well as ADB safeguard requirements as mentioned in **Annexure 1.**

2.0 DESCRIPTION OF THE PROJECT

2.1 The Project

17. The Rajasthan's Bhadla Solar Park will be developed in phases over 10,000 hectare vacant Government land in village Bhadla by Rajasthan Renewable Energy Corporation Limited (RREC), Government of Rajasthan (GoR) with the support of Asian Development Bank similar to a special economic zone (SEZ) dedicated for generation of power through solar energy. The park will have adjoining manufacturing area for solar energy components being developed by Rajasthan State Industrial Development and Investment Corporation (RIICO). The Solar Park will hold a number of solar power plants developed by several promoters. The solar park site will provide necessary infrastructure, developed land, water access, gas availability and access infrastructure through a lease arrangement as well the associated, power evacuation/transmission system.

18. For development of transmission system, the Board of Directors of RRVPNL in 178th meeting held on 23.3.2010 have accorded administrative and financial approval for transmission system for new Solar and Wind Power plants in Jaisalmer, Barmer and Jodhpur districts. **Table 1** shows Tranche 1 Components and their associated environmental issues under Rajasthan Renewable Energy Transmission Investment Program (RRETIP) funded by ADB.

Table 1: Tranche 1 Components and Summary Environmental Issues

SNo	Subproject	Details	Environmental Issues
Component A - New Transmission Lines – 400/220/132 kV lines			
I	400 kV double circuit 160 km long transmission line from 400/220/132/33 kV grid sub-station Bhadla to LILO point at 400 kV S/C Jodhpur-Merta line.	160 km, 400 kV, double circuit, twin moose conductor transmission line, from Bhadla grid sub-station to LILO point at Jodhpur Merta line passing through Phalodi, Osian and Jodhpur tehsil of Jodhpur district.	• Line has no land issue, no sanctuary/reserve forest within 10 km vicinity of the line alignment. • No Land acquisition required
II.	400 kV double circuit 180 km long transmission line from 400/220/132/33 kV Ramgarh Gird substation to 400/220/132/ 33 kV Bhadla substation.	180 km, 400 kV, double circuit, twin moose conductor transmission line, from Bhadla grid sub-station to Ramgarh grid sub-station passing through Phalodi, Pokhran and Jaisalmer tehsil of Jaisalmer district.	• Line has no land issue, no sanctuary/reserve forest within 10 km vicinity of the line alignment. • No land acquisition required.
III.	400 kV double circuit 100 km long transmission line from 400/220/132 kV Akal grid sub-station to 400/220/132/33 kV Ramgarh grid sub-station.	100 km, 400 kV, double circuit, twin moose conductor transmission line, from Ramgarh grid sub-station to Akal grid sub-station from Jaisalmer tehsil of Jaisalmer district.	• Line has no land issue, no sanctuary/reserve forest within 10 km vicinity of the line alignment. • No land acquisition required.
Component B - New Grid sub-stations - 400/220/132 kV			
IV	New 400/220/132 kV grid sub-Station at Bhadla.	400/220 kV, 2 X 315 MVA grid substation at Bhadla (Jodhpur district) along with 400 kV, 1x125 MVAR Shunt Reactor (Bus type) and 4x50 MVAR, 400 kV Shunt Reactors (line type) for Bhadla ends of 400 kV D/C Bhadla - Bikaner line, 400 kV LILO Jodhpur - Merta at Bhadla line and 400 kV D/C Ramgarh – Bhadla line.	• 25.89 ha. land already allotted to RRVPNL by state government. • No wildlife sanctuary or Ecological sensitive area within the 10 km vicinity of the substation.
V.	New 400/220/132 kV grid sub-station Ramgarh	400/220 kV, 2 X 500 MVA grid sub-station at Ramgarh (Jaisalmer district) along with 400 kV, 1x125 MVAR, 400 kV Shunt Reactor (Bus type) and 2x50 MVAR Shunt Reactor (line type) for 400 kV D/C Ramgarh - Bhadla line.	• 23.46 ha. land already given on lease to RRVPNL by state government. • No wildlife sanctuary or Ecological sensitive area within the 10 km vicinity of the substation.

SNo	Subproject	Details	Environmental Issues
VI	Existing and under construction 220 kV GSS at Bap (District Jodhpur) and associated 220 kV and 132 kV lines	220/132/33 kV grid sub-station at Bap. LILO of 220 kV Barsingsar LTPS-Phalodi 25 km long line at 220/132/33 kV Bap GSS. 220 kV double circuit transmission line 90 km long from 400/220/132 kV Bhadla GSS to 220/132/33 kV Bap GSS.	• Line corridor for proposed 400 kV Bhadla – Merta (Jodhpur) line used for the LILO and 220 kV line. • Line has no land issue, no sanctuary/reserve forest within 10 km vicinity of the line alignment. • GSS under construction, no land acquisition required.
VII	220 kV GSS at Kanasar (District Jodhpur) and associated 220 kV and 132 kV lines	220/132/33 kV grid substation at Kanasar. LILO of 132 kV PS1-PS2 12 km long line at 220/132/33 kV GSS at Kanasar. LILO of 132 kV PS2-PS3 10 km long line at 220/132/33 kV GSS at Kanasar. 220 kV double circuit transmission line 25 km long 400/220/132 Bhadla GSS to 220/132 Kanasar GSS	• Line corridor for proposed 400 kV Bhadla – Merta (Jodhpur) line used for these LILO and 220 kV lines. • Line has no land issue, no sanctuary/reserve forest within 10 km vicinity of the line alignment. • Government land used for GSS land, no land acquisition required.
COMPONENT C - Augmentation of Grid Sub-stations – 400 kV/220/132/33 kV			
VIII	Augmentation of 400/220/132 kV Akal grid substation	Augmentation of 400 kV GSS Akal by installation of 400/220 kV, 1 X500 MVA Transformer along with 400 kV, 1x125 MVAR Bus Reactor and 400 kV, 2x50 MVAR Shunt Reactor.	• Civil work within existing Akal grid substation. • No associated environment and social impacts.
IX	Augmentation at 400 kV GSS Bikaner	Augmentation at 400 kV GSS Bikaner along with 1x125 MVAR, 400 kV Bus Reactor at 400 kV GSS Bikaner and 400 kV Bays for 400 kV D/C Bhadla-Bikaner line and 400 kV D/C Bikaner-Sikar (PGCIL) line at Bikaner end of the lines.	• Civil work within existing Bikaner grid substation. • No associated environment and social impacts.
COMPONENT D - Transformer package – 400/220/132 kV at Grid substation			
X	Transformers	Transformer package for Ramgarh, Bhadla and Aka GSS.	• No associated social and environment impact as no civil work required.
COMPONENT E - Shunt Reactor packages – 400/220/132 kV at Grid substation			
XI	Shunt Reactors	Shunt Reactors package for Ramgarh, Bhadla, Bikaner and Akal.	• No associated social and environment impact as no civil work required.
COMPONENT F - New conductors for new Transmission lines in COMPONENT I above.			
XII	400 kV conductor	400 kV Conductor for 400 kV lines in Component A - I, II and III.	• No social and environment impact as no civil work required.
COMPONENT G - Up-gradation of 132 kV Grid Sub-stations			
XIII	Upgradation to 132 kV grid substation with 132/33 kV, 2x20/25 MVA Transformers with associated 132 kV line	Up-gradation of PS No. 2 to 132 kV grid substation with 132/33 kV, 2x20/25 MVA Transformers with associated 132 kV line. Up-gradation of PS No. 3 to 132 kV grid substation with 132/33 kV, 2x20/25 MVA Transformers.	• No associated social and environment impact as no civil work required.
COMPONENT H - Charging of 132 kV lines at existing sub-stations			
XIV	Charging of 132 kV transmission lines	Charging of 132 kV line from PS_No.5 to PS_No.1 on 132 kV voltage level via 132 kV PS_No.2 GSS , 132 kV PS_No.3 GSS and 132 kV PS_No.4 GSS	• No associated social and environment impact as no civil work required.

Source: Revised Power Evacuation system of New Solar & Wind Power Plants in Jaisalmer, Barmer and Jodhpur Districts, RRVPNL

2.2 Justification of the Project

19. Due to the fast emerging energy demand in the country, there is a distinct necessity for strengthening and expanding the transmission network. The power generation from future wind and solar projects in Western Rajasthan is indicated below. Wind/solar developers have registered in Jaisalmer, Jodhpur and Bikaner districts. In compliance to above directives, RRVPNL has planned an evacuation system of appropriate capacity from Jaisalmer/Bap/Bhadla area.

20. **Table 2** gives the list of additional wind / solar generation anticipated in Ramgarh area and Akal area of Jaisalmer district:

Table 2: Future wind/solar power plants anticipated in Jaisalmer/Jodhpur area

Non-Conventional Energy Sources	Jaisalmer/Barmer area
Wind Farm Projects	2,300 MW 1,500 MW has been lumped at 400 kV Akal GSS & 220 kV Amarsagar GSS 800 MW has been lumped at approved 400 kV Ramgarh GSS
Solar Power Plants	400 MW 400 MW has been lumped at approved 400 kV Ramgarh GSS
Total (Solar + Wind)	**2700 MW**

Future wind/solar power plants anticipated in Jodhpur/Bikaner area

21. **Table 3** gives the list of additional wind and solar power generation anticipated to be operational in Bhadla area of Jodhpur district:

Table 3: Future wind/solar power plants anticipated in Jodhpur/Bikaner area

Non - Conventional Energy Sources	Jodhpur/Bikaner area
Wind Farm Projects	200 MW 200 MW has been lumped at approved 400 kV Bhadla GSS
Solar Power Plants	1,340 MW 150 MW has been lumped at approved 400 kV Bhadla GSS 125 MW has been lumped at approved 220 kV Kanasar GSS 125 MW has been lumped at approved 220 kV Bap GSS 725 MW has been lumped at new 220 kV GSS to be identified. 215 MW has been lumped at existing/approved 132 kV GSS at PS_No.1 to PS_No.5 & Bajju.
Total (Solar + Wind)	**1,540 MW**

22. This will lead to improved reliability of supply and the operational flexibility of North grid Transmission network. Under the adopted standards, the forecast loading of each grid sub-station is compared with the firm capacity and the necessary transformer augmentations as well as construction of new sub-stations. It is a standard adopted by RRVPNL that, loading of each transformer should not exceed 100% of its capacity under single transformer outage conditions.

2.3 Location

23. The Rajasthan Solar Park and Bhadla GSS are situated in village Bhadla which is situated in Phalodi sub division of Jodhpur district. Phalodi is situated between latitude 27° 06' to 27° 09' north and 72° 20' to 72° 23' east on the Jodhpur - Jaisalmer railway line. Phalodi is the second largest town in the district and is also the sub-divisional headquarter. The town is situated at a distance of 140 km. from Jodhpur. All Tranche 1 subprojects are situated in Jodhpur and Jaisalmer districts of Western Rajasthan.

24. **Figure 1** provides the location of Bhadla solar park and ADB's funded tranche 1 transmission sub-projects. **Figure 2** provides the detail power map of Rajasthan. Details of Bhadla solar park are listed in **Annexure 2.**

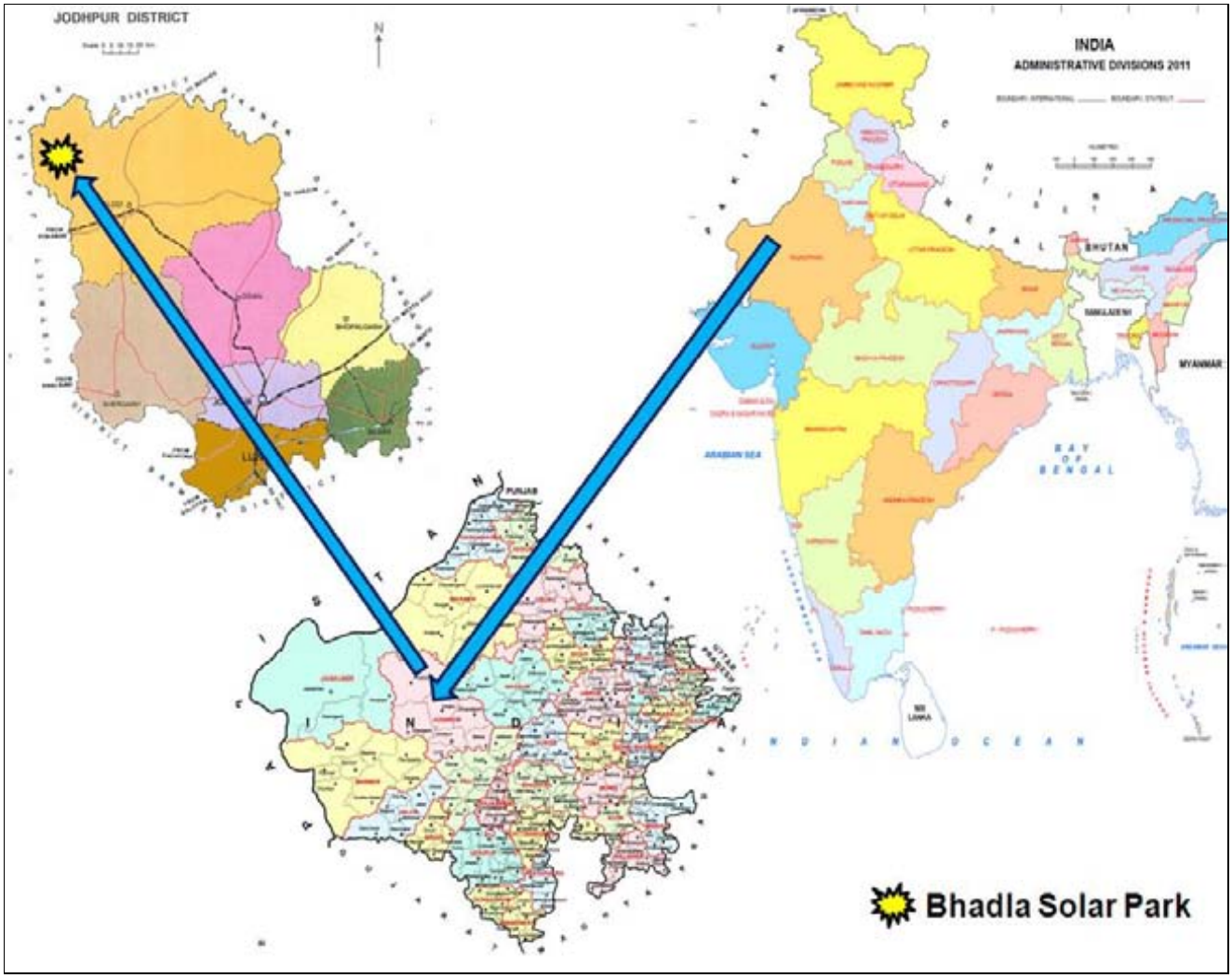


Figure 1: Location of Bhadla Solar Park

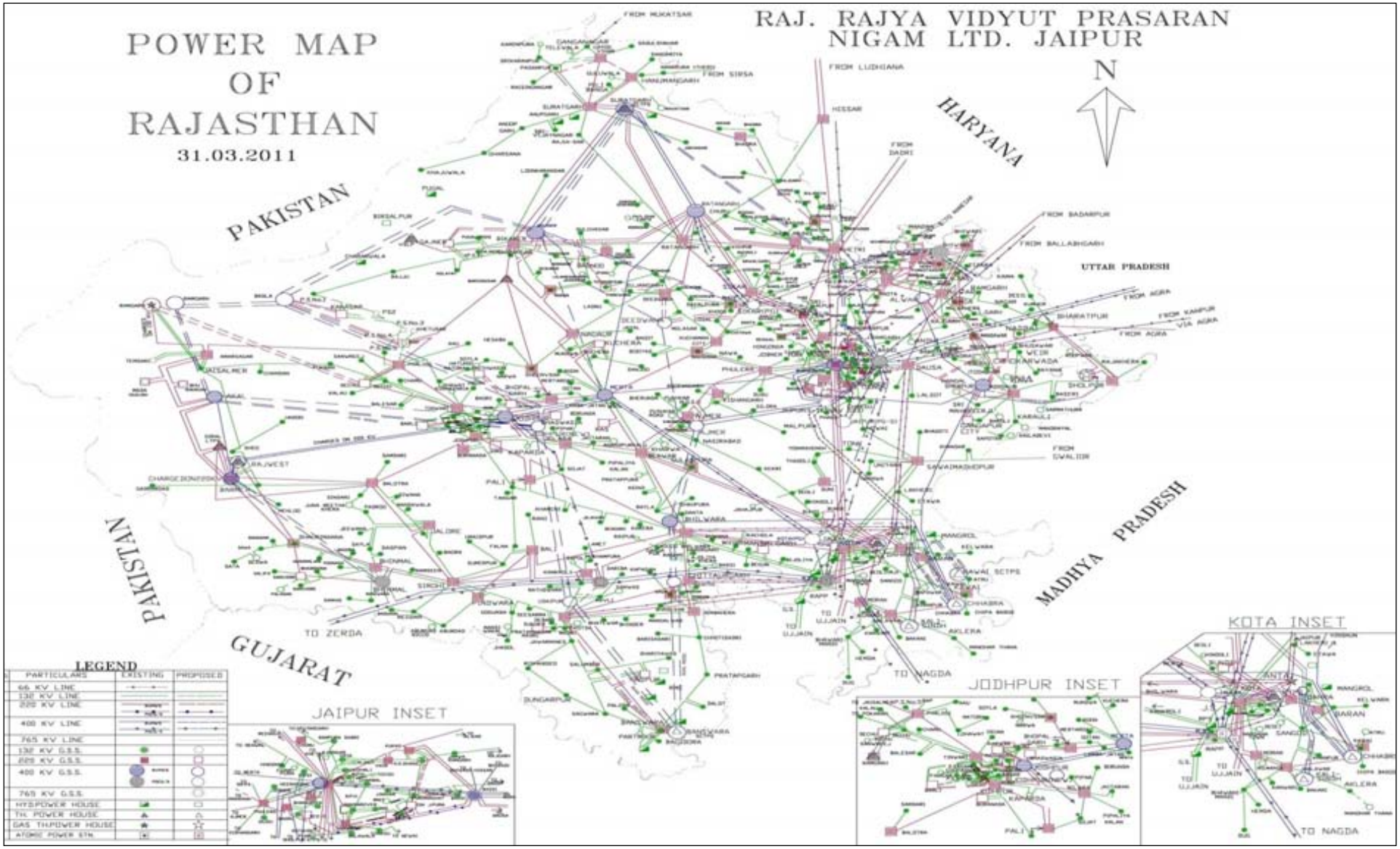


Figure 2: Power Map of Rajasthan

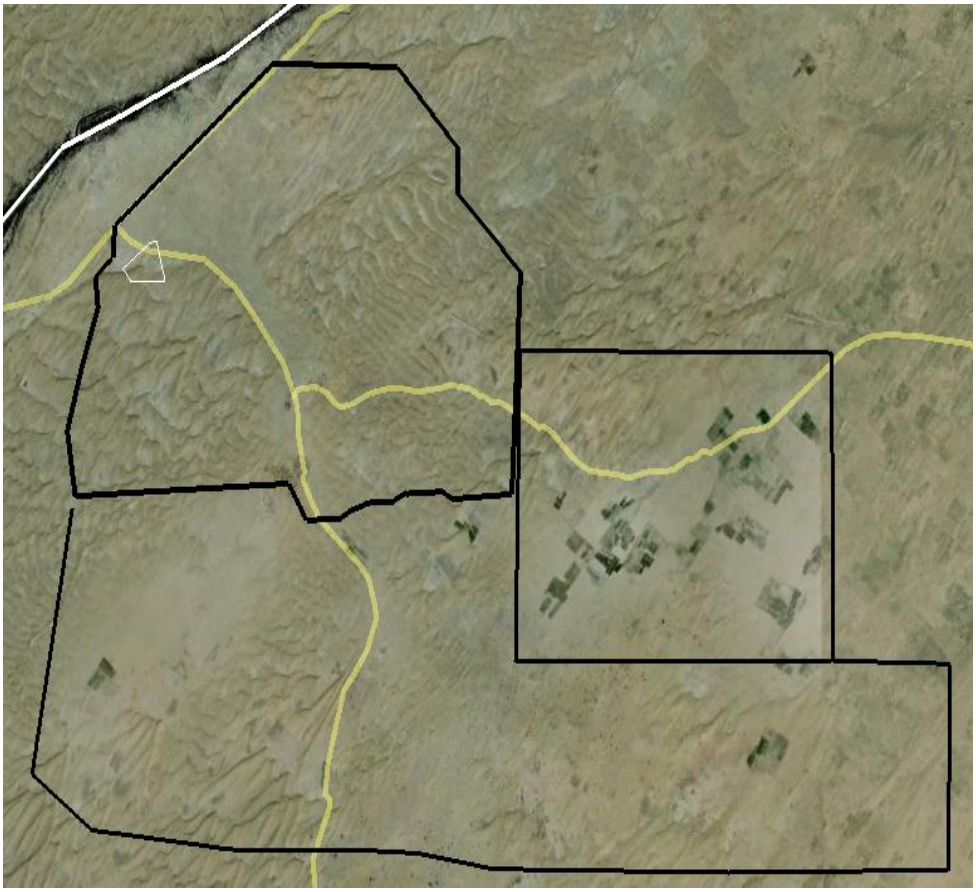


Figure 3: Satellite Map of the Solar Park

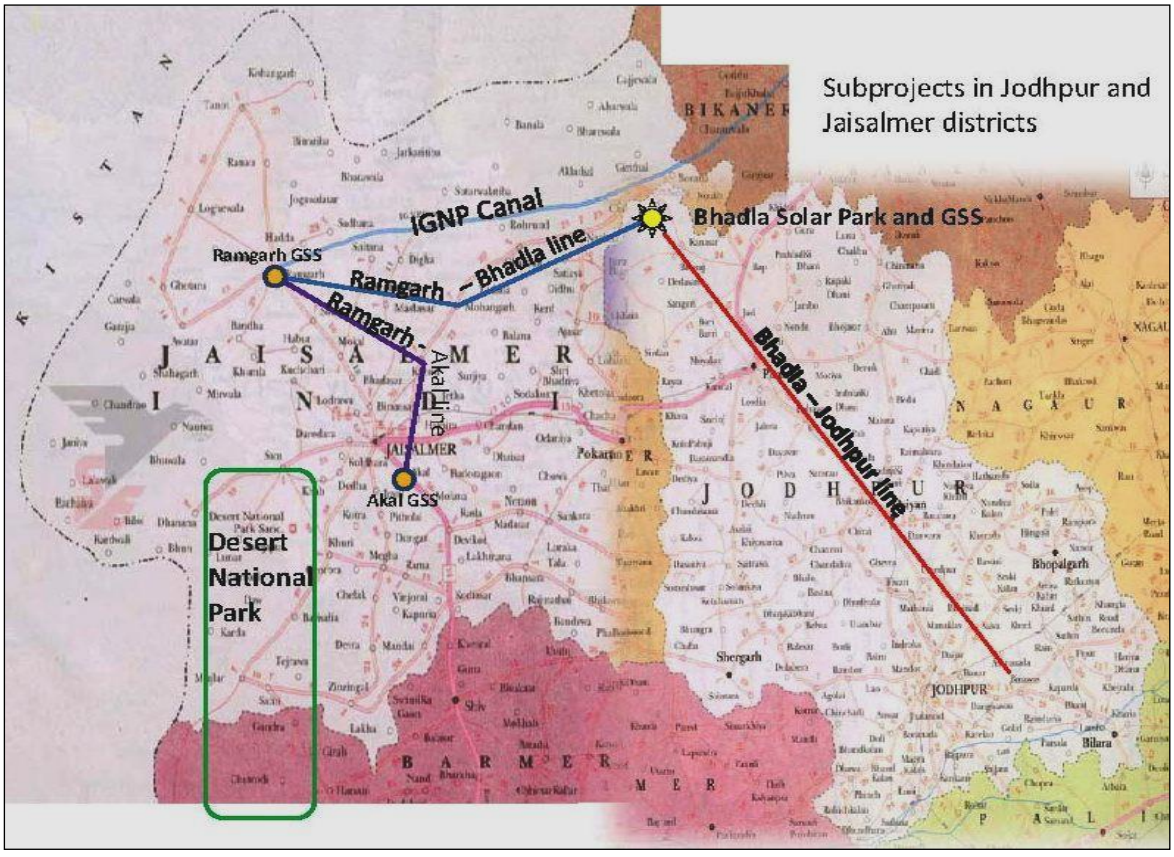


Figure 4: Location of Tranche 1 components in Jodhpur and Jaisalmer district

2.4 Size and Magnitude of Operation

25. The Tranche 1 project consists of following components which are funded both by ADB and RVPNL:

A. New Transmission lines - 400/220/132 kV lines.
B. New Grid Sub-stations - 400/220/132 kV.
C. Augmentation of Grid Sub-stations – 400 kV/220/132 kV.
D. Transformer packages – 400/220/132 kV at Grid Sub-stations.
E. Shunt Reactor packages – 400/220/132 kV Grid Sub-stations.
F. New conductors for new transmission lines in A above.
G. Up-gradation of existing 132 kV Grid Sub-stations.
H. Charging of 132 kV lines at existing sub-stations.

COMPONENT A - New Transmission lines – 400/220/132 kV lines

I. <u>400 kV double circuit 160 km long transmission line from 400/220/132/33 kV GSS Bhadla to LILO point at 400 kV S/C Jodhpur-Merta line.</u>

i. The new 400 kV Bhadla - Jodhpur transmission line on twin moose conductor will pool power from various upcoming wind and solar power projects in Bhap area in Jodhpur district to the national grid. The total power proposed installed capacity of wind and solar power projects in the Jodhpur area is about 4,100 MW.
ii. The Bhadla sub-station will be connected through national grid system for pooling the solar generated power. The line will be constructed on self - supporting latticed type steel towers with ACSR moose conductor in bundle of two conductors per phase.
iii. Line has the following features:

• Length of line estimated	160 km.
• No. of railway crossings	4 no.
• No. of national/state highway crossings	10 crossings.
• No. of existing HT line crossings	04 no.
• No. of forest trees to be cut	0 no
• No of fruit trees to be cut	0 no
• No of canal crossing	1 no

II. <u>400 kV double circuit 180 km long transmission line from 400/220/132/33 kV Ramgarh GSS to 400/220/132/33 kV Bhadla GSS.</u>

i. The new 400 kV Ramgarh - Bhadla transmission line on twin moose conductor will pool in power from various upcoming wind and solar power projects in Jaisalmer/Barmer and Jodhpur/Bikaner area of western Rajasthan.
ii. The power transmission line will evacuate power from upcoming solar and wind power projects of various IPPs in the Jaisalmer and Jodhpur area. The total potential installed capacity of wind and solar power projects in the Jaisalmer and Jodhpur area is 1,700 MW and 4,100 MW respectively.
iii. The Ramgarh and Bhadla sub-stations will be connected to national grid system for pooling the generated power. The line will be constructed on self-supporting latticed type steel towers with ACSR moose conductor in bundle of two conductors per phase.
iv. Line has the following features:

• Length of line estimated	180 km
• No. of railway crossings	0 no.
• No. of national highway crossings	0 crossing
• No. of existing HT line crossings	4 no
• No. of Forest trees to be cut	0 no
• No of Fruit trees to be cut	0 no

III. <u>400 kV double circuit 100 km long transmission line from 400/220/132 kV Akal grid sub-station to 400/220/132/33 kV Ramgarh grid Sub-station.</u>

i. The new 400 kV Akal – Ramgarh transmission line on twin moose conductor will pool in power from various upcoming wind and solar power projects in Jaisalmer / Barmer area of western

Rajasthan.

ii. The power transmission line is being constructed to evacuate power from upcoming solar and wind power projects of various IPPs in the Jaisalmer and Barmer area, total potential installed capacity of wind and solar power projects in the area is 2,700 MW.

iii. The Ramgarh grid substation will be connected to national grid system for pooling the generated power. The transmission line will be constructed on self-supporting latticed type steel towers with ACSR moose conductor in bundle of two conductors per phase. This line is being constructed to evacuate renewable energy generated in the Ramgarh and Akal area of Jaisalmer by various IPPs.

iv. Line has the following features:

• Length of line estimated	100 km.
• No. of railway crossings	1 no.
• No. of national highway crossings	1 crossing
• No. of existing HT line crossings	5 no.
• No. of Forest trees to be cut	0 no
• No of Fruit trees to be cut	0 no

COMPONENT B - New Grid sub-stations - 400/220/132 kV.

IV. <u>New 400/220/132 kV Grid Sub-Station at Bhadla.</u>

i. The new 400 kV grid substation (GSS) at Bhadla, district Jodhpur which will evacuate power from 10,000 hectare Bhadla solar park and other solar parks to be developed in phases coming up in the Bhadla/Bhap area.

ii. Nearest wildlife sanctuary - Desert National Park which is situated about 150 km from the sub-station location. The sub-station is proposed to be constructed on 25.89 ha. land already allotted to RRVPNL by state government.

iii. The work involves construction of new 400/220/132/33 kV grid substation at Bhadla in the Jodhpur district of Rajasthan. The sub-station is proposed to be constructed on 160 Bigha land already allotted to RRVPNL.

V. <u>New 400/220/132 kV Grid Sub-station Ramgarh.</u>

i. The new 400/220/132/33 kV grid substation (GSS) at Ramgarh, district Jaisalmer involves construction of switchyard at 400/220/132/33 kV voltages. The sub-station is proposed to be constructed on 23.46 ha land already given on lease to RRVPNL by state government.

ii. Nearest wildlife sanctuary to the sub-station site is the Desert National Park, which is situated at about 45 km from the sub-station location.

VI. <u>Existing and under construction 220 kV GSS at Bap (District Jodhpur) and associated 220 kV and 132 kV lines</u>

This is RRVPNL funded subproject component which consists of:

1. 220/132/33 kV grid substation – Transformers - 220/132 kV, 2x160 MVA & 132/33 kV, 2x40/50 MVA, indoor and outdoor, switch-gear, power and control cables, auxiliary transformer, lightening arrestors, D.C. equipment, control and relay boards, steel structures, SCADA, fire-fighting equipment.
2. LILO of 220 kV Barsingsar LTPS-Phalodi 25 km long line at 220/132/33 kV Bap GSS.
3. 220 kV double circuit transmission line 90 km long from 400/220/132 kV Bhadla GSS to 220/132/33 kV Bap GSS.

VII. <u>220 kV GSS at Kanasar (District Jodhpur) and associated 220 kV and 132 kV lines</u>

This is RRVPNL funded subproject component which consists of:

i. 220/132/33 kV grid substation – Transformers - 220/132 kV, 2x160 MVA & 132/33 kV, 2x40/50 MVA, indoor and outdoor, switch-gear, power and control cables, auxiliary transformer, lightening arrestors, D.C. eq uipment, control and relay boards, steel structures, SCADA, Fire-fighting equipment etc.

ii. LILO of 132 kV PS1-PS2 12 km long line at 220/132/33 kV GSS at Kanasar.

iii. LILO of 132 kV PS2-PS3 10 km long line at 220/132/33 kV GSS at Kanasar.

iv. 220 kV double circuit transmission line 25 km long 400/220/132 Bhadla GSS to 220/132 Kanasar GSS.

COMPONENT C: Augmentation of Grid Sub-stations – 400 kV/220/132/33 kV.

VIII. Augmentation of 400/220/132 kV Akal grid substation

i. The Akal grid substation is situated on national highway 15 – Barmer Jaisalmer highway at village Akal. It evacuates 1080 MW (135 MW x 8 turbines) from the Raj West Thermal power via Barmer 400 kV GSS.

ii. This subproject includes equipment to be installed inside the existing GSS premises and there are no environmental implications.

Equipment funded for augmentation includes:

- 400/220 kV, 1 X500 MVA Transformer.
- 400 kV, 1x125 MVAR Bus Reactor.
- 400 kV, 2x50 MVAR Shunt Reactor.
- 400 kV Equipment (Breaker & Half Scheme).
- 400 kV Bus-bar Protection scheme for the complete system.
- Marshalling Kiosks for 400 kV system.
- SCADA system.
- PLCC system.

IX. Augmentation at 400 kV GSS Bikaner

i. The Bikaner grid sub-station is situated on Jaipur-Bikaner Road- 10 km from Raisar Village. It evacuates 1500 MW (250 MW x 6 turbines) from the Surathgarh Super Thermal Power Project.

ii. 400 kV inter-connections between RRVPNL's 400 kV GSS Bikaner and PGCIL's 400 kV GSS Sikar would facilitate the exchange of solar power generation with the regional grid.

iii. This subproject includes equipment to be installed inside the existing GSS premises and there are no environmental implications.

Equipment funded for augmentation includes:

- 1x125 MVAR, 400 kV Bus Reactor.
- 400 kV Bays for 400 kV D/C Bhadla-Bikaner line.
- 400 kV D/C Bikaner-Sikar (PGCIL) line at Bikaner end of the lines.
- 400 kV Equipment (Breaker & Half Scheme).
- 400 kV Bus-bar Protection scheme for the complete system.
- Marshalling Kiosks for 400 kV system.
- SCADA system.
- PLCC system.

COMPONENT D: Transformer package – 400/220/132 kV at Grid Sub-stations.

X. Transformer package for Ramgarh, Bhadla and Akal GSS

COMPONENT E: Shunt Reactor packages – 400/220/132 kV Grid Sub-stations.

XI. Shunt Reactors package for Ramgarh, Bhadla, Bikaner and Akal GSS

COMPONENT F: New conductors for new transmission lines in COMPONENT I above.

XII. 400 kV Conductor for 400 kV lines mentioned in Component A - I, II, and III.

COMPONENT G: Up-gradation of 132 kV Grid Sub-stations.

XIII. These are RVPNL funded subproject component which consists of:

- Up-gradation of PS_No. 2 to 132 kV grid substation with 132/33 kV, 2x20/25 MVA Transformers with associated 132 kV line.
- Up-gradation of PS_No. 3 to 132 kV grid substation with 132/33 kV, 2x20/25 MVA Transformers.

COMPONENT H: Charging of 132 kV lines at existing sub-stations.

XIV. Charging of 132 kV line from PS_No.5 to PS_No.1 on 132 kV voltage level via 132 kV PS_No.2 GSS, 132 kV PS_No.3 GSS and 132 kV PS_No.4 GSS.

These Components D, E, F, G, H includes equipment to be installed inside the existing GSS's and

charging of 132 kV existing lines. There are no environmental implications involved in equipment installation and line charging activities as proposed by RRVPNL.

26. The sale of power from this area will be handled by the Government of Rajasthan through the Department of Energy whereas RRVPNL will get transmission charges as per Rajasthan Electricity Regulatory Commission (RERC) norms. Environmental Features along the 400 kV transmission lines funded by ADB are shown in **Tables 4, 5 and 6.** The 220/132 kV lines in the Bhadla, Bap and Kanasar area which are being constructed by the RRVPNL use parallel corridors of the proposed 400 kV lines in the Jodhpur district in Phalodi tehsil. Therefore, the environmental profiles are nearly similar to the ones described.

2.5 Implementation Plan

27. The proposed project involves construction of 400/220/132 kV transmission lines. The construction of new grid sub-stations involves government land at Ramgarh, Bhadla, Bap, and Kanasar and augmentation works at Bikaner and Akal. The project will involve survey work, land clearance, design and engineering of plant equipment, floating tenders for procurement, civil work and system testing and commissioning related to line and sub-station.

28. The overall draft project implementation schedule for the project is attached as **Table 7.**

Table 4: Environmental features along the 400 kV Bhadla Jodhpur transmission line

Sr. No.	ANGLE POINT #		Distance between two angle points (m)	Approximate Distance of transmission line from nearby village Habitation (Village name) (in m)	Name of district	No. of Towers	Area of tower (in M²)	Area under the ROW (in m)	Ownership of land (private, Govt. Forest)	Use of Land	Name of Crops	Number of trees under cutting/ trimming	No. of affected Household	No. of affected tribal households (if Any)	Other
	FROM	TO													
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	AP0	AP1	10,584	400 m Jajiwal Gehlotan 550 m Jajiwal Bhatiyan 900 m Lordi 550 m Gharav 650 m Jhipasni	Jodhpur	TBD*	81	52 m	TBD*	Agriculture and Barren	TBD*	TBD*	TBD*	TBD*	3 Road Crossing (1 SH -58, 1 NH 65) 1 HT line Crossing
2	AP1	AP2	10,060	2.1 km Ujliya	Jodhpur		81	52 m		Agriculture and Barren					1 Road Crossing
3	AP2	AP3	10,863	200m Umed Nagar	Jodhpur		81	52 m		Agriculture					4 Road Crossing (SH -61)
4	AP3	AP4	10,876	2.5 km Bhainser Kotwali 2.5 km Khudiyala	Jodhpur		81	52 m		Agriculture and Barren					2 Road crossing 1 Rly crossing
5	AP4	AP5	10,126	3.5 km Osian	Jodhpur		81	52 m		Barren					2 road Crossing
6	AP5	AP6	11,575	100 m Bhimkor	Jodhpur		81	52 m		Barren					2 road Crossing (2 SH -61) 1 Rly Crossing
7	AP6	AP7	10,807	100 m Harali	Jodhpur		81	52 m		Agriculture and Barren					1 Road (SH -61)
8	AP7	AP8	4,320	3.4 km Dhelna	Jodhpur		81	52 m		Agriculture and Barren					
9	AP8	AP9	7,656	1.8 km Lohawat	Jodhpur		81	52 m		Agriculture and Barren					3 Road Crossing
10	AP9	AP10	10,867	7.9 km Chhila	Jodhpur		81	52 m		Agriculture and Barren					3 Road Crossing
11	AP10	AP11	7,653	1.6 km Amla	Jodhpur		81	52 m		Agriculture and Barren					SH -19 crossing
12	AP11	AP12	8,983	100 m Godarli	Jodhpur		81	52 m		Agriculture and Barren					
13	AP12	AP13	14,882	1,7 km Malhar 3 km Hidal Gol	Jodhpur		81	52 m		Agriculture and Barren					NH -15 crossing; Rly crossing

Sr. No.	ANGLE POINT #		Distance between two angle points (m)	Approximate Distance of transmission line from nearby village Habitation (Village name) (in m)	Name of district	No. of Towers	Area of tower (in M²)	Area under the ROW (in m)	Ownership of land (private, Govt. Forest)	Use of Land	Name of Crops	Number of trees under cutting/ trimming	No. of affected Household	No. of affected tribal households (if Any)	Other
	FROM	TO													
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
				6 km Kichan											
14	AP13	AP14	12,128	500 m Khirwa	Jodhpur		81	52 m		Agriculture					1 Road, 1 Canal crossing
15	AP14	AP15	14,091		Jodhpur		81	52 m		Agriculture					
16	AP15	AP16	11,078	300 m Kanasar	Jodhpur		81	52 m		Barren					Sand dunes
17	AP16	Bhadla GSS	10,777	100 m Bhadla	Jodhpur		81	52 m		Barren					Sand dunes

Source: Detailed site survey, study of Survey of India 1:50,000 toposheet and Google earth Satellite maps of tentative alignment provided by RRVPNL
TBD* - To be determine after detailed Survey by contractor
Note - The Angle point / Section length may vary slightly depending upon the site conditions.
Angle Point is a point where the line makes a minor angle deviation. It is marked on Topographic sheet.

Table 5: Environmental features along the 400 kV Bhadla - Ramgarh transmission **line**

Sr. No.	ANGLE POINT #		Distance between two angle points	Approximate Distance of transmission line from nearby village Habitation (Village name) (in m)	Name of district	No. of Towers	Area of tower (in m²)	Area under the ROW (in M)	Ownership of land (private, Govt. Forest)	Use of Land	Name of Crops	Number of trees under cutting/ trimming	No. of affected Household	No. of affected tribal households (if any)	Other
	FROM	TO													
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Bhadla GSS	AP1	4,591	1.3 km Bhadla	Jodhpur	TBD*	81	52 m	TBD	Barren	TBD	TBD	TBD*	TBD*	HT line Crossing, Sand dunes

Sr. No.	ANGLE POINT #		Distance between two angle points	Approximate Distance of transmission line from nearby village Habitation (Village name) (in m)	Name of district	No. of Towers	Area of tower (in m²)	Area under the ROW (in M)	Ownership of land (private, Govt. Forest)	Use of Land	Name of Crops	Number of trees under cutting/ trimming	No. of affected Household	No. of affected tribal households (if any)	Other
	FROM	TO													
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
2	AP1	AP2	10,372	1.3 km Rola	Jodhpur		81	52 m		Barren					HT line Crossing, 1 Canal Crossing
3	AP2	AP3	14,250	3.1 km Askandra	Jaisalmer		81	52 m		Barren					1 Road Crossing
4	AP3	AP4	15,800	4.5 Didu 5.9 Satyaya	Jaisalmer		81	52 m		Barren					3 Road Crossing
5	AP4	AP5	18,941	1.3 km Tadana	Jaisalmer		81	52 m		Barren					Sandy
6	AP5	AP6	10,863	1.9 km Balana	Jaisalmer		81	52 m		Barren					Sandy
7	AP6	AP7	10,634	2.3 km Shri Mohangarh	Jaisalmer		81	52 m		Agriculture and Barren					1 Road 1 Canal Crossing
8	AP7	AP8	10,162		Jaisalmer		81	52 m		Agriculture					2 Road Crossing
9	AP8	AP9	8,975	5.8 km Nedhi	Jaisalmer		81	52 m		Agriculture and Barren					1 Canal Crossing
10	AP9	AP10	10,411	2.1 km Boa 4.4 Madhawa	Jaisalmer		81	52 m		Agriculture and Barren					1 Road Crossing Water Logged area
11	AP10	AP11	9672	4.2 km Khiniya 1.5 km Khinasar	Jaisalmer		81	52 m		Agriculture and Barren					2 Road Crossing
12	AP11	AP12	11,997	3.2km Kabir Basti, 5.7 km Parewal	Jaisalmer		81	52 m		Barren and Agriculture					Rocky, Water Logged
13	AP12	AP13	10,977	2.9 km Joga	Jaisalmer		81	52 m		Barren					Rocky, Water Logged
14	AP13	Ramgarh GSS	1,490	6 km Ramgarh	Jaisalmer		81	52 m		Barren					Rocky, Water Logged 1 Road Crossing 2 HT Crossing

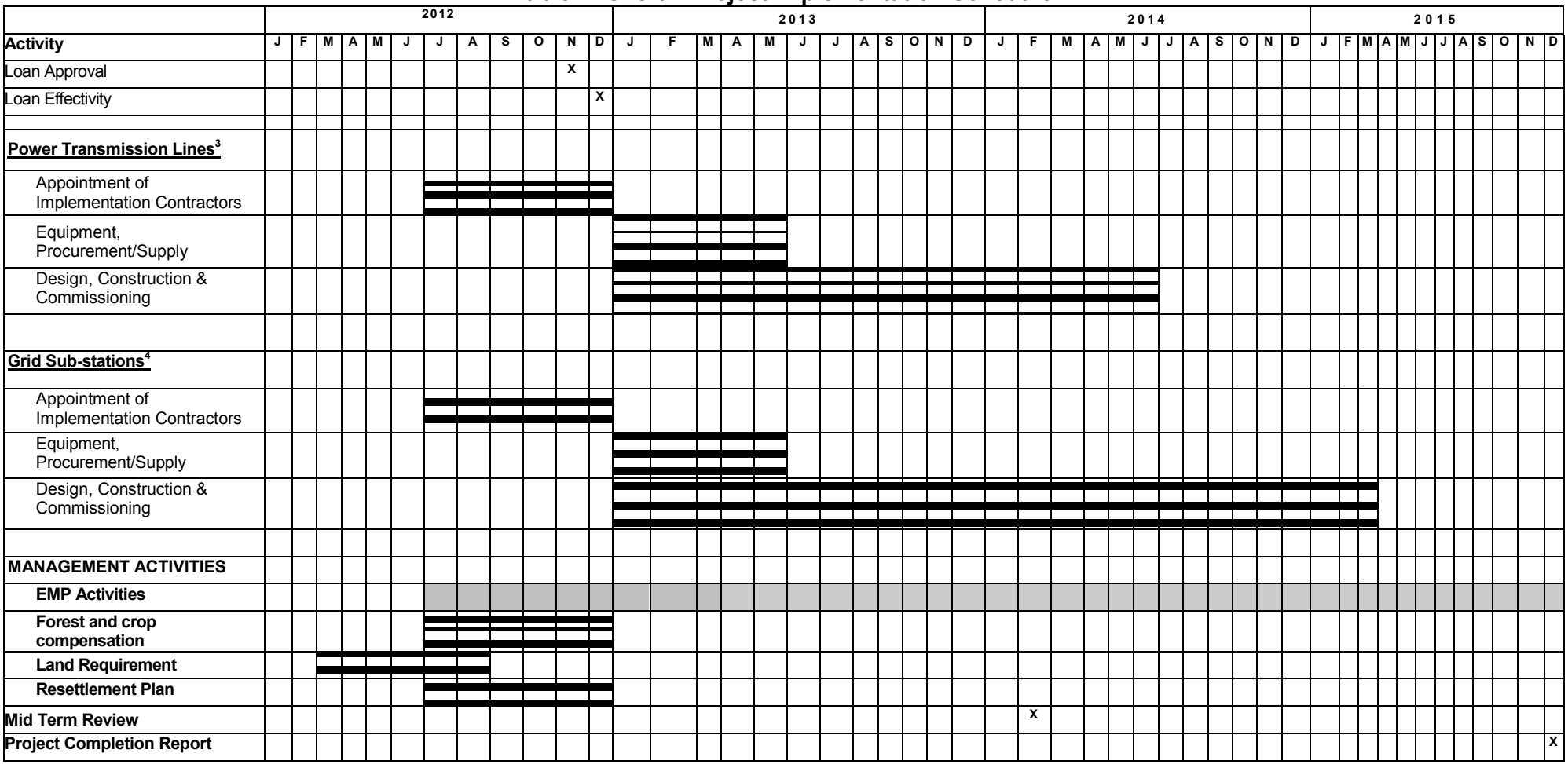
Source: Detailed site survey, study of Survey of India 1:50,000 toposheet and Google earth Satellite maps of tentative alignment provided by RRVPNL
TBD* – To be determined during detailed survey by RRVPL or the contractor.
Note - The Angle point / Section length may vary slightly depending upon the site conditions.
Angle Point is a point where the line makes a minor angle deviation. It is marked on larger topographic sheet.

Table 6: Environmental features along the 400 kV Ramgarh Akal transmission line

Sr. No.	ANGLE POINT #		Distance between two angle points	Approximate Distance of transmission line from nearby village Habitation (Village name) (in m)	Name of district	No. of Towers	Area of tower (in m^2)	Area under the ROW (in m^2)	Ownership of land (private, Govt. Forest)	Use of Land	Name of Crops	Number of trees under cutting/ trimming	No. of affected Household	No. of affected tribal households (If Any)	Other
	FROM	TO													
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Akal GSS	AP1	360	1 km Akal	Jaisalmer	TBD*	81	52 m	TBD*	Barren	TBD*	TBD*	TBD*	TBD*	
2	AP1	AP2	194	1.2 km Akal	Jaisalmer		81	52 m		Barren					NH 15 Crossing
3	AP2	AP3	2,420		Jaisalmer		81	52 m		Agriculture and Barren					
4	AP3	AP4	2,786		Jaisalmer		81	52 m		Barren and Agriculture					1 Road Crossing
5	AP4	AP5	6,090	800m Basanpir	Jaisalmer		81	52 m		Agriculture and Barren					NH 15, Crossing
6	AP5	AP6	7,880	1.4 km Thaiyat	Jaisalmer		81	52 m		Agriculture and Barren					1 Road, 1 Rly crossing 3 km Kharajor Protected forest
7	AP6	AP7	12,968	700m Hamira 200m Hadda	Jaisalmer		81	52 m		Barren					2 Road Crossing
8	AP7	AP8	9,257	5 km Chaudhriya	Jaisalmer		81	52 m		Agriculture and Barren					3 Road crossing
9	AP8	AP9	1,0273	400 m Asde 2.7 km Gugade	Jaisalmer		81	52 m		Agriculture and Barren					1 Road Crossing
10	AP9	AP10	7,730	4 km Khinasar	Jaisalmer		81	52 m		Agriculture and Barren					Rocky, Water logged
11	AP10	AP11	9,394	2 km Parewar	Jaisalmer		81	52 m		Barren					1 Road crossing
12	AP11	AP12	1,3392	1.6 km Joga	Jaisalmer		81	52 m		Barren					Water logged
13	AP12	AP13	6,388		Jaisalmer		81	52 m		Barren					
14	AP13	Ramgarh GS	1,321	6 km Ramgarh	Jaisalmer		81	52 m		Barren					1 Road crossing, 2 HT Crossing

Source: Detailed site survey, study of Survey of India 1:50,000 toposheet and Google earth Satellite maps of tentative alignment provided by RRVPNL
TBD* – To be determined during detailed survey by RRVPL or the contractor.
Note - The Angle point / Section length may vary slightly depending upon the site conditions.
Angle Point is a point where the line makes a minor angle deviation. It is marked on larger topographic sheet.

Table 7: Overall Project Implementation Schedule



NOTE - This schedule is tentative and will be finalised based on the line length/quantum of ROW at site as well as estimated schedule indicated by bidders for each sub-project.

[3] Includes all procurement packages, and line charging etc.
[4] Includes all procurement packages, upgradation, and augmentation packages.

3.0 DESCRIPTION OF ENVIRONMENT

29. The 400/220/132/33 kV grid substation and 400/220/132 kV transmission lines are funded under Tranche 1. The Tranche 1 subprojects are situated in Jodhpur, Phalodi and Osian tehsil of Jodhpur district and Jaisalmer and Pokhran tehsil of Jaisalmer district of Western Rajasthan. This chapter focuses on the present environmental conditions of the project areas in Jodhpur and Jaisalmer districts.

30. Jodhpur, one of the largest districts of Rajasthan State, is centrally situated in Western region of the State, having geographical area of 22,850 square km. It has population of 3,685,681 as per 2011 census. The district stretches between 26°00' and 27°37' at north Latitude and between 72°55' and 73° 52' at East Longitude. This district is situated at a height between 250 - 300 meters above mean sea level (MSL). Jodhpur is bound by Nagaur in East, Jaisalmer in West, Bikaner in North and Barmer as well as Pali in the South. The length of the district from North to South and from East to West is 197 km and 208 km respectively. Jodhpur district comes under arid zone of the Rajasthan state. It covers 11.60% of total area of arid zone of the state. Part of the area of Great Indian Desert "THAR" also comes within the district. General slope of the terrain is towards west. Despite its arid climate, Jodhpur is blessed with a variety of flora and fauna.

31. Similarly, Jaisalmer district is located in the extreme west of both Rajasthan and India, and shares western and northern borders with Pakistan. It lies between the longitudes of 69° 29' to 72° 20' East, and latitudes of 26° 01' 20" to 28° 02' North, is at an average altitude of 242 m above Mean Sea Level (MSL), and forms the major part of the Great Indian Desert (Thar Desert). Jaisalmer Town is the district headquarters and lies roughly in the centre, 550 km west of the State capital Jaipur and 300 km northwest of Jodhpur. The municipal area covers 126.27 km^2 in total, in which, there is a population of only 672,008 according to the 2011 census. Most of the area consists of rocky hillsides and uninhabited areas of sand.

32. The Solar Park in Bhadla village, which is an associated facility to this ADB funded Tranche 1 project, is situated in Phalodi sub division. Phalodi is situated between latitude 27° 06' to 27° 09' north and 72° 20' to 72° 23' east on the Jodhpur - Jaisalmer railway line. Phalodi is the second largest town in the district and is also the sub-divisional headquarter. The town is situated at distance of 140 km. from Jodhpur. The present population of the town, as per census 2001 is 44,756. A number of Government and semi government offices are situated in the town. Geographically, Phalodi is surrounded by Bikaner, Nagaur and Jaisalmer districts and well connected by road and railway. The railway station of the town was established in 1914. national highway 15 (Pathankot - Kandla) and State highway No. 2 (Jodhpur- Jaisalmer) passes through the town. The nearest railway Station is at Phalodi, nearest Airport is at Jodhpur at a distance of 227 km and the nearest sea port is Kandla at a distance 520 km.

3.1 Physical Resources

3.1.1 Topography

33. The Jodhpur district resembles an irregular rectangle, in shape. There are scattered open hills and sand dunes in the North West and South. District falls under the category of Great Indian Desert, particularly its southern, western and northern portions. The average height of the district above the mean sea level is between 250 and 300 metres the general Slope is towards West. In this arid region where sand dunes present a common sight, there are a few hillocks scattered here and there, especially in Bilara and Osian tehsil The greatest height of hills in the north is 284 metres; in the south 358 and East 294 metres and in East 450 metres.

34. The general shape of the Jaisalmer district is an irregular polygon of seven sides, the longest axis being 337.96 kin, in length. The area is a sandy plain with a few rocky patches and many sand dunes. The district lies in the west of Rajasthan. It is sandy, dry and ill-watered, unkind to all forms or life, animal and plant. It lies in the Great Indian Desert of Thar. The entire area is barren and dreary, the only variations on the landscape being a few hills and many sand-dunes. The land covered by the district slopes towards the Indus Valley and the Rann of Kutch. The topography is undulating, covered with sand-dunes. The ridges usually are parallel to the prevailing direction or the wind. No other part of Rajasthan is as lifeless and forbidding in appearance. The blown sand forms into shifting sand-dunes. The few stationary sand-hills in the west are covered with the Phog (*Calligonum ploygonoides*) bushes and those in the east with tufts of long grass. There is hardly any vegetation owing to lack of water.

3.1.2 Geology

35. The geological set-up of the Jodhpur district is represented by various igneous, metamorphic and sedimentary rocks. Delhi Super Group litho units are very limited and in the form of isolated pockets. Erinpura granites and Malani igneous rocks cover large area in the southern part of the district. Marwar Super Group of rocks occupies maximum geographical area of the district lying in the central, western, and eastern parts of the district. The rock units of various formations belonging to Cenozoic epoch/era represented in very small area and lies in the north-western parts of the district. In the entire district, the hard rocks are overlain by thin blanket of alluvium and windblown sand.

36. Jaisalmer district was submerged under a sea during Jurassic, Cretaceous and Eocene Ages. In due course of time, the coastal regions of the Indian shield appear to have witnessed a marine transgression covering large portions of Kutch, Kathiawar and Rajasthan, extending over as far as the salt-range in the Punjab. It is not competently ascertained when this area was uplifted into dry land. It may have occurred a few million years ago, probably sometime in the Upper Tertiary. Even then, some large lakes and lagoons might have been left over which gradually dried up. It is asserted that it was only after Pleistocene and the last Glacial Period that this district began to get gradually dry. Small out crops of Jurassic rocks comprising lime- sandstone and shales amidst the desert sands and alluvium in the district can still be found. These Outcrops form the first mark on the geological history of this area, contemporaneous with this, the earth witnessed the evolution of flowering plants, sea urchins and birds of the first kind. This was followed by a short spell of marine regression in the succeeding Cretaceous Period, but the marine deposition resumed again in the Eocene period.

3.1.3 Soil Regimes:

37. Soils of the area are classified as follows:

- **Red desertic soils:** These types of soils are most predominant soils in central, eastern and southern parts of the district. These are pale brown to reddish brown soils, loose and well drained and texture varies from sandy loam to sandy clay loam.
- **Desert soils:** Desert soils occupy a considerable area of the district forming its northern and western part of the district. These are mainly windblown sand and soils of inter-dunal depressions.
- **Sand dunes:** Sand dunes occupy a small part in northern and north-western margin of the district. These are sandy to loamy sand, loose, structure less and well drained.
- **Lithosol and Regosols of hills:** These types of soils are found in hills and hill slopes of central and western part of the district. These are shallow, light textured, fairly drained, reddish brown to greyish brown in colour.

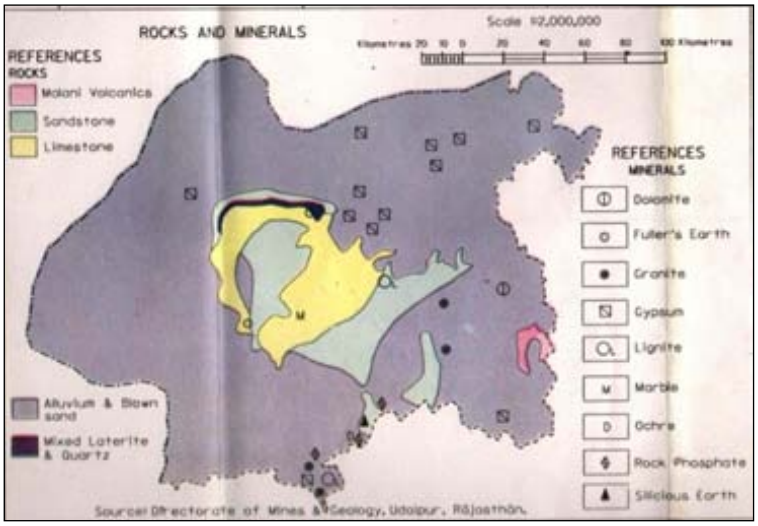
3.2 Mineral Resources

38. Minerals have been playing an important role in development of Jodhpur district for last many decades. District is mainly rich in non-metallic minerals like Sandstone, Rhyolite, Dolomite, Limestone, Jasper, and Granite & Clay. Murram, Kankar, Brick earth, Bajri and other minor minerals. Major Important minerals of Jodhpur district are Sandstone, Limestone, Dolomite Granite, Rhyolite, Jasper, Clay, Agate, Salt, and Quartz.

39. Similarly, Jaisalmer have deposition of major minerals - Limestone, Siliceous Earth, Rock Phosphate, Dolomite, Jesper, Yellow Clay, and Ball Clay, and minor minerals - Marble, Masonry Stone, Lime Stone (Flooring), and Granite. Map showing soil types are mentioned below as **Figure 5** and **Figure 6**.

Source: District Planning map series, Jodhpur, Survey of India

Figure 5: Rocks and minerals of Jodhpur district



Source: District Planning map series, Jaisalmer, Survey of India

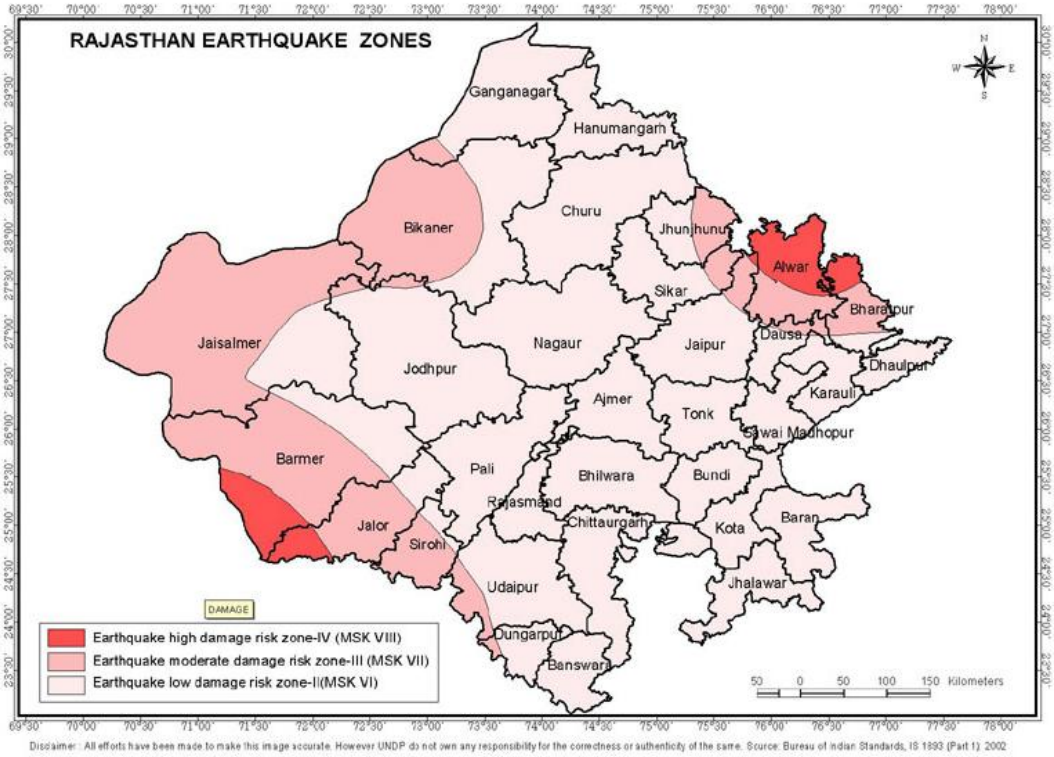
Figure 6: Rocks and Minerals of Jaisalmer district

3.2.1 Earthquake Zone:

40. Rajasthan has not had a major earthquake in recent years, though small to moderate earthquake have been felt in the state. Several faults have been identified in this region out of which many show evidence of movement during the Holocene epoch. The Cambay Graben terminates in the south-western part of the state. The Konoi Fault near Jaisalmer trends in a north-south direction and was associated with the 1991 Jaisalmer earthquake. Several active faults criss-cross the Aravalli range and lie parallel to each other. The most prominent of them is the north-south trending Sardar Shahar Fault and the Great Boundary Fault which runs along the Chambal River and then continues in the same direction into Uttar Pradesh. However, it must be stated that proximity to faults does not necessarily translate into a higher hazard as compared to areas located further away, as damage from earthquakes depends on numerous factors such as subsurface geology as well as adherence to the building codes.

3.2.2 Earthquake Zones of Rajasthan

41. Western parts of the districts of Barmer and Sirohi as well as northern sections of Alwar district lie in Zone IV, where the maximum intensity could reach VIII (MSK). The remaining areas of Barmer and Sirohi districts, as well as the districts of Bikaner, Jaisalmer and Sirohi lie in Zone III. The north-eastern districts of Jhunjhunu, Sikar, Bharatpur and the rest of Alwar also lie in Zone III. The maximum intensity expected in these areas would be around MSK VII. The rest of the state, including the capital, Jaipur, lie in Zone II, where the maximum intensity expected would be around MSK VI. It must be noted that Bureau of Indian Standards (BIS) estimates the hazard on previously known earthquakes. Since the earthquake database in India is still incomplete, especially with regards to earthquakes prior to the historical period (before 1800 A.D.), these zones offer a rough guide of the earthquake hazard in any particular region and need to be regularly updated, **Figure 7 s**hows earthquake zones of Rajasthan.



Source: http://www.rajrelief.nic.in

Figure 7: Earthquake Zones of Rajasthan

3.3 Climate

42. The Jodhpur district experiences arid to semi-arid type of climate. The rainy days are limited to maximum 15 in a year. Almost 80% of the total annual rainfall is received during the southwest monsoon, which enters the district in the first week of July and withdraws in the mid of September. Probability of annual rainfall exceeding 650 mm is only 10%. However, there is 90% probability that the annual rainfall will be more than 190 mm. The probability of occurrence of mean annual rainfall is 45%. Drought analysis based on agriculture criteria indicates that the district is prone to mild and normal type of droughts. Occurrence of severe and very severe type of drought is very rare. As the district lies in the desert area, extreme heat in summer and cold in winter is the characteristic of the desert. Both day and night temperatures increase gradually and reach their maximum values in May and June respectively. The temperature varies from 49 degree Centigrade in summer to 1 degree centigrade in winter. Atmosphere is generally dry except during the monsoon period. The humidity is highest in August with mean daily relative humidity at 81%. The annual maximum potential evapo - transpiration in the district is quite high and it is highest (264.7 mm) in the month of May and lowest (76.5 mm) in the month of December.

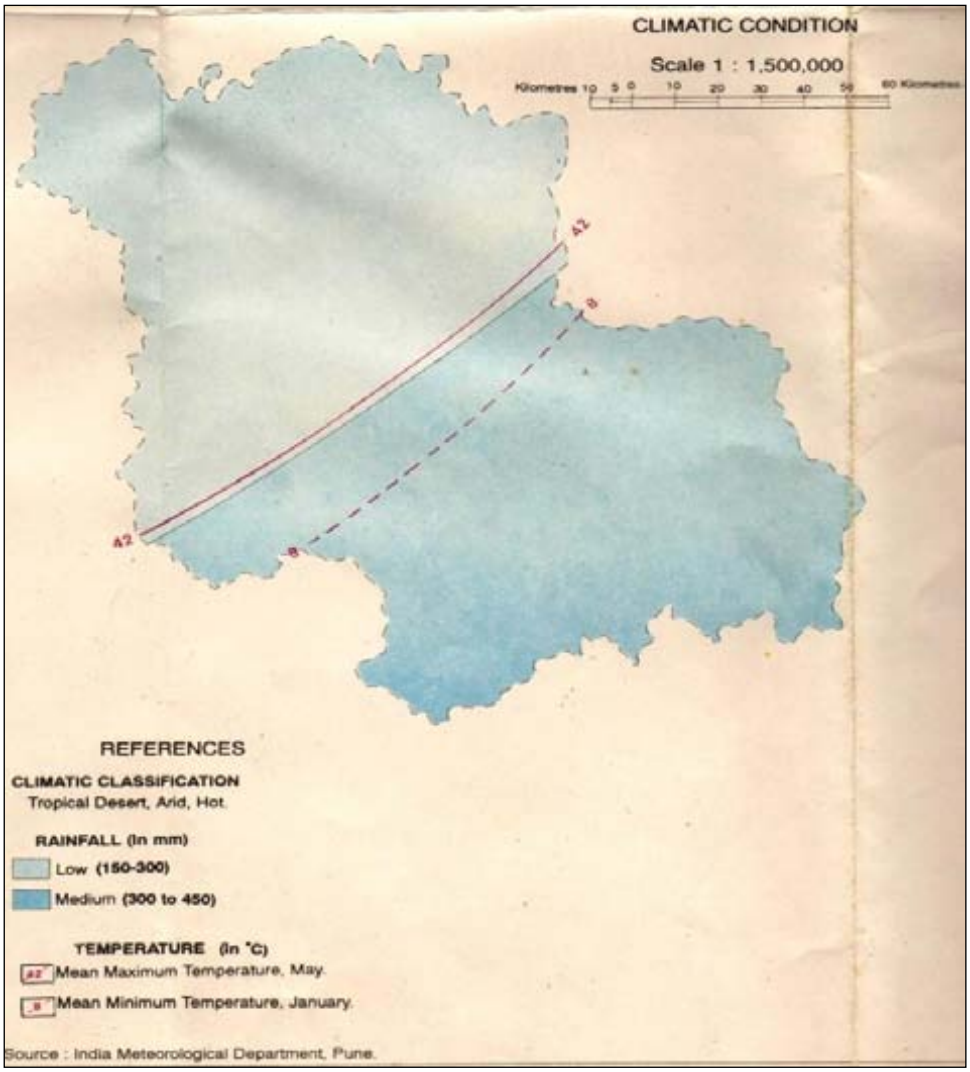
43. The Jaisalmer district has a desert climate characterized by extreme dryness of air, large extremes of temperature and fitful and erratic rainfall. The winter season from November to about the middle of March is followed by the hot season which extends up to the end of June. The south-west monsoon season is from July to the middle of September. The latter half of September and October constitute the post monsoon season.

44. **Humidity:** The air is generally very dry. Even during the brief monsoon season the air is dry in between the fitful rains.

45. **Winds** in the area are generally light in the post-monsoon and winter months. For the rest of the year winds are moderate, getting slightly stronger in the south-west monsoon period. In the period from May to September, winds are mainly from directions between south and south-west. In October, winds are light and variable in direction. During the rest of the year, winds are from directions between south-west and north-west.

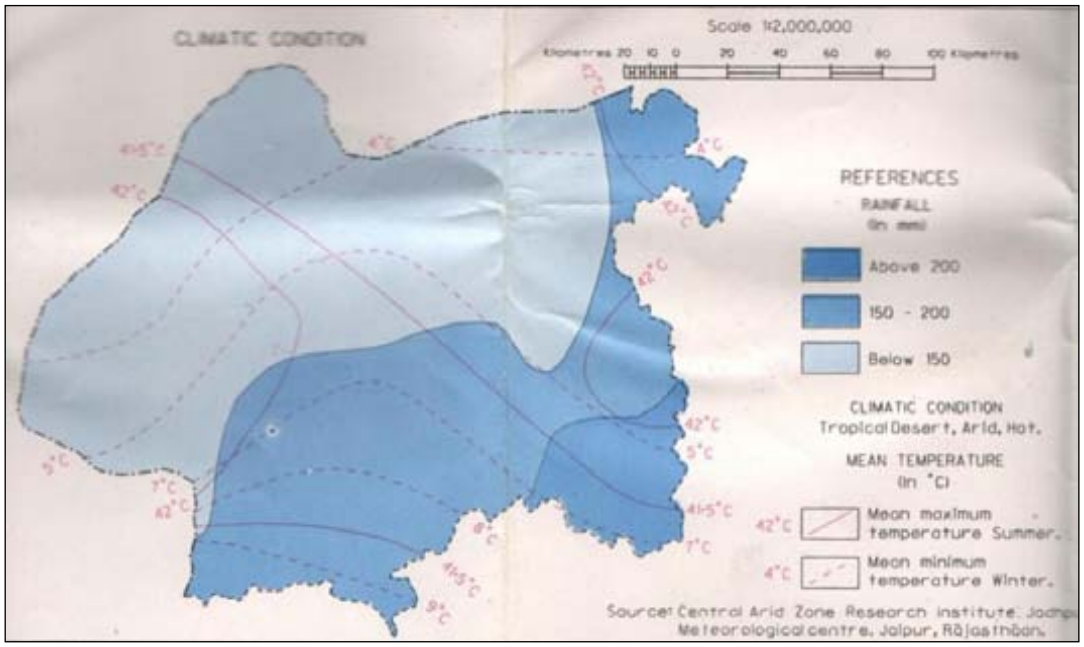
46. **Special Weather Phenomena**: A few depressions in July and August originate in the Bay of Bengal and move in a westerly direction, reach the district and its neighbourhood during their last stages causing gusty winds and heavy rain. Dust storms and thunderstorms accompanied by squalls occur in the summer and even in the early monsoon period. In the cold season western disturbances affect the district causing cloudy sky. **Figures 8 and 9** shows the climatic condition of Jodhpur and Jaisalmer district respectively.

47. **Cloudiness:** Sky is generally clear or lightly clouded except in the south-west monsoon season, when the cloudiness is moderate. Heavily clouded or overcast sky may be seen only on a few days. Tables showing rainfall data in Jodhpur and Jaisalmer districts are mentioned in **Table 8 and 9.**



Source: District Planning map series, Jodhpur, Survey of India

Figure 8: Map Showing Climatic conditions in Jodhpur district



Source: District Planning map series, Jaisalmer, Survey of India

Figure 9: Map Showing Climatic conditions in Jaisalmer district

Table 8: Rainfall Data (Year 2006 to 2010), Jodhpur district

Year	January		February		March		April		May		June		July		August		September		October		November		December	
	RF	%D	RF	%D	RF	%D	RF	%D	RF	%D	RF	%D	RF	%D	RF	%D	RF	%D	RF	%D	RF	%D	RF	%D
2006	0.0	-100	0.0	-100	0.6	-80	0.4	-87	1.3	-89	22.0	-19	28.5	-76	109.4	5	60.9	44	0.0	-100	0.0	-100	0.3	-79
2007	0.0	-100	45.0	1186	21.0	600	3.2	3	2.8	-76	42.3	55	106.2	-10	65.9	-37	34.8	-18	0.0	-100	0.0	-100	0.0	-100
2008	0.0	-100	0.0	-100	0.5	-83	4.4	42	13.6	18	45.6	67	50.0	-58	126.0	20	33.0	-22	0.0	-100	0.0	-100	0.6	-57
2009	0.0	-100	1.3	-63	0.4	-87	0.0	-100	3.0	-74	14.3	-48	89.3	-24	22.2	-79	8.7	-79	0.0	-100	0.0	-100	0.0	-100
2010	0.3	-91	0.1	-97	0.0	-100	1.3	-58	0.1	-99	22.1	-19	109.1	-8	147.1	41	111.8	164	0.0	-100	40.3	1450	8.9	536

Note: The district rainfall (mm.) (RF) shown are the arithmetic averages of rainfall of stations under the district.
%D is the Departures of rainfall from the long period averages of rainfall for the district.
Source: Hydromet Division, Indian Meteorological Department (http://www.imd.gov.in/section/hydro/distrainfall/rajasthan.html)

Table 9: Rainfall Data (Year 2006 to 2010); Jaisalmer district

Year	January		February		March		April		May		June		July		August		September		October		November		December	
	RF	%D	RF	%D	RF	%D	RF	%D	RF	%D	RF	%D	RF	%D	RF	%D	RF	%D	RF	%D	RF	%D	RF	%D
2006	0.0	-100	.0	-100	7.5	257	2.0	-49	0.0	-100	28.5	59	5.4	-90	273.9	418	4.0	-78	0.5	-50	0.0	-100	3.6	157
2007	0.0	-100	11.7	277	13.1	524	1.7	-56	2.8	-53	4.1	-77	44.1	-20	88.6	67	21.5	16	0.0	-100	0.0	-100	0.8	-43
2008	1.4	8	0.4	-87	0.0	-100	0.4	-90	1.4	-76	5.1	-72	52.9	-4	153.7	191	11.3	-39	0.0	-100	0.0	-100	20.6	1371
2009	0.4	-69	3.3	6	0.1	-95	0.5	-87	0.0	-100	23.6	32	40.4	-27	19.0	-64	5.5	-70	0.0	-100	0.0	-100	0.0	-100
2010	0.7	-46	0.0	-100	0.0	-100	1.1	-72	0.0	-100	85.6	378	88.2	60	124.0	134	62.9	238	1.7	70	14.2	914	0.0	-100

Note: (1) The district rainfall (mm.) (RF) shown are the arithmetic averages of rainfall of stations under the district.
(2) %D are the Departures of rainfall from the long period averages of rainfall for the district.
Source: Hydromet Division, Indian Meteorological Department (http://www.imd.gov.in/section/hydro/distrainfall/rajasthan.html)

3.4 Water Resources (Ground Water and Surface)

48. The area under irrigation in Jodhpur district is 206,412 ha. which is about 6.07 per cent of the total geographical area of the district. The main sources of water in the district are wells, few dams and tanks which are suitable for irrigation purposes, Soorpura tank, Pichiyak (Jaswant Sagar) and Golejor bundh are worth mentioning.

49. There is not a single perennial river in the Jaisalmer district. A few streams flow around Jaisalmer town, during the rainy season. The streams are shallow and water seeps through the porous sand very quickly. One such, locally known as Kakni rises near the village Kotri about 22 km. south of Jaisalmer, flows first towards the north and then turns west Near Rupsi village it forms into a lake called the Bhuj Jihil or Mitha Rann. During years of heavy rainfall, it deviates from its normal course and instead or turning west continues to flow north for about 20 km where the water is harnessed by the Daiya dam. The stream inundates the area near Dheda village and forms a shallow stretch of water known as Masori Khadeen. When the water dries up, wheat and gram are grown in the area. Most of the seasonal streams are only, nullahs with limited catchment areas. The waters are locked-in by the inhabitations to form Khadeens used for cultivation.

50. The area under irrigation in Jaisalmer district is 123,571 hectares. The main source of irrigation in the district is canals. There is no major or medium irrigation project in the district. However, there are 12 minor irrigation projects in Pokhran and 29 in Jaisalmer tehsil. **Table 10** provides details of Irrigation sources.

Table 10: Sources of Irrigation

Source of Irrigation	Net Irrigated area in Hectares		
	Jaisalmer	Jodhpur	Rajasthan (Total)
Canals	90,047	0	1,687,753
Tanks	0	0	101,724
Wells	33,502	204,880	4,572,049
Other sources	22	1,532	82,534
Total	**123,571**	**be206,412**	**6,444,060**

Source: Statistical Abstract, Rajasthan, 2010

51. Depth to water level (2006) in the Jodhpur district, monitored on 74 stations, ranges from 2.10 to 77.94 meters below ground level (MBGL) and 0.30 to 70.88 m during pre-monsoon and post monsoon, 2006, respectively. During pre-monsoon, shallow (2.10 to 34.54 m) water level exists in Balesar, Bap, Bilara, Luni and Shergarh blocks. In Bhopalgarh, Mandore, Osian, and Phalodi blocks water level is from 3.78 to 77.94 m. During post monsoon, shallow (0.30 to 37.60 m) water level exists in Balesar, Bap, Bilara and Luni blocks. In the Bhopalgarh, Mandore, Osian, Phalodi and Shergarh blocks water level is from 3.48 to 70.88 m. Seasonal fluctuation of pre & post monsoon, 2006 indicates rise in all the blocks except Bhopalgarh and Bilara due to widespread and good rainfall. Rise in water level more than 10 m was observed in Mandore and Phalodi blocks as shown in Table 11.

Table 11.0 Seasonal fluctuation of pre & post monsoon in Ground Water level

Block	Pre Monsoon water level in m		Post Monsoon water level in m		Water level fluctuation in m (Pre- Post)			
					Rise		Fall	
	Min	Max	Min	Max	Min	Max		Max
Balesar	25.18	25.18	25.21	25.21	-	-	0.03	0.03
Bap	4.24	13.63	2.77	13.08	0.55	1.59	-	-
Bhopalgarh	23.80	46.48	29.28	46.88	-	-	0.40	5.48
Bilara	9.84	23.73	13.19	13.19	-	-	3.35	3.35
Luni	2.10	38.80	0.30	37.60	0.05	4.33	0.13	0.13
Mandore	3.78	44.95	3.48	42.95	0.30	10.70	0.06	0.48
Osian	24.56	72.82	24.63	70.88	1.94	1.94	0.07	0.12
Phalodi	43.03	77.94	40.60	67.75	2.43	10.19	-	-

Block	Pre Monsoon water level in m		Post Monsoon water level in m		Water level fluctuation in m (Pre- Post)			
					Rise		Fall	
	Min	Max	Min	Max	Min	Max		Max
Shergarh	34.54	34.54	34.47	43.10	0.07	0.07	-	-
District	**2.10**	**77.94**	**0.30**	**70.88**	**0.05**	**10.70**	**0.03**	**5.48**

52. In view of long term change in ground water regime, it is observed that over a major part of lying in central and eastern parts of the Jodhpur district shows maximum decline. This significant decline is observed due to increased ground water draft. In some areas of Osian, Bhopalgarh and Bilara, water level decline of more than 25 m has been noticed during last 10 years. There is a large variation in chemical quality of ground water in the district depending on the characteristics of water bearing formation, movement of ground water, depth to water levels etc.

3.5 Monitoring of Environmental Parameters: Air and Ground Water Quality, Soil and Noise

Primary Monitoring of Air, Noise, Soil and Water along the project alignment

53. The establishment of a baseline for environmental monitoring is to determine trends in the quality of ambient air, water, ambient noise and soil and how that quality is affected by the release of contaminants, other anthropogenic activities, and/or by waste treatment operations (impact monitoring). Environment monitoring needs to be carried out to estimate nutrient or pollutant fluxes discharged in atmosphere or ground waters or lakes or to the land across project and nearby areas. Monitoring is done to determine the quality of the ambient Environment before start of any kind of project related activities, as it provides a means of comparison with impact monitoring. It will be also used simply to check whether any unexpected change is occurring in otherwise pristine conditions. The primary tests were conducted by a recognized laboratory from Rajasthan State Pollution Control Board. The environmental monitoring for Air, Water, Soil and Noise were conducted at the different locations inside the solar park and along with the transmission route and at the associated grid sub-stations using standard methodology prescribed by the Central Pollution Control Board.

3.5.1 Ambient Noise

54. Ambient Noise can seriously harm human health and interfere with people's daily activities at school, at work, at home and during leisure time. The main health risks of noise identified by the World Health Organisation (WHO) are - pain and hearing fatigue, hearing impairment including tinnitus, annoyance, interference with social behaviour (aggressiveness, protest and helplessness) and speech communication, sleep disturbance and all its consequences on a long and short term basis, cardiovascular effects, hormonal responses (stress hormones) and their possible consequences on human metabolism (nutrition) and immune system, and poor performance at work and school.

55. The results of Ambient Noise monitoring (shown in Table 12) are also much "LOWER" than standard permissible limits of the Industrial area.

Table 12: Test Results for Ambient Noise Monitoring

Standard permissible limits for Industrial area	Results within Bhadla solar park	Results within grid sub-station sites	Results near transmission line alignments
75 dB (A) Leq in Day time (6.00 a.m. to 10.00 p.m.)	between 44.20 to 47.53 dB (A) Leq for Day time	45.45 to 53.17 dB (A) Leq for Day time	44.38 to 54.09 dB (A) Leq for Day time
70 dB (A) Leq Night time (10.00 p.m. to 6.00 a.m.)	40.31 to 41.71 dB (A) Leq for Night time	41.00 to 42.31 dB (A) Leq for Night time	40.87 to 44.12 dB (A) Leq for Night time.

3.5.2 Air Quality

56. Concentrated road traffic or presence of air polluting industries in the area can result in a significant decline in air quality. Since most of the transmission line tower locations and

the sub-station are located in rural and semi-urban areas, the Ambient Air Quality measurements along the project alignments are within the limits of National Ambient Air Quality Standards. Particulate Matter ($PM_{2.5}$)[5] is produced by combustion, including vehicle exhaust, and by chemical reactions between gases such as Sulphur dioxide, nitrogen oxides, and volatile organic compounds. Adverse health effects from breathing air with a high $PM_{2.5}$ concentration include premature death, increased respiratory symptoms and disease, chronic bronchitis, and decreased lung function particularly for individuals with asthma.

57. The results for Air Quality monitoring at Solar Park Site and at various points along the proposed transmission lines are within the permissible limits prescribed by the Central Pollution Control Board (CPCB) for commercial and residential areas. The results of ambient air quality monitoring (Table 13) within Bhadla Solar Park area are well within the National Ambient Air Quality Standards (NAAQS):

Table 13: Test Results for Air Quality Monitoring

	Results within Bhadla solar park	Results within grid sub-station sites	Results near transmission line alignments
PM of 2.5 diameter[6]	21.4 μg/m^3 to 31.4 μg/m^3 (standard value 60 μg/m3)	20.5 μg/m3 to 32.6 μg/ m^3 (standard value 60 μg/ m^3)	18.6 μg/ m^3 to 41.4 μg/ m^3 (standard value 60 μg/ m^3)
PM of 10 diameter	43.6 μg / m^3 to 58.6 μg / m^3 (standard value 100 μg/m3)	44.6 μg / m^3 to 65.8 μg / m^3 (standard value 100 μg/ m3)	41.4 μg / m^3 to 76.6 μg / m^3 (standard value 100 μg/m^3)
Sulphur Dioxide[7]	6.0 μg / m^3 to 6.3 μg / m^3 (standard value 80 μg/m^3)	6.0 μg / m^3 to 6.5 μg / m^3 (standard value 80 μg/ m^3)	6.0 μg / m^3 to 7.6 μg / m^3 (standard value 80 μg/ m^3)
Oxide of Nitrogen[8]	9.0 μg / m^3 to 9.3 μg / m^3 (standard value 80 μg/m^3)	9.0 μg / m^3 to 9.7 μg / m^3 (standard value 80 μg/ m^3)	9.0 μg / m^3 to 11.9 μg / m^3 (standard value 80 μg/ m3)
Carbon monoxide[9]	373 μg / m3 to 573 μg / m^3 (standard value 2000 μg/m^3)	373 μg / m3 to 687 μg / m^3 (standard value 2000 μg/ m^3	344 μg / m^3 to 687 μg / m^3 (standard value 2000 μg/ m^3)

58. The highest load of all the monitoring parameters was observed at the existing Akal GSS which is situated on the national highway.

3.5.3 Ground Water

59. The results of ground water analysis (Table 14) shows “HIGH” level content of Total Hardness ($CaCO_3$), Dissolved Solids and Chlorides making the water un-potable and corrosive in nature in most places.

Table 14: Test Results of Ground Water Sampling

Parameters	Results within Bhadla solar park	Results within grid sub-station sites	Results near transmission line alignments
Calcium Hardness	552 Mg/l to 588.00 Mg/l	548 Mg/l – Bhadla GSS 495 Mg/l - Ramgarh GSS	Village Sirmandi (588 Mg/l), Village Askandra (600 Mg/l), Tanusar (344 Mg/l), Village Hadda (596 Mg/l)
Chloride in water	44.86 Mg/L to 851.74 Mg/l	775.76 Mg/l – Bhadla GSS 495 Mg/l – Ramgarh GSS	Sirmandi (591 Mg/l), Village Askandra (404.87 Mg/l), Village Hadda (427 Mg/l),
Dissolved Solids	2,674.00 Mg/l	2,532 Mg/l– Bhadla GSS Ramgarh (1785 Mg/l) Akal GSS (977 Mg/l)	Higher range at all locations ranges from 748 Mg/L (Tanusar) to 3619 Mg/l (Sirmandi)
Calcium as Ca	118.40 Mg/l	110.40 Mg/l at Bhadla GSS	Sirmandi (113.60 Mg/l), Village Askandra (104 Mg/l), Tanusar (97.60 Mg/l), Village

[5] Fine Particulate Matter with a diameter smaller than 2.5 microns. (Human hair diameters range from 40 to 120 microns.)
[6] Test for particulate matter done by Gravimetric Method
[7] Sulphur test by Improved West and Gaeke Method
[8] Nitrogen test by Modified Jacob and Hochheiser Method
[99] Using method of IS: 5182–1975 Part X

Parameters	Results within Bhadla solar park	Results within grid sub-station sites	Results near transmission line alignments
Magnesium (Mg)	62.72 Mg/l	Bhadla (66.64 Mg/l)	Hadda (84.80 Mg/l), Sirmandi (74.48 Mg/l), Village Askandra (83.30 Mg/l), Village Hadda (45.08 Mg/l)
Fluoride	1.31 Mg/l	Bhadla GSS (1.33 Mg/l) Ramgarh GSS (1.47 Mg/l)	Higher ranges from 1.16 mg/l (Amla) to 1.86 mg/l at Bhagu ka Gaon)
Alkalinity	372 mg/l	404 mg/l at Bhadla GSS 268 mg/l at Ramgarh GSS	Higher ranges with 240 mg/l (Tanusar) to 452 mg/l (Hadda)

60. The water quality results show the ground water within the Bhadla village is not drinkable and it has high amount of hardness and makes water unfit for drinking purpose. High amount of colony forming units of Coliform organisms were observed in water storage by villagers which show unhygienic conditions. For GSS sub-stations water quality results shows the ground water has high amount of hardness. The ground water samples along the transmission line alignment were collected from the nearest drinking ground water sources which also show that ground water has high amount of hardness. All other parameters such as copper, manganese, sulphate, nitrate, fluoride, phenolic compounds as C_6H_5OH, mercury, cadmium, selenium, arsenic, cyanide, lead, zinc, anionic detergents, chromium, mineral oil, alkalinity, aluminium and boron are found within permissible limits.

3.5.4 Soil Analysis

61. A soil test chemically extracts and measures the elements essential to plant nutrition. It also measures soil acidity and pH. These factors are indicators of nutrient availability, and the potential of the soil to produce crops and presence of metals like chromium, cadmium, copper etc. before beginning of any project related activities. Table 15 gives the site test results for soil analysis.

Table 15: Results of Soil Analysis Monitoring

Parameters	Results within Bhadla solar park	Results within grid sub-station sites	Results near transmission line alignments
PH	7.56 to 7.87	7.25 to 7.87	7.06 to 7.58
Conductivity (μS/cm)	141 to 291	141 to 823	110 to 2520
Moisture (%)	4.8 to 6.1	6.1 to 7.2	0.06 to 2.64
Chlorides (%)	0.002 to 0.004	0.001 to 0.037	0.003 to 0.072
Sulphates (SO4) (%)	0.001 to 0.005	0.002 to 0.016	0.004 to 0.156
Total Carbonates (%)	0.04 to 0.05	0.02 to 0.05	1.17 to 22.54
Total Soluble Solids (%)	0.036 to 0.136	0.33 to 0.122	0.108 to 1.199
Total Organic Matter (%)	0.04 to 0.13	0.07 to 0.14	0.004 to 0.187
Nitrogen (%)	0.03 to 0.09	0.04 to 0.09	0.005 to 0.119
Phosphorus (P) (%)	< 0.0005	< 0.0005	< 0.0005
Potassium (K) (%)	0.012 to 0.25	0.004 to 0.24	0.002 to 0.015

62. Other metals like zinc, copper, chromium, cadmium, nickel, lead are found below detectable limits signifies the low productivity of soil with no traces of any pollutants before start of project activities.

63. A summary of environmental baseline results is attached as **Annexure 6**. In this annexure, **Figure 15** depicts sampling locations within Bhadla Park maps. A regular monitoring of all above parameters during construction, operation, and management phase will further describe the pollutants loads in the ambient environmental conditions, effective use of Environment monitoring Plan and environmental good practices by the project proponent.

3.6 Ecological Resources

3.6.1 Forest

64. On account of arid climate, both districts land-use consists of negligible percentage of total reporting area under forests. Due to sandy soil only scrub and thorny bushes of vegetation are found in the forest areas of the district. The main species of trees are Kumat, Kair, Khejri, Babul, Bir, Jal Khara, Pilu, etc. Fruit bearing trees are Pomegranates and Guavas. The fauna of the district include Jackal, Jungle Cat, Indian Fox, Black Buck, Chinkara, Common Hare, etc. The birds commonly found are Baya, Koyal, Parrot, Vulture, Jungle Crow, Bulbul, House Sparrow, Kite, Sand Grouse, Common Quail, Grey Partridge, Little egret, etc.

65. The nearest wildlife sanctuary to the project area is the Desert National Park which is situated about at a distance of 150 km from the proposed Bhadla grid substation site and about 45 km away from Ramgarh grid substation site in Jaisalmer district.

3.6.2 Desert National Park (Refer Figure 4)

66. Desert National Park, a protected sanctuary, is situated 45 km away from the town of Jaisalmer. This is one of the largest national parks; covering an area of 3,162 sq. km. Park is an excellent example of ecosystem of the Thar Desert and its diverse fauna. Sand dunes form around 20% of the Park. The major landform consists of craggy rocks and compact salt lake bottoms, intermediate areas and fixed dunes which are quite suitable for the Chinkara to move at high speed. The blackbuck is another common antelope in this region; its other notable inhabitants are desert fox, bengal fox, wolf and desert cat, great Indian bustard, eagles, harriers, falcons, buzzards, kestrel and vultures, short- toed eagles, tawny eagles, spotted eagles, laager falcons and kestrels are the most common among these.

67. The landscape of the park comprises of lakebed of extinct salt lakes and thorny scrubs; a considerable area of the Desert National Park consists of sand dunes. **Table 16** shows the status of forest area in Jodhpur and Jaisalmer districts in comparison to Rajasthan State.

Table 16: Forest area (in Hectares)

S. No.	Name of District	Reserved Forest	Protected Forest	Unclassified Forest	Total
1	Jodhpur district	4.68	175.52	62.70	242.89
2	Jaisalmer district	0.00	199.77	383.52	581.29
3	Rajasthan state	12,453.92	17,415.96	2,768.86	32,638.74

Source: http://rajforest.nic.in/

68. The transmission lines have been designed to keep away from forest and buffer zones of national park and sanctuaries. However exact details of government lands and open scrub covered under forest can be ascertained only after collection of revenue records from state authorities. As per preliminary route survey, the proposed line route is not passing in any protected, reserved and sanctuary forest area.

3.6.3 Flora

69. On account of arid climate, and sandy soil only scrub and thorny bushes of vegetation are found in the forest areas of the Jodhpur district. The main species of trees are Kumat, Kair, Khejri, Babul, Bir, Jal khara, Pilu, etc. Fruit bearing trees are Pomegranates and Guavas.

70. Since the whole Jaisalmer district is covered with blown sand, only scattered vegetation is possible. Consequently, no particular botanical divisions can be drawn of this

area. The vegetation of this area can be included in Tropical Thorn Forest area. Most of the flowering plants found in the area are shrubs and wild grasses which, however, do not survive for more than a few months after the rains. Prominent trees found in the area are Neem (*Azadirachta indica*) Bubul (*Acacia nilotica*) and Khejri (*Prosopis spicigera*). The shrubs include the *Aernatomentosa* (Bui), *Calotropis procera* (Safed ak or Akra), *Calligonun Polygonoides* (Phog), *Euphorbia tirucalli* (Thohur) or (Konpai), *Gynadropris pentaphvlla* (Bagra), *Haloxylon salieornicum*, Bungeese boirs, (Jahrbuti) or (Lana), *Mimosa rubicaulis* (Hajern) and *Trianthenmonogyna* (Santhi).

3.6.4 Wild Animals

71. The usual fauna of the Jodhpur district consists of Jackal (*Canis aurens*), Jungle Cat (*Felis chaus*), Indian Fox (*Hystrix leucura*), Nilgai (*Boselaphus iragocamelus*), Black Buck or Indian Antelope (*Antelope bezoarrica*), Chinkara or Indian Gazelle (*Gazella benetti*), Common Hare (*Lepus dayanus*), Hedge Hog (*Hemiechinus collaris*), Common Langur (*Seinno pithecus*) and Mongoose (*Herpestes edwardssi*).

72. The fauna in the Jaisalmer district is not plentiful. Hyaenas (*Hyaena hyena*) are found in fairly large numbers. Desert fox (*Vulpes pusilla*), Jackal (*Canis aureus*) and Chinkara (*Gazelle gazella padlas*) are numerous. Wolves (*Canis lupus*) were at one time very common and were much dreaded by the people, but the number of packs appears to have dwindled. Other species of wild animals found in the district are the wild boar (*Sus scrofa cristatus*), the Chumcher (*Pipistrello vesperugo*), the Shela (*Hiechinus auritus*), the Cat (*Felis libyca*), the Newla (*Herpestes edwardsi Geoffroy*) and the Five Striped Palm Squirrels (*Funambulus pennanti*). The Indian Hare (*Lepus nigricoullis dayanuc*) can be found in a few places. Two varieties of rats and mice viz., the Indian Desert Garbilla (*Meriones hurrianal*) and the House Mouse (*Musmusculus Linnacus*) exist in plenty. Besides, domesticated animals include camels, horse, cow, buffalo, goat, and dog etc.

3.6.5 Birds

73. Owing to scarcity of water and absence of greenery in the Jodhpur district, only few common birds are found in the district which are Baja (*Ploccus manyar*), Koyal (*Eudynannis scpacens*), Parrot (*Psinacula, Krameri*), Vulture (*Psendogyps bengalensis*), Jungle Crow (*Carvus macrorhynchos*), Bulbul (*Molpastes cafer*), House Sparrow (*Passer domesticus*). Owl (*Bubo bubo*), Kite (*Milvus migrans*), Green Pigeon (*Crocoupus phoenicopterus*), Pigeon (*columba libia*), Sand Grouse (Pterocles exustus), Pea Fowl (*Pavo cristatus*), Common Quail (*Coturnix coturnix*), Jungle Bush Quail (*Perdicula asiatica*), Black Partridge (*Francolinus francolinus*), Grey Partridge (*Francolinus pondicerianus*), Saras (*Antigone antigone*), Common Sand Piper (*Actitis hypolencos*), Little Egret (*Egreua garzeua*), Flamingo (*Phoenicopterus ruber*), Common Teal (*Anas crecca*), Snipe (*Rostratula benghabusis*), migratory Indian Bustard (*Choriatus migriceps*) and other migratory birds like Domicile Cranes.

74. The birds of Jaisalmer district, a desert region, are not as numerous as in other more favoured parts of the State. Among birds most commonly found are the House Crows, Jungle Crow, Pigeon, Sparrow, Peacock, Parrot, Myna, Blue Jay, Hoopoe, Bulbul and Robin. In addition to these, cocks and hens are found as domesticated birds. An outstanding characteristic of the birds of this area is that they are pale in colour than others of their own class in the eastern districts of the state.

75. The game birds are the Imperial Sand grouse (*Petrocles exusrus*), the common Bustard (*Chlamydotis undulata*), the Great Indian Bustard (*Choriotis nigriceps*) the Indian Courser (*Cursorius coromandelicus*), the Kashmir Common Roller (*Coracias garrul*) and Grey Partridge (*Franccolinus Pondicerianus*). The Imperial Sand Grouse is a winter visitor to

this area, arriving here about the third week of October and leaving by the end of February. This bird is much prized for sport. The Indian Courser (*Cursorius coromandelicus*) is seen in very large numbers even on the outskirts of Jaisalmer town. The Kashmir Common Roller (*Coracias garrul*) passes through the district on its flight from Kashmir to Africa in the months of September to October. Another bird of interest which visits the district in winter is the Rosy Pastor (*Pastor roseus*). This bird is one of the greatest natural agents for destroying locusts which are a frequent menace to this area. These birds along with Starlings (*Sturnus vulgaris*) and the Common Mynah (*Acridotheres tristis*) prey on locusts and prevent their damaging vegetation.

3.6.6 Reptiles

76. Lizards of the following families are found in the Jodhpur district: Gekko - Nidae, Agamidac, and Scincidae. Lacertidae and Varanidae. Snakes are plentiful in the district and are found in the desert tracts and in the bushes. Their varieties are: *Typhlops graminas* (Daudin) or Blind Snake or Marm Snake, Eryx Conicus (Schincider) or the rassee's sand Boa, *Erhx johni* (Runell) or the John's Sand Boa, Ptyas mucosus (Linnaius) or Dhaman or rat snake, *Coluber diadema sehlegl* or the Royal Snake *Natrix piscator* (Schneider) or the Checkered Ked back, Boiga Trigonata common Indian Krait, Najnaja (Linnaeus) or the Indian Cobra and *Echis Carinatus* (Schneider) or the or Saw-Scaled Viper Phoorsa.

77. In Jaisalmer district, all the three types of poisonous snakes viz., Vipers (*Vipera russellii*), Cobras (*Naia tripudians*) and Kraits (*Bungarus coeruleus*) are found. Other important reptiles found in the district are, the common house lizard (*Hemidacrylics flavivirdis*), Fat Tailed Lizard (*Uromastrix hardwickel*), Desert Monitor (*Varanus grisesics*), Common Blind Snake (*Typhiops braminus*), Sand Boas (*Eryx conicus* and *Eryx Johnii*).

3.6.7 Insects

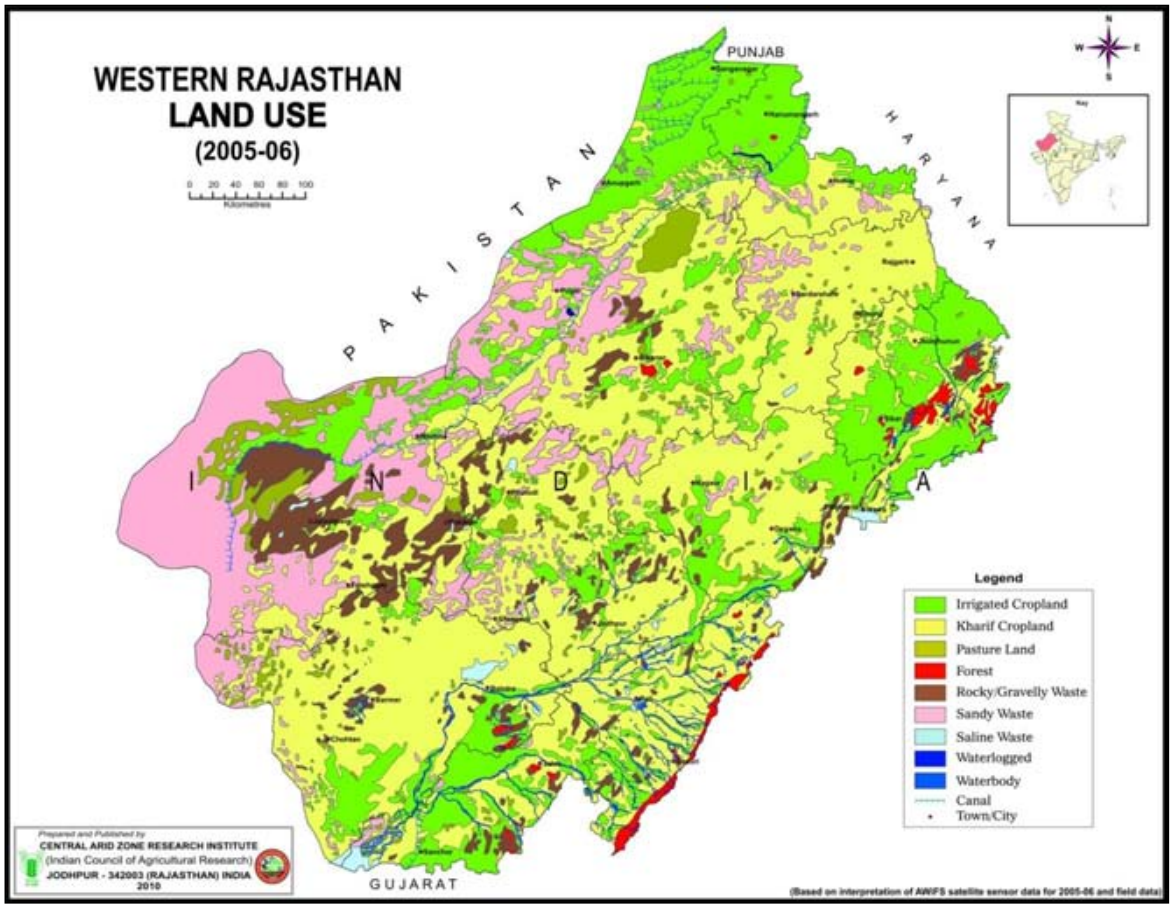
78. The most common desert insects are the locust. Swarms arrive in the district every year, in greater or lesser numbers from their west Asian breeding grounds and cross into India via the Sindh desert. Locust control has been taken up on an international level and in India; preventive measures are directed by a unit stationed at the district headquarters. The other insect which damages crops in the district are the grass hoppers.

3.7 Economic Development

3.7.1 Land Use and Agriculture

Land use pattern

79. Land use pattern of the Jodhpur and Jaisalmer district are listed in **Table 17** below. The land use pattern map of western Rajasthan is shown below in **Figure 10** which shows most of the land in the area consists of sandy and rocky waste lands.



Source: http://www.cazri.res.in/images/LandUse-WRaj.jpg

Figure 10: Land use pattern in western Rajasthan

Table 17: Land use pattern in project area

LAND USE PATTERN (2007-2008) Classification of land area (Hectares)	Rajasthan State	Jodhpur district (Western Rajasthan)	Jaisalmer district (Western Rajasthan)
Total Reporting area	34,269,701	2,256,405	3,839,154
Areas under forest	2,726,690	6,996	44,577
Area under non agriculture use	1,846,662	80,121	135,620
Barren and uncultivable land	2,417,764	145,374	366,013
Permanent Pastures and other grazing lands	172,558	121,998	103,926
Miscellaneous trees crops and Groves not included in the net area Sown	15,788	81	272
Cultivable waste land	4,573,280	40,649	2,453,877
Fallow land other than current fallow	2,166,861	322,790	113,367
Current Fellow	1,724,426	283,736	59,132
Net area Sown	17,095,672	1,254,660	562,370
Total cropped area	22,208,291	1,378,693	637,580
Area Sown more than One time	5,112,619	124,033	75,212

Source: Statistical Abstract Rajasthan 2010

3.7.2 Agricultural

80. The project area comes under arid zone of the state and on account of non-availability of adequate water and has only single cropping pattern. Only 2.91% of the net cultivated area are being utilised for double / multiple cropping. **Table 18** provide list of important crops of the area.

Table18: Important crops of the project area

Kharif Crop	Rabi Crops
Maize	Wheat
Guar	Barley
Bajra	Chana
Moth	Isabgol
Moong	Rap (Sarso)
Chanwla	Mustard(Raida)
Till	Taramira
Groundnut	
Chilli	
Cotton	

Source: www.jodhpur.nic.in

3.7.3 Crops

81. Soils of the area are classified mainly as sandy and loamy. Bajra (pearl millet) is the major crop in Kharif. Jodhpur has excellent ground water in many part of district. In Rabi, wheat, pulse and a variety of masala like jeera, dhania and red chilly are also grown. Jodhpur has a name for its red chilli, onion and garlic. It is one of the major production centres for Guar.

82. The total area under Kharif crop is 561,200 hectare. During Kharif, bajra, jawar, moong, moth, and guar and til are the main crops cultivated and during Rabi, wheat, barley and mustard are the main crops in the district. **Tables 19 and 20** provide the area production and yield of Kharif crops in project districts.

Table No. 19: Area, Production and Yield of Kharif Crops in Jodhpur district

(Area in ha., Production in tonnes & Yield in kg. /ha..)

Region/District	2006-07			2007-08		
	Area	Production	Yield	Area	Production	Yield
Rice	0	0	-	0	0	-
Jowar	45,062	19,597	435	42,925	22,667	528
Bajra	509,544	118,625	233	590,862	376,384	637
Maize	5	5	1000	8	15	1875
S.Millets	0	0	-	3	0	0
Cereals Total	**554,611**	**138,227**	**249**	**633,798**	**399,066**	**630**
Arhar	0	0	-	0	0	-
Moong	81,861	16,624	203	117,239	50,606	432
Moth	151,255	9,097	60	159,411	39,964	251
Kharif Pulses	-	-	-	-	,-	-
Pulses Total	**233,116**	**25,721**	**110**	**276,650**	**90,570**	**327**
Sesamum (Til)	24,028	4,443	185	30,486	13,389	439
Ground Nut	22,966	39,191	1706	28,869	47,366	1,641
Castor	11,915	6,825	573	14,825	8,888	600
Oil-Seeds Total	**58,909**	**50,459**	**857**	**74,180**	**69,643**	**939**
Sugarcane	0	0	-	-	-	-
Cotton	8,131	25,493	3135	-	-	-
Guar	183,810	6,230	34	149,975	21,590	144
Others Total	**191,941**	**31,723**	**165**	**149,975**	**21,590**	**144**
Gross Total	**1,038,577**	**246,130**	**237**	**1,134,603**	**580,869**	**512**

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

Table 20: Area, production and yield of Kharif crops in Jaisalmer district

(Area in ha.., Production in tonnes & Yield in Kg./ha.)

Region/District	2006-07			2007-08		
	Area	Production	Yield	Area	Production	Yield
Rice	0	0	-	0	0	-
Jowar	6,091	2,649	435	5,048	2,666	528
Bajra	101,758	1,856	18	128,697	27,377	213
Cereals Total	**107,849**	**4,505**	**42**	**133,745**	**30,043**	**225**
Moong	1,931	392	203	3247	305	94
Moth	577	96	166	360	113	314

Pulses Total	**2,508**	**488**	**195**	**3,607**	**418**	**116**
Sesamum (Til)	86	28	326	320	129	403
Ground Nut	6,085	7,689	1,264	7,298	12,215	1,674
Castor	683	270	395	834	248	297
Oil-Seeds Total	**6,854**	**7,987**	**1,165**	**8,452**	**12,592**	**1,490**
Sugarcane	1	58	58,000	-	-	-
Cotton	45	96	2,133	-	-	-
Guar	340,474	14,532	43	329,752	19,686	60
Others Total	**340,520**	**14,686**	**43**	**329,752**	**19,686**	**60**
Gross Total	**457,731**	**27,666**	**60**	**475,556**	**62,739**	**132**

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

3.7.4 Industries

83. On account of location and availability of better infrastructural facilities, industrial growth is noticeable in the Jodhpur district. Industrial units are engaged in manufacture of cement, industrial gases, textiles, derivatives of gaur gum, chemicals, plastics, electronics, electrical, mineral based, stainless steel utensils etc. there are 100 rolling mills engaged in processing of stainless steel sheets/patta.

84. There are large number of handicraft units engaged in production of items of White metal, wooden toys, Fancy items of sheep and decoration. A large number of artisan based industries are engaged in screen printing of cloth, shoe embroidery, dyeing and printing of clothes, salt making, etc.

85. In Jodhpur, there are five main industrial clusters namely textile, handicraft, guar gum, stainless steel patta patti / utensils, stone processing. Details of employment in these clusters are shown below in **Table 21.**

Table 21: Industrial clusters in Jodhpur district

S. No	Name of Cluster	No. of Units	Employment in the Cluster
1	Textile	150	1,290
2	Handicraft	1,000	15,000
3	Guar Gum	60	1,050
4	Stainless Steel Patta Patti / Utensils	150	8,000
5	Stone Processing	116	1,400

Source: www.jodhpur.nic.in

86. **An Export Promotion Industrial Park (EPIP),** second in the state has been setup in the Boranada industrial area in accordance with the scheme of ministry of commerce, Govt. of India. The establishment of this park will lead to:

- Plots will be allotted to those industrialists who will be able to export 33% of the total production.
- Allotment of land with all technical facilities at a comparative price.
- This park will help in the increase of exports from the state, especially from Jodhpur, where presently around 600 to 700 crores of export is being done.
- The increase in exports is expected to go up to 1600.00 crores in the next five years.

87. **Special Economic Zones (SEZs)** are specifically delineated duty free enclaves treated as a foreign territory for the purpose of industrial, service and trade operations, with exemptions from customs duties and a more liberal regime in respect of other levies, foreign investment and other transactions. Domestic regulations, restrictions and infrastructure inadequacies are sought to be eliminated in the SEZs for creating a hassle-free environment.

88. Major Industries of Jaisalmer district include Tourism, Stone Cutting & Carving, Khadi industry; and Mineral based industry. Concessions and incentives provided by Central

Government to units established in SEZ:

- Exemption from Income Tax for ten years where 100% exemption for first five years, 50% for next two years and another 50% exemption on new investment for next three years.
- No import license required.
- Exemption from custom duty on import.
- Exemption from all kind of taxes / levies etc. Right from the inception of the unit to completion of construction work and establishment of plant & machinery.
- Products sold by units of domestic industrial area to the units established in SEZ will be considered as deemed export.
- Reimbursement of CST on domestic import.
- Units established in SEZ can engage in manufacturing, trading and/or service based activities

89. Woollen Khadi items of this district are very popular all over the country. Khadi industry has developed as the most important cottage industry. About 0.2 million square meter of Khadi items are produced in this district every year. Major Cement plants and other mineral based industries are developing in this district very rapidly. In Jaisalmer town, the RICCO industrial area at Gandhi Colony is already developed. Baramsar and Hamira areas have also been set apart. Also, the industrial area in Pokhran is known as Ashapura industrial area. There are three saline areas viz. Pokhran Rann, Gudi Rann and Kanod Rann. The areas nearby Indira Gandhi Nahar are developing for oil mills, Dal mills and other agro-based industries.

90. **Rajasthan State Industrial Development & Investment Corporation Ltd (RIICO)** is a government agency involved in development of land for industrial enterprises. Large, medium and small scale projects get an easy access to a ready – to - use base with supportive infrastructure facilities in the industrial areas, developed and managed by RIICO. The financial and vital infrastructural facility provided by RIICO has contributed to promoting accelerated growth of industrial sector in the State. It has kept pace with the industrialisation process in providing complete and innovative means of financial and investment support services.

91. RIICO will develop a manufacturing hub with Bureau of Investment Promotion (BIP) on the northern part of the Bhadla Solar Park. The area provided is around 560 ha. (1400 acres), which will accommodate several industries, assemblies and warehouses required for manufacturing solar products within the Rajasthan State.

Employment

92. Employment growth in Rajasthan during the past two decades largely followed the national employment growth rate, though the growth in the major sectors like agriculture, industry and services was differed. Employment grew at 2.2% per annum in the State as compared to 2.1% in the country. In Rajasthan, agriculture and allied activities still provide over 60% of all jobs, with industry (mainly construction and manufacturing) and services (mainly trade, hospitality, government and community services) accounting for the rest of employment.

93. Creation of adequate job opportunities for youth is a major challenge before the planners. The State Government has been creating a number of job opportunities under various sectors, but the increase in the job has been more than offset by the rapid growth of population. Consequently there has been gradual increase in the number of job seekers.

94. The rate of growth of employment is lesser than the growth of labour force, thus creating a backlog of unemployment. As a result of rapid increase in the labour force, a small

percentage of persons have been absorbed in the paid employment in the organised sector. In June, 2004, only 11.75 lakhs persons were engaged in organised sector in Rajasthan, comprising of 9.33 lakhs under public sector and 2.42 lakhs under private sector. The only solution to the problem of unemployment lies through promotion of substantial gainful employment opportunities in the un-organised sector. The data available with the employment exchanges reveals that about 7.93 lakhs unemployed persons were registered in district employment exchanges as on 31st Dec. 2005.

3.8 Infrastructure Facilities

3.8.1 Transport and Accessibility Infrastructure:

95. Jodhpur and Jaisalmer are connected by road, railways and airways to all other important cities of the country. There are broad gauge and meter gauge railway lines. The Jodhpur district headquarter is connected by air route to Jaipur, Delhi, Udaipur and Bombay. The nearest airport to Jaisalmer is Jodhpur Airport which is around 285 km from Jaisalmer.

96. The district has road connections with Sirohi, Pali, Bikaner, Nagaur, and Ajmer, Jaipur, Jalore, Barmer and Jaisalmer district of the state. Bhadla Solar Park and Bhadla GSS are connected with black top painted road within Bhadla village which is connected by Chinnu–Nachana road. Similarly, Ramgarh sub-station is connected by Jaisalmer–Ramgarh road. The detail of available road infrastructure in Jodhpur and Jaisalmer districts is mentioned in **Table 22** below.

Table 22: Road Length in km

District	Painted Roads (BR)	Gravelled Roads (GR)	Seasonal Roads (FR)	Total Roads
Jodhpur district	6,337 km	466 km	0 km	6,803 km
Jaisalmer district	3,978 km	443 km	0 km	4,421 km
Rajasthan state	140,813 km	39,853 km	4,909 km	186,807 km

Source: Statistical Abstract Rajasthan, 2010

97. Jodhpur city is directly connected by railway with Bombay, Ahmedabad, Howrah, Kalka, Jaipur, Delhi, and Bangalore, Guwahati, Jammu and many other main cities of India. Jaisalmer is connected by railways through Jodhpur. Jodhpur comes under Northern railway division and the total length of railway lines for Broad gauge is 853.46 km and the Meter gauge 728.25 km.

3.8.2 Electricity

98. The main sources of supply of power to area are Kota Atomic Power Station, Bhakra Beas Project, Rana Pratap Sagar and Jawahar Sagar Dams. Jodhpur is connected by 132 kV lines with Bhilwara and Pali. 220 kV lines connect it with Bhilwara and 220 kV Kota Beawar line is extended up to Jodhpur district.

99. Till Dec. 2009, 1,062 villages in the district have been electrified out of total 1,063 villages as per census 2001. All the four towns of the district have been electrified. Details of transmission facilities of the Rajasthan state are provided in **Table 23** and the number of electrified villages in **Table 24**.

Table 23: Transmission Lines and Grid Sub-stations in Rajasthan as On 30.09.2010

TRANSMISSION LINES	Circuit km	
400 kV lines	2,489	
220 kV lines	10,149	
132 kV lines	13,438	
EHV GRID SUBSTATIONS		
Voltage	**No**	**MVA**
400 kV	9	4,530
220 kV	69	13,505
132 kV	301	16,409

Source: http://www.rvpn.co.in

Table 24: Number of Electrified villages up to 31.03.2009

District	No. of villages electrified
Jodhpur	1,062
Jaisalmer	562

Source: Statistical abstract, Rajasthan, 2010

100. As on August 2011, 1674.795 MW of wind farm projects are connected to the grid. For this generation, the following transmission system (Table 25) is available for evacuation of generation from wind farms located in Jaisalmer area:

Table 25: Transmission system for evacuation from Wind farms

400 kV Transmission System

- 2x315 MVA, 220/400 kV GSS at Akal (Jaisalmer).
- 400 kV S/C Akal (Jaisalmer) – Jodhpur line.
- 400 kV S/C Akal (Jaisalmer) – Barmer line.
- 2x315 MVA, 400/220 kV GSS at Barmer.

220 kV and 132 kV Transmission System

- 3x100 MVA, 220/132 kV transformers and 4x20/25 MVA, 132/33 transformers are installed at 33/132/220 kV GSS at Amarsagar (Jaisalmer).
- LILO of 220 kV S/C Ramgarh GTPS – Phalodi line at 220 kV Amarsagar GSS.
- 2x100 MVA, 220/132 kV GSS at Phalodi.
- 220 kV S/C Phalodi – Tinwari line.
- 220 kV D/C Amarsagar – Barmer line.
- LILO of 220 kV D/C Amarsagar – Barmer line at 220/400 kV Akal (Jaisalmer) GSS.

132 kV Transmission System

- 132 kV D/C Amarsagar – Jaisalmer line.
- 132 kV S/C Jaisalmer – Chandan – Pokhran-Dechu-Phalodi line
- 132 kV S/C Jaisalmer – Sheo-Barmer line

3.9 Social and Cultural Development

3.9.1 Population

101. Jodhpur had a population of 3,685,681 as per census 2011 of which male and female were 1,924,326 and 1,761,355 respectively. There was change of 27.69% in the population compared to population as per 2001. In the previous census of India 2001, Jodhpur district recorded increase of 27.59% to its population compared to 1991. The initial provisional data suggest a density of 161 in 2011 compared to 126 of 2001. Total area under Jodhpur district is about 22,901 sq km. Average literacy rate of Jodhpur in 2011 was 67.09 as compared to 56.67 of 2001. Gender wise, male and female literacy were 80.46 and 52.57 respectively. For 2001 census, same figures stood at 72.96 and 38.64 in Jodhpur district. Total literate in Jodhpur district were 2,075,029 of which male and female were 1,295,900 and 779,129 respectively. In 2001, Jodhpur district had 1,319,879 in its total region. The sex ratio in Jodhpur stood at 915 per 1000 male as compared to 2001 census figure of 907. The average national sex ratio in India is 940 as per latest reports of Census 2011 Directorate.

102. Similarly In 2011, Jaisalmer had population of 672,008 of which male and female were 363,346 and 308,662 respectively. There was change of 32.22% in the population compared to population as per 2001. In the previous census of India 2001, Jaisalmer district recorded increase of 24.39% to its population compared to 1991. The initial provisional data suggests a density of 17 in 2011 compared to 13 of 2001. Total area under Jaisalmer district is about 39,313 sq. km. Average literacy rate of Jaisalmer in 2011 was 58.04 as compared to 50.97 of 2001. Gender statistics for male and female literacy were 73.09 and 40.23 respectively. For 2001 census, same figures stood at 66.26 and 32.05 in Jaisalmer district. Total literate in Jaisalmer district were 314,345 of which male and female were 214,540 and 99,805 respectively. In 2001, Jaisalmer district had 201,960 in its total region. The sex ratio in Jaisalmer stood at 849 per 1000 male compared to 2001 census figure of 821. The average national sex ratio in India is 940 as per latest reports of Census 2011 Directorate.

103. Due to unfertile land and desert like condition, majority of the villagers earn their livelihood as marginal labourers in salt manufacturing units. Few families are also dependent on subsistence agriculture and animal husbandry.

3.9.2 Education

104. There are 2824 and 998 primary schools and 832 and 97 secondary and higher secondary schools in Jodhpur and Jaisalmer district respectively. District has technical and law colleges, distance learning programs and correspondence courses. The Indian Institute of Technology Rajasthan (IIT-R) is situated in Jodhpur. The **Table 26 and 27** give the details of educational institutes in the area.

Table 26: Schools in Secondary Education up to 2008 - 09

Area		Pre – primary and primary	Upper primary (middle)	Secondary & Sr. Secondary
Jodhpur				
Students	Male (M)	151,274	185,697	143,014
	Female (F)	135,982	143,260	44,743
	Total (M+F)	287,256	328,957	187,757
Teachers	Male (M)	2,856	4,070	3,978
	Female (F)	200	2,172	2,323
	Total (M+F)	3,056	6,242	6,301
Institutions		2,824	2,454	832
Jaisalmer				
Students	Male (M)	29,973	36,875	12,178
	Female (F)	22,491	25,762	3,364
	Total (M+F)	52,464	62,637	15,542
Teachers	Male (M)	1,323	1,629	503
	Female (F)	296	539	79
	Total (M+F)	1,619	2,168	582
Institutions		998	435	97
Rajasthan				
Students	Male (M)	2,810,457	3,438,614	2,658,475
	Female (F)	2,347,369	2,795,211	1,501,009
	Total (M+F)	5,157,826	6,233,825	4,159,484
Teachers	Male (M)	80,793	143,366	119,735
	Female (F)	36,783	67,772	46,493
	Total (M+F)	117,576	211,138	166,228
Institutions		49,895	38,698	17,602

Source: Statistical abstract, Rajasthan, 2010

Table 27: Institutes for Higher Educations

Area	Colleges						Polytechnic		ITI	
	Institutes		Scholars		Teachers					
	Boys	Girls	Boys	Girls	Male	Female	Institutions	Scholars	Institution	Scholar
Jodhpur	18	10	3,029	4,580	6	4	2	715	6	833
Jaisalmer	3	1	603	261	24	2	0	0	2	217
Rajasthan	640	356	230,146	149,302	2,158	1,472	27	9,048	134	13,744

Source: Statistical abstract, Rajasthan, 2010

3.9.3 Health Environment

105. Jodhpur has 13 hospitals, 14 dispensaries, 14 community health centres, 4 mother & child welfare centres, 66 rural primary health centres, 4 urban primary health centres, 5 Aid Posts and 505 Sub centres. Similarly Jaisalmer has 2 hospitals, 5 dispensaries, 5 community health centres, 2 mother & child welfare centres, 15 rural primary health centres, and 136 sub centres.

3.10 Historical, Cultural and Archaeology Sites/Places

106. The list of important heritage, cultural and religious sites (Table 28) of the Jodhpur

and Jaisalmer districts are listed below. Details of these monuments are given in **Annexure 4.**

Table 28: List of Important sites

Jodhpur district	Jaisalmer district
• Mandore	• Jaisalmer fort
• Osian village	• Nathmal Ji Ki Haveli.
• Balsamand Lake	• The Patwon Ji ki Haveli.
• Balsamand palace	• Salim Ji Ki Haveli
	• Bada Bagh
	• Cenotaph of Bada Bagh
	• Amar Sagar Lake
	• Gadi Sagar Lake,
	• Akal Wood fossil Park

4.0 SCREENING OF POTENTIAL ENVIRONMENTAL IMPACT AND MITIGATION MEASURES

4.1 RRVPNL Approach for Planning of a subproject

107. At the planning stage itself, one of the factors that govern the establishment of the transmission line is the infringement of populated/forest/cultivated area and scarce land. Wherever such infringements are substantial, different alternative options are to be considered. During route alignment all possible efforts are made to avoid the populated/forest/cultivated area infringement completely or to keep it to the barest minimum. Whenever it becomes unavoidable due to the geographical locations/terrain, mitigation costs involved towards avoidance needs to be worked out. While identifying the transmission system for a generation project or an expansion of transmission system, preliminary route selection is done by RRVPNL based on the interpretation and walk over surveys according to the 1:50,000 Maps/Topographical maps of the area. The selected route is easily accessible both in dry and rainy seasons for maintenance point of view.

108. As per Rajasthan State Power Sector Restructuring Project, Environmental Guidelines for Planning, Construction and Maintenance of Transmission Lines (World Bank report) RRVPNL undertakes the planning of transmission line and sub-station projects in the following steps:

- The Transmission Planning Department identifies requirements for transmission lines and sub-stations, these are then approved by Government of Rajasthan;
- these requirements are passed on to the Corporate office of RRVPNL, and tentative route mapping is done on Survey of India topographic maps;
- a transect walk is conducted by the engineers for preliminary ground survey;
- detailed route surveys are made, including profiles, control points, obstacle crossings and avoidance of forest areas, habitations, cultural landmarks, etc.;
- the surveyed route is approved by the concerned engineer of RRVPNL, at this stage the applications are made for required clearances, such as forest and railway crossings, technical compliance with the Electricity Act and Rules is reviewed and assured, and the design features of the towers are prepared; and
- Procurement actions are taken on the basis of the project report of the scheme, simultaneously with the environmental evaluation.

4.2 Methodology for selection of route: environmental and social view

109. Route selection among alternatives consider requirements of environmental parameters, availability of logistic support during construction, operation and maintenance of transmission lines and specific geographical condition to construct the lines along most feasible routes that were identified based on the relevant topographic maps and walkover survey.

110. For selection of optimum route, the following points are taken into consideration:

i) The route of the proposed transmission lines avoids or minimizes passage through human habitations.
ii) Any monument of cultural or historical importance is not affected by the route of the transmission line.
iii) The proposed route of transmission line does not create any threat to the survival of any community with special reference to tribal community.
iv) The proposed route of transmission line does not affect any public utility services like playgrounds, schools, other similar establishments etc.
v) Minimum cutting of trees and safety of people and property.
vi) Shortest possible length and favourable ground profile.
vii) Avoidance of reserved forest, archaeological and other sensitive areas and

unstable ground feature.

viii) Minimizing number of crossing of major rivers / railway lines, national and state highways, overhead EHV power line, number of angle points and communication lines.

ix) Avoidance of rocky stretches and areas reserved for planned and future development.

x) Marshy low lying areas, river beds and earth sleep zones avoided.

xi) Restricted areas such as civil and military air field avoided.

xii) Sufficient shifting of angle points within 100 m. radius during construction is also considered.

xiii) Routing is kept away from large habitations, densely populated areas, animal / bird sanctuaries and hydrocarbon pipelines to the extent possible.

4.3 Alternatives for transmission line alignment

111. In order to achieve this, RRVPNL has undertaken route selection for transmission line in close consultation with representatives from Revenue department, Land Acquisition Department, Departments of Forest (and Department of Wildlife Conservation if required) and the local community. Although under national law, RRVPNL has the right of way, yet it considers alternative alignments during site selection, with minor alterations often added to avoid environmentally sensitive areas and settlements at the implementation stage.

- As a principle, alignments are generally cited a minimum of 500 m away from major settlements, whenever possible, to account for future expansion.
- Similarly, forests are avoided to the maximum extent possible. When it is not possible, a route is selected in consultation with the forest officials that causes minimum damage to existing plantation/forest resources.
- Alignments are selected to avoid wetlands and unstable areas for both financial and environmental reasons.
- In addition, care is also taken to avoid protected parks/forests, bird sanctuaries and any other forest area rich in wild life.

112. Keeping above in mind, various alignments of line were considered taking care of above factors and two alternatives each were considered. Alternatives studied for each of the 400 kV project components are given in **Annexure 3.** Since the 220/132 kV proposed system has already been finalised/under construction as well as uses the same corridor with 400 kV systems, no separate alternatives could be considered. As such, two alternatives of each line were studied by the RRVPNL officials before being proposed to ADB for funding to arrive at most optimum route which can be taken up for detailed survey and assessment of environmental and social impacts for their proper management.

Topo sheet

113. The Survey of India (SOI) topographic maps were referred during the study, to any the route with 8 km both side data to be covered as statutory requirement for PTCC approval.

4.3.1 Distance from Reserve Forest/Protected Areas/national Park/Sanctuary

114. As per primary survey, the transmission lines are not passing through and protected areas. The nearest wildlife sanctuary is Desert National Park in Jaisalmer and Barmer districts which is around 35 km away from the nearest project transmission line and around 130 km away from solar park site. The Ramgarh – Akal line is passing around 3 km away from Karhajor protected forest between village Thaiyat and Hamira. This sanctuary and forest area does not have any negative impact due to project activities. However, RRVPNL will submit the SOI toposheet marked with transmission line alignment to the forest

department for getting exact location of forest lands marked on the map along the alignment in the area.

115. Similarly, Akal Wood Fossil Park is located at about 2 km aerial distance from Akal GSS and from 17 km from the main Jaisalmer city on Barmer Road, the park is famous for its Fossil remains of Jurassic era till 130 million years ago. The fossil trunks lie scattered in this park. Fossilized tree trunks are of various sizes with the largest being 13 meters in length and 1.5 meters in width. Covering about 10 sq. km of bare hillside, the Fossil Park contains 25 petrified trunks, in total. The park has 21 hectares of preserved area.

4.4 Environment baseline information for Subprojects

116. A separate study for "Field Investigation, Data Collection, and Baseline Study for Development of Bhadla Solar Park and its Associated Power Evacuation Transmission System in Rajasthan" was completed to collect baseline information and perform environmental parameter testing.

4.5 Environment Impacts and Mitigation Measures

4.5.1 Environment Problems due to Project Location and Design

117. Potential adverse environment impacts associated with transmission lines has been avoided or minimised through careful route selection. The alignment is sited away from major settlements, whenever possible, to account for future urban expansion. Forests areas and vegetation areas are avoided wherever possible; however route alignment passes through scrub lands, cultivated and abandoned fields. Alignment in this project has avoided geologically unstable areas, which can also pose foundation related problems. No land acquisition is required for placing transmission towers on private land. However any damage to the crops during the construction phase of the project will be duly compensated. Associated impacts on agricultural land will be restricted to the construction phase and will be temporary in nature. Agricultural land will be lost permanently at the base of the transmission tower. After construction, agricultural land within the transmission corridors can be used again for farming purpose of crops less than 3 m.

4.5.2 Environmental Impacts Associated with Pre-Construction Stage

4.5.2.1 Acquisition of Cultivable and Non cultivable lands

118. There may be loss of agricultural productivity due to obstruction and reduce the land of fields. Thus following measures will have to be taken prior to the project activities:

- Avoid farming season wherever possible for the project activities,
- Ensure existing irrigation facilities are maintained in working condition,
- Protect /preserve topsoil and reinstate after construction is completed,
- Repair /reinstate damaged bunds etc. after construction is completed, and
- Compensation for temporary loss in agricultural production.

4.5.2.2 Impacts on Temporary Use of Land

119. The mobilisation of construction equipment and construction materials will require space for storage and parking of construction vehicles and equipment, construction material storage yards, disposal sites, and labour camps for human resource to avoid environmental impact and public inconvenience. These locations must comply with the local laws and regulations and need approval from authorities to utilise these facilities (access roads, telecommunication, and pipe borne water supply). It is important that selection of temporary lands is at least 500 m away from highly populated areas, water bodies, natural flow paths, agricultural lands, important ecological habitats and residential areas. Removal of trees and green cover vegetation should be minimised during preparation of access road and other facilities.

4.5.3 Environmental problems associated with construction and operation stage

120. The project activities during construction phase will involve clearing of trees along the route alignment wherever required, excavation for installation of towers, erection of towers, civil works related to transmission line and line stringing. For sub-station, it will involve excavation for building and equipment foundations, civil works and erection of equipment. During the operation phase, most of the construction phase impacts will get stabilised and the impacts will be restricted only to the operation and maintenance of the project.

121. The impacts on the environment from various activities of the project can be categorised as follows:

- Impact on Physical Resources
  - Impact on Topography
  - Impact on Climate
- Impact on Environmental Resources
  - Impact on Air Quality
  - Impact on Noise Levels
  - Impact on surface Water Quality
  - Impact on ground Water Quality
  - Impact on Soils and Geology
- Impact on Ecological Resources
  - Terrestrial Ecology
  - Wild Life
  - Aquatic Ecology
- Impact on Human Environment
  - Health and Safety
  - Agriculture
  - Socio-economics
  - Resettlement and Rehabilitation
  - Cultural sites
  - Traffic and Transport
  - Interference with other utilises and traffic
- Waste Disposal
  - Solid waste disposal
  - Liquid waste disposal.

122. The impacts of the project activities on various environmental attributes are discussed in subsequent sections.

4.5.3.1 Impact on Physical Resources

Impact on Topography

123. During the construction of the transmission line and sub-station, the topography will change due to excavation and erection of tower, fill and cut for levelling the tower erection place. The most prominent impact on the surface topography will be due to the removing of the trees at the tower erection site and all along the right-of-way (RoW) for construction facilitation. This will lead to change in the surface features only. The impact will be irreversible as the present features along the RoW will be changed due to presence of the transmission line.

124. No topographical changes are envisaged during the operation phase of the transmission line and the sub-station. The existing access routes will be utilised during the operation and maintenance of the transmission lines.

Impact on Climate

125. The study area along the RoW is predominantly barren, scrubs or medium size trees

in the project area. However, impact on the climate conditions from the proposed projects both during the construction and operation phases will not be significant.

4.5.3.2 Impact on Environmental Resources

Impact on Air Quality

126. During the construction phase, the activity would involve excavation for the tower erection, movement of transporting vehicles carrying the construction materials etc. along the haul road (through un-built roads, but are not maintained). All these activities would give rise to emission of dust particles thereby affecting air quality marginally at the site which although will be transitory in nature. Sprinkling of water during excavation will reduce the dust emission to a great extent.

127. The construction of transmission line and the sub-station will not have any negative impact on the air quality of the region during the operation phase.

Impact on Noise Levels

128. During the construction phase, the major sources of noise pollution are movement of vehicles transporting the construction material and equipment to the site. Most of the access roads along the alignment are motor able. The major work of the construction is expected to be carried out during the day time. There will be very limited presence of population being exposed to noise generated during the construction phase.

129. Following measures will help to keep noise and vibration in acceptable level during construction phase:

- Contractor shall equip their heavy construction equipment and plants with exhaust silencers to limit the engine noise not to exceed 75 db (compacters/rollers, loaders and cranes) and regularly maintain all construction vehicles and machinery that should meet the national Emission Standards.
- Contractor shall preferably limit working time for activities that create noise within normal waking hours of the public except for construction site near public sensitive receptors. Construction related activities closer to sensitive receptors have to be scheduled in coordination with the relevant authorities.
- Contractor and its suppliers of construction materials should strictly implement noise control regulations stipulated by the Noise Pollution (Regulation and Control Rules 2000) for all construction vehicles and equipment.

130. During the operation phase of the project, there may be corona noise from the conductors which will be felt only up to 15 to 30 m area, hence the ambient noise level meets the CPCB standard for residential areas (55 dB(A) during daytime and 45 dB(A) during night time).

Impact on Surface Water Quality

131. The construction and operation of the transmission lines will not have any major impact on the surface and ground water quality in the area. Contamination of water bodies may result due to spilling of construction materials and surface runoff from the construction site joining the water body. There may be increase in the turbidity levels temporarily where the proposed alignment is crossing and if the surface runoff during construction meets the river. This can be avoided by careful selection of the tower site and the access roads so that the surface runoff does not meet the river.

132. Proposed activities will create temporary impacts to the existing drainage system in the area including irrigation canals, natural flow paths and also earth and line drains. Thus it will create temporary inundation closer to the above locations during rainy season. Stagnation of water will create temporary breeding sites to mosquitoes which will have direct

impact on public health. Thus incorporation of following measures will minimise anticipated impact due to obstruction of natural flow paths and existing drainage:

- Provisions of temporary drainage facilities to the particular locations if existing drains are obstructed due to construction activities.
- Maintenance of all drainage paths by avoiding blockages at all times.
- Contractor should minimise excavation of beds of any streams, irrigation systems, and other water resources available in the project affected area.

133. Care shall be taken to locate the temporary construction worker sheds away from the water bodies. Adequate drinking water facilities, sanitary facilities and drainage in the temporary sheds of the construction workers should be provided to avoid the surface water pollution. Provision of adequate washing and toilet facilities should be made obligatory. This should from an integral component in the planning stage before commencement of construction activity.

Impact on Ground Water Quality

134. Ground water pollution can take place, if chemical substances and oily waste get leached by precipitation of water and percolate to the ground water table. For transmission line construction activity, no chemical substance or oil is used hence there is no impact on ground water quality. The silt discharge from the earth work around water bodies, oil, grease and fuel release from the construction vehicles / equipment and spoil from construction and other construction related activities such as raw sewerage from worker accommodation sites will mix with runoff water. This situation will increase during the rainy season and have a critical impact on surface and ground water. Thus following measures will be required in order to prevent deterioration of water from the construction and construction related activities:

- All construction vehicles and equipment should be maintained in proper conditions without any leakages,
- Contractors shall use silt traps and erosion control measures where the construction is carried out in close proximity to the water bodies to avoid entering of cement particles, rock, rubbles and waste water to the surrounding water bodies,
- Construction activities requiring digging should be preferably done in the dry season,
- Waste oil should be collected properly and disposed to the approved location.

Impact on Soil and Geology

135. Project activities including excavation, cut and fill operations, removal of trees and green cover vegetation etc. will enhance the soil erosion during the rainy season. The impact on soils will be due to the soil erosion at the tower construction sites along the access routes. The excavation activity and land clearance in the erosion prone areas have been minimised while conducting the site selection for towers. Levelling and stabilisation of tower construction sites will be done after completion of construction activity. Also increased acceleration of surface runoff will damage the topsoil. The impacts associated with excessive erosion and other civil works can be avoided or minimised by following mitigation measures:

- Effort should be taken to minimise removal of trees and green cover vegetation.
- Minimise obstruction or destruction to natural drainage pattern of the surrounding area.
- Proper treatment of clearing and filling areas against flow acceleration.
- Contractors shall restrict cut and fill operation around sharp/deep slope areas.
- Piling activities will preferably be done in non-rainy season, as the piled materials will spread all over the area and contaminate close by water bodies.
- Top soil which are removed during construction from the cultivated lands must be

stored separately for future utilisation of cultivated lands near tower leg locations.

4.5.3.3 Impact on Ecological Resources

136. Since sub-station is constructed in government waste land and transmission line is routed through inhabitant areas, there is no displacement of people or animal. It is also not causing any disturbance to the life of people and local animals and birds movement. In transmission business, there is no dynamic equipment and moving machinery causing noise pollution, water and air pollution. There is no national wildlife park, bird sanctuary, wetland in the route alignment of the proposed transmission line. The ecological impacts are briefly described in the following sections

Effect on Flora and Fauna

137. On visual inspection, it seems that no trees will need to be removed from the project area for RoW for 400 kV line is 35 m. None of the declared environmentally sensitive areas is located within the route alignment. It is not expected that any flora and fauna that are rare, endangered, endemic or threatened will be affected. Migratory paths of small mammals and reptiles may be affected due to construction activities. Also, noise, vibration and emission from construction vehicles, equipment will occur during construction and pre-construction stages in temporary manner. The impacts related to above activities are temporary and can be mitigated through following measures:

- Strict attention on worker force regarding disturbance to surrounding habitats, flora and fauna including hunting of animals and fishing in water bodies
- Selection of approved locations for material storage yards and labour camps away from the environmental sensitive areas
- Avoid entering of construction waste (cement particles, rock, rubbles and waste water) and sanitary waste to the surrounding water bodies.

Impact on Terrestrial Ecology

138. There is no sensitive ecological area / protected forest area such as national wildlife park, bird sanctuary crossing the proposed route alignment. The removal of herbaceous vegetation from the soil and loosening of the top soil generally causes soil erosion. However, such impacts would be primarily confined to the project site during initial periods of the construction phase and would be minimised through adoption of mitigation measures like paving and surface treatment and water sprinkling.

Removal of Trees

139. No trees shall be removed during the line construction. The initial construction works along the alignment involving land clearance, cutting, filling and levelling that may cause loss of vegetation. This will be an irreversible impact. Care has been taken to avoid the thick vegetation as far as possible and tower locations are selected mostly in plain cultivable fields where the vegetation is thin. This will minimise the tree loss. Compensation will be paid to the tree owners in the private areas as per Government norms. Clearing of forest area would not be involved along the route alignment, hence the compensatory afforestation is not required for forest areas and for private trees, the amount for compensation for plantations will be paid direct to the farmers.

Effect on Local Road Network

140. Transformers, tower material, sub-station equipment, iron bars, concrete materials, piling equipment, etc. will be transported through the local road network to the project site. Transporting of large quantities of materials using heavy vehicles could exceed the carrying capacity of the road. This would lead to physical damages to local road network. Thus it will be necessary to obtain consent from Public Works Department (PWD) or national highway Authority to use local/national highway roads prior to transportation. Also contractor should properly maintain all road sections, which will be utilised for the construction related

activities.

Disposal of Debris

141. As a result of construction related activities, spoil and debris will be generated during the construction stage. Improper disposal of the debris will have an impact on the surrounding ecology, public health and scenic beauty. Following measures will minimise the impacts associated with disposal of debris:

- Spoil materials (soil, sand, rock etc.) generated from construction activities shall be used wherever possible for site levelling, back - filling etc. Dismantled and demolished structural materials, if any, should not be dumped at agricultural lands.
- Preparation of Disposal Management Plan for the project and selection of the disposal site by excluding locations, which are closer to residential, commercial and public sensitive areas, is necessary by the contractor. Prior approval should be obtained for such dumping grounds / land fill sites from relevant local authorities.
- Dumped materials will interfere with the drainage pattern of the area, any water bodies, agricultural lands, marshlands and down slope or any environmental sensitive areas if not planned properly.

142. During operation phase, corridor along the alignment will be chopped of vegetation and lopping of trees will be done for maintenance purpose. This will also reduce the chances of fires due to electric sparks.

Wild Life

143. For selecting the route alignment, any wild life travel routes have been avoided as far as possible during the field visits.

144. Desert National Park in Jaisalmer and Barmer districts which is around 35 km away from the nearest project transmission line and around 130 km away from solar park site. This sanctuary does not have any negative impact due to project activities.

Impact on Aquatic Ecology

145. There are no river rivers or tributaries in the alignment of subprojects. No significant impacts on aquatic ecology of the river are envisaged, only perennial water body is Indira Gandhi Canal which is an irrigation canal and will not have any impact due to subproject activities.

Availability of Water for Power Generation

146. As per the Rajasthan Solar Energy Policy, 2011 Water Resource Department will allocate required quantity of water from IGNP canal/the nearest available source for development of solar thermal power plants subject to the availability of water for power generation.

147. Power producers will intimate estimated water requirement to RREC along with source of water. After assessment/scrutiny, case of water requirement shall be forwarded to the Water Resource department. The modifications(s) required, if any, in the existing canal system shall be done by the Water Resources Department at the cost of the Power Producer.

148. Indira Gandhi Nahar Department vide letter No.F.6(6)IGNB/2009 dated 7.9.2009 had authorized Energy Department to issue individual sanctions in respect of Solar Thermal Power projects within the overall allocation of 58 Cusec water from IGNP for Solar Power projects. **Table 29** gives details of allocated water from Indira Gandhi Canal for Solar Thermal Power Project only.

Table 29: Allocation of water for solar thermal power projects selected under National Solar Mission (Phase - 1) from IGNP till 26.05.2011

S. No	Name	Final Location	Capacity	Water allocated
1	M/s Raj. Sun Technique Energy Pvt. Ltd.	Village Dhurasar, Tehsil Pokhran, Jaisalmer	100 MW	2.5 Cusec
2	M/s Diwakar Solar project Pvt. Ltd	Village Askandra, Tehsil Pokhran, Jaisalmer	100 MW	2.9 Cusec
3	M/s KVK Energy ventures pvt. Ltd	Village Askandra, Tehsil Pokhran, Jaisalmer	100 MW	2.9 Cusec
4	M/s Godawari green Energy Ltd	Village Nokh, Tehsil Pokhran, Jaisalmer	50 MW	1.6 Cusec
5	M/s Corporate Ispat Alloys Ltd.	Village Nokh, Tehsil Pokhran, Jaisalmer	50 MW	2.02 Cusec
	Total		**400 MW**	**11.92 Cusec**

Source: RREC Letter No F12 (573) RREC/ Rajasthan Sun Technique Energy/12010-2011/D 2369 dated: 30.05.2011

4.5.3.4 Impact on Human Environment

Health and Safety

149. Health and safety impacts will be in terms of risk of accidents and exposure to electromagnetic fields along the alignment. The accidents may be caused due to electro-cutting, lightening, fires and explosions. To avoid this, the houses will not be allowed within the RoW of the project. Necessary training regarding safety aspects to the personnel working at the line will be provided by the contractor. Personal protective equipment like safety gloves, helmet, mufflers etc. will be provided during construction period and during the maintenance work. First aid facilities will be made available with the labour gangs and doctors called in from nearby towns when necessary. Workers are also covered by the statutory workmen compensation as per GoI laws by the contractor.

150. Project activities may create accidental damage to general public and the construction workers. Therefore, contractors should take necessary action to enhance personal safety during the construction through following measures:

- Organise awareness programmes relevant to personal safety of the workers and general public in the area;
- Installation of warning signs to particular locations such as transverse points of local road network by transmission lines;
- Provide protective safety belts, footwear, helmets, goggles, eye-shields and clothes to workers depending on their duty; and
- Arrangement of proper first aid unit and transport facilities to take injured people to the hospitals.

Agriculture

151. Permanent and temporary loss of agricultural land occurs due to tower location in the agricultural field and loss of crop for access route etc. There will not be any land acquisition for the tower erection. As far as possible, the prime agricultural land will be avoided and the construction will be done after crop harvesting.

Socio-Economics

152. Construction of transmission line will generate local employment, as number of unskilled labourers (both men and women) will be required at the time of construction activities. Local employment during this period will increase socio-economic standards.

Temporary Outage of the Electricity

153. Temporary disconnection of power supply will occur during the construction activities. Thus, general public and the industrial places, which are located in project-affected area, will face inconvenience for short periods of time. Thus following measures will have to be taken:

- Advance notice to the public about the time and the duration of the utility disruption, and
- Restore the utilities immediately to overcome public inconvenience.

Resettlement and Rehabilitation

154. For the construction of transmission line, no land acquisition is required, hence there is no resettlement and rehabilitation involved in the project.

Cultural sites

155. There are no archaeological, historical or cultural important sites along the route alignment; hence the impacts on these sites are not envisaged.

Traffic and Transport

156. During the construction phase, traffic disturbance needs to be minimised by avoiding high-density areas, using proper traffic signs, ensuring proper access roads and avoiding road blockage.

Interference with Other Utilities and Traffic

157. As per regulations enacted by GoI, it is mandatory for RRVPNL to seek clearance prior to construction from Railways, Telecommunications and wherever necessary from aviation authorities that are likely to be affected by the construction of transmission lines. The transmission lines affect nearby telecommunication circuits by causing electrical interference and induced voltage which may occur to nearby telecom circuit and suggested necessary protection measures will need to be adopted. This may require measures like rerouting of the telecom circuits, conversion of overhead telecom circuits into cables etc. to minimise the interference. The exact cost to mitigate the impacts of induction in neighbouring telecom circuits would vary from case to case. Wherever transmission line crosses the railways, clearance is taken from that department. In general, the system is planned and executed in such a way that adequate clearance is maintained between transmission lines on the one hand, and railways, civil aviation and defence installations on the other. Wherever the transmission lines passes near the airport, the towers beyond specified height are painted in alternate orange and white stripes for easy visibility and warning lights are placed on the top of these towers.

4.5.3.5 Waste Disposal

Solid Waste Disposal

158. The solid waste generation will be at the location of the tower erection site which will include metal scraps, wooden packing material etc. Wooden waste and metal scrap will be collected and disposed of in compliance with applicable regulations and rules.

Sanitary Waste Disposal at Construction Sites and Labour Camps

159. The labour camps at the site of tower erection will be temporary in nature and the human excreta will not be significant to cause contamination of ground water. Those places where most labour will be staying will be near hamlets which shall use the community services for solid waste, water and sanitation. Adequate drinking water facilities, sanitary facilities and drainage in the temporary sheds of the construction workers should be provided to avoid the surface water pollution. Provision of adequate washing and toilet facilities should be made obligatory. This should from an integral component in the planning stage before commencement of construction activity.

160. There should be proper solid waste disposal procedure to enhance sanitation of workers who stay in camps. Thus possibilities of infecting water borne diseases or vector borne diseases (Parasitic infections) will be eliminated by adopting proper solid waste disposal procedure. Unacceptable solid waste disposal practices such as open dumping of solid waste and poor sanitation facilities will lead to pollution of surrounding environment,

contamination of water bodies and increase adverse impact to the aquatic; terrestrial lives and general public inhabited in the area. Surrounding of labour camps, garbage disposal sites and material storage yards provide favourable habitats for vectors of diseases such as mosquitoes, rats and flies.

161. Thus following measures are needed to protect and enhance the quality of environment during the construction stage:

- A better way to overcome garbage disposal as mentioned above by reducing or avoiding the construction of labour camps, thus the selection of majority of skilled and unskilled workers from the project influence area will be a proper measure in this regard.
- Contractor should provide adequate facilities to manage its wastes in accordance with the guidance given by the Central and State Pollution Control Board.
- Provision of the solid waste disposal, sanitation and sewage facilities at all site of the construction/labour camps to avoid or minimise health hazards and environmental pollution.
- Contractor should handle and manage waste generated from the construction/labour camps without contamination to natural environment and it will reduce risk to general public who stay close to sites. Also contractor should be responsible to enhance the quality of environment.
- Adequate supply of water should be provided to the urinals, toilets and wash rooms of the workers' accommodation
- Contractor should provide garbage bins to all workers accommodation and construction sites, for dumping wastes regularly in a hygienic manner in the area.

Liquid Waste Disposal

162. There will be no oil or chemical waste generated during the construction of transmission line, hence no mitigation is required.

4.5.4 Environmental Impacts Associated with Operational Stage

Electric Shock

163. This may lead to death or injury to the workers and public in the area. This can be minimised or avoided by providing security fences around sub-station, establishment of warning signs, and careful design using appropriate technologies to minimise hazards.

Noise Generation

164. Nuisance to the community around the site can occur during the project implementation stage. Provision of appropriate noise barriers will be essential in this regard.

Maintenance of Transmission Line and Substation

165. Possible exposure to electromagnetic interference could occur during these activities. Design of transmission line should comply with the limits of electromagnetic interference from overhead power lines.

Oil Spillage

166. Contamination of water on land/nearby water bodies by the transformer oil can occur during operation due to leakage or accident. Substation transformers are normally located within secure and impervious areas with a storage capacity of 100% spare oil. Also proper drainage facilities will be constructed during the construction stage to avoid overflow or contamination with natural flow paths especially during the rainy season. RRVPNL maintains account of the usage of oil, has inbuilt technical methods and procedures for oil monitoring mechanism, and has mitigation plan for any oil spillage.

Sulphur Hexa Floride (SF_6) Leakage

167. Very high grade sealing system and erection methodology to keep the loss of SF_6 within 0.01% every year. SF_6 gas handling system for evacuation and storage is always used for the maintenance of the circuit breaker. SF_6 gas leakage is one of the checks in every shift of the operation. Stock SF_6 records are maintained in each sub-station. This allows tracking of any release of SF_6 gas to the atmosphere. SF_6 handling is part of technical specification for contract and required design and routine testing by the manufacturer of the circuit breaker.

4.6 Environmental Management Plan

168. The environmental management plan (EMP) has been prepared for the project that discusses the anticipated impacts, monitoring requirements, and development of mitigation measures with respect to the following stages: (i) pre-construction, (ii) construction, and (iii) operation and maintenance. Detailed, site-specific mitigation measures and monitoring plans were developed and will be implemented during the project implementation phase.

169. The Environmental Management Plan (EMP) for the project is attached as **Annexure 5**, which identifies feasible and cost - effective measures to be taken to reduce potential significant, adverse, impacts to acceptable levels. Here, proper mitigation measures are proposed for each potential impact, including details on responsible parties for implementation of mitigation measures and supervision. A summary environmental impact matrix and the mitigation measures are mentioned in **Table 30.**

Table 30: Environmental Impact Matrix

Sl. Nº	Environmental attribute	Potential impacts	Nature of impact	Magnitude of impacts			Mitigation measures	Implementation and Monitoring
				Low	Medium	High		
A.	**Physical Resources**							
1.	Topography	Change in the surface features and present aesthetics due to the construction of the project.	Direct/Local/ irreversible		X		The surface soil will be restored to normal slope after tower erection. If there is any excess soil, it shall be disposed off at suitable location. Any loss of vegetation will be attended by RRVPNL as per existing GoR norms. Within the sub-station, the excess soil will be disposed off in consultation with RRVPNL as per EMP.	During construction activity.
2.	Climate	No impact on the climatic conditions	Direct/Local/ irreversible	X			No impact on the climatic conditions, hence no mitigation is required.	
		Monitoring of SF_6 gas from Electrical Sub-stations.	Direct/Local/ irreversible	X			Proper record of all SF_6 leakages in sub-stations kept for record.	During Construction and Operation.
B.	**Environmental Resources**							
1.	Air Quality	Project will have marginal impact on air quality during the construction period due to increase in the dust emission.	Direct/Local/ reversible	X			Water sprinkling at construction site, limited bare soils, maintenance of vehicles.	During construction activity.
2.	Noise	Noise due to general construction activities.	Direct/Local/ reversible	X			Restriction of noise generating activities at night and use of personal protective equipment like ear plugs, mufflers.	During construction activity.
		Noise arising from corona noise from conductors.	Direct/Local/ reversible	X			Monitoring of possible corona noise to identify and correct problems.	During operational phase.
3.	Surface and Ground Water quality	Runoff from the construction site.	Direct/Local/ reversible	X			Careful siting of towers, and access roads.	Before and during construction activity.
		Domestic wastewater from construction sites.	Direct/Local/ reversible	X			Domestic waste treatment by providing septic tank/soak pits at	During construction and operation.

Sl. Nº	Environmental attribute	Potential impacts	Nature of impact	Magnitude of impacts			Mitigation measures	Implementation and Monitoring
				Low	Medium	High		
							substation. For tower locations, it will be temporary sites.	
4.	Soils and Geology	Soil erosion due to tower erecting and clearing of vegetation in the RoW and access roads.	Direct/Local/ reversible		X		Avoiding sites, which are prone to soil erosion. Levelling of tower construction sites. Use of few access roads. Rehabilitation and stabilisation of disturbed land at the sub-stations.	During and after the construction activity.
		Damage due to seismic activity.	Direct/regional/ reversible	X			Site selection and proper tower foundation design considering the geological conditions and seismicity of the area.	Before the construction activity.
C.	**Ecological Resources**							
1.	Terrestrial Ecology	Loss of vegetation.	Direct/Local/ irreversible		X		Location of towers on non-cultivable land area. Selection of few access roads. Compensation for crop and trees to villagers. The tree planting for forest land diverted to non-forest and trees felled will be done by the forest department and paid by RRVPNL.	Before the construction phase.
2.	Terrestrial Fauna	Disturbance to the local fauna during construction.	Direct/Local/ reversible	X			Wildlife routes and their habitats have been avoided as far as possible during the route selection. Minimise encroachments, and indirect impacts.	Before and during construction phase.
	Avifauna	Disturbance to the local fauna during operation.	Direct/Local/ reversible	X			Monitoring of line especially for bird strikes during the operation and use of deflectors if required.	During operation phase
3.	Aquatic Ecology	No significant impacts envisaged.	Direct/Local/ reversible	X			Disposal of construction waste and other waste to avoid polluting the river and streams.	Before and during construction phase
D.	**Human Environment**							
1		Fires, explosion and other accidents at the route alignment of transmission	Direct/Local	X			Use of personal protective equipment during construction. By lopping and chopping of trees fire	During construction and operation phase

Sl. Nº	Environmental attribute	Potential impacts	Nature of impact	Magnitude of impacts			Mitigation measures	Implementation and Monitoring
				Low	Medium	High		
		line.					hazards will be minimised during maintenance period. Regular inspection of lines for faults prone to accidents.	
2.	Health and Safety	Exposure to electromagnetic fields	Direct/Local/ continuous	X			Alignment route away from the settlement. No houses in the immediate vicinity and will be allowed in the RoW of the alignment. No further mitigation required.	Before and after the construction phase.
3.	Agriculture	Permanent and temporary loss of agriculture land due to tower erection and due to access routes.	Direct/Local/ reversible	X			Avoid prime agriculture land. Assessment of land required and compensation. Construction activity after crop harvesting and selection of few access routes.	Before and during construction phase.
4.	Socio-economics	Beneficial impacts job opportunities during construction phase	Direct/regional		X		Unskilled labour and indirect benefits. Overall economic growth of the region.	During operational phase
5.	Resettlement	Resettlement of any house falling along the RoW.	Direct/Local/ reversible	X			Route alignment is selected in such a way that there is no resettlement issue.	Before the construction phase.
6.	Cultural sites	No archaeological, historical or cultural important sites are affected by the construction of the lines.	Direct/Local/ reversible	X			No archaeological, historical or cultural important sites are affected.	--
7.	Traffic and Transportation	Traffic congestion due to movement of construction vehicles.	Direct/Local/ reversible	X			Proper traffic signs at the construction site, ensuring availability and maintenance of proper access roads.	During construction phase
8.	Solid Waste Generation	Probability of Surface and ground water pollution.	indirect/Local/ reversible	X			Minimisation, reuse and recycle whenever possible. Final wastes to be collected and disposed off in compliance with applicable regulations and rules.	During operation phase

5.0 INSTITUTIONAL REQUIREMENTS AND ENVIRONMENTAL MONITORING PROGRAMME

5.1 Institutional Arrangements

170. The RRVPNL will be the Executing Agency (EA) as well as the Implementing Agency (IA) for the project. The RRVPNL will constitute a Project Management Unit (PMU) for implementing the ADB loan at the corporate level and designate relevant field offices of RRVPNL to work with the PMU at the sub-project level. The proposed structure is shown in **Figure 11**. The PMU shall be headed by the Chief Engineer (T&C) and the Superintending Engineer (Planning) shall be responsible for coordinating all external functions with ADB. GOI, DEA, GoR as well as the internal functions such as Environment and Social/R&R reporting, Legal, Finance and Accounts, Field project offices, Procurement and Contracts etc. and other functions from within RRVPNL. One Environment and Social Cell (ESC) shall be designated and headed by an Executive Engineer who shall be designated for monitoring ADB funded projects in areas such as Environment, R&R and Social safeguards. To assist ESC in these specialist functions, RRVPNL may hire appropriate consultants for monitoring purposes.

171. Under PMU, the field offices of RRVPNL will assume primary responsibility for the environmental assessment as well as implementation of EMPs through contractors or third party consultants in consultation with ESC. The Project Head will be assisted by the PMU's Environmental and Social cell (ESC) for environmental monitoring and designing of appropriate mitigation measures. Keeping in view the minimal capacity of RRVPNL, it is proposed that this ESC must coordinate with each project divisions to address environmental and social issues[10].

172. The duties of the ESC will include at a minimum: (i) oversight of field office and construction contractors for monitoring and implementing mitigation measures; (ii) liaising with the field office of RRVPNL and contractor and seeking their help to solve the environment-related issues of project implementation; and (iii) preparation of environmental management reports every 6 months (as required by ADB).

173. For each sub-project EMPs, RRVPNL will do the overall coordination, preparation, planning, implementation, and financing of all activities. Additional third-party services may be employed by the RRVPNL as necessary.

174. The field office of RRVPNL will have overall responsibility to manage the site activities. The RRVPNL will ensure that contractor engaged for each subproject is involved in EMP monitoring and implementation. Further details on agencies responsible for EMP activities are in **Table 31**.

Table 31: Institutional Roles and Responsibilities for EMP Implementation Activities

Activity	Responsible Agency
Sub-project Initiation Stage	
Assign field offices for each subproject	RRVPNL
Clearances/approvals from relevant GOI/GoR agencies- forest, roads, rivers, railways, telecom etc.	RRVPNL

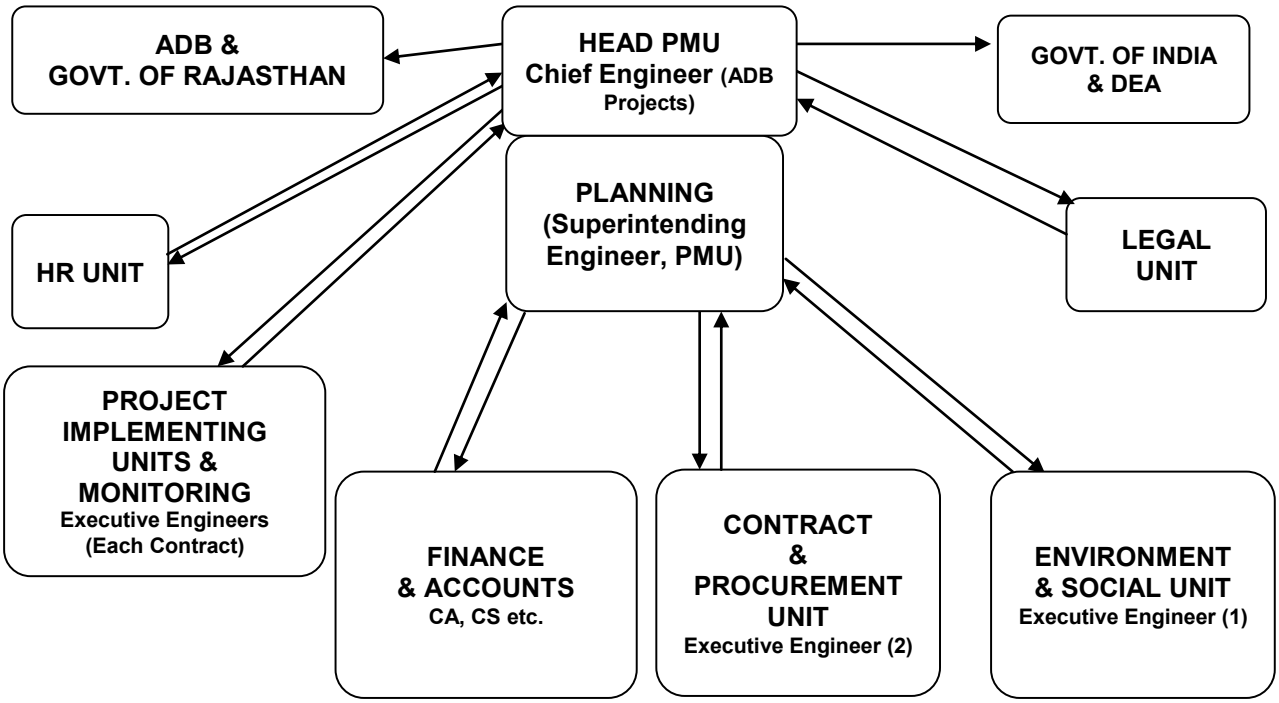
[10] ADB advises that all EAs develop in-house capability for environmental, health, and safety (EHS) program consistent with international best practices. The EHS program should include accounting for environmental benefits resulting from investment projects within three months of loan approval. The monitoring agency shall report on semi-annual basis directly to ADB and determine whether sound environmental management practices have been achieved, and suggest suitable recommendations and remedial measures for midterm correction and improvement.

Activity	Responsible Agency
Disclosure of subproject EMP details on RRVPNL website	PMU-ESC/ RRVPNL
Conducting discussions/meetings/workshops with APs and other stakeholders	PMU-ESC RRVPNL
Updating of EMP mitigation measures based on discussions	PMU – ESC
EMP Implementation Stage	
Meetings at community/household level with APs	Field Office RRVPNL /Contractor
Implementation of proposed EMP mitigation measures	Field Office RRVPNL /Contractor
Consultations with APs during EMP mitigation measures implementation	Field Office RRVPNL /Contractor
Grievances Redressal	PMU/ RRVPNL /Sub - Divisional Administration, ESC
Internal monitoring	PMU/ RRVPNL, ESC
External monitoring*	External Experts

ADB-Asian Development Bank; AP-Affected Persons; EA-Executing Agency; EMP-Environmental Management Plan; ESC – Environment and Social Cell; PMU- Project Management Unit

*Note –External monitoring only required when projects are noticed to have significant adverse environmental impacts.

Figure 11: PMU Structure



5.2 Environmental Monitoring Plan (EMoP)

175. The mitigation measures suggested requires monitoring of environmental attributes both during construction and operational phase of the project by the RRVPNL. During the construction and operation phase of this project, the monitoring of the environmental aspects shall be done at the transmission lines by the designated Environment Officer of the RRVPNL. During the construction phase, the contractor should ensure that activities like handling of earth works clearing work, access road construction, putting proper traffic signals is done properly to have minimum impact. This in turn should be monitored by the Engineer-in-Charge of the individual transmission line/sub-station project.

176. The field office of RRVPNL and (its contractors) will adhere and comply with all measures and procedures identified in the EMP. The plans, endorsed by the EA and GoR, will be monitored in accordance to ADB Safeguard Policy 2009 requirements. Mitigation measures related to construction as specified in the EMP will be incorporated into civil works contracts, and their implementation will be primarily the responsibility of the contractors. In addition, contractors will be requested to submit monthly progress reports on the implementation of EMP measures. The EA in turn will be expected to report to the ADB on progress achieved against the EMP activities and milestones on a quarterly basis. Progress reports will include a description of implementable activities and their status; identify the responsible party (ies) involved in their implementation; and provide project management schedules and timeframes for doing so, along with their associated costs.

177. In addition to the EMP, to ensure that project would not be generating a negative impact to the overall environment quality, an EMoP will be prepared. The monitoring activities of the project include site supervision, verification of permits, monitoring of water quality, soil, noise and air. Monitoring of the quality of water, soil, air and noise during the construction stage is a responsibility of the contractor by the approved government agency. Field office, RRVPNL will supervise the contractor. Monitoring of sanitary waste treatment should be done periodically to avoid water pollution. Other environmental good practices include noise abatement, maintaining hygienic conditions, maintenance of fire and safety equipment etc. Monitoring report should be prepared once in six months with the corrective action plan for the problem areas.

178. RRVPNL will be responsible for implementing internal monitoring systems for EMP implementation, and will forward semi-annual progress reports to the Government and ADB. The reports will cover EMP implementation with attention to compliance and any needed corrective actions. On-going consultation measures will be incorporated in the EMP.

179. The field office, RRVPNL will be responsible for internal monitoring of the EMP implementation, and will forward quarterly progress reports to the PMU with details of activities and progress made during EMP implementation. The PMU will submit semi-annual monitoring reports to ADB. If project activities are noticed to have significant adverse environmental impacts, ADB requires RRVPNL to retain qualified and experienced experts[11] or qualified Non-Government Organisation (NGO) or Community Based Organization (CBO) to verify the report. If required, these external experts/NGO or CBO will report on a semi-annual basis directly to ADB to verify if sound environmental management practices were followed during implementation. In case the implementation of EMP measures is not satisfactory, the external experts/NGO or CBO will recommend actions to enhance environmental compliance. A sample Environment Monitoring Report is attached as **Annexure 7,** which will be required to submit bi-annually by RRVPNL to ADB.

[11] External expert who is not involved in day-to-day project implementation or supervision

5.3 Critical Environmental Review Criteria

(i) Loss of irreplaceable resources

180. The transmission projects do not involve any large scale excavation and land is lost to the extent of 0.2-1 m^2 for each tower foundation. Rest of the area under the tower continues to be under use by the land owner. Forest cover felled in the Right-of-Way (RoW) is allowed to regenerate except in 52 metre wide strips, after construction work is over. The compensatory afforestation of equal to double the area of forest land under the RoW would be undertaken if required. The EMP includes compensation for the loss by minimising the impact of loss of vegetation as per existing norms of GoR and MoEF. Thus, there will be no net "Biodiversity Loss" due to project implementation due to felling of trees.

(ii) Accelerated use of resources for short-term gains

181. The project will not use any natural resources occurring in the area during construction, operation and maintenance phases. The construction material such as tower parts, cement etc. shall come from factories while the excavated soil shall be used for backfilling and revetment to restore the surface. Thus the project shall not cause any accelerated use of resources for short term gains.

(iii) Endangering of species

182. No endangered species of flora and fauna exist in the project area as well as in the affected forest thus there seems to be no possibility of endangering/causing extinction of any species.

(iv) Promoting undesirable rural-to urban migration

183. The project will not cause any submergence or loss of land holdings that normally trigger migration. It also does not involve acquisition of any private land holdings. Hence, there is no possibility of any migration.

(v) Increase in affluent/poor income gap

184. The project will increase availability and reliability of power in Rajasthan state. It is well known that power is a key input to the economic development of any area. Past experience indicates that economic development leads to generation of more jobs which in turn should raise the living standards of poor. Thus the project is expected to contribute in reduction of affluent/poor income gap by providing opportunities for employment and rural based economic activities.

5.4 Environmental Management Plan Budget Costs

185. The main benefits of the environmental mitigation plan are (i) ensuring that environmental standards are met during design, construction, and operation of the project; (ii) providing offsets to negate project impacts especially ecological impacts. Without such expenditures, the project might generate significant environmental impacts, causing the biophysical environment in the area to deteriorate and indirectly depressing the economies of local communities.

186. The compliance with the EMP has been prepared based upon optimum and reasonable costs that are derived upon minimisation of mitigation measures on a "least-cost" basis. INR 233.5 million has been included as the EMP costs (**Table 32**). The cost components include items such as tree compensation, cost crop compensation, cost towards implementation of EMP (contractor's scope), EMP implementation and monitoring in entire route of transmission lines, training for HIV/AIDS prevention and independent audit.

Procedure for Tree and Crop compensation

187. Procedure for damage tree/crop compensation is in place with standard GoR procedures. Assessment of damaged area of crop is measured by a Patwari, (an officer from revenue department) in presence of RRVPNL field in charge. The assessment of damage is

decided by Revenue department based on fertility of land record available. For damage to tree, it is assessed by the Tehsildar based on the government rate set by horticulture department. For crop compensation, the RRVPNL normally reimburses an estimated rate of INR 25,000-15,000 per kilometre of the 400/220/132 kV transmission line.

Table 32: Environmental Costs

S.Nº	Environmental Cost Elements	Costs in INR (Million)*
A.	Design and Pre-Construction Stage	
1.	Tree and Crop Compensation	
	Transmission line 400/220/132 kV	INR 198 million
2	Cost towards EMP (Contractors cost)	INR 20 million
B.	Construction Stage	
1	EMP implementation Monitoring	INR 10 million
2	Medical camps for workmen and society including checkups of Sexually Transmitted Infections (STI) and Sexually Transmitted Diseases (STD) including HIV/AIDS and health awareness program on regular basis	INR 5 million
3	Independent Audit	INR0.5 million
	Total	**INR 233.5 million**

* Maximum 1% of total project cost for individual package

5.5 Associated facilities

188. Bhadla Solar Park (details in **Annexure 2**) is deemed to be an associated facility to the transmission system being proposed in the project. In addition to existing/anticipated wind farm projects in Jaisalmer and Barmer areas there also existing Lignite based Thermal Power Stations and Gas based Thermal Power Stations (**Table 33**) have existing evacuation systems which will also provide additional paths for wind/solar energy to flow:

Table 33: List of Thermal Power Stations

RajWest Lignite based Thermal Power Stations (8x135 MW)

- 400 kV D/C Rajwest LTPS-Jodhpur (Mandore) line
- 400 kV S/C Rajwest LTPS-Barmer line
- 220 kV D/C Rajwest LTPS-Barmer line
- 220 kV S/C Rajwest LTPS-Dhorimanna line

Giral Lignite based Thermal Power Stations (2x125 MW)

- 220 kV Giral LTPS-Barmer lines (3 circuits)
- 220 kV S/C Barmer-Balotra line
- 220 kV S/C Barmer-Dhorimanna line
- 220 kV S/C Giral LTPS-Balotra line

Ramgarh_Gas based Thermal Power Stations (113.5 MW)

- 132 kV D/C Ramgarh GTPS-Jaisalmer line
- 220 kV S/C Ramgarh GTPS – Amarsagar - Phalodi line

Ramgarh_Extension Gas based Thermal Power Stations (160 MW) under implementation

- 220 kV S/C Ramgarh GTPS-Dechu (New location) line
- 2x100 MVA, 220/132 kV GSS at Dechu (New location)
- 220 kV D/C Dechu (New location)-Phalodi line
- 220 kV S/C Dechu (New location)-Tinwari line

189. Ramgarh gas thermal power station is the first gas thermal power plant of Rajasthan commissioned on dated 13-11-1994. Ramgarh gas thermal power plant station is situated near village Ramgarh and 60 km away from Jaisalmer, on Ramgarh Jaisalmer Road. It has the installed capacity of 113.5 MW. The Environment Clearance under EIA Act for 160 MW Ramgarh Gas Thermal Power Station Stage –III, Ramgarh, was granted by Ministry of Forest and Environment, GoI vide letter number Letter No:- F1 (4)/SEIAA/SEAC- Raj/Sectt/ Project/Cat 1 (d) B1 (174)/09 -10 dated 30 April 2010 State Level Environment impact Assessment Authority, Rajasthan. Details of stage wise capacities and number of turbine units are mentioned below in **Table 34**.

Table 34: Detail of Ramgarh Gas Based Thermal Power Station

Stage	Unit No	Capacity (MW)	Cost (Crores)	Synchronizing (Date)
I	*1 (Gas Turbine)	3*	19	13.11.1994
I	1 (Gas Turbine)	35.5	180	12.1.1996
II	2 (Gas Turbine)	37.5	300	7.08.2002
III	3 (Steam Turbine)	37.5		25.04.2003

Source: http://www.rvunl.com

*No generation due to shortage of adequate gas availability

190. The list of solar and wind parks in the area is attached as **Annexure 8.**

5.6 Disaster Management, Health and Safety

Disaster Management

191. Though the state of Rajasthan has not had a major earthquake in recent years, small to moderate earthquake have been felt in the state. The flood risk in western Rajasthan is lower than that of the other parts of country. The land strata in Jodhpur and Jaisalmer are mostly sandy and do not allow water to flow. Some part of Jaisalmer district is rocky and have seasonal water loggings. Rajasthan State Disaster Management Authority has been formed under the Disaster Management and Relief Department, Government of Rajasthan has been designated to take care of disaster management issues.

Health and Safety Issues Management

192. To avoid/ minimize inherent risks during construction, operation and maintenance, RRVPNL will follow national and international Environment, Health and Safety Procedure for EHV sub-stations and lines Operations and Maintenance (O&M) period. Power evacuation system has been designed so that each developer is provided with two distinct points for power evacuation. This arrangement provides reliability and any fault at one point can ensure continuity of power. All power producing elements shall be solidly connected to earth to ensure the safety of operating personal. Some other implications and mitigations from safety point of view are listed in Table 35 below:

Table 35: Safety Implication and Mitigation

S. No	Implication	Mitigation
1	Electromagnetic effect	Adequate ground clearances are provided.
2	Mechanical	Factor of safety in tower structure, conductor and insulator is provided
3	Lightning stroke	Each tower is provided with ground wire and earthed. Earthing system for permissible step and touch potential in sub-station design.
4	Ground clearance infringement	No construction below the line is permitted. Land is not allowed to be converted to non-agriculture use. However, there is no restriction on movement of people

6.0 GRIEVANCE REDRESS MECHANISM

6.1 Awareness of Stakeholders

193. During Public consultation sessions of the IEE study, the discussions with groups and individuals were conducted to make them aware of the proposed project. Thus the project-affected community residing beside the proposed transmission line has already gained a reasonable knowledge about the potential grievances, which may arise in future.

194. The public was informed that there will be no involuntary acquisition of land, or involuntary restrictions on land use which result in physical displacement and economic displacement. During construction of EHV lines, the land used will be preferably of agriculture use or barren land. Only agricultural land with crop is appropriate to get compensation. As area lies more or less in the desert region, it is expected that there will be no or very less agricultural land, therefore concern of damage of crop is minimum and erection of line would be faster.

195. A community awareness programme must be conducted one month prior to construction by the field office of RRVPNL regarding the scope of the project, procedure of construction activities, utility of resources, identified impacts and mitigation measures. These awareness programmes will help the community to resolve problems, clarify their distrusts related to the proposed project at initial stage. The Community should be informed about the Grievance Redress Mechanism (GRM), which is already established as per RRVPNL and GoR procedure for making complaints, including the place and the responsible person to contact in practical way in this regard. Almost all the stakeholders related to the GRM will also be aware of the established grievance process, the requirement of grievance mechanism, goals, benefits, relevant laws regulations etc.

6.2 The Grievance Redress Mechanism

196. RRVPNL does not have any specific Environment or Social Safeguards Policy currently. ADB procedures require RRVPNL to establish a Grievance Redressal Mechanism (GRM) having suitable grievance redress procedure for the project affected persons. The GRM would address affected persons' concerns and complaints promptly, using an understandable and transparent process that is gender responsive, culturally appropriate, and readily accessible to the affected persons at no costs. This GRM consists of a Grievance Redress Committee (GRC) headed by the Project Head. The committee consists of the following constitution as listed in **Table 36**:

Table 36: Constitution of Grievance Redress Committee

1	Project Head / CE (ADB Projects)
2	Sub District Magistrate or nominee of SDM
3	Land acquisition officer / Secretary RRVPNL
4	Head of Finance wing at the project level
5	Representative of local Panchayat/ NGO
6	Representative of contractor
7	Executive Engineer -Environment and Social Cell

197. This Grievance Redress Mechanism (GRM) would provide an effective approach for resolution of complaints and issues of the affected person/community. Project Management Unit (PMU) shall formulate procedures for implementing the GRM. The field office, RRVPNL shall undertake GRM's initiatives that include procedures of taking/recording complaints, handling of on-the-spot resolution of minor problems, taking care of complainants and provisions of responses to distressed stakeholders etc. paying particular attention to the impacts on vulnerable groups.

198. Grievances of APs will first be brought to the attention of the Project head of the Project Implementing Unit. Grievances not redressed by the field office, RRVPNL will be brought to the Grievance Redress Committee (GRC) set up to monitor project Implementation for each project area. The GRC will determine the merit of each grievance, and resolve grievances within three months of receiving the complaint, further grievances will be referred by APs to the appropriate courts of law. The field office, RRVPNL will keep records of all grievances received including: contact details of complainant, date that the complaint was received, nature of grievance, agreed corrective actions and the date these were effected, and final outcome. The flow chart showing Grievance Redress Mechanism is presented **in Figure 12**.

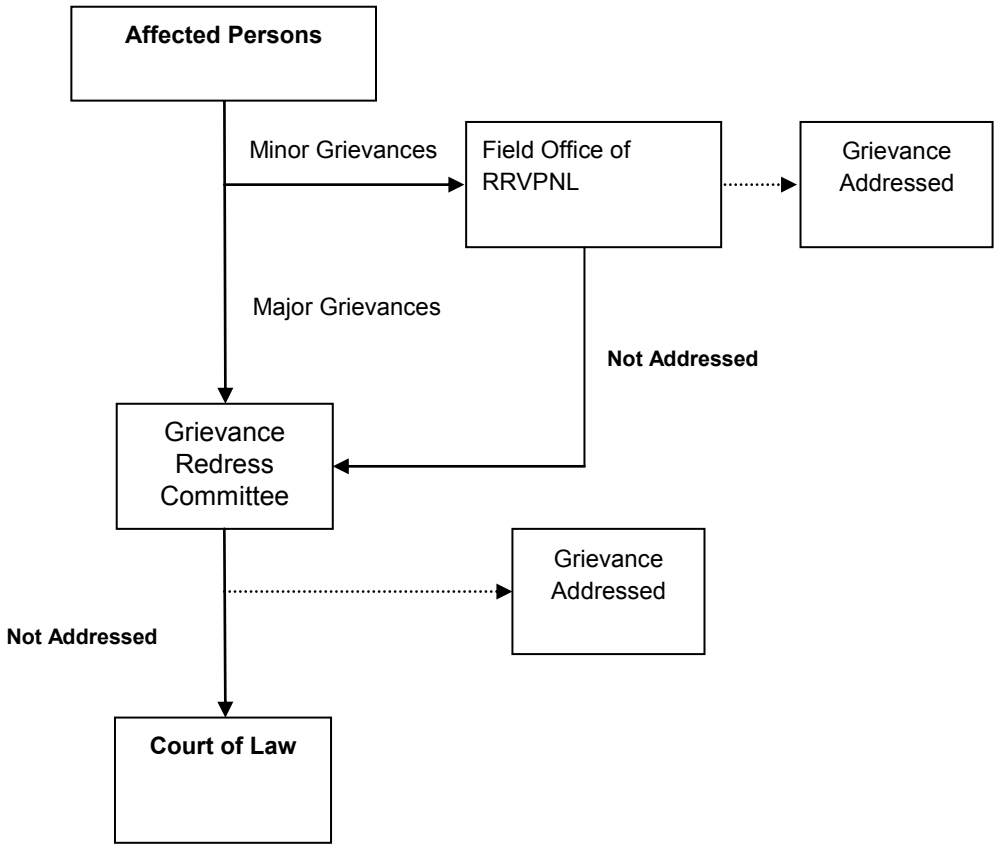
199. RRVPNL Practise (as per Draft Social Policy and Procedures Rajasthan State Electricity Board Jaipur November, 1999 to grievance issues is as follows:

(i) Assurance to APs of RRVPNL's practice of providing proper and adequate compensation to the affected person/ community.
(ii) Set procedure of RRVPNL and for authenticity purpose; estimate is assessed by Patwari/Tehsildar of that area and Panchayat of that village.
(iii) Erection of line will not cause damage to top soil during construction, so the farmers continue to use land for agriculture purpose.
(iv) Minimum complaints are expected as payment of compensation is done through Government revenue authority. However, in the event of any complaint The following procedure is adopted:
    a. In case of protest from local villagers for planting a tower in owner's land –RRVPNL shall take up the clearance of District Collector citing power vested with transmission licensee as per Electricity Act 2003.
    b. In case of objection from the local villagers for crop and tree compensation, Grievance Redressal Committee consist of following members shall resolve the dispute amicably:
    c. Project Engineer (line) in the field.
    d. Panchayat Head.
    e. Nominated District Revenue officer.
(v) In case of any other complaint, other than above, shall also be addressed by the Grievance Redressal Committee. **Table 37** below gives a summary of RRVPNL Practices.

Table 37: Summary of RRVPNL Practise

S. No.	Grievance Issues	Mitigation
1	Crop and tree compensation	Paid as per rate of local authorities.
2	Land acquisition	No land acquisition is required for transmission line.
3	Transmission line	Proper compensation while erection of line.
4	Sub-station land	Sub-station is located in the Govt. waste land, where there are no inhabitants.

Figure: 12 - Flow chart showing Grievance Redress Mechanism



7.0 PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

7.1 Information Disclosure

200. In line with ADB's Public Communications Policy, RRVPNL is required to ensure that relevant project information about social and environment safeguard issues is made available during the initial stages to affected people and other stakeholders, including the general public at district headquarters where it is publicly accessible in English, Hindi and any other vernacular local language. ADB and RVPL will also post these documents as well as the Environment Assessment and Review Framework Document (EARF) and the IEE on their respective websites.

201. Incorporation of the environmental concerns of APs through the public consultation in the decision making process will avoid or minimise conflict situations during the implementation process as well as enable them to provide meaningful inputs into the project design and its implementation. RRVPNL can conduct public consultation and information disclosure through public meetings and notice.

7.2 Public Consultation

202. During the project formulation stage, RRVPNL has conducted a project scoping exercise and reconnaissance survey of the existing system. Accordingly, during public consultation sessions, considerable dialogue had been held between RRVPNL representatives, individuals, and groups from the community to make them aware of the proposed project.

203. The project-affected community residing beside the proposed transmission line has already gained a reasonable knowledge about the potential grievances, which may arise in the future. The community were also informed about the Grievance Redressal Mechanism (GRM), which will be followed by RRVPNL as per procedure as describe in EARF.

7.2.1 Consultation Findings

204. Public consultations were conducted in semi-urban and rural areas with persons of proposed project affected area from November 2011 to January 2012. **Annexure 9B** indicates a summary of public consultations conducted during the field survey along with socio economic profile and of project villages.

205. Consultations were carried out with various stakeholders such as RREC officials, GoR officials, relevant land departments and the sub divisional magistrate of the project area. As part of the social assessment, approximately 150 households have been surveyed where the heads of the households were interviewed to collect the data during the month of November 2011 to January 2012. Additionally, public consultations were carried out by the social survey team through focused group discussion in the sensitive area along the project site. The discussions were carried out at various places.

206. The community consulted was requested to air their opinions freely, on the project, its impact, and suggestions for mitigating adverse impacts. People participated in voluntary public consultation sessions to express their view about the proposed project. No major environmental issues were raised during the consultation process. The people are most supportive of the project stating that the project will help bring work and labour opportunities in the area and improve roads and infrastructure and will improve their living conditions. **Annexure 9C** givens the names of all participants of the public consultation conducted by the team.

207. Most of the land in the area is sand dunes and rocky land with seasonal water logging not utilised for agricultural or any other purposes people of the area requested to use that barren areas on priority, people of the area are already got employment benefits due to the upcoming power wind and solar projects. People of the area requested RRVPNL to give maximum employment and construction and labour works to the locals with first preference to project affected persons. On the whole, the people accepted the project by giving their assurance for supporting the project activities.

208. Establishment of the new transmission line will reduce land value in this area as it transverses through mostly arid cultivated lands although it passes through non cultivable barren lands to a greater extent. They were also concerned that as transmission line runs over sandy terrain, the soil erosion and the siltation will occur due to construction during the rainy season. Thus it is highly recommended the construction activities related to soil digging and cut and fill operations must be done preferably in the non-rainy season. Farming activities will be affected during the proposed construction activities. So construction activities of the area, which comprises of one season arid cultivation, must be restricted preferably to non-cultivating seasons.

8.0 FINDINGS AND RECOMMENDATIONS

209. Impacts are manageable and can be managed cost effectively - Environmental impacts are likely to result from the proposed transmission system development. Careful mitigation and monitoring, specific selection criteria and review/assessment procedures for candidate subprojects have been specified to ensure that minimal impacts take place. The detailed design would ensure inclusion of any such environmental impacts that could not be specified or identified at this stage are taken into account and mitigated where necessary. Those impacts can be reduced through the use of mitigation measures such as correction in work practices at the construction sites, or through the careful selection of sites and access routes.

210. The selected lands for two new GSS are located within the government land. Thus acquisition of land will not be required from the surrounding communities. Since proposed for Bhadla sub-station land is covered with scrubs and weed plants, thus there is no need for removal of trees for the construction of new GSS. Larger extent of proposed transmission line from Jodhpur to Bhadla, Bhadla to Ramgarh and Ramgarh to Akal runs through single season cultivated lands, uncultivated lands and lesser extend runs through human settlements and parallel to the existing transmission lines.

211. The proposed project will have number of positive impacts and negative impacts to the existing environment as follows:

- Significantly improvement of the quality and reliability of the electricity supply to the project affected area according to current demand is the main positive impact.
- There is negligible removal of trees for the transmission line/grid sub-station, which is the main positive impact to the proposed project area.
- However currently most of the area for the transmission line is already cleared by the RRVPNL with the approval of relevant authorities.
- Environment pollution due to cut and fill operations, transportation of construction materials, disposal of debris, disturbance to the farming activities, nuisance from dust, noise, vehicle fumes, black smoke, vibration etc. due to construction activities are the short term negative impacts due to proposed project.

212. The primary baseline monitoring on water, air, soil and noise is already done along the transmission lines, within sub-station and within Bhadla solar park. Further it is required to establish baseline parameters in the beginning to monitor changes of the quality of water, air, soil and noise during the construction and operation periods.

213. Proper GRM will have to be implemented by RRVPNL to overcome public inconvenience during the proposed project activities. It is highly recommended to establish a tree replanting programme which would be undertaken as per the directives/requirements of the Forest Department, and financed by RRVPNL where two trees will be planted when a single tree is cut.

214. Benefits far outweigh negative impacts - the proposed project will improve operational efficiency and quality of power, reliability of the system and at the same time will reduce losses. Supply of power to the region will boost economic development of the area and by strengthening the power transmission infrastructure. Overall, the major social and environmental impacts associated with transmission projects are limited to the construction period and can be mitigated to an acceptable level by implementation of recommended measures and by best engineering and environmental practices. The impact matrix depicts that the project will not have significant negative environmental impacts and the project would help in improving the socio-economic conditions of this developing state. As the project falls in category B as per the ADB’s guidelines, no detailed EIA study is required.

9.0 CONCLUSIONS

215. Based on the MoEF Guidelines of GoI, the proposed project was categorised as “B”. Thus IEE report has been prepared for the project. In accordance with the ADB’s Safeguard Policy Statement 2009, the proposed project: new sub-station and transmission line are categorised as Category B. Thus a full Environmental Impact Assessments (EIA) for the project is not required.

216. The IEE performed is adequate for purposes of project implementation. Based on the environmental assessment and surveys conducted for the project, the potential adverse environmental impacts can be mitigated to an acceptable level by adequate implementation of the mitigation measures identified in the EMP. Adequate provisions are being made in the project to cover the environmental mitigation and monitoring requirements, and their associated costs.

217. Environment and social impact analysis have been done with various criteria like demographic factors, climate and natural habitat, community and employee health and safety etc. based on the impact analysis, It is found that there is no adverse impact on the migration of habitat, any natural existing land resources and affect in the regular life of people. The environment and social impact associated with transmission line project is limited to the extent of construction phase and can be mitigated through a set of recommended measures and adequate provision for environment and social impact which cover monitoring, measuring and mitigation.

218. EMP has been prepared and attached as **Annexure 5**. One round of public consultation was conducted along the transmission corridor. The results indicate broad support for the project based on perceived economic and social benefits. Most impacts are expected to occur during the construction phase and are considered to be of a temporary nature. The transmission corridor was carefully selected after undergoing an options assessment. This enabled the right of way alignment to bypass nearby sensitive ecological areas, villages and important water supplies and resources. The main project impacts are associated with clearing of shrub vegetation, waste management and excavation and movement of soils.

219. No endangered or protected species of flora or fauna are reported at any of the subproject sites. The sub-station sites are located mostly on land owned by GoR, characterized as mostly barren, uninhabited and unused lands, removed from populated areas. Adequate provisions have been made for the environmental mitigation and monitoring of predicted impacts, along with their associated costs. Adverse impacts if noticed during implementation will be mitigated using appropriate design and management measures and through the provision of compensation for the temporary loss of crops/trees. The potential cumulative and residual impacts of the transmission sub-components as a whole indicate the project classifies as a Category “B”, in accordance with ADB’s Safeguards Policy Statement 2009. The project is not considered highly sensitive or complex.