Environment and Social Impact Assessment for 220 kV Power Transmission Line: *Manali to Nalagarh, Himachal Pradesh, India*

AD Hydro Power Limited

Final Report

August 2008

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FINAL REPORT

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August 2008

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EXECUTIVE SUMMARY

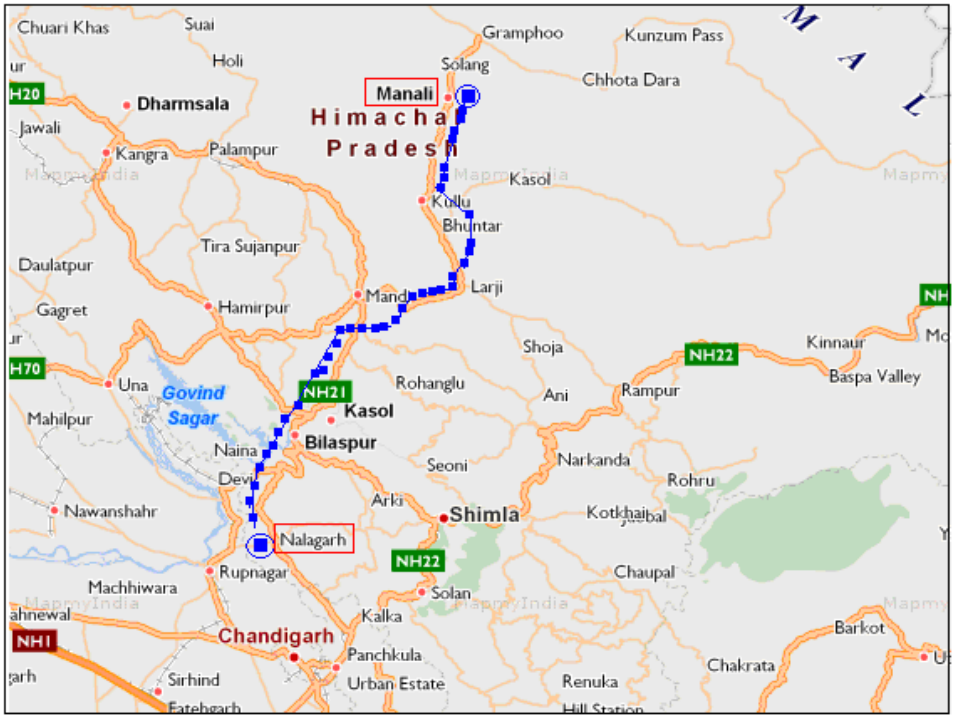
A) INTRODUCTION

1. AD Hydro Power Limited, a Bhilwara Group Company (hereinafter referred to as ADHPL) is setting up Allain - Duhangan Hydroelectric Project (ADHEP), a 192 MW (2 x 96 MW) hydropower generation facility, on Allain and Duhangan tributaries of Beas River in Tehsil Manali, District Kullu, Himachal Pradesh.
2. In order to evacuate generated hydroelectric power, the project has planned a 174.7km long 220 kV – double circuit power transmission line.
3. This report intends to assess Environmental and Social Impact Assessment (ESIA) of the proposed transmission line.
4. Based on the environmental and social impact identified and mitigation discussed the project is categorised as Category B. Category B projects are those with "potentially limited adverse social or environmental impacts that are few in number, generally site specific, largely reversible and readily addressed through mitigation measure".

B) ROUTE OF TRANSMISSION LINE

5. The proposed transmission line begins from the switch yard of the power generation facility at village Prini located at about three km Southeast of Manali town and traverse through Kullu, Mandi, Bilaspur and Solan districts of Himachal Pradesh before terminating at Nalagarh sub-station of Power Grid Corporation of India Limited (PGCIL). An indicative location map of the proposed transmission line is shown in the figure below.

Indicative Location of the Proposed Power Transmission Line



C) NEED & OBJECTIVE

6. The objective of this ESIA is:
   - to document various environmental and social impacts related to field activities that are being planned and being undertaken by the ADHPL for laying of transmission line; and

- to highlight the environmental and social management strategies, systems and procedures being employed along the transmission line route and to meet the environmental and social requirements of the Funding Institutions [International Finance Corporation (IFC) and Equator Principles Funding Institutions (EPFIs].

D) PROJECT DESCRIPTION

7. The transmission line route was finalised by ADHPL based on walk over and detailed surveys to identify constraints and opportunities. The transmission line route is divided into three stretches for better administration and management. Stretch-1 extends from Prini Switch yard to Panarsa (57.2km), Stretch-2 from Panarsa to Dehar (71.6km) and Stretch-3 from Dehar to Nalagarh (45.9 km). The route of the transmission line is divided as snow zone (from Prini to Panarsa also Stretch-1) and non-snow zone (from Panarsa to Nalagarh i.e. Stretch 1 &2).
8. There will be two switching stations one at Prini located close to the Power House and another at Nalagarh located close to sub-station of PGCIL.
9. The right of way proposed is 17.5 m either sides of the centre line of the transmission line as per requirement of BIS (IS: 5613). The corridor will cover an area of 611.31ha. which includes private land of 390.3ha. and constitutes about 1500 to 2000 project affected people.
10. The designs, fabrication, testing, erection procedures and materials to be used for erection of towers, line materials, construction of foundations, etc will conform to the Bureau of Indian Standards (BIS), as amended up to date and provisions of the Indian Electricity Act and Electricity Rules and related statutory approvals.

D-1) CONSTRUCTION OF TRANSMISSION LINES

11. Along the 174.7 km route of transmission line, about 580 towers are estimated with the minimum and maximum span varying from 60 m to 960 m and an average span of around 302m.
12. For erection of towers along the transmission line, wooden pegs are marked in accordance with the line design. Foundations will be dug to a depth of about 3m x 3m x 3m depending upon the ground conditions. This area may vary depending on the topography of the area.
13. The formwork, reinforcing bars, the embedded parts of the towers and any earthing elements will be placed in the pits. A 50 mm thick Pre-stressed Concrete Cement (PCC) pad is to be laid at the base of the foundation. The casting of is done by 40 to 50 workers.
14. The constructions of towers require 80 to 100m^3 of concrete requiring approximately 6m^3 of water for concrete mix and curing. The water requirement will be met locally through tankers.
15. The expected time for tower erection on an average is three days, involving 25 to 30 workers. It is done manually by assembling prefabricated components of the lattice structure.
16. The stringing operations between two towers normally take 2 to 4 days involving 50 workers. The operation involves 'paying off' conductors and earth wires on the ground and then hoisting them.
17. The materials for construction of towers including conductors and insulators will be delivered from the storage contractor's yard at Nalagarh, Sunder Nagar and Bhuntar directly to the tower sites.

D-2) OPERATION & MAINTENANCE

18. The commissioning of transmission line involves back charging of 220kV power from the Nalagarh sub station to ADHEP switchyard at Prini. This will help synchronise power generators at ADHEP; once this is established the transmission

line will start transmitting 220kV power from switchyard at Prini to sub station at Nalagarh.

19. ADHPL will undertake a preventive, regular maintenance and monitoring programme for the transmission line and will follow measure for any breakdown during operation phase of the transmission line.

D-3) PROJECT SCHEDULE

20. The construction activities have already initiated and the project is expected to be operational by the end of April 2009.

D-4) POLLUTION SOURCES & CONTROL MEASURES

21. The pollution expected from construction activities includes fugitive dust emission due to excavation and project related vehicular movement and waste debris from casting of foundations. There is potential for disturbance to habitations in proximity of the towers due to construction related activities.
22. During operation there will be generation of electromagnetic field and some noise due to transmission of power.
23. Implementation of suggested measures will enable suppression of dust generation, disposal of waste debris and other adverse impacts.

D-5) SOCIAL ISSUES & MANAGEMENT

24. The community has raised issues such as objection to access, loss of crop and impacts on agriculture due to stringing activities. Community also had expectations for local benefits and other opportunities from project besides apprehension on potential exposure to electromagnetic fields during operation phase of the project.
25. Reportedly, the project is in process of disbursing compensation through negotiations with the community. The negotiations and agreements on land utilization as well as assets valuations have been on bipartite agreement basis. The project has planned to maintain safe distances all along the corridor and ensure mitigations for adverse impacts. There is a grievance redressal mechanism to ensure that individual and community grievances are properly handled and addressed in a timely and appropriate manner.

D-6) RISKS & SAFETY MEASURES

26. Construction of transmission line involves safety issues such as slip-trip hazard, , fall hazards during towers erection, occupational hazards and road accidents due to vehicle movement in hilly area.
27. Operation of the project involves potential risk of electrocution and physical hazards due to potential any contact with transmission line or snapping of lines or structure failure of towers resulting in fall of tower structure on to the ground.
28. ADHPL staff and contractors will be trained about the mandatory precaution and safety practices prior to commencement of construction activities, including use of Protection Equipment at site. Safety harness will be ensured for workers during erection of tower.
29. It would be mandatory for all contractors engaged by ADHPL for construction and erection to comply with provisions of Workmen Compensation Act 1923 and Employee State Insurance Act 1948.
30. Risks to general public during operation will be reduced by public awareness and education along with physical measures such as attaching appropriate warning signboards on all faces of each tower.

F) ENVIRONMENTAL BASELINE

31. Topography along the route varies from lesser Himalayan regions of Kullu to plains of Solan. Most parts of the route follow the hilly terrain. Glimate along the route of transmission line varies with change in altitude from the lesser Himalayas towards the Shivalik. In general three seasons are prevailing in the area i.e. winter season (October to March); summer season (April to June); and monsoon season (July to September). Drainage of the route along the transmission line is controlled by river Beas and Parvati in the upper stretch and river Sultlej in the area after Mandi. The soil along the transmission line is characterized by sub-montane type (sandy loam) in the upper region and brown hill soil and sub montane soils (silty loam) in middle and lower regions. The pH of the soil samples varies from 5.9 (moderately acidic) to 8.2 (moderately basic).
32. Ambient air quality with respect to suspended particulate matter, sulphur-di-oxide, oxides of nitrogen, carbon monoxide and hydrocarbon for the study area were observed within the prescribed limits for rural/residential set up except for respirable particulate matter which was found to marginally exceeded at one location close to commercial set up near Sundar Nagar.
33. Water quality was assessed for physical, chemical and bacteriological parameters at ten locations. The Dissolved Oxygen levels in all the water samples collected were good while Bio-chemical Oxygen Demand (BOD) were low indicating good quality however the Coliform bacteria content was very high rendering it unsuitable for consumption.
34. Equivalent noise levels for day time $L_{eq\ day}$ varied from 54.6 to 59.2 dB(A) as against the prescribed standard of 55 dB(A) for residential area and night time equivalent noise level varied from 47.3 to 49.7 dB(A) as against the prescribed standard of 45 dB(A). The marginally high noise levels during day time and night time are due to nearby Beas River flowing in the area and other activities including traffic on the nearby national highway.
35. Ecological surveys were carried out along the transmission line corridor within 100 m on either side of the line. The total stretch of the transmission line fall in three ecological zones i.e. Temperate Zone Forest (from Manali to Panarsa), Middle Montane Zone Forest (from Panarsa to Dehar) and Lower Montane Zone Forest (from Dehar to Nalagarh). The line passes through 11 Protected Forests besides other areas declared as forestland. Of the bird and mammal species identified along the corridor, eight species each of birds and mammals fall in schedule 1 and one species of birds and five species of mammals fall in schedule 2 of the Wildlife Act.
36. The transmission line runs through four districts i.e. Kullu, Mandi, Bilaspur and Solan. All these districts predominantly represent rural set up. Based on primary consultations and select discussion with the block and district level officials, no designated indigenous population group fall within the project corridor. Similarly, no site of cultural, religious, heritage and archaeological importance was observed or reported based on select consultations with the community, panchayat representatives and project proponents.
37. Plantation and agriculture are the two predominant occupations among the affected families/households in the project area. Most people in the villages depend on agriculture and plantation for their livelihood. However, increasing tourist traffic, influx of industries and growth of allied business/commerce opportunities (contracting, shops, guesthouses, repair units etc) have seen a slow but gradual shift in the occupational patterns of the community.
38. Income levels in the project area across the four districts show a marked variation primarily due to the nature of the crop, type of terrain, the availability of irrigational sources, markets, credit linkages etc. While cash crops like apple, apricot, pomegranate and vegetables yield high returns (subject to factors like

produce, weather etc) in the hills the return from crops like wheat, maize, mustard and other cereals were reported to be low as compared to the other cash crops. Income levels of the families were also enhanced by other sources like business, service, labour etc.

G) IMPACT ASSESSMENT

39. Potential impacts of proposed transmission line during:
    - Construction phase for casting of foundation, tower erection and stringing activities will be mainly disturbance to fauna and flora, traffic hazards, noise, safety issue and waste disposal. Socio-economic issues will be due to restricted use of land and loss of crop.
    - Operation phase involves disturbance to vegetation and noise etc. The social impacts will be from movement along the corridor, expectation management, and perception about generation of electromagnetic field.
40. Mitigations to counter adverse impacts are discussed in the Environmental and Social Management Plan.

H) ANALYSIS OF ALTERNATIVES

41. Analyses of alternatives were carried out with respect to two variables, i.e. alternative method and alternate route. Underground cables were observed as unviable owing to terrain and cost while route of line was planned considering forests and major habitations.
42. Additional pylons with modifications and detouring of route have been addressed to avoid habitations.

I) ENVIRONMENTAL SOCIAL MANAGEMENT AND MONITORING PLAN

43. The ESMP provides a delivery mechanism to address potential adverse impacts, to instruct contractors and to introduce standards of good practice to be adopted for project activities taken up during construction and operation phases of the project. Inspection and monitoring of the environmental and social components phase activities will increase the effectiveness of suggested mitigations.
44. Through the process of inspection, audit, and monitoring ADHPL will ensure that all the contractors comply with the requirements of conditions of forest clearance, and other permits including suggested action plans.
45. The inspections and audits will be done by trained team of ADHPL's Environment, Health, Safety and Social (EHS&S) Department as well subject to be reviewed and conducted by external agencies/experts. The entire process of inspections and audits are being documented. The inspection and audit findings are to be implemented by the contractors in their respective areas.
46. ADHPL has engaged a Himachal Pradesh based reputed NGO (Lok Kalyan Mandal) to oversee and guide its compliance with ESIA.
47. The Environment and Social mitigation measures, monitoring and management responsibility for impacts during construction activities and operation of the transmission lines is as given in ***Table 1.***

Table 1 Environment and Social Action Plan for the Proposed 220 kV Power Transmission Line

SN	Aspect	Impact	Suggested Mitigation	Monitoring and Awareness	Management Responsibility
A) Construction Phase					
A1.1	General	▪ Prior Planning	▪ Construction contractor to develop a detailed design for the electricity transmission line.	▪ Work force to be briefed about the relevant environmental issues, including pollution control and site management, before work begins. ▪ ADHPL has engaged a Himachal Pradesh based reputed NGO (Lok Kalyan Mondal) to oversee and guide its compliance with ESIA.	▪ Head Transmission Line
A2.1	Land Take / Right of Use	▪ Land will be used for permanent facilities like foundation, pylons etc (Currently the hindrances due to use of land is being compensated. The rates for land are agreed on a negotiated basis)	▪ Ensure that negotiations for compensation are free and fair. Also ensure that the compensation rates are at par with the market rates. ▪ It also needs to be ensured that the opportunity cost of such land is considered when deciding the compensation amount.	▪ Land owner should be adequately informed about compensation package by the ADHPL's Liaison Officer.	▪ Head Administration/ Land/RoW ▪ Liaison Officer. ▪ Local Administration
A2.2		▪ There may be some changes in the alignment to take into account any specific requirement along the route which may result in some deviations from the original route profile.	▪ Inform landowners about the change in the route. ▪ Release land not required after re-routing to the landowners	▪ A final check survey need to be conducted just before the time of construction for exact tower spotting.	▪ Head Administration/ Land/RoW ▪ Liaison Officer.

SN	Aspect	Impact	Suggested Mitigation	Monitoring and Awareness	Management Responsibility
A3.1	Right of Use/ Stringing	▪ Crop/ Plantation and asset loss. (Currently there is no uniformity in the valuation process of crop, plantation income and assets like trees. At some places it is being done on the horticulture rates while at others places it is done on an individually negotiated basis).	▪ Ensure replacement value for crops, plantation and other assets. ▪ Ensure uniformity in the process of methods and procedures followed in assessment of such losses.	▪ Use a third party independent valuation to define replacement value.	▪ Head Administration/ Land/RoW ▪ Liaison Officer. ▪ Local Administration
A4.1	Communication on compensation	▪ Communication on compensation. (Currently the PAPs are communicated of manner and methods of assessment of land, crop and asset value either during the time of negotiation or during the disbursement process.)	▪ Specific communication on how compensation amounts have been decided, and the total compensation to be paid to the PAP. The process of deciding upon the compensation and the manner of disbursal needs to be communicated in advance to the PAPs.	▪ Liaison officer to prepare basis of calculation to estimate the rate for different crops and communicate the same to affected PAPs	▪ Head Administration/ Land/RoW ▪ Liaison Officer.

SN	Aspect	Impact	Suggested Mitigation	Monitoring and Awareness	Management Responsibility
A5.1	Access	▪ Access can be disrupted during construction, at individual land owner level, and at the community level when village/ link roads are damaged/used beyond capacity for transportation and construction related activities. (ADHPL has wherever possible tried to avoid any access routes to avoid any disruption or inconvenience to the individual/community. Wherever such access is mandatory the negotiations have been done with the affected landowner by the construction contractor).	▪ Avoid using community /village roads for project activities. Alternative roads should be constructed and used. All access roads to be fully restored after use. ▪ Ensure that the compensation amount negotiated between the contractor and the affected PAP is adequate and paid in time. ▪ In case the land owner's access to his fields is disrupted for longer than what he/she has been compensated for, then the additional loss of crops needs to be compensated at the existing rates.	▪ Ensure prior approval and discussion with the local administration and concerned departments for any disruption of traffic/access. ▪ Supervise construction contractors as well as vehicle operators	▪ Head Administration/ Land/RoW ▪ Liaison Officer. ▪ Construction Contractor ▪ Local Administration ▪ NHAI regional office ▪ Department of Forest

SN	Aspect	Impact	Suggested Mitigation	Monitoring and Awareness	Management Responsibility
A6.1	Community and private property	▪ Damages to community and private/individual property during construction activities. The analysis of alternatives has been done by the project proponents and community or private property resources have at best been avoided in the transmission line corridor. Wherever such private resources have been impacted the compensation has been negotiated and included in the compensation amount	▪ Ensure that the construction activities are to be so planned that any use of community and individual property is either avoided or prior permission sought before use. ▪ Any unforeseen use and/or damage to property or structures etc. needs to be immediately compensated. ▪	▪ The grievance redressal process should closely monitor construction activities for such incidences. All such commitments should be a part of the contractor agreements.	▪ Head Administration/ Land/RoW ▪ Liaison Officer. ▪ Construction Contractor ▪ Local Administration

SN	Aspect	Impact	Suggested Mitigation	Monitoring and Awareness	Management Responsibility
A7.1	Local amenities and infrastructure	▪ Local infrastructure may come under pressure as construction activities use local resources. However, such impacts are envisaged to be minimal and short term in case for the project. [Construction workers and the contractors involved in the foundation or stringing work reside close to the site in the nearby villages. They negotiate their stay and logistics individually with the house owners (in case of rented accommodation) and make use of the local resources like water, sanitation arrangement etc.]	▪ Ensure (through provisions in the contract) that the construction workers do not negatively impact the nearby households or cause any inconvenience to them. ▪ Also that the terms and conditions negotiated with the house owner are respected by the workers. ▪ Behaviour and conduct of the workers to be monitored to ensure that there are no cultural or psychological impacts.	▪ Grievance redressal process should closely monitor construction activities for such incidences. All such commitments should be a part of the contractor agreements.	▪ Head Administration/ Land/RoW ▪ Liaison Officer. ▪ Construction Contractor ▪ Local Administration
A8.1	Community impacts	▪ Presence of labour in the area, even for short duration, can create local conflicts (Health impacts including risks of sexually transmitted diseases on the community)	▪ Commit to meet Indian regulation requirements as well as international conventions on labour, especially on issues of child and forced labour, working conditions, collective bargaining, non-discrimination and equal opportunity, complaint and grievance mechanism as well as occupation health and safety.	▪ Weekly inspection of construction locations	▪ Head Administration/ Land/RoW ▪ Liaison Officer. ▪ Construction Contractor ▪ Local Administration

SN	Aspect	Impact	Suggested Mitigation	Monitoring and Awareness	Management Responsibility
A9.1	Community expectations	▪ Community expectations for local benefits and other opportunities need to be addressed and managed. (The ADHPL have at places tried to accommodate the local community by giving them contracts for foundation works. Contribution to the local community development activities is ensured through donation in the district fund or as and when request made by the panchayat/ administration)	▪ Identify contracting/employment opportunities for people whose land plots will be impacted. Several of these opportunities would be limited to the construction period, but some could be long term employment. ▪ Communicate about employment opportunities on a regular basis and demonstrate the efforts being made to accommodate as many people as possible. ▪ Ensure there is a transparent process of giving benefits. Give priority to people with cumulative impacts as well as vulnerable families (with small land holdings). ▪ As employment opportunities will be limited, use other measures as is currently being done to bring local benefits like enhancement of local infrastructure, targeted social investment programme to address local and regional development issues like employment, skill development and agriculture etc.	▪ ADHPL to develop mechanism to advertise, identify and recruit suitable worker from the local community. ▪ ADHPL to develop mechanism to communicate the skill requirement to eliminate unwanted expectations.	▪ Head (HR & Stores)
A10.1	Cultural Heritage	▪ Cultural and religious sensitivities may be impacted by the project. (The ADHPL have ensured and taken steps to avoid any impact on cultural and religious properties all across the transmission line corridor.)	▪ Map all cultural heritage sites in a location before commencement of construction and ensure that such cultural and heritage sites or structures are not impacted. ▪ Comply with national laws and international obligations on heritage.	▪ Monitor all activities close to places of religious and cultural importance on weekly basis.	▪ Construction contractor ▪ Liason officer

SN	Aspect	Impact	Suggested Mitigation	Monitoring and Awareness	Management Responsibility
A11.1	Soils	▪ Dumping of construction material outside the project construction foot print ▪ Erosion and compaction (The waste and rubble management is currently either dumped in the nearby area or locally managed by the construction contractor.)	▪ Construction to be undertaken during non-monsoon months to reduce any potential run-off induced erosion ▪ All construction material to be kept within the footprint of the area acquired. ▪ Loose construction material to be covered to avoid being carried into adjoining areas by wind. ▪ Ensure that the land is physically restored before leaving the project site to another location ▪ Use of existing track for transport of man and material to the extent possible.	ADHPL representatives to make weekly visits to each tower construction site to monitor such issues.	▪ ADHPL ▪ To be mentioned in the contract with the construction contractor ▪ Phase Manager shall arrange for routine monitoring
A11.2		▪ Soil Contamination due to spill of civil construction material and Aluminium oxide paint	▪ Ensure secured storage of civil construction materials including paint, thinner etc. ▪ Spread sheet underneath the tower structure prior to start of any painting activity. ▪ Remove empty containers/sacs/boxes etc on daily basis and dispose off through authorised vendors. ▪ In case of any spill, ensure clean up immediately		
A11.3		▪ Waste construction debris creating nuisance in the corridor	▪ Construction debris to be removed on a daily basis from the site and no debris to be left at the site upon completion of the site work. ▪ Debris to be kept within the footprint of the site. ▪ Construction near water bodies to avoid contamination	▪ The towers need to be inspected at all locations at least once during the casting of each foundation to monitor storage of construction material and loose excavated soil.	▪ Will form part of the subcontractors contract with regular audit by ADHPL ▪ Phase Manager shall arrange for routine monitoring

SN	Aspect	Impact	Suggested Mitigation	Monitoring and Awareness	Management Responsibility
A12.1	Land use and Agriculture	▪ Disturbance to land uses and agricultural activities ▪ Loss of existing crop ▪ Limited access to the area under the towers ▪ Loss of crop due to movement of workers	▪ Pylons to be located to avoid interference with the existing areas of agricultural or other cultural significance ▪ Barriers or boundary markings to be provided to prevent incursion of tractors or workers into surrounding crops during construction ▪ Tractors, equipment and personnel to follow a predefined route and instructed not to wander in neighbouring areas unnecessarily ▪ Site clearance activities to be restricted to the minimum required area ▪ Construction to avoid key planting/ harvesting periods wherever possible specially for apple orchards in flowering season.	▪ All stringing activities to be regularly monitored by ADHPL personals to reduce damages to the extent possible. ▪ Construction workers to be instructed through contractors to work within the identified footprint. ▪ Regular checks by ADHPL to ensure compliance	▪ Phase manager to arrange and schedule monitoring.
A13.1	Ecology	▪ Disruption to existing flora and Fauna ▪ Loss of trees due to construction activity ▪ Damage to trees from stringing process ▪ Disturbance to fauna due to movement of workers in forest areas	▪ Ensure Forest Clearance prior to start of any work in the Forest area. ▪ Any disruption to flora to be kept to a minimum and restricted to only the essential area required for construction ▪ Prior to construction, the route to be surveyed again (and consultation to take place with the landowners) to establish the precise alignment. ▪ Wherever possible, mature trees to be avoided and use of existing gaps in vegetation maximised ▪ In areas where the route is off existing roads/ tracks, the roads to not be graded nor to the topsoil be removed ▪ Education of the workers to respect the local flora and fauna ▪ Other measures to be taken to reduce dust, noise, control of surface run-off, waste management, etc	▪ The workers to be sensitised about the local crops and the extent of care to be taken to minimise any potential damage. ▪ Contractors and local workers to be completely restricted from indulging in fishing, hunting and any other such activity. ▪ Final approval of the precise route to be done by ADHPL considering the local constraint.	▪ Will form part of the contract with the subcontractor ▪ Site Supervisor to monitor any damage to flora and fauna.

SN	Aspect	Impact	Suggested Mitigation	Monitoring and Awareness	Management Responsibility
A14.1	Traffic and Transport	▪ Increase in traffic and transport	▪ Wherever possible, existing roads to be used for the movement of the tractors/trolleys for transporting personnel and material to the site ▪ Proper trained drivers to be employed for the project	▪ Instruction for drivers/ officers and construction workers to avoid obstruction in the movement of local people while parking at construction site.	▪ Phase Manger
A14.2		▪ Obstruction to traffic movement	▪ Where temporary closure of road is required, provision to be made for alternative access to property and land, through the use of diversions around the working corridor. ▪ Construction vehicles to follow a safe speed limit in the hilly terrain and populated areas.	▪ All vehicles plying in the construction area will be instructed to maintain the speed under the limit. ▪ Drivers to be assessed for their knowledge on traffic rule before appointment.	▪ Site Supervisor
A15.1	Air Quality/ Atmospheric Conditions	▪ Dust emissions associated with construction activities	▪ All vehicles delivering loose construction material to the construction site (or removing construction) debris to be covered to prevent any escape of dust ▪ Speed limit of 15 km per hour to be maintained by vehicles moving on non-graded/ unpaved roads and tracks ▪ Sprinkling of water on dust generating areas	▪ Dust deposition in adjoining areas to be physically monitored by ADHEP personals atleast once during the excavation and casting activity to ensure compliance.	▪ Phase Manager
A16.1	Noise	▪ Noise from construction activities	▪ Use of manual labour to the extent possible instead of heavy machinery ▪ Construction activity to be undertaken only during daytime. ▪ Sequential arrangement of construction activities	▪ To be a part of the subcontractors contract	▪ Each schedule of the construction activities to be reviewed and approved by ADHPL
A17.1	Major Accident Risks	▪ Fall and Trip Hazards for passers by along the tower construction sites	▪ Risks to general public during construction of digging for foundation and erection of towers to be reduced by putting construction and warning signs (danger sign boards)	▪ Display of sign boards or warning signs at construction site to be monitored by ADHPL personals at site. ▪ Regular review to ensure compliance	▪ Shall form part of the contractor's contract.
A17.2			▪ Risks to general public during stringing activities to be mitigated by initial on-site training of workers and sensitisation of the local community	▪ Initial on-site training to be undertaken by the Contractor under supervision of ADHPL.	▪ Sensitisation of local community to be undertaken jointly by ADHPL and Contractor

SN	Aspect	Impact	Suggested Mitigation	Monitoring and Awareness	Management Responsibility
A17.3			▪ Once the stringing is complete, notices (danger sign boards) and anti climbing devices to be put on all the faces of the tower	▪ Inspection of towers after every six months to check the danger sign and anti climbing arrangements.	▪ Phase Manager
A17.4		▪ Occupational hazards	▪ Ensure compliance of safe practices and implementation of safety manual ▪ Provide and ensure use of personal protective equipment (PPEs) like, safety goggles, gloves, safety harness, helmets, gumboots etc. ▪ Prior training of the workers regarding health and safety procedures.	▪ Compliance monitoring to be undertaken by ADHPL supervisors and Contractors.	▪ Site Supervisor and Phase manager for ADHPL
A18.1	Natural Hazards	▪ Risk of tower failure resulting in occupational and societal health hazards	▪ The design of the tower to be made as per the IS and other government regulations, which to ensure that a safety margin is included in the design to reduce the risk from any seismic activity, wind loads, etc	▪ Will form part of the contractor's contract.	▪ Final designs will be reviewed and approved by ADHPL
B) Operation Phase					
B1.1	Community Health and Safety	▪ Community will have concerns about its safety and possibility of any accidents like electrocution, skin diseases etc. (The project proponents through select consultations with relevant stakeholders have tried to allay all fears related to health impact.)	▪ Evaluate possible risks and ensure that these are addressed and minimised. ▪ Communicate about the technical aspects of the transmission line construction and operations, and allay fears about accidents or any other health concerns ▪ Use simple diagrams and pamphlets in local language for this purpose. ▪ Train land owners about safety issues and action to be taken in case of risks. ▪ Demonstrate that ADHP and its contractors are very concerned about health and safety of workers as well as the community.	▪ Ensure communication of health and safety risks to villagers near to settlements in batches and explain the various H & S measures being undertaken.	▪ Head (Snow Zone) ▪ Head (Non Snow Zone) ▪ Safety Officer
B2.1	Noise	▪ Noise from Overhead line due to Corona effect	▪ Noise generation is unavoidable ▪ Use of conductors conforming to IS standard to minimise corona effect during foul weather conditions	▪ Will form part of the purchasing policy of ADHPL ▪ Monitoring during heavy rains and snow	▪ Head (Snow Zone) ▪ Head (Non Snow Zone)

SN	Aspect	Impact	Suggested Mitigation	Monitoring and Awareness	Management Responsibility
B3.1	Ecology	▪ Clearance of vegetation to avoid contact with transmission line	▪ Vegetation along the transmission line route will be reduced to required height using mechanical/ manual means and not by use of herbicides or other chemicals ▪ The sag of the transmission line will be planned to be optimal for all the seasons	▪ ADHPL to plan and discuss with stakeholders.	▪ Head (Snow Zone) ▪ Head (Non Snow Zone)
B3.2		▪ Avian collision with the transmission line	▪ Visibility enhancement objects such as marker balls, bird deterrents, or diverters to be installed to avoid avian collision	▪ Visibility enhancement devices to inspected after every two-three years.	▪ Head (Snow Zone) ▪ Head (Non Snow Zone)
B4.1	Energising Power Transmission Line	▪ Risk to public from operation of high voltage transmission line	▪ Start date for electricity transmission and safety implication will be announced locally using public announcement systems. ▪ Fixing of permanent warning plates (danger sign boards) ▪ Fixing of anti-climbing devices on all faces of the towers	▪ Half yearly monitoring to be done as part of the standard monitoring and maintenance schedule by ADHPL	▪ Head (Snow Zone) ▪ Head (Non Snow Zone)
B5.1	Electro-magnetic Field	▪ Concern over the potential health effects	▪ Potential exposure to the public to be maintained below the reference levels developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP)	▪ To be monitored annually and after any kind of modification to the transmission system	▪ Head (Snow Zone) ▪ Head (Non Snow Zone) ▪ Safety Officer ▪ Zonal Head Technical
B5.2		▪ Exposure of workers	▪ Potential occupational exposure to be maintained below the reference levels developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP)	▪ To be monitored on half yearly basis.	▪ Head (Snow Zone) ▪ Head (Non Snow Zone) ▪ Safety Officer
B5.3		▪ Telecommunication systems	▪ Clearance from telecommunication and telegraph wires will be maintained as per the Electricity act 2003	▪ To be monitored during construction Phase	▪ Head (Snow Zone) ▪ Head (Non Snow Zone) ▪ Department of Post and Telecommunication

SN	Aspect	Impact	Suggested Mitigation	Monitoring and Awareness	Management Responsibility
B6.1	Storage of flammable material Forest resources striking the height of the transmission line	▪ Potential fire of flammable material or the forest resources within the corridor	▪ Ensure no storage of flammables take place within the corridor ▪ Ensure pruning of twigs to a safe height as described in SN B3.1 above.	▪ Fortnightly survey of the whole of the corridor	▪ Head (Snow Zone) ▪ Head (Non Snow Zone)
B7.1	Transmission line snapping Transmission Tower/ Pylon collapse Flooding and destruction/ fire of sub stations	▪ Potential disaster	▪ ADHPL's experience personnel will develop exhaustive TL-DMP prior to commissioning of the transmission line. ▪ Implement disaster management plan ▪ Widely circulate DMP to ADHPL personnel and local administration officials ▪ Constitute Emergency Management Group (EMG), communication network etc as identified in the DMP (refer to ***Section 7.4***)	▪ ADHPL will also ensure periodical update of the TL-DMP ▪ Quarterly mock drilling to tackle various emergency situations as identified in the DMP ▪ Regular training to EMG and other staff responsible for implementation of DMP. ▪ Annual safety audits of the transmission line and sub stations	▪ Head (Snow Zone) ▪ Head (Non Snow Zone) ▪ Safety Officer ▪ Zonal Head Technical

J) CONCLUSION

48. The ESIA has assessed the overall acceptability of environmental and social impacts likely to arise as a result of construction and operation of Transmission line for ADHPL project.
49. The project is likely to generate some environmental and social impacts both during construction and operation. During construction phase the environmental impacts expected from the project include disturbance to fauna and flora, construction wastes disposal, traffic movement, increase of noise levels and social impacts mainly from engagement of land and loss of crop. During operation phase the impacts include disturbance to vegetation, electromagnetic field, noise generation and social impacts of restricted activities within the corridor.
50. Environmental and Social Management Plan describes implementation mechanism for recommended mitigation measures during construction and operation phase to verify overall project performance. This ESIA study together with suggested mitigations and follow up of recommendations on management actions will help ADHPL in complying with the International Standards on environmental and social components.

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LIST OF ACRONYM

	Acronym	
1	ACSR	Aluminium Conductor Steel Reinforced
2	ADHEP	Allain - Duhangan Hydroelectric Project
3	ADHPL	AD Hydro Power Limited,
4	BOD	Bio-Chemical Oxygen Demand
5	CDM	Clean Development Mechanism
6	CEA	Central Electricity Authority
7	CGWA	Central Ground Water Authority
8	CO	Carbon Monoxide
9	CPCB	Central Pollution Control Board
10	DISH	Directorate Industrial Safety and Health
11	DO	Dissolved Oxygen
12	E.P.F	Employees' Provident Fund
13	EFPI	Equator Principle Financing Institution
14	EHS	environmental, health and safety
15	EMF	Electromagnetic Fields
16	ESAP	Environmental and Social Action Plan
17	ESI	Employees State Insurance
18	ESIA	environmental and social Impact
19	FCA	The Forest (Conservation) Act
20	FCCC	Framework Convention on Climate Change
21	HPPCB	Himachal Pradesh Pollution Control Board
22	ICNIRP	International Commission on Non-Ionizing Radiation Protection
23	IFC	International Finance Corporation
24	IMD	India Meteorological Department
25	MoEF	Ministry of Environment and Forest
26	NAAQ	National Ambient Air Quality
27	NO_x	Oxides of Nitrogen
28	NSFWQI	National Sanitation Foundation water quality Index
29	OECD	Organisation for Economic Co-operation and Development
30	OSHA	Occupational Safety and Health Administration
31	PAP	Project Affected People
32	PESO	Petroleum and Explosives Safety Organisation
33	PGCIL	Power Grid Corporation India limited
34	PIL	Public Interest Litigation
35	RoW	Right of Way
36	RPM	Respirable Particulate Matter
37	SC	Schedule Caste
38	SEIAA	State Environment Impact Assessment Authority
39	SO_2	Sulphur Dioxide
40	SPM	Suspended Particulate Matter
41	ST	Schedule Tribe

1 INTRODUCTION

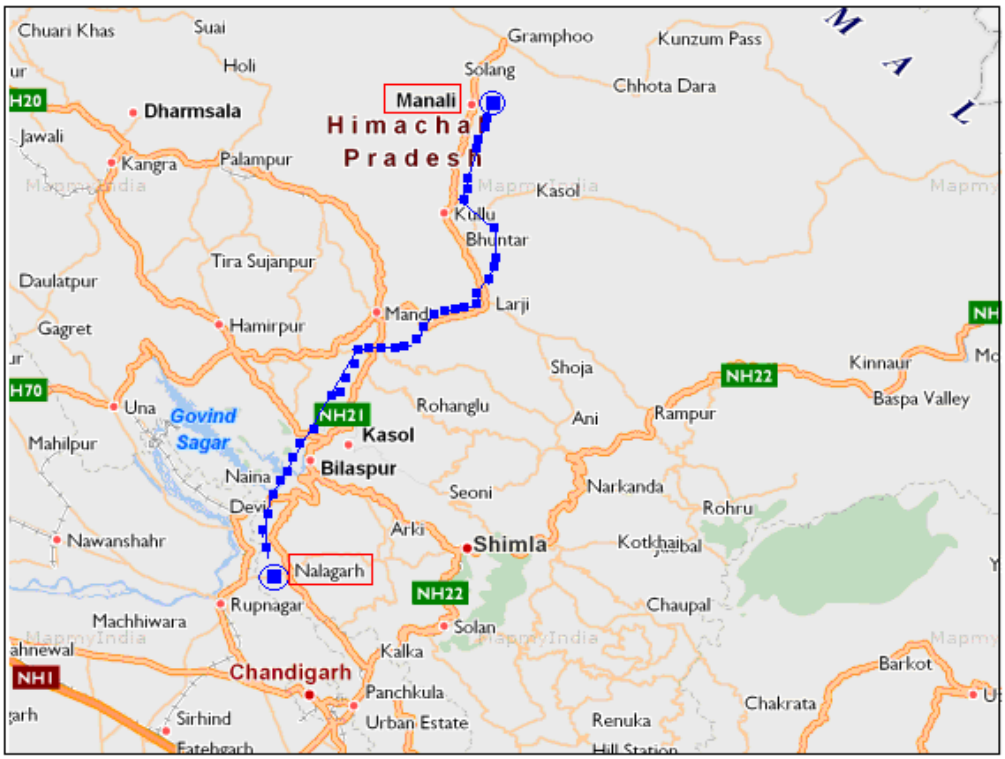
1.1 PROJECT BACKGROUND

AD Hydro Power Limited, a Bhilwara Group Company (hereinafter referred to as ADHPL) is in the process of setting up Allain - Duhangan Hydroelectric Project (ADHEP) a 2 x 96 MW (192 MW) hydropower generation facility on Allain and Duhangan tributaries of Beas river in Tehsil Manali, District Kullu, Himachal Pradesh in India. The project is located near village Prini, approximately 3 km SE of Manali town.

In order to evacuate the generated hydroelectric power, the project has planned a 174.66 km long 220 kV – double circuit power transmission line from switchyard near Prini village to the sub station at village Mahadeo, tehsil Nalagarh in district Solan, Himachal Pradesh. The route of the transmission line passes through Kullu, Mandi, Bilaspur and Solan Districts of Himachal Pradesh.

This report intends to assess the environmental and social impact (ESIA) of the proposed power transmission line. The project activities have already commenced and the project is expected to be operational by end of April, 2009.

Figure 1.1 Indicative Location of the Proposed Power Transmission Line



1.2 NEED & OBJECTIVE OF THE ESIA STUDY

ADHPL intends to commission ESIA study to fulfil the requirement of the project funding institution, the International Finance Corporation (IFC), Washington. The study fulfils the requirements of IFC Performance Standards and compliance of Equator Principles by Equator Principle Financing Institution (EFPI) besides considering compliance of the State and National level regulatory context and relevant International conventions/treaties signed by India.

The objective of this ESIA reporting is:

- to document various environmental and social related field activities that are being planned and or being undertaken by the ADHPL for laying of the power transmission line; and
- to highlight the environmental and social management strategies, systems and procedures being employed along the transmission line route and to meet the expectations of the IFC/EPFI Lender.

1.3 SCOPE OF ESIA

The scope of work for ESIA included the following:

a) Identification of the legal and policy framework applicable to the project;
b) Description of the principal project features and technical specifications, including pre construction, testing and commissioning, operation and maintenance (as provided by ADHPL);
c) Summary of approach adopted by ADHPL for design of the transmission line and assessment of alternatives available for the project together with an overview of outcome of the key decisions already taken up by the company for the transmission line route;
d) Description of the environmental and social baseline of the project in terms of key sensitivities and potential constraints on the construction and operation and maintenance of the transmission line;
e) Assessment of the land, air, noise, water, and the natural (biological) environment including parameters of human interest (social issues) based on primary surveys and available secondary data;
f) Identification of potential adverse environmental and social impacts during erection and operation of the transmission line and mitigation measures to be adopted by ADHPL; and
g) Develop Environmental and Social Action Plan (ESAP) outlining preventive and control strategies for minimizing adverse impacts during construction and operation (including maintenance) phases of the proposed project along with the cost and time schedule for implementation of the ESAP.

1.4 ERM'S APPROACH & BRIEF METHODOLOGY FOR THE STUDY

ERM adopted following approach for the project:

a) Identification and review of the applicable local, state, national and international environmental and social regulatory and institutional framework;
b) Assess requirement of Performance Standards of IFC [which have been accepted by Equator Principles Financial Institutions (EPFI) for Environmental and Social Assessment studies of various category A and B projects];
c) Establishing environmental and social baseline conditions along the stretch by the following:
    - Reconnaissance surveys to observe environmental and social characteristics on either side of the transmission line (primarily within 100 m);
    - Discussions with the local community and identification of hot spots and issues raised by people during construction of the project;
    - Primary baseline data collection along the transmission line route with respect to water, soil, ambient air, noise quality and traffic density on roads where proposed the transmission line crossed;
    - Socio-economic survey to assess the socioeconomic status of the route involving private land 100 m either side of the route. The survey involved discussion with the local people to understand their perceptions about the project, anticipated changes due to the proposed transmission line; and identification of historical/ cultural archaeological sites/ monuments along the route;
    - Ecological survey of flora and fauna prevailing along the transmission line route through primary and secondary surveys. For the stretches falling within the reserve and protected forests, discussions were held with concerned Divisional Forest Officers keeping in mind project information on diversion of forestland for non forest purposes; and
    - Identification of land use of the stretch through satellite imageries of the whole stretch of the transmission line.
d) Consideration of feasible environmentally and socially preferable alternatives (although the options avai1able at this stage was minimum);
e) Identification, prediction and evaluation of environmental and social impacts of the project;
f) Development of mitigation measures to minimise adverse environmental and social impacts;
g) Preparation of Environmental and Social Action Plan (ESAP) and Management System to include the following:
    - Mitigations suggested for adverse environmental and social impacts and associated risks;
    - Institutional arrangement - management tools and techniques for the implementation of environmental impacts and risk mitigations; and

- Monitoring and reporting of requirements and mechanisms for the effective implementation of the suggested mitigations.

Specific methodology and techniques used also discussed in relevant sections of this study.

1.5 LIMITATIONS

This ESIA study is based upon the application of professional judgment to certain facts with resultant subjective interpretations. Professional judgments expressed herein are based on the facts currently available within the limits of the scope of work, information provided by the client or its representative, prevailing secondary data, budget and schedule. To the extent that more definitive conclusions are desired by client than are warranted by the currently available facts, it is specifically ERM's intent that the conclusions and recommendations stated herein will be intended as guidance and not necessarily a firm course of action except where explicitly stated as such. We make no warranties, express or implied, including, without limitation, warranties as to merchantability or fitness for a particular purpose. In addition, the information provided to client in this report is not to be construed as legal advice.

1.6 USE OF THE REPORT

ERM is not engaged in consulting or reporting for the purpose of advertising, sales promotion, or endorsement of any client interests, recommending investment decisions, or other publicity purposes. Client acknowledges that the report has been prepared for their exclusive use and agrees that ERM reports or correspondence will not be used or reproduced in full or in part for such purposes, and may not be used or relied upon in any prospectus or offering circular. Client agrees that none of its advertising, sales promotion, or other publicity matter containing information obtained from this assessment and report will mention or imply the name of ERM.

1.7 AGENCIES CONTACTED

Following agencies were contacted for the conduct of this study:

- Divisional Forest Office, Kullu
- Revenue Office, Kullu;
- Directorate of Census Operations, Kullu district;
- Department of Census, Government of India, New Delhi;
- Village Panchayats;
- World Wide Fund for Nature- India;
- Sriram Institute of Industrial Research, Delhi; and
- India Meteorological Department (IMD), New Delhi.

1.8 LAYOUT OF THE REPORT

The remaining sections of the report include the following:

Section 2: Project description;

Section 3: Applicable Legislations;

Section 4: Environmental and Social baseline along the transmission line route;

Section 5: Impact Assessment and Mitigations;

Section 6: Analysis of Alternatives;

Section 7: Environmental and Social Action Plan; and

Section 8: Conclusion.

Annexes to the report include the following:

Annex A: Analysis results of ambient air quality monitored;

Annex B: Traffic volumes observed at locations crossing the transmission line;

Annex C: Noise levels monitored at various locations along the transmission line route;

Annex D: Analysis result of water samples

Annex E: Photo-documentation along the transmission line

Annex F: Weighing Chart for water Quality Index

Annex G: EHS guideline for Transmission line -IFC

Annex H: IUCN Red Data Categories and Criteria

Annex I: Brief CV's of the Team

2.1 PROJECT LOCATION

The proposed power transmission project intends to establish a medium for evacuating power generated from the AD Hydroelectric Project at village Prini, Manali. The nearest sub station of the power grid is located at Nalagarh.

The proposed route of transmission line of 220 kV will begin from the switch yard of power generation facility at village Prini located at about three km south east of Manali town and traverse through Kullu, Mandi, Bilaspur and Solan districts of Himachal Pradesh and terminates at Nalagarh. The transmission line corridor passes through agricultural and forestland for length of 174.66km. The upper part of the transmission line for the first 57km will be in snow zone while the remaining 118 km falls in the non snow zone.

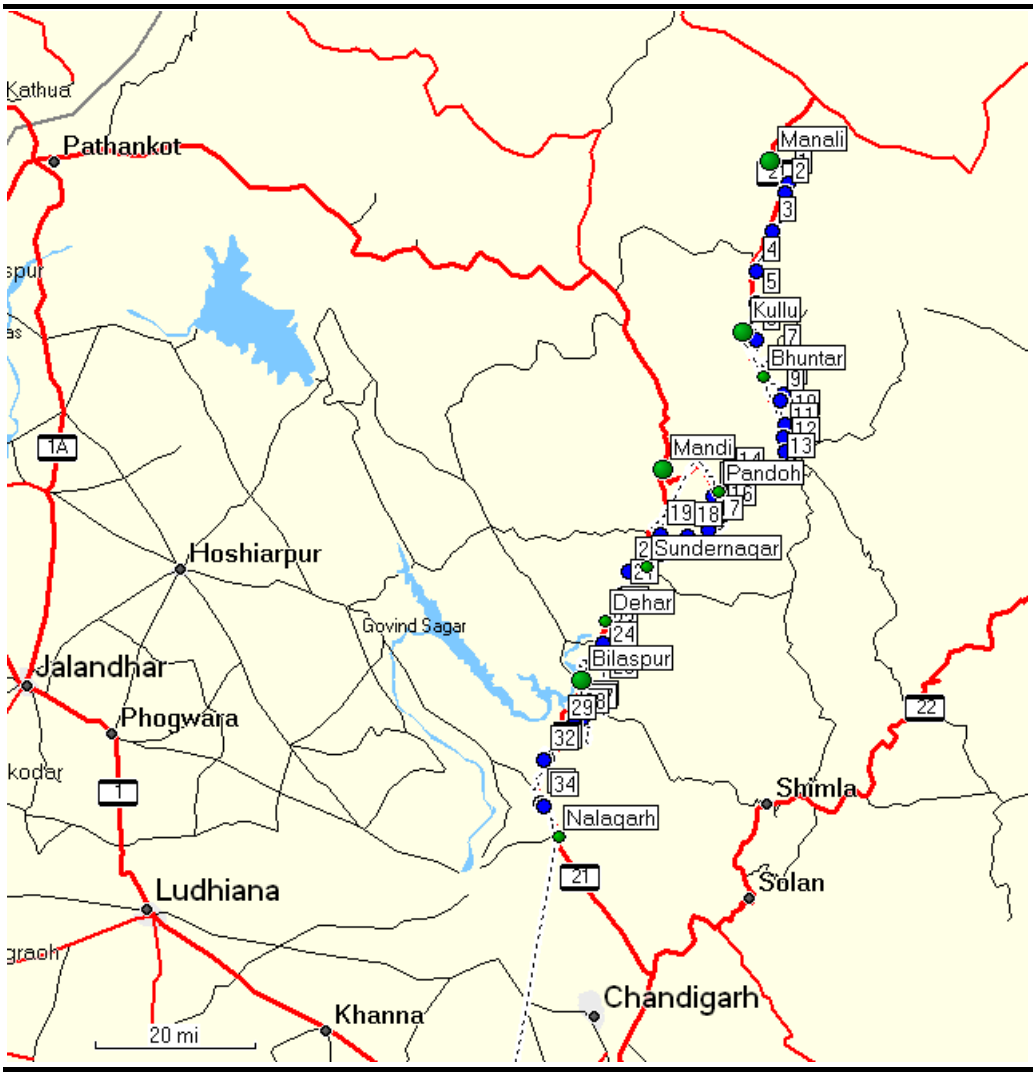
The indicative geographical coordinates for the transmission line route are provided in ***Table 2.1*** as shown in ***Figures 2.1 to 2.8.***

Table 2.1 Indicative Geographical Co-ordinates outlining the route of transmission line

Outline Points from Prini to Nalagarh	Indicative Geographical coordinates
1	32º 13′ 30.5″N 77º 12 23.3″E
2	32º 12′ 37.6″N 77º 11 58.4″E
3	32º 08′ 27.1″N 77º 10 21.4″E
4	32º 03′ 57.9″N 77º 08 12.8″E
5	32º 00′ 37.6″N 77º 08 14.0″E
6	31º 56′ 34.1″N 77º 08 17.1″E
7	31º 54′ 33.1″N 77º 10 48.3″E
8	31º 50′ 45.8″N 77º 11 44.7″E
9	31º 50′ 00.8″N 77º 11 22.3″E
10	31º 47′ 26.7″N 77º 11 50.3″E
11	31º 46′ 03.6″N 77º 11 42.1″E
12	31º 44′ 30.9″N 77º 11 56.2″E
13	31º 42′ 46.0″N 77º 11 15.3″E
14	31º 41′ 08.1″N 77º 04 50.5″E
15	31º 39′ 37.0″N 77º 02 48.3″E
16	31º 37′ 27.5″N 77º 03 42.6″E
17	31º 35′ 57.2″N 77º 02 02.6″E
18	31º 35′ 12.6″N 76º 59 34.9″E
19	31º 35′ 20.3″N 76º 56 04.8″E
20	31º 31′ 28.8″N 76º 52 00.0″E
21	31º 28′ 58.2″N 76º 51 24.9″E
22	31º 26′ 05.5″N 76º 50 01.3″E
23	31º 23′ 35.8″N 76º 48 46.5″E
24	31º 22′ 10.8″N 76º 48 37.5″E
25	31º 18′ 44.2″N 76º 48 44.6″E
26	31º 15′ 44.0″N 76º 46 19.8″E
27	31º 15′ 33.1″N 76º 46 00.6″E
28	31º 14′ 52.6″N 76º 45 04.3″E
29	31º 14′ 13.0″N 76º 43 23.8″E
30	31º 11′ 19.8″N 76º 41 33.5″E

Outline Points from Prini to Nalagarh	Indicative Geographical coordinates
31	31° 11′ 12.5″N 76° 41 27.8″E
32	31° 10′ 55.2″N 76° 41 12.4″E
33	31° 06′ 18.5″N 76° 40 48.3″E
34	31° 05′ 59.4″N 76° 41 12.9″E

Figure 2.1 Route of transmission line outlined on the map



2.2 PROFILE OF THE PROJECT ROUTE

2.2.1 *Transmission Line Routes*

The existing profile of the transmission line route is based on the walk over survey to identify the corridor and subsequent detailed survey, which was conducted by ADHPL and its contractors to fix the alignment of the towers. The transmission line route passed through private and forest land between Prini and the Nalagarh substations. Construction activities have been initiated in most of the private land; however clearance is awaited for the some areas falling in forest land. There may be small changes in the alignment to take into account any specific requirement along the route which may result in some deviations from the original route profile.

The transmission line route is divided into three stretches for better administration and management. The details of the stretches are as given in ***Table 2.2.*** A detailed route map of the transmission line is as given ***Figure 2.2.***

Table 2.2 Transmission Line Details

Stretch	Location	Districts traversed	Route Length in km
1	Manali to Panarsa	Kullu	57.16
2	Panarsa to Dehar	Kullu, Mandi	71.60
3	Dehar to Nalagarh	Mandi, Bilaspura and Solan	45.90
		Total	**174.66**

Stretch 1: 220 kV Double Circuit Overhead Transmission Line from Prini Switch yard to Panarsa

Stretch 1 is 57.16 km in length which emanates from the Prini Switch yard; it moves south ward along the river Beas and National Highway 21 from Manali towards Kullu. The entire stretch of the route passes through hilly undulating terrain. The area is predominantly agricultural with apple orchards being the primary cultivation.

There are two river crossings in the stretch i.e. River Parbati and River Beas. There are also nine rivulets (also referred as Nalas in local language) which flow across the route of transmission line i.e. Pahali Nala, Duhangan Nala, Pakhnoj Nala , Chhaki Nala ,Mashal Nala ,Ragoi Nala and Kais Nala .

The route has been diverted after Kullu towards the east to avoid the Bhuntar airport and again runs parallel to the Beas River finally crossing the river near Panarsa.

Stretch 2: Transmission line from Panarsa to Dehar

Stretch 2 is of 71.6 km in length and mostly passes through hilly terrain. After Panarsa the transmission line moves westward along with the river Beas towards Pandoh where it crosses the river Beas again. After Pandoh the transmission line moves further south towards Chachyot and turn west towards Suket. After Suket the transmission line aligns itself to the right of NH 21 and moves south wards towards Dehar.

Stretch 3: Transmission line from Dehar to Nalagarh

Stretch 2 is of 45.9km in length. The overhead transmission line traverses through hilly terrain in most of the stretch till it enters Solan district after which the terrain is mostly agricultural plain land with wheat as the primary crop.

The transmission line crosses River Sutlej at Dehar and moves south wards into Bilaspur district towards Swarghat and then to Nalagarh Substation along the National Highway 21A.

In this stretch, the transmission line crosses the national highway 21A twice. The transmission line also crosses high tension line distributors at four locations.

The summary of tentative towers proposed for the transmission route length is given in ***Table 2.3.***

Table 2.3 ***Tentative Details of Transmission Towers***

Type	B (T) type	C (U) type	D (V) type	E (X) type	Gantry	Total Towers	Towers in Forest
Angle	**0°-15°**	**15°-30°**	**30°to 60°**	**Special type over span**	**HT line Crossing**		
Area in m (without extension)	**14 x 14**	**14.5 x 14.5**	**15 x 15**	**18 x 18**	**42 x 6**	**-**	
Stretch 1: Prini to Pansara	111	46	49	11	-	217	50
Stretch 2: Pansara to Dehar	68	60	55	20	-	203	54
Stretch 3: Dehar to Nalagarh	71	39	37	5	8	160	42
Total	-	-	-	-	-	**580**	**146**

2.2.2 Switching Stations

There will be a two switching stations, one at the sending end i.e. at Prini close to Power house and another one at the receiving end i.e. at Nalagarh sub station. The details of the switching stations are given in the following subsections.

Prini Switching Station

The 220 kV switching station at Prini will consist of two generator bays, two outgoing bays and one bus coupler bay . This will be located close to the 2 x 96 MW Hydro Power project at Manali and will serve as the sending end for evacuation of power.

Nalagarh Switching Yard

The Power Grid Corporation India limited (PGCIL) has allotted ADHPL two 220kV Bays at Nalagarh sub station which will serve as the receiving end for the power evacuated from the Manali Plant. The bays will be constructed by ADHPL after getting approval on drawings/documents etc. from PGCIL. Most of concurrence/approvals for civil works and equipment drawings have already been received from PGCIL and site work is in progress

Figure 2.2 ***Route Map of ADHPL Transmission Line: Stretch 1 from Prini-AP1 to Vahad-AP70***

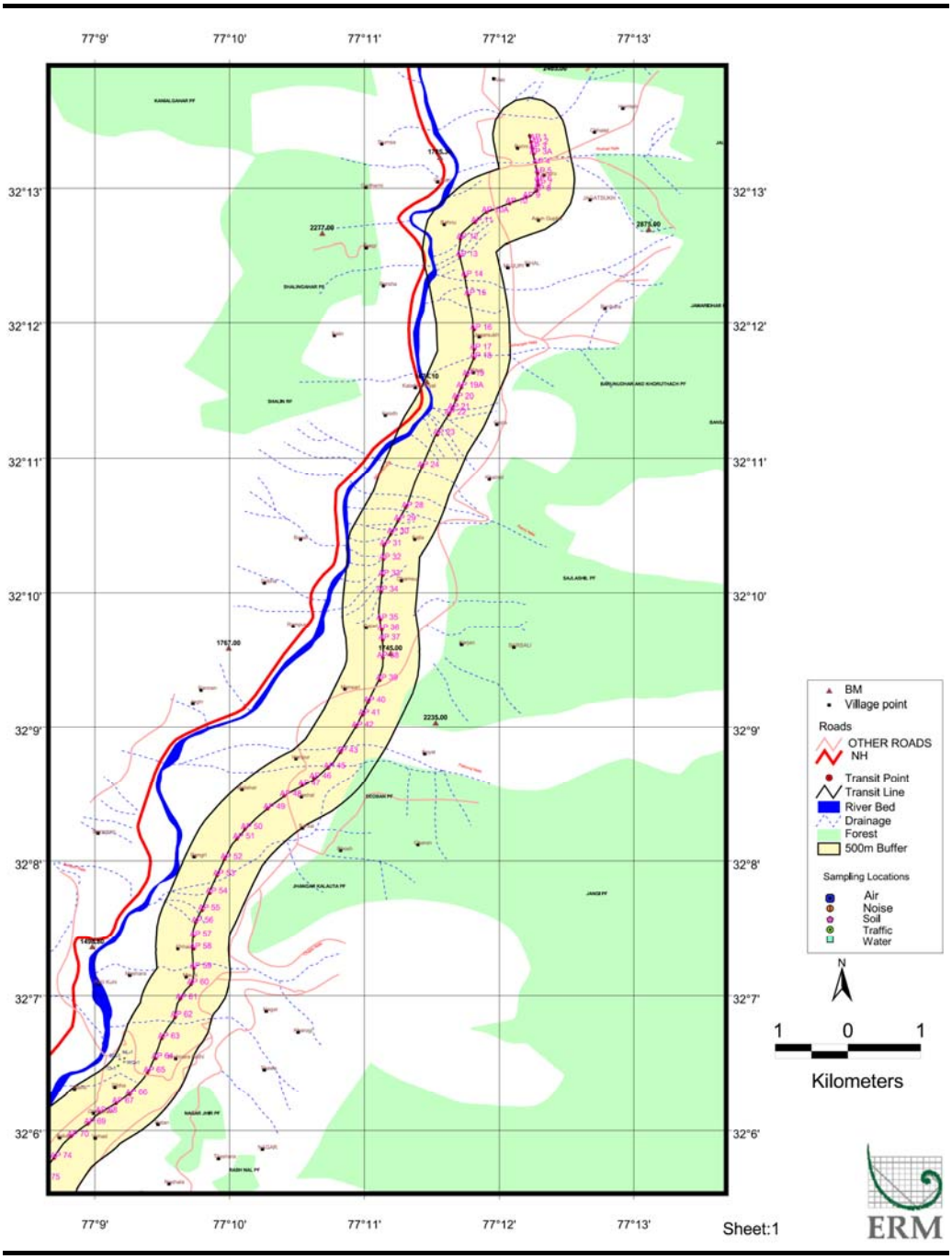


Figure 2.3 ***Route Map of ADHPL Transmission Line: Stretch 1 from Vahad-AP70 to Tarain-AP187***

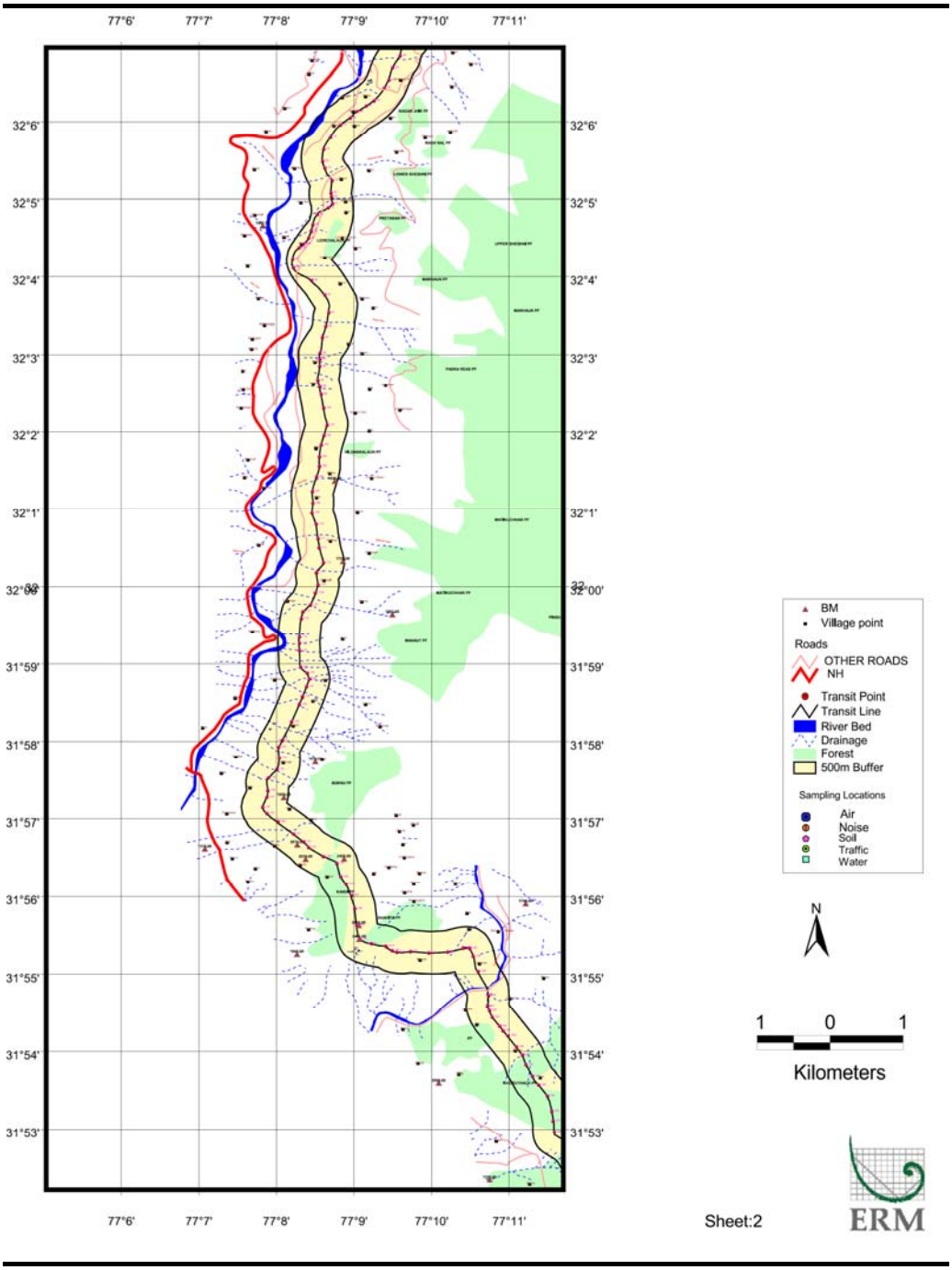


Figure 2.4 *Route Map of ADHPL Transmission Line: Stretch 1 from Tarain-AP187 to Panarsa –AP222 and Stretch 2 from Panarsa-AP3A to Chalaunti-AP37*

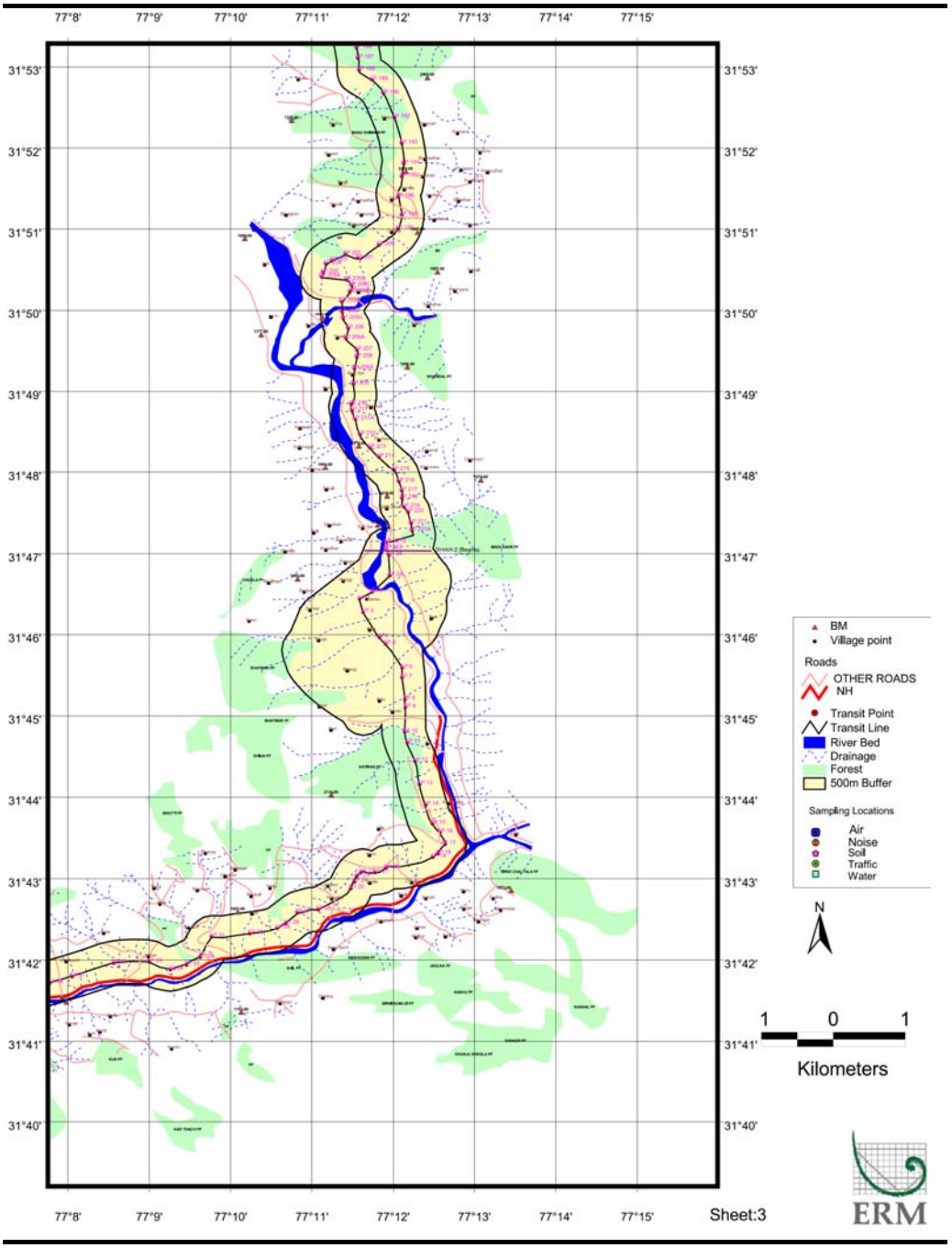


Figure 2.5 ***Route Map of ADHPL Transmission Line: Stretch 2 from Chalaunti-AP37 to Baggi-AP13***

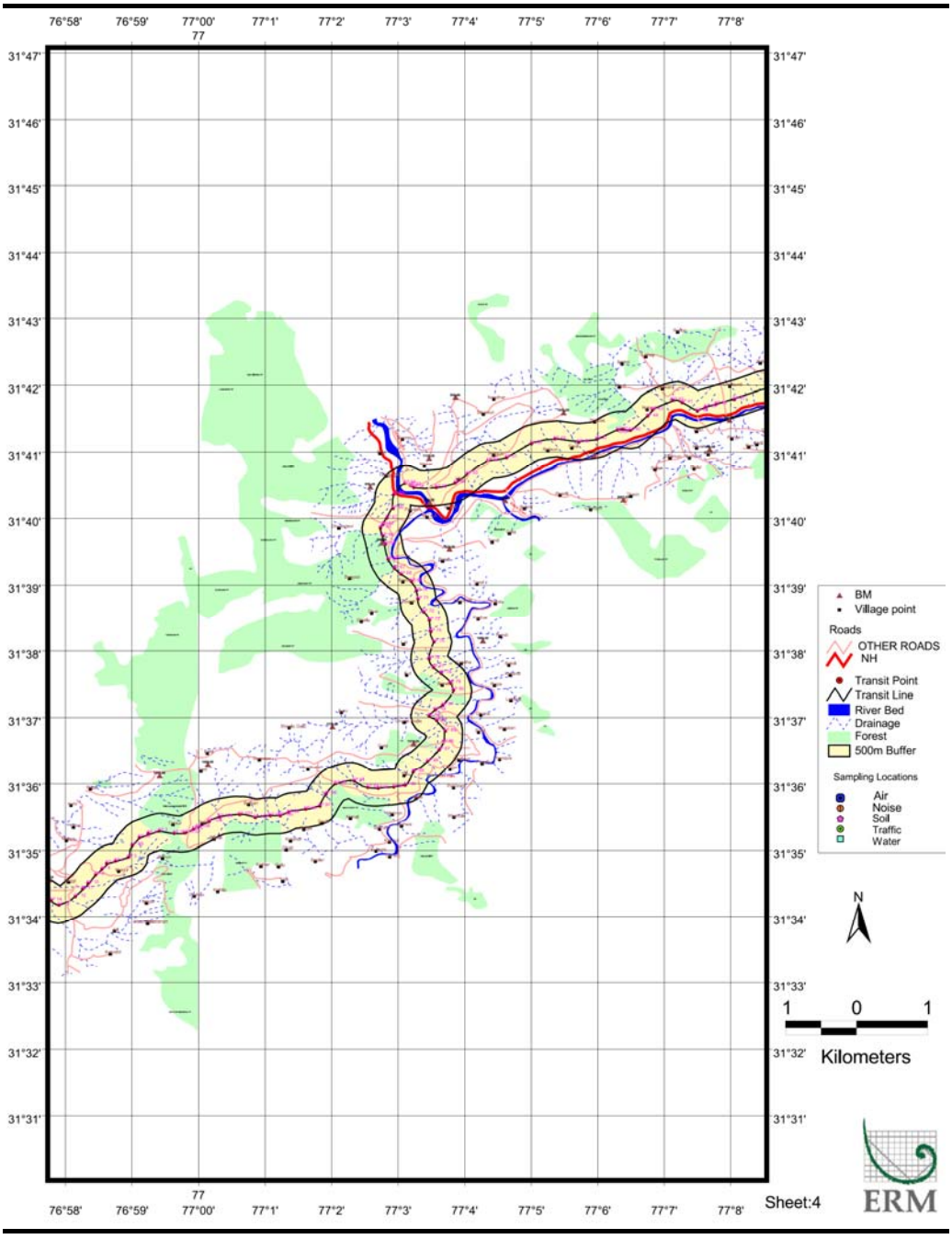


Figure 2.6 *Route Map of ADHPL Transmission Line: Stretch 2 from Baggi-AP13 to Saroshi-AP44*

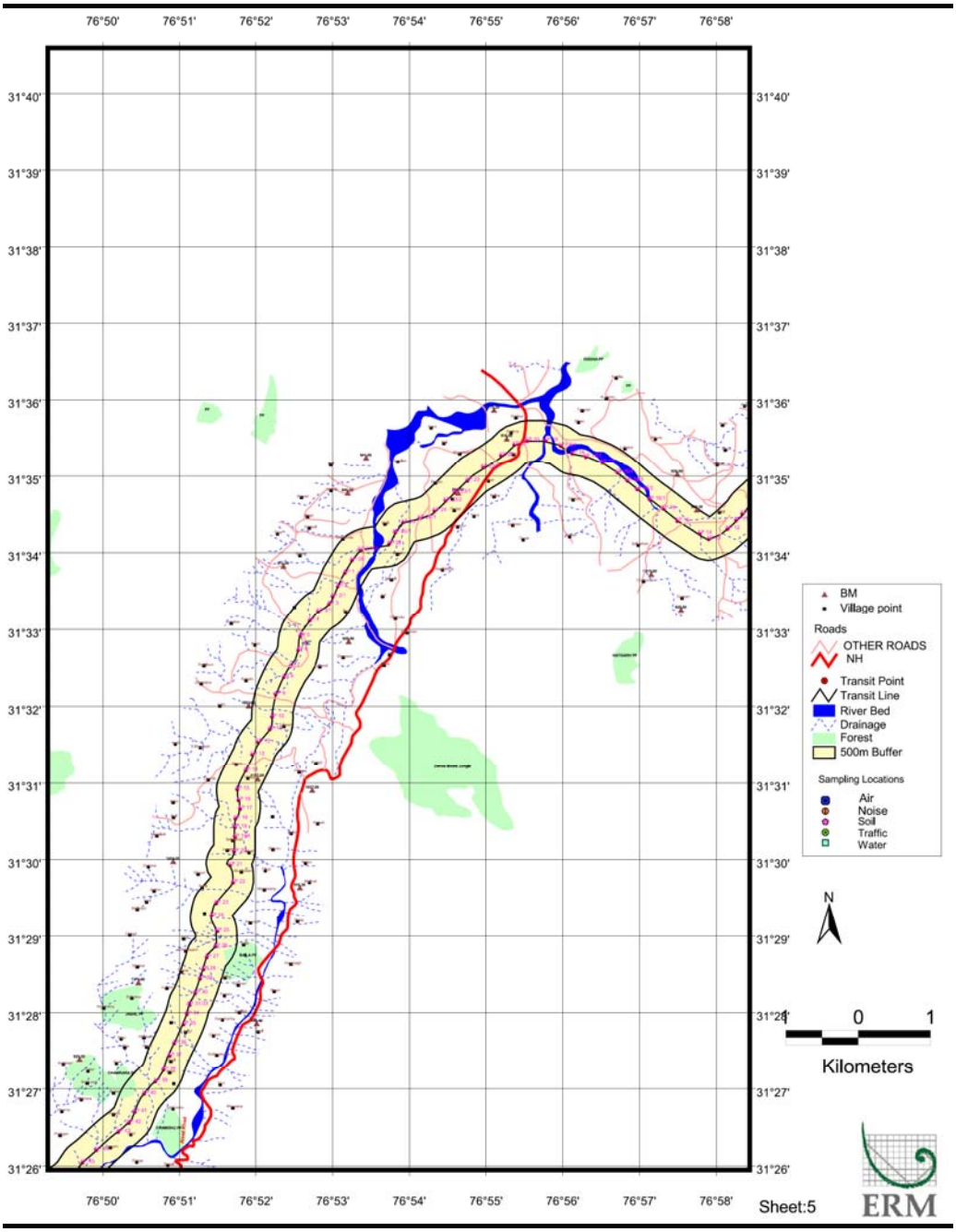


Figure 2.7 ***Route Map of ADHPL Transmission Line: Stretch 2 from Saroshi-AP44 to Rambagh-AP49 and Stretch 3 from Jamla-AP50 to Chhadol-AP65***

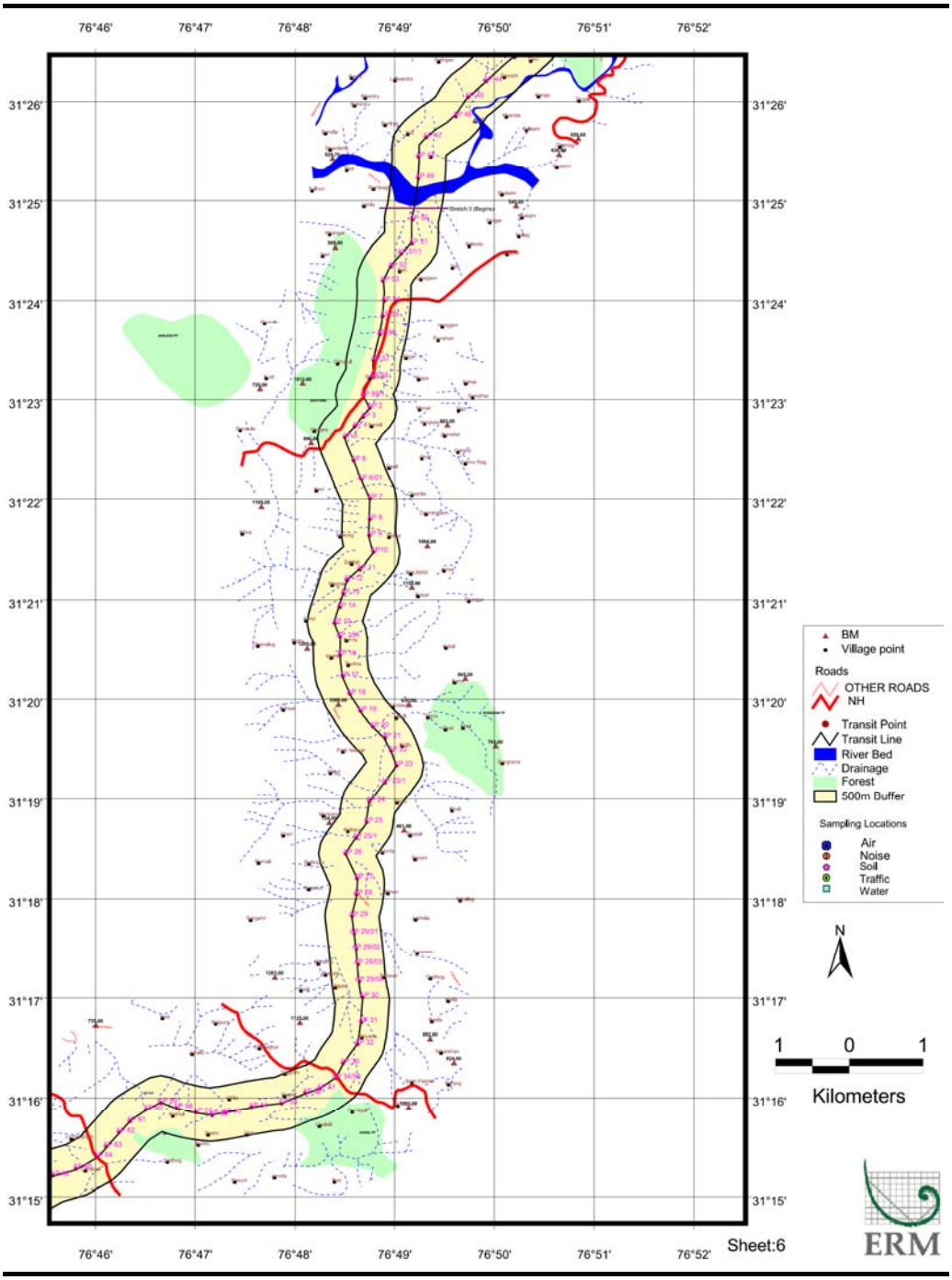
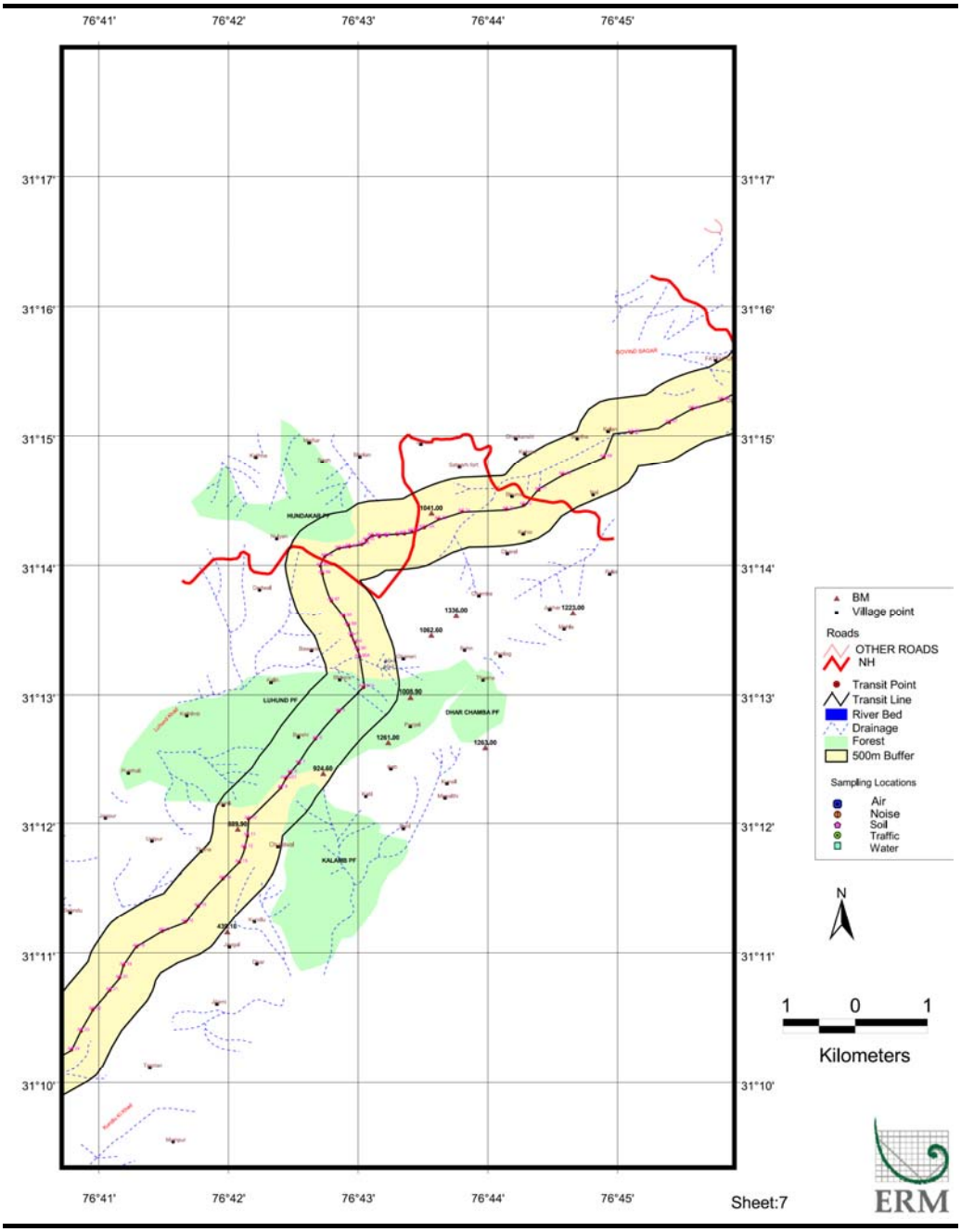


Figure 2.8 ***Route Map of ADHPL Transmission Line: Stretch 3 from Taprian-AP23 to Reniopara-AP44***



2.3 TRANSMISSION LINE CONSTRUCTION

The construction for transmission line is already under progress through sub-contractors engaged by the two key contractors i.e. Reliance Infrastructure Limited and L&T Limited. The walkover survey and the route profiling for fixing of alignment was completed by ADHPL. The detailed check survey for exact tower spotting has been completed for all the stretches of the route from Manali to Nalagarh. The survey of private land was conducted in presence of official from revenue department while forest officials were included for surveys related to forest land. The Forest Clearance for the finalised route through forest land is yet to be received by ADHPL.

The construction work with respect to private land has already initiated in all the stretches. Transmission line construction is a sequential process and comprises of a distinct operations and phases, which are described in the following sections.

2.3.1 *Transmission Line Design*

1a) Transmission Line Towers

Along the 174.66 km route of transmission lines, the estimated total number of towers to be erected is 580 with the minimum and maximum span between any two towers being around 60 m to 960 m respectively. The average distance between two towers is estimated to be around 302m.

There are four categories of towers which are classified as B (or T), C (or U), D (or V) and E (or X) depending on the angle of deviation. The B/T type small angle towers are used on straight runs with a maximum of 0° to 15°. The type C/U type medium angle towers are used for line deviation in the range of 15° to 30°. The type D/V heavy angle towers are used for line deviation from 30° to 60°. The E/X type towers are special type towers where the technical parameters are not covered in the standard type of towers. The B, C, D and E type towers are to be used with different types of body extensions depending on the span lengths and for the purpose of maintaining adequate clearances.

1b) Tower and Transmission Line Construction Materials

The designs, manufacturing, fabrication, galvanising, testing, erection procedures and materials to be used for manufacture and erection of towers, line materials, construction of foundations, *etc* will conform to the latest revisions of the Indian Standards, as amended up to date and provisions of the latest revision of the Indian Electricity Act and the Electricity Rules and/ or any other electrical statutory provision rules and regulations. ***Table 2.4*** presents the Indian Standards applicable to the construction methods and materials followed:

Table 2.4 Applicable Indian Standards/Code of Practice on Power Transmission Line

S. N.	Indian Standards (IS)	Title
1	IS:209	Specification for Zinc
2	IS:269	Ordinary and Low heat Portland Cement
3	IS:383	Coarse and fine aggregates from natural source for concrete.
4	IS:398(Part-II)	Aluminium Conductors, Galvanised Steel reinforced
5	IS:432	Mild Steel and Medium Tensile Steel deformed bars for concrete reinforcement.
6	IS:455	Portland Slag Cement
7	IS:456	Code of practice for plain and reinforced concrete.
8	IS:800	Code of practice general construction in steel
9	IS:802	Code of practice for use of structural steel in Overhead Transmission Line Towers.
10	IS:802(Part-I/Sec-I) & (Part-I/Sec-II)	Loads and permissible stresses.
11	IS:802(Part-II)	Fabrication, galvanising inspection and packing
12	IS:802(Part-III)	Testing of Towers.
13	IS:1363	Hexagonal head bolt screws and nuts of prudent grade C part 3 : Hexagonal nuts (size range M5 to M36)
14	IS:1367	Technical supply condition for threaded steel fasteners
15	IS:1573	Electroplated coating if zinc on iron and steel
16	IS:1893	Criteria for earthquake resistant design of structures.
17	IS:1786	High strength deformed steel bars and wires for concrete reinforcement.
18	IS:2016	Plain washers
19	IS:2062	Weldable structural steel.
20	IS:2121	Conductor and Earthwire accessories.
21	IS:2121(Part-I)	Armour rods, binding wires and tapes for conductors.
22	IS:2121(Part-II)	Mid span joints and repair sleeves for Conductors.
23	IS:2486	Insulator fitting for overhead power lines of 33 kV and above.
24	IS:2486(Part-I)	General requirement and tests.
25	IS:2486(Part-II)	Dimensional requirements
26	IS:2551	Danger notice plates
27	IS:2633	Method of testing uniformity of coating on zinc coated articles.
28	IS:3063	Single coil rectangular section spring washers for bolts, nuts and screws and washers.
29	IS:3757	High strength structural bolts.
30	IS:4000	Code of practice for high strength bolts in steel structure.
31	IS:4091	Code of practice for design and construction of foundations for Transmission Line Towers and poles.
32	IS:4759	Specification for hot dip zinc coating on structural steel and other allied products.
33	IS:4826	Hot dip galvanising coating on round steel wires.
34	IS:5613	Code of practice for design, installation and maintenance of Overhead Power Lines.
35	IS:5624	Foundation bolts
36	IS:6610	Heavy washers for steel structures
37	IS:6613	High strength structural nuts.
38	IS:6639	Hexagonal bolts for steel structures.
39	IS:6649	Hardened and tempered washers for high strength structural bolts and nuts.
40	IS:6745	Methods for determination of weight of zinc coating on zinc coated iron and steel articles
41	IS:8500	Weldable structural steel (medium and high strength qualities)
42	IS:9708	Stock bridge vibration dampers for Overhead Power conductors.

S. N.	Indian Standards (IS)	Title
43	IS:10238	Step bolts for steel structures as in the Indian Electricity Rules , 1956.
44	IS:12427	Transmission tower bolts.
45	Publication No. 19(N) /700-1963	Regulation for electrical clearance
46	Publication No. 239 of C.B.I.P.	Guide for new code for design of Transmission Line Towers in India.
47	IS:731	Specification of Porcelain insulators for Overhead power Lines, with a nominal voltage, greater than 1,000 volts.
48	IS:5358	Hot dip galvanised coating of fasteners.
49	IS:226	Structural steel (Standard quality)
50	IS:1883	Method of load test on soils
51	IS:1139	Hot rolled mild steel medium tensile and High yield strength steel deformed bars for concrete reinforcement.
52	IS:1489	Portland Pozzoland Cement.
53	IS:2131	Method of standard penetration test for soil
54	IS:2629	Recommended practice for hot dip galvanising of iron and steel
55	IS:3043	Code of practice for earthing (with amendment Nos.1 and 2)

2) General Construction Methodology

2a) Pre-construction Activity

The following activities form part of the pre-construction phase:

- Walkover survey to identify the corridor;
- Detailed survey for fixing the alignment;
- Check survey for exact tower spotting before actual construction; and
- Soil investigation of important tower locations to ascertain the type of foundation to be adopted.

2b) Marking of the Route and Right of Way (RoW)

All construction activities will be undertaken within the right of way for the safe operation of the transmission line, considering minimum clearances indicated in Government Regulations. The right of way is taken as 17.5 m on both sides of the centre line of the transmission line as per IS: 5613. The transmission line route will be marked by wooden pegs within the ground in accordance with the line design.

2c) Clearing of Tower Sites

At the tower sites, all vegetation within the footprint of the tower base and for a distance of approximately 2 m beyond the base in all directions will be cleared to ground level.

2d) Excavation of Tower Foundation

Pit marking is done for the legs of the tower. Foundations will be dug to a depth of about 3m x 3m x 3m depending upon the ground conditions. This area may vary depending on the slope of the area. The excavated soils will be

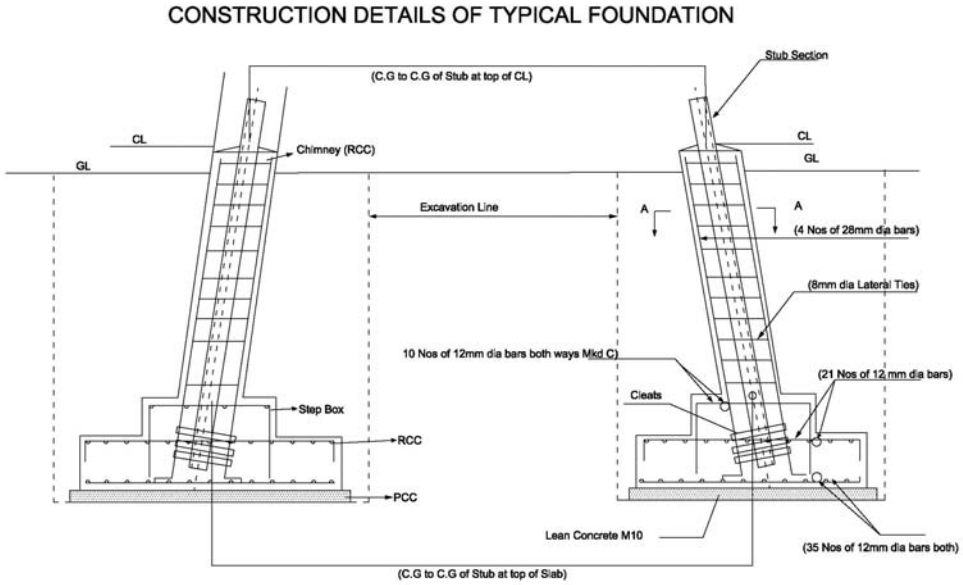
stored at the site of each foundation and will be used for backfilling purposes. The project proponent does not intend to use any imported soil for backfilling purposes.

2e) Foundations for Towers

Foundation for towers is laid depending upon the type of soils encountered. The formwork, reinforcing bars, the embedded parts of the towers and any earthing elements will be placed in the pits. A 50 mm thick Pre-stressed Concrete Cement pad is to be laid at the base of the foundation. The concrete mix will be prepared at the site and will be M-20 grade. The steel used for foundation is Fe -415 conforming to IS: 456-2000. The casting and foundation work at each tower site require 15 to30 days with 10 to15 workers depending on the type of terrain.

In hilly terrains where head loading of construction material is required the time taken for casting and foundation is more. About 60litres of water per m^3 of construction is required daily for construction. An average of about 80 to 100m3 of concrete is required per tower. The water requirement is met locally through tankers. A detailed diagram of construction of foundation is as given in ***Figure 2.3.***

Figure 2.9 Construction Details for Foundation of Tower (typical)



2f) Backfilling

The foundation pits will be backfilled following the removal of the formwork with soil excavated from the site itself. The top part of the stub of the tower leg remains above the ground level after the backfilling. The backfilling soil will be compacted in accordance with good engineering practices.

2g) Tower Material Delivery

The materials for construction of towers will be delivered from the storage yard directly to the site. Material required for one particular tower will be issued for work at site. The material will be brought to the construction site using either a tractor / trailer or manually depending on the terrain.

For the storage of construction materials, the construction contractors have built a storage yards at Nalagarh, Sunder Nagar and Bhuntar. Each storage yard will serves as supply source to tower construction sites in the vicinity.

2h) Erection of Towers

Lag time, as specified by the Indian Standards, will be maintained for curing of concrete before erection of the towers. About 50litres of water is required at each site for curing of foundation. The expected time for tower erection on an average is three days. Erection of towers takes 25 to 30 workers, which is done manually by assembling prefabricated components of the lattice structure.

2i) Stringing (Transmission Cabling Installation)

The stringing operations between two towers normally take 2-4 days. The operation involves 'paying off' conductors and earth wires on the ground and then hoisting them manually at most places and with the help of tractors/ puller machine at some places for fixing with the towers at both ends along with insulators and hardware. Stringing of the section between two angle towers is done at a time.

The conductor used for the project will be Aluminium Conductor Steel Reinforced (ACSR Zebra) and the insulators to be used are of 120KN. The stringing process will require 50 workers when the process is carried out manually, however use of machinery or tractors will reduce the number of workers required.

2j) Reinstatement

Once backfilling is completed, the surface of the towers will be graded to ensure that water drains away from the tower supports and that the surface is smooth. All excess construction materials and debris will be removed from the site and disposed off at the nearest municipal disposal site.

2k) Testing and Inspection

On completion of the work, physical inspection and checking of all foundation work, tower erection and stringing will be carried out to ensure strict adherence to the technical requirements.

Insulation and continuity test of the transmission line, as well as earth resistance of each tower will be carried out before final commissioning.

2l) Safety Measures for Operations

A warning sign (as per IS: 2551) will be attached to each tower approximately 2m above ground advising on high voltage. Once stringing is complete, anti-climbing devices will be placed on all faces of the tower. Also before the activation of the transmission line, a public announcement regarding operations of the transmission line will be made to the inhabitants in the vicinity.

2.3.2 Major Equipment and Materials Required During Construction

Equipment and materials necessary for the construction of the transmission line is listed in ***Table 2.5.***

Table 2.5 Equipment and Materials Required

SN	Activity	Requirements
	Foundation of Towers	
1		Stubs of towers
2		Stub setting templates
3		Stub setting jacks
4		Form boxes for concreting, wooden planks for shuttering
5		Concrete Mixer machines, vibrator, dewatering pumps
6		Sand, cement and stone chips
7		Metal screens/ sand screens etc and other related tools/ tackles for excavation/ concreting and backfilling
	Erection of Towers	
1		Tower steel members with nuts and bolts and various tower accessories
2		Derrick poles for lifting of tower members
3		Poly propylene ropes for guying purposes
4		Various single sheave pulleys and other related tools/ tackles for tower erection
	Stringing of Conductor and Earth wire	
1		Conductor and earth wire drums
2		Insulator discs, hardware fillings and accessories
3		Tensioner and puller machine for stringing purposes
4		Turn table and drum mounting jacks
5		Pilot wires for "paying off" conductor and earthwire
6		Hydraulic compressor machine for making joints of conductor and earthwire
7		Various four sheave pulleys, rollers, clamps, wire ropes, etc and other related tools and tackles for stringing purposes

Tractors trailers will be used for movement of the above listed equipment and materials across the fields.

2.3.3 Manpower Requirements during Construction

The maximum number of persons required for construction of transmission line will be:

- Casting of foundation: 40 to 50 workers
- Erection of Tower: 25 to 30 workers

- Stringing: 50 workers

The number of workers may vary depending on the type of terrain.

2.3.4 Vehicular Access Requirements

As far as possible, access to tower sites will be via existing roads and tracks. In some cases temporary roads might have to be created in order to access the tower site. These roads will not be graded and some of them would be retained for maintenance activity in future.

2.3.5 Provision of Accommodation of Construction Workforce

Unskilled workforce will be deployed by the Contractors from time to time from the local area as and when required. Skilled workers will however, be resourced from outside the area. This workforce will be stationed in rented accommodation in areas close to project office/village.

2.4 OPERATION AND MAINTENANCE

The transmission line will be operated and maintained by ADHPL following completion of the construction works. The details of operation and maintenance are as provided.

2.4.1 Operation Details

The 220 kV D/C Allain Duhangan- Nalagarh Transmission Line will connect 220 kV switchyard of ADHEP at Prini with the existing 400/220 kV sub-station (of PGCIL) at Nalagarh. The control rooms of the sub-stations will be managed by qualified & experienced engineers round the clock.

When starting the AD Hydro Electric Plant from cold condition (starting condition), the line will be back charged on 220 kV by closing the Circuit Breakers, Isolators etc. at 400/ 220 kV Nalagarh sub station, which is connected with the Northern Grid. Thus, 220 kV back voltage will be available at Prini Switchyard. The generating machines at ADHEP will be synchronized with this 220 kV (back voltage) at Prini switchyard. Thus, the Plant will be connected to feed power into Northern Grid.

2.4.2 Maintenance

ADHPL will undertake a regular maintenance and monitoring programme for the transmission line which comprises of:
- Preventive measures and;
- measure for breakdown

Preventive maintenance

The following preventive checks are planned to be carried out periodically along the transmission line:

- Pruning of trees /branches along the corridor/right of way i.e. 35 m for maintaining adequate electrical clearances.
- Visual inspections of (through binoculars)
    - insulators & hardware fittings
    - conductor and ground wire, and their accessories such as vibration dampers, compression joints, repairs sleeves etc.
    - hot spots at night hours
    - missing towers members (if any), nuts, bolts etc.
- Measurement of earth footing resistance for all towers periodically & taking necessary action by improving earthing arrangements as per site conditions in case of earth footing resistance is more than 10 ohms;
- Checking of anti climbing device, phase plate, number plate, circuit plate, danger plate;
- Checking of corrosion on tower members, tower earthing etc and taking necessary actions for Aluminium oxide painting;
- Checking of foundation chimneys, coping etc.;
- Checking of adequate conductor clearances at important crossings, conductor creep etc.

Break down Maintenance

The breakdown maintenance will include the following:

1) Patrolling of entire route length to check

a) Conductor / Ground wire breakage;
b) Phase to phase or phase to ground fault occurrence;
c) Trees / branches touching the 220 kV line conductors;
d) Insulator breakage / failure causing earth fault;
e) Tower collapse due to landslide etc.;

2) Rectification of fault as per causes 1 (a to e) above.

3 LEGISLATIVE REQUIREMENTS APPLICABLE TO THE TRANSMISSON LINE

3.1 INTRODUCTION

This section highlights the environmental and social regulations applicable to the proposed transmission line project. The section broadly focuses on:

- Institutional Framework;
- Constitutional provisions safeguarding individual rights and the environment;
- Environmental Laws, Regulations and Policy
- Social Laws, Regulations and Policy
- Applicable Permits – Licences, approvals and Consents
- Equator Principles – requirement and compliance;
- Applicable Standards;
- Applicable International Conventions/Protocols; and
- ADHPL's Groups Environment Policy.

Primary legislations in India are in the form of Acts, which provide a framework for environmental protection and control. The regulatory framework identifies the key institutions and departments that have a role to play in environment management of the country and state and also describes the laws and policies that govern environmental management and may be applicable to the project. The description given in this section will be helpful in identifying regulatory agencies for effective implementation of the Environment Management Plan.

3.2 INSTITUTIONAL FRAMEWORK - ENFORCEMENT AGENCIES

A brief description of the relevant enforcement agencies with respect to the institutional framework is described in the following sub-sections.

3.2.1 *Ministry of Environment and Forests*

The Ministry of Environment and Forests (MoEF) is responsible for the environment. The specific functions of MoEF are as follows:

- Environmental policy planning;
- Effective implementation of legislation;
- Monitoring and control of pollution;
- Environmental Clearances for industrial and development projects covered under EIA notification;
- Promotion of environmental education, training and awareness; and
- Forest conservation, development, and wildlife protection.

The MoEF is responsible for the implementation and enforcement of the Environment Protection Act, 1986, and Rules issued under the Act, including

the EIA notification. Under sections 3 and 5 of the EP Act, 1986, it retains enormous powers to issue directions in the interests of environment protection.

3.2.2 Central Pollution Control Board

The Central Pollution Control Board (CPCB) has been created for the control of water, air and noise pollution, land degradation and hazardous substances and waste management.

The CPCB was established in September 1974, for the purpose of implementing provisions of the Water (Prevention and Control of Pollution) Act, 1974. The executive responsibilities for the industrial pollution prevention and control are primarily executed by the CPCB at the Central level, which is a statutory body, attached to the MoEF. The specific functions of CPCB are as follows:

- Prevent pollution of streams and wells;
- Advise the Central Government on matters concerning prevention, control and abatement of water and air pollution;
- Co-ordinate the activities of State Pollution Control Boards and provide them with technical and research assistance;
- Establish and keep under review quality standards for surface water, groundwater and ambient air quality; and
- Planning and execution of national programme for the prevention, control and abatement of pollution through the Water and Air Acts.

The CPCB is responsible for the overall implementation and monitoring of air and water pollution control under the Water Act, 1974, and the Air Act, 1981.

3.2.3 Himachal Pradesh Pollution Control Board (HPPCB)

The Himachal Pradesh State Pollution Control Board (HPPCB) was constituted to control pollution from any activities in the States. HPPCB also provides advisory support to the Department of Environment in the States on Environmental Policy matters. The HPPCB implements and enforces the policies of the Department of Environment in addition to those formulated by the MoEF. The specific functions of HPPCB are as follows:

- Planning and execution of state wide programmes for prevention, control and abatement of water and air pollution;
- Advise the State Government on prevention, control and abatement of water and air pollution and siting of industries;
- Ensure compliance with the provisions of relevant environmental legislation;
- Establish and review local effluent and emission standards;
- Ensure legal action against defaulters; and
- Develop cost effective methods for treatment, disposal and utilisation of effluent.

3.2.4 *Himachal Pradesh Department of Forests and Environment*

The Department is a Nodal Department for dealing with forest and environmental management of the State. The department promotes environment conservation activities such as recycling of solid and liquid wastes, bio composting, rainwater harvesting, tree planting, etc.

The department is also responsible to formulate State Environment Impact Assessment Authority (SEIAA) for appraising projects falling under B1 category of the new EIA notification prior to assigning environmental clearance to such projects.

Chief Conservator of Forests (CCF) is responsible for forest related management in the State. CCF is supported by Divisional Forest Officers for all matters related to diversion of forestland and management of forest in the divisions within the State.

Department of Wildlife is managed by Chief Wildlife Warden of the State who is supported by Wildlife Wardens and Rangers for management and upkeep of wildlife in the State.

3.2.5 *Petroleum and Explosives Safety Organisation (PESO)*

The PESO is under the Department of Industrial Policy & Promotion, Ministry of Commerce & Industry, Government of India. The Chief Controller of explosives is responsible to deal with provisions of

- The Explosive Act 1884 and Rules, 1983,
- The Petroleum Act 1934 and the Rules 2002,
- The Static and Mobile pressure vessels {Unfired} Rules, 1981 and amendment 2000, 2004;
- Manufacture, Storage and Import of Hazardous Chemical Rules, 1989 and amendment 2000.

The use of any explosives during excavation in rocky area for setting up transmission towers foundations requires prior approval from PESO.

3.2.6 *Transport Departments, Government of HP*

Transport Departments is established for enforcement of the provisions of the Central Motor Vehicles Act, 1988 and Rules, 1989. Transport Department is responsible for management of traffic on roads and compliance of requirement for freight of hazardous goods including (flammable hazardous petroleum products) as per safety codes and safety requirements as laid down in Central Motor Vehicles Rules.

3.2.7 *HP State Electricity Board*

HP State Electricity Board was formed in the year 1971 in accordance with the provisions of Electricity Supply Act, 1948. The board performs functions of

generation, execution of hydro electric projects, power supply and distribution to consumers.

3.2.8 District Administration for Acquisition of Land

Any land acquisition, if any under the Land Acquisition Act, 1894 for the proposed transmission line purposes will be regularised by the State government through district collector's office.

3.3 APPLICABLE ENVIRONMENTAL AND SOCIAL LEGISLATIONS & POLICIES

Table 3.1 Applicable Environmental Laws and Regulations

S.N.	Issues	Applicable Legislation	Agency Responsible	Applicable Permits and Requirement
1	Protection and improvement of Natural Environmental Resources	Article 51-A Clause (g) of the & Directive Principles of State Policy (Article 47)	• Every Citizen of India	• Article 51-A of the Constitution of India states that it will be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for all living creatures. • Article 47 of the Constitution of India requires not only a Protectionist stance by the state but also compels the state to seek the improvement of polluted environments
2	Environmental Protection	The Environment (Protection) Act 1986, as amended in April 2003; EPA Rules 1986, as amended in 2002;	• HPPCB • MoEF • CPCB	• Compliance under the rules to maintain stipulated standards and environmental management through various supporting rules promulgated under the Act.

S.N.	Issues	Applicable Legislation	Agency Responsible	Applicable Permits and Requirement
3	Diversion of Forest land	The Forest (Conservation) Act (FCA), 1980 as amended in 1988 and revised Rules, 2003 (in suppression of FC Rules of 1981) require prior Forest Clearance from Central and State Government depending upon type and extent of forestland. Under the Act, an Advisory Committee advises GoI for grant/rejection of Forest Clearance and matters connected with conservation of forests.	• MoEF, • State Department of Forests	• The stretch of transmission line passing through forest area will require prior Forest Clearance from MoEF and HP State Department of Forest.and • Compliance of stipulated conditions including catchment area treatment plan and compensatory afforestation
4	Private Forest land and cutting of trees	The Himachal Pradesh Private Forest Act 1954 & The Himachal Pradesh Forest (Sale of Timber) Act 1968 The Act notifies all land other than agricultural or existing forest land as private forest and regulates cutting down of trees without prior approval.	• State Department of Forests	• Cutting of trees will be required for construction of towers. • ADHPL to seek prior approval from Zonal Forest Office prior to cutting of tree in any kind of land use.
5	Disturbance to Wildlife	Wildlife (Protection) Act, 1972 The Act inter-alia deals with prohibition of hunting of wild animals except in certain cases; protection of specified plants; declaration and protection of sanctuaries; restrictions on entry in sanctuary; prohibition on destruction in sanctuary except under a permit; declaration of national parks; power of Central Government to declare areas as sanctuaries or national parks; regulations for trade and commerce in wild animals, animal articles and trophies; prohibition of dealings in trophy and animal articles without a licence; forfeiture of property derived from illegal hunting and trade; penalties for contravention; etc.	• State Department of Forests • Wildlife Warden	• The Act primarily deals with regulating or prohibiting activities inside a National Park or Sanctuary. • The Transmission line does not pass through any Wildlife Protected Area (National Park/ Sanctuary). • Necessary precautions will be required for any area sheltering scheduled wildlife under the Act.

S.N.	Issues	Applicable Legislation	Agency Responsible	Applicable Permits and Requirement
6	Land acquisition	The Land Acquisition Act,1894 The Act provides for notification for affected land, notification for payment for damages, hearing of objections, declaration of the intended acquisition, enquiry into measurement, values and claims & award and finally taking possession of the land.	• Local Administration - District Collector • Revenue Officer	• The transmission line will not acquire any private Land through LA Act, 1894. • The project will pay compensation for the hindrance to access (opportunity cost) of land used for tower legs and the damage to the crops as agreed with local administration.
7	General Safety	The Electricity Act, 2003 including rules 1956 and 2005 The Rules specify the general safety requirements for construction, installation, protection, operation and maintenance of electricity supply lines and apparatus. It also contains general conditions relating to supply and use of energy, the requirements for electricity supply lines, systems and apparatus for low, medium, high and extra-high voltages. It specifies the requirements for overhead lines, underground cables and generating stations, including material strength, factors of safety, clearances required above the ground for the lowest conductor, clearances from buildings of low, medium, high and extra-high voltage lines and service lines; as well as conditions for transporting and storing of material near overhead lines.	• State Electricity Board	• The transmission line to be laid as per the standards prescribed under the electricity rules.

S.N.	Issues	Applicable Legislation	Agency Responsible	Applicable Permits and Requirement
8	Disturbance to telegraph lines	Indian telegraph Act,1885 The Act empowers the Telegraph authorities to use the land / property for telegraph lines without having any ownership or right in the property even for the land occupied by the telegraph line supports or belts covered by overhead wires and the only obligation of the telegraph authority is to compensate for the actual loss / damage to the owner for the property.	• State Department of Telegraph – Communication	• The project will take all reasonable precautions to avoid any negative affect on the telegraphic or telephonic signalling communication either through induction or any other work during laying or operation of transmission line.
9	Prevention and Control of Water Pollution	The Water (Prevention and Control of Pollution) Act, 1974, amended in 1988	• HPPPCB	• Consent for Establishment in case of setting up a camp site wherein sewage is expected to be generated and disposed of during project construction phase. • The project has reportedly, resorting labour mainly from the local sources and no significant sewage generation is expected. • ADHPL to ensure that any construction contractor setting up a labour camp takes Consent to Establish/NOC prior to its set up.
10	Prevention and Control of Air Pollution	The Air (Prevention and Control of Pollution) Act, 1981, amended in 1987. (Movement of vehicles, excavation of pits for tower erection, operation of diesel generators for power at campsite or other construction activities).	• HPPCB	• Consent for Establishment in case of setting up a camp site requiring power generation through diesel generators during project construction phase. • The project has reportedly, resorting labour mainly from the local sources and no emissions from diesel generators are expected.

S.N.	Issues	Applicable Legislation	Agency Responsible	Applicable Permits and Requirement
11	Noise Emissions	The Noise (Regulation & Control) Rules, 2000 as amended in October 2002 As per the Environment (Protection) Act (EPA) 1986 the ambient noise levels are to be maintained as stipulated by the Central Pollution Control Board (CPCB) for different categories of areas like, commercial, residential and silence zones etc	• HPPPCB • District administration	• There will be generation of Noise during the erection of transmission line due to construction activities. • Compliance under the rules to maintain stipulated standards
12	Hazardous Wastes Management	Hazardous Wastes (Management and Handling) Rules+, 1989 and amendment Rules 2000 and 2003 under the Environment (Protection) Act, 1986	• HPPCB	• Authorisation for collection, reception, storage, transportation and disposal of hazardous wastes. • The project will be using Aluminium Oxide Paint for maintenance of tower structures. The empty paint containers will constitute hazardous waste for which ADHPL will require prior authorisation from HPPCB for its disposal. • Filing of annual return under Form 4 to the rules • Other compliance under the rules • Authorisation by Central Pollution Control Boards to vendors accepting waste/used oil • The occupier and operator of a facility will also be liable to reinstate or restore damaged or destroyed elements of the environment; • The occupier and operator of a facility will be liable to pay a fine as levied by the HPPCB with the approval of the CPCB for any violation of the provisions under these rules.

S.N.	Issues	Applicable Legislation	Agency Responsible	Applicable Permits and Requirement
13	Surface Transportation	The Motor Vehicles Act 1988, as amended by Motor Vehicles (Amendment) Act 2000, dated 14th August 2000 The Central Motor Vehicles Rules 1989, as amended through 20th October 2004 by the Central Motor Vehicles (Fourth Amendment) Rules 2004.	• Ministry of Road Transport and Highways • State Transport Authority	• Compliance of stipulated standards under rule 115 • Display of emergency information panel by vehicles carrying hazardous substances as per Rule 134 • Other environmental and safety compliance under the rules
14	Storage and use of Explosives and or Petroleum products	The Explosive Act 1884 and Rules, 1983 The Petroleum Act 1934, The Petroleum Rules 1976, as amended in March 2002.	• PESO (Chief Controller of Explosives)	• Licence for use and storage of explosives required for excavation of rocky structures for tower erection during construction phase. • No use of petroleum products is reportedly required by the project.

Specific provisions of some of the above mentioned legislative requirements are discussed in the following subsections:

3.3.1 Constitutional Provisions Safeguarding Individual Rights and Environmental Provisions

In India environmental and community relations are governed by the 'intent of law' apart from specific acts and regulations. Any facility / business operations/ corporate/ private/ public sector units can be held accountable for its impact on the larger community based on the interpretation of certain constitutional safeguards and provisions. The Constitution of India guarantees every citizen the fundamental right to life and personal liberty. The fundamental *Right to Life* is guaranteed under *Article 21* that states "No person shall be deprived of his life or except according to the procedure established by law". *Article 21* has been used by the courts in a number of judgements, dealing with a range of social and environmental issues and has constantly progressed to include a number of rights, which interpret the "right to life". These include the 'right to food, water, clothing, environment, education, medical care and shelter.'

The Article 48-A of the Constitution of India states that the State shall endeavour to protect and improve the environment and to safeguard the forest and wild life of the country. At the same time, it shall be the fundamental duty of every citizen of India under Article 51-A (g) of the Constitution of India, to protect and improve the natural environment including forests, lakes, rivers and wild life, and to have compassion for living creatures.

Constitutional Provisions Protecting Tribes and Extending Special Status

The Constitution of India identifies certain groups/communities as tribal groups and lays out special provisions for such group with the objective of promoting and safeguarding the social, educational and economic interests of the Schedules Tribes. The President is empowered to specify, after consultations with the Governor of a state "tribes or tribal communities" to be listed under the Schedules tribe list. In conjunction with this certain areas have been declared as "Scheduled Areas" in the constitution. Thus the specification of Scheduled Areas in relation to a particular State/Union Territory is by a notified Order of the President, after consultation with the State Governments concerned. Regulations are framed under the Fifth schedule of the Constitution to prevent the exploitation of tribals by non-tribals and alienation of agricultural land of tribals being passed on to non-tribals. The Constitutional provisions (fifth schedule and article 224) empower the governor of a state to regulate and make regulations for Scheduled Areas and Scheduled Tribes.

Judicial remedy under the Constitution of India through Public Interest Litigations

Public Interest Litigation (PIL) has become one of the most important tools of legal aid and has served to bring justice in cases involving social and environmental concerns. Under a PIL, any public-spirited individual or group can move the court of law (under *Article 226* of the Constitution for High Courts, and *Article 32* for the Supreme Court) in case of breach of any fundamental right, to seek judicial redressal. The PIL is a form of writ petition, which can be filed by anybody, even if he or she is not directly affected by the perceived injustice. This has enabled environmentally conscious, public-spirited individuals or groups, which are not an aggrieved party, to have easy access to the highest court of the nation.

Indian courts are taking an increasingly aggressive stance towards defaulters and the legal system is moving towards the principle of 'polluter pays'.

3.3.2 National Environmental Policy 2006

Government of India has recently released the National Environment Policy, 2006. The present national policies for environmental management are contained in the National Forest Policy, 1988, the National Conservation Strategy and Policy Statement on Environment and Development, 1992; and the Policy Statement on Abatement of Pollution, 1992. Some sector policies such as the National Agriculture Policy, 2000; National Population Policy, 2000; and National Water Policy, 2002; have also contributed towards environmental management. All of these policies have recognized the need for sustainable development in their specific contexts and formulated necessary strategies to give effect to such recognition.

The dominant theme of this policy is that while conservation of environmental resources is necessary to secure livelihoods and well-being of all, the most secure basis for conservation is to ensure that people dependent on particular

resources obtain better livelihoods from the fact of conservation, than from degradation of the resource.

The policy describes seven objectives i.e. conservation of critical environmental resources, inter and intra-generation equity, integration of environmental concerns in economic and social development, efficiency in environmental resource use, environmental governance and enhancement of resources for environmental conservation. These objectives are to be realized through various strategic interventions by different public authorities at Central, State, and Local Government levels. The strategic interventions are premised diverse principles.

3.3.3 *Forest (Conservation) Act, 1980 and Rules, 2003*

The Forest (Conservation) Act (FCA), 1980 as amended in 1988 and revised Rules made there under in 2003 (in suppression of FC Rules of 1981) provide for prevention of diversion of any forestland for non-forest purposes. In all such cases, prior approval is required from Central and State Government depending upon type and extent of forestland required for non-forest purposes. Under the Act, an Advisory Committee advises GoI for grant of approval and other matters connected with the conservation of forests.

As per Rule 6 of the Forest (Conservation) Rules, 2003, every user agency, who wants to use any forest land for non-forest purposes shall make his proposal in the appropriate Form appended to these rules, i.e. Form 'A' for proposals seeking first time approval under the Act and Form 'B' for proposals seeking renewal of leases where approval of the Central Government under the Act had already been obtained earlier, to the concerned nodal officer authorized in this behalf by the State Government, along with requisite information and documents, complete in all respects, well in advance of taking up any non-forest activity on the forest land.

3.3.4 The Environment (Protection) Act; 1986 and Environment (Protection) Rules 1986 and amendments

This Act is an umbrella legislation that provides a single focus for the protection of the environment. Several sets of Rules and notifications are promulgated under the E(P) Act ranging from approvals required for a new development project to those required for environmental management during their operation phases. The salient provisions of the Act include but not limited to the following:

- Restrict or prohibit industries, operations or processes in specified areas;
- Undertake environmental impact assessment for certain categories of industries to inform the decision making in approval of new or expansion projects;
- Restrict or prohibit handling of hazardous substances in specified areas;
- Protect and improve the quality of the environment and prevention, control and abatement of environmental pollution;

- Lay down standards for the quality of the environment, emissions or discharges of environmental pollutants from various sources;
- Lay down procedures and safeguards for the prevention of accidents, which may cause environmental pollution;
- Bar on filling of any suit or legal proceedings against the Government or officials empowered by it for action taken in good faith, in pursuance of the Act; and
- Bar of jurisdiction to Civil Court to entertain any suit or proceedings in respect of anything done, action taken or directions issued by the Central Government or any other authority empowered by it, in pursuance of the Act.

3.3.5 The Indian Telegraph Act, 1885

The Indian Telegraph Act, 1885, empowers the Telegraph authorities to use the land / property for telegraph lines without having any ownership or right in the property even for the land occupied by the telegraph line supports or belts covered by overhead wires and the only obligation of the telegraph authority is to compensate for the actual loss / damage to the owner fo the property. The relevant section of the Act is as under:

"The telegraph authority may, from time to time, place and maintain a telegraph line under, over, along or across, and posts in or upon, any immovable property:
Provided that:

(a) the telegraph authority shall not exercise the powers conferred by this section except for the purpose of a telegraph established or maintained by the Central Government or to be so established or maintained:
(b) the Central Government shall not acquire any right other than that of user only in the property under over along across in or upon which the telegraph authority places any telegraph line, or post;
(c) except as hereinafter provided, the telegraph authority shall not exercise those powers in respect of any property vested in or under the control or management of any local authority, without the permission of that authority;
(d) in the exercise of the powers conferred by this section, the telegraph authority shall do as little damage as possible, and when it has exercised those powers in respect of any property other than that referred.
(e) shall pay full compensation to all persons interested for any damages sustained by them by reason of the exercise of those powers."

The project proponent will have the same powers and authorities of the telegraph authorities through the provisions of Section 51 of the Indian Electricity Act, 1910.

3.3.6 The Electricity Act 2003

The sections of the Electricity Act, 2003 that are relevant for laying (and repairs) of transmission line for the supply of energy are described as following:

- *Section 67* details the provisions (a) to open and break up the soil and pavement of any street, railway or tramway; (b) to open and break up any sewer, drain or tunnel in or under any street, railway or tramway; (c) to alter the position of any line or works or pipes, other than a main sewer pipe; (d) to lay down and place electric lines, electrical plant and other works;(e) to repair, alter or remove the same; (f) to do all other acts necessary for transmission or supply of electricity.
- Section 159 describes that no person shall be engaged in the generation, transmission, distribution, supply or use of electricity, in any way injure any railway, highway, airports, tramway, canal or water-way or any dock, wharf or pier vested in or controlled by a local authority, or obstruct or interfere with the traffic on any railway, airway, tramway, canal or water-way.
- Section, 160(1) describes that every person generating, transmitting, distributing, supplying or using electricity (hereinafter in this section referred to as the "operator") shall take all reasonable precautions in constructing, laying down and placing his electric lines, electrical plant and other works and in working his system, so as not injuriously to affect, whether by induction or otherwise, the working of any wire or line used for the purpose of telegraphic, telephone or electric signalling communication, or the currents in such wire or line.
- *Section 34* describes that every transmission licensee shall comply with such technical standards, of operation and maintenance of transmission line, in accordance with the Grid Standards, as may be specified by the Authority.
- Section 53 (1) describes that the Authority may in consultation with the State Government, specify suitable measures for –(a) protecting the public (including the persons engaged in the generation, transmission or distribution or trading) from dangers arising from the generation, transmission or distribution or trading of electricity, or use of electricity supplied or installation, maintenance or use of any electric line or electrical plant; (b) eliminating or reducing the risks of personal injury to any person, or damage to property of any person or interference with use of such property ; (c) prohibiting the supply or transmission of electricity except by means of a system which conforms to the specification as may be specified; (d) giving notice in the specified form to the Appropriate Commission and the Electrical Inspector, of accidents and failures of supplies or transmissions of electricity; (e) keeping by a generating company or licensee the maps, plans and sections relating to supply or transmission of electricity; (f) inspection of maps, plans and sections by any person authorised by it or by Electrical Inspector or by any person on payment of specified fee; (g) specifying action to be taken in relation to any electric line or electrical plant, or any electrical appliance under the control

of a consumer for the purpose of eliminating or reducing a risk of personal injury or damage to property or interference with its use;

- Section 165 (1) In section 40, sub-section (1) of clause (b) and section 41, subsection (5) of the Land Acquisition Act, 1894, the term "work" shall be deemed to include electricity supplied or to be supplied by means of the work to be constructed. (2) The Appropriate Government may, on recommendation of the Appropriate Commission in this behalf, if it thinks fit, on the application of any person, not being a company desirous of obtaining any land for its purposes, direct that he may acquire such land under the provisions of the Land Acquisition Act, 1894 in the same manner and on the same conditions as it might be acquired if the person were a company.

3.3.7 Social Policy & Regulatory Framework

The social regulatory framework in India draws more from the 'intent of law', landmark judgements and policy statements rather than Acts or Laws. In context with development and operation of the policies, judgements and regulations (including state and local) are mainly related to land acquisition, resettlement rehabilitation and special rights/ protection extended to scheduled castes/tribes.

Land Acquisition, Resettlement & Rehabilitation

The more significant project impact on the local community is the acquisition of land for project purposes and the subsequent project induced displacements in some cases. Land acquisition in India is covered by a national law, the 1894 Land Acquisition Act (LAA) and its subsequent amendments. The LAA allows for land acquisition in the national interest to be carried out by the respective States, in accordance with its provisions. The LAA lays down procedures for acquisition of land, including notification, payment for damages, hearing of objections, declaration of the intended acquisition, enquiry into measurement, values and claims and award by the competent authority and finally taking possession of the land:

- Preliminary notification for land proposed for acquisition
- Clearing of objection within 30 days of the notification and the provision for hearing of all objections;
- Declaration of intended acquisition award;
- Reference to court if award is not accepted and hearing in court;
- Apportionment of compensation and dispute settlement regarding the same;
- Payment of compensation for land value, trees and structures including 30% solatium and 12% p.a. interest for delayed payment;
- Temporary Occupation of Land; and
- Acquisition for companies.

National Policy for Resettlement and Rehabilitation 2007

The National Policy for Resettlement and Rehabilitation 2007 and associated measures aim at striking a balance between the need for land for developmental activities and, at the same time, protecting the interests of the land owners, and others, such as the tenants, the landless, the agricultural and non-agricultural labourers, artisans, and others whose livelihood depends on the land involved. The benefits under the new Policy shall be available to all affected persons and families whose land, property or livelihood is adversely affected by land acquisition or by involuntary displacement of a permanent nature due to any other reason, such as natural calamities, etc. The Policy will be applicable to all these cases irrespective of the number of people involved.

The benefits to be offered under the new Policy to the affected families include; land-for-land, to the extent Government land would be available in the resettlement areas; preference for employment in the project to at least one person from each nuclear family within the definition of the 'affected family', subject to the availability of vacancies and suitability of the affected person; training and capacity building for taking up suitable jobs and for self-employment; scholarships for education of the eligible persons from the affected families; preference to groups of cooperatives of the affected persons in the allotment of contracts and other economic opportunities in or around the project site; wage employment to the willing affected persons in the construction work in the project; housing benefits including houses to the landless affected families in both rural and urban areas; and other benefits. Adequate provisions have also been made for financial support to the affected families for construction of cattle sheds, shops, and working sheds; transportation costs, temporary and transitional accommodation, and comprehensive infrastructural facilities and amenities in the resettlement area including education, health care, drinking water, roads, electricity, sanitation, religious activities, cattle grazing, and other community resources, etc.

The benefits expressed in monetary terms have been linked to the Consumer Price Index, and the same shall also be revised suitably at appropriate intervals.

The Requiring Bodies shall be responsible for development of designated areas on the periphery of the project site, and shall earmark funds for the purpose of such periphery development activities.

A special provision has been made for providing life-time monthly pension to the vulnerable persons, such as the disabled, destitute, orphans, widows, unmarried girls, abandoned women, or persons above 50 years of age (who are not provided or cannot immediately be provided with alternative livelihood).

Special provision for the STs and SCs include preference in land-for-land for STs followed by SCs; a Tribal Development Plan which will also include a programme for development for alternate fuel which will also include a

programme for development for alternate fuel and non-timber forest produce resources, consultations with Gram Sabhas and Tribal Advisory Councils, protection of fishing rights, land free-of-cost for community and religious gatherings, continuation of reservation benefits in resettlement areas, etc.

A strong grievance redressal mechanism has been prescribed, which includes standing R&R Committees at the district level, R&R Committees at the project level, and an Ombudsman duly empowered in this regard. The R&R Committees shall have representatives from the affected families including women, voluntary organisations, Panchayats, local elected representatives, etc. Provision ahs also been made for post-implementation social audits of the rehabilitation and resettlement schemes and plans.

The key changes that have been proposed in the policy of 2007 include:

- It includes displacement for any reason, unlike the 2003 policy that focused on displacement due to land acquisition;
- The minimum number of people being displaced to trigger the policy has been reduced both in plains and in the hills, tribal areas and DDP blocks. Now the NPRR will get triggered if there are more than 400 families getting displaced in plain areas and more than 200 in hills and DDP areas;
- It will be mandatory for the Requiring Body to prepare a Social Impact Assessment (SIA);
- SIAs will go through a clearance process similar to the Environmental Clearance process, and public hearings will include social impact issues and, where the EC process does not require a Public Hearing, a separate hearing for the SIA will be held;
- Draft resettlement and rehabilitation plans need to be discussed in the gram sabha in rural areas and through public hearings in urban and rural areas without gram sabhas; and
- Provision of shares, cash benefits, employment, pensions etc to the affected family as a part of the rehabilitation grant, if the Requiring Body is a corporate organization/company

3.3.8 Labour Laws

There are several laws and rules that govern labour issues in India. The issues covered include:

a) Child Labour

The Constitution of India (Part III, Fundamental Rights No 24) describes that no child below the age of fourteen years shall be employed to work in any factory or engaged in any other hazardous employment

b) The Child Labour (Prohibition and Regulation) Act, 1986

A child is defined as a person who has not completed 14years of age. The Act prohibits employment of children in certain occupation and processes (part II, Section 3). The Act also specifies conditions of work for children, if permitted

to work. These include a working day of maximum of 6 hours a day (including rest), no work period exceeding 3 hours at a stretch, and no overtime (Section 7). The Act requires maintenance of a register for employed children (Section 11).

c) Forced Labour

Constitution of India (Part III, Fundamental Rights No 23): Right against Exploitation

The Bonded Labour (Abolition) Act 1976: States that all forms of bonded labour stands abolished and every bonded labourer stands freed and discharged from any obligations to render any bonded labour (Ch II, Section 4)

d) Freedom of Association

The Trade Union Act, 1926: Provides procedures for formation and registration of Trade Unions and lists their rights and liabilities. It encompasses any combination, permanent or temporary, that gets formed to regulate relationship between workmen and their employers.

e) Wages

Minimum Wages Act, 1948 requires the Government to fix minimum rates of wages and reviews this at an interval of not more than 5 years. The Payment of Wages Act, 1936, amended in 2005. Every employer shall be responsible for the payment to persons employed by him of all wages required to be paid under this Act.

As per the Equal Remuneration Act 1976, it is the duty of an employer to pay equal remuneration to men and women workers for same work or work of a similar nature.

f) Compensation

Workmen's Compensation Act, 1923 requires if personal injury is caused to a workman by accident arising out of and in the course of his employment, his employer shall be liable to pay compensation in accordance with the provisions of this Act.

g) Welfare and working conditions

As per the Maternity Benefit Act, 1961 no employer shall knowingly employ a woman in any establishment during the six weeks immediately following the day of her delivery or her miscarriage. No pregnant woman shall, on a request being made by her in this behalf, be required by her employer to do during the period any work which is of an arduous nature or which involves long hours of standing, or which in any way is likely to interfere with her

pregnancy or the normal development of the foetus, or is likely to cause her miscarriage or otherwise to adversely affect her health.

Other Acts include:

- The E.P.F. and Miscellaneous Provisions act, 1952
- Payment of Bonus Act, 1965
- Payment of Gratuity Act, 1972
- Public Provident Fund Act, 1968
- ESI Act , 1948 (Employees State Insurance Act, 1948)

Rules include:

- Contract Labour (Regulation & Abolition) Central Rules, 1971
- Industrial Disputes (Central) Rules, 1957
- Minimum Wages (Central) Rules, 1950
- Payment of Bonus Rules, 1975

3.3.9 Consultations and Public Disclosure

This section reviews the national laws, policies, regulations pertaining to consultations and disclosure with respect to land acquisition and environmental impacts in India and IFC requirements.

Land Acquisition Act

At every stage of the land acquisition process there is adequate flow of communication by virtue of publication of various notifications, declarations, notices etc in the Government Gazette, local press, local areas etc. This ensures provision of timely and reasonable opportunity to all the interested persons to claim rights and compensation.

At the first level the method is transparent and also provides for due opportunities to all the concerned before the determination of the quantum of compensation and the persons entitled to receive it. At the second level the method provides for redressal of any grievance arising out of the aforesaid first level determinations. An aggrieved person can seek reference to the court to look into the grievances concerning the measurement of the land, the amount of compensation, eligibility to receive compensation, apportionment of compensation amongst the interested persons etc.

The Land Acquisition Act, 1894 initially stated that a notification for land acquisition would have to be issued under Section 4(1) indicating the intention of the Government to acquire land or other property in official gazette. However, the 1984 amendment requires the Section 4 (1) notification to be also published in two local newspapers, of which at least one should be in a regional language. In addition to the public notice, the substance of such notification made by the Collector has to be made available at convenient places in the locality where the land is situated. Compensation for the land acquired has to be paid on the basis of market value as on the data of notification under Section 4 (1).

This notification gives the affected/interested parties an opportunity to file objections before the Collector. In case any objection is filed, Collector has to arrange for an oral hearing and thereafter submit a report to the concerned Government department. If the Government after reviewing the objections and responding to it wishes to go ahead with the Land Acquisition, it has to make a declaration under section 6 of the Act. The declaration under section 6 has to be published in a similar manner as Section 4(1).

3.4 APPLICABLE PERMITS – LICENCES, APPROVALS AND CONSENTS

Table 3.2 List of permits obtained for the transmission line erection and its operation

Sl.No.	Govt./Govt. Agency	Order/Authorisation issued by the Govt./ Govt. Agency	Remarks
1	Govt. of Himachal Pradesh	Implementation Agreement signed on 22.2.2001	Implementation Agreement for entire project
2	Govt. of Himachal Pradesh	Gazette Notification of HP Govt. dated 11.9.2001	For entire project.
3	HPSEB	DPR approved by HPSEB and forwarded vide its letter dated 1.2.2002 to CEA.	DPR for entire project.
4	CEA	Techno Economic Clearance (TEC) given by CEA vide letter dated 20.8.2002	For entire project.
5	PGCIL	Open Access and Connectivity granted by PGCIL vide letter dated 26.4.2007	For Transmission Line
6	Ministry of Power, GOI	Permission under Section 68, Electricity Act vide letter dated 21.08.2007	For Transmission Line
7	Airport Authority of India	NOC dated 22.07.08 from Civil Aviation Authrity	For Transmission Line

3.5 INTERNATIONAL FINANCE CORPORATION'S PERFORMANCE STANDARDS ON SOCIAL & ENVIRONMENTAL SUSTAINABILITY

International Finance Corporation (IFC) applies the Performance Standards to manage social and environmental risks and impacts and to enhance development opportunities in its private sector financing in its member countries eligible for financing. The Performance Standards may also be applied by other financial institutions choosing to support them in the proposed project.

Together, the eight Performance Standards establish standards that the client is required to meet throughout the life of an investment by IFC or other relevant financial institution:

- Performance Standard 1: Social and Environmental Assessment and Management System;

- Performance Standard 2: Labour and Working Conditions;
- Performance Standard 3: Pollution Prevention and Abatement;
- Performance Standard 4: Community Health, Safety and Security;
- Performance Standard 5: Land Acquisition and Involuntary Resettlement;
- Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management;
- Performance Standard 7: Indigenous Peoples; and
- Performance Standard 8: Cultural Heritage.

These performance standards and guidelines provide ways and means to identify impacts and affected stakeholders and lay down processes for management and mitigation of adverse impacts.

3.6 EQUATOR PRINCIPLES – REQUIREMENT AND COMPLIANCE

The Equator Principles Financial Institutions (EPFIs) have adopted a set of principles in order to ensure that the projects they finance are developed in a manner that is socially responsible and reflect sound environmental management practices. These principles are intended to serve as a common baseline and framework for the implementation of each EPFI of its own internal social and environmental policies, procedures and standards related to its project financing activities. The signatory banks have principally committed to not providing loans to projects where the borrower will not, or is unable to, comply with the EP.

Project, with investment of US$10 million or more, seeking funding from Equator Principle Financial Institutions (EPFI) lenders require to comply with requirement of Equator Principles, July 2006. There are nine requirements under the Equator Principles for borrowers, and specific standards get defined by the International Finance Corporations (IFC) Performance Standards.

There are ten principles that include:

3.6.1 Principle 1: Review and Categorisation of the Project

Equator Principles Financial Institutions (EFPIs) are required to categorise projects according to the magnitude of its potential impacts based on the environmental and social screening criteria of IFC. Projects are designated as Category A, B or C when it represents, respectively, a high, medium or low level of risk as per the following understanding:

- Category A: Projects with potential significant adverse social or environmental impacts that are diverse, irreversible or unprecedented;
- Category B: Projects with potential limited adverse social or environmental impacts that are few in number, site-specific, largely reversible, and readily addressed through mitigation measures; or
- Category C: Projects with minimal or no adverse social or environmental impacts.

3.6.2 Principle 2: Social and Environmental Assessment.

For each project categorized as A or B, the borrower has conducted a social and environmental assessment to appropriately address social and environmental impacts and risks. The assessment should also propose mitigation and management measures.

3.6.3 Principle 3: Applicable Social and Environmental Standards.

For projects located in non-OECD countries the assessment will refer to the applicable IFC Performance Standards and applicable industry specific EHS guidelines. The assessment process should address compliance with the relevant host country laws, regulations, permits that pertain to social and environmental issues.

3.6.4 Principle 4: Action Plan and Management Plan.

For all category A and B projects located in non-OECD countries, the borrower has to prepare and Action Plan which addresses the relevant findings and draws on the conclusions of the Assessment. The AP will describe and prioritize the actions needed to implement the mitigation measures, corrective actions and monitoring measures necessary to manage the impacts and risks identified in the assessment. The borrower has to maintain a Social and Environmental Management System.

3.6.5 Principle 5: Consultation and Disclosure

All category A and as appropriate, category B projects, the project affected communities have been consulted and culturally appropriate manner. For projects with significant adverse impacts, the process will ensure their free, prior and informed consultation and facilitate their informed participation as a means to establish, to the satisfaction of the EPFIs, whether the project has adequately incorporated affected communities' concerns. For this purpose non-technical summaries will made available to the public by the borrower in the local language and in a culturally appropriate manner.

3.6.6 Principle 6: Grievance Mechanism.

For all category A projects, and where appropriate category B projects, the borrower will ensure that consultation, disclosure and community engagement continues through the construction and operation period, and as appropriate to the scale of impacts, the project will have a grievance mechanism as a part of the management system. This system will facilitate receiving and facilitating resolution of concerns and grievances about the project's environmental and social performance raised by the project affected communities;

3.6.7 Principle 7: Independent Review.

For all Category A projects, and as appropriate category B projects, an independent social or environmental expert, not directly associated with the borrower will review the assessment, AP and consultation process documentation in order to assist the EPFI's due diligence and assess EP compliance.

3.6.8 Principle 8: Covenants

It is important to incorporate covenants linked to compliance. For all category A and B projects, the borrower will covenant in financing documentation a) to comply with all host country laws; b) to comply with AP; c) to provide periodic reports to the EPFIs and d) to de-commission the facilities in accordance with a decommissioning plan.

3.6.9 Principle 9: Independent Monitoring and Reporting.

To ensure ongoing monitoring and reporting over the life of the loan, the EPFI will, for all category A projects, and as appropriate category B projects, require an independent environmental and /or social expert, or require that the borrower retain qualified and experienced external experts to verify its monitoring information which would be shared with the EPFIs.

3.6.10 Principle 10: EPFI Reporting

Each EPFI adopting the EP commits to report publicly at least annually about EP implementation processes and experience, taking into account appropriate confidentiality consideration.

3.7 APPLICABLE INTERNATIONAL CONVENTIONS

Transboundary environmental problems are those problems that migrate beyond the jurisdiction with the power to control that problem through international co-operation by either becoming a Contracting Party (CP) i.e. ratifying treaties or as a Signatory by officially signing the treaties and agreeing to carry out provisions of various treaties. The sub sections describe applicable International Conventions ratified and signed by India.

3.7.1 The Convention on Wetlands of International Importance Especially as Waterfowl Habitat, 1971 (Ramsar Convention).

This convention was signed by India in 1981 and ratified in February 1982. The convention requires protection of identified wetlands of international importance as identified under Ramsar convention.

3.7.2 Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), 1973.

India is signatory to CITES and is responsible for identification and protection of wild flora and fauna which are internationally as endangered.

3.7.3 Conventions on the Conservation of Migratory species of wild animals and migratory species

India is contacting party to the convention on conservation of migratory species of wild animals and migratory species.

3.7.4 Basel Convention

Basel convention was signed by India in March 1990 and ratified in June 1992. The import and export norms for the hazardous waste have been provided in conformance with the Basel Convention.

3.7.5 Kyoto Protocol

The Kyoto protocol was signed by India in August 2002 and ratified in February 2005. The convention pertains to the United Nations framework on Climate Change.

The 3rd Conference of the Parties to the Framework Convention on Climate Change (FCCC) in Kyoto in December 1997 introduced the Clean Development Mechanism (CDM) as a new concept for voluntary greenhouse-gas emission reduction agreements between industrialized and developing countries on the project level.

The proposed transmission line project together with the hydro power generation project becomes the basis for CDM mechanism.

3.8 APPLICABLE ENVIRONMENTAL STANDARDS

The Ministry of Environment and Forests (MoEF) has the overall responsibility to set policy and standards for the protection of environment in association with the Central Pollution Control Board (CPCB).

Ambient Air Quality

National Ambient Air Quality (NAAQ), as prescribed by CPCB vide Gazette Notification dated 11th April, 1994. The prescribed standards are given below in ***Table 3.3.***

Table 3.3 National Ambient Air Quality Standards

Pollutant	Concentration in Ambient Air (µg/m^3

	Time Weighted Avg.	Industrial Area	Residential, Rural & Other Areas	Sensitive Areas
Sulphur dioxide, SO_2	Annual Average*	80	60	15
	24 Hours**	120	80	30
Oxides of Nitrogen, NO_x	Annual Average*	80	60	15
	24 Hours**	120	80	30
Suspended Particulate SPM	Annual Average*	360	140	70
	24 Hours**	500	200	100
Respirable Particulate Matter, RPM (<10 μm)	Annual Average*	120	60	50
	24 Hours**	150	100	75
Lead, Pb	Annual Average*	1.0	0.75	0.50
	24 Hours**	1.5	1.0	0.75
Carbon monoxide, CO	8 Hours	5000	2000	1000
	1 Hour**	10000	4000	2000

Note: *Annual arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval. ** 24 hourly/8 hourly values should be met 98% of the time in a year. However 2% of the time, it may exceed but not on two consecutive days.

Water Quality Standards

The designated best use classification as prescribed by CPCB for surface water is as given:

Table 3.4 Primary Water Quality Criteria for Designated-Best-Use-Classes

Designated-Best-Use	Class	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	Total Coliforms OrganismMPN/100ml shall be 50 or less pH between 6.5 and 8.5 Dissolved Oxygen 6mg/l or more Biochemical Oxygen Demand 5 days 20°C 2mg/l or less
Outdoor bathing (Organised)	B	Total Coliforms Organism MPN/100ml shall be 500 or less pH between 6.5 and 8.5 Dissolved Oxygen 5mg/l or more Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	Total Coliforms Organism MPN/100ml shall be 5000 or less pH between 6 to 9 Dissolved Oxygen 4mg/l or more Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Propagation of Wild life and Fisheries	D	pH between 6.5 to 8.5 Dissolved Oxygen 4mg/l or more Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	pH between 6.0 to 8.5 Electrical Conductivity at 25°C micro mhos/cm Max.2250 Sodium absorption Ratio Max. 26 Boron Max. 2mg/l
	Below-E	Not Meeting A, B, C, D & E Criteria

Source: Central Pollution Control Board

Ambient Noise Standards

Noise standards notified by the MoEF vide gazette notification dated 14 February 2000 based on the *A* weighted equivalent noise level (L_{eq}) are as presented in ***Table 3.5.***

Table 3.5 Ambient Noise Standards

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

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

Noise Standards for Occupational Exposure

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

Table 3.6 Standards for Occupational Noise Exposure

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

Note:

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

Clearance of the Transmission Line from Ground and Various Structures

The clearance of conductor from utilities and ground is defined based on the voltage conducted by them. The minimum clearance requirement as provided in the Indian Electricity Rules 1956 is provided in the ***Table 3.7.***

*Table 3.7: The Minimum Clearances as per Indian Electricity Rules, 1956**

Voltage Category (IE Rules, 1956	High Voltage					Extra High Voltage		
Nominal System-Voltage	33kV	66kV	110kV	132kV	220kV	400kV	±500kV	800kV
Clearance			(Minimum Value in m)				HVDC	
(i) Clearance to Ground								
(a) Across Street	6.1	6.1	6.1	6.1	7.0	8.84	13.20	12.40
(b) Along Street	5.8	6.1	6.1	6.1	7.0	8.84	13.20	12.40
(c) Other areas	5.2	5.5	6.1	6.1	7.0	8.84	13.20	12.40

Voltage Category (IE Rules, 1956		High Voltage					Extra High Voltage		
(ii)	**Clearance to Buildings**								
	(a) Vertical (*)-from Highest object	3.66	3.97	4.58	4.58	5.49$	7.32	11.59	10.90
	(b) Horizontal (+)- from Nearest point	1.83	2.14	2.75	2.75	3.66$	5.49	10.98	9.15
(iii)	**At Crossings with**								
	(a) Tramway/trolley bus	3.05	3.36	3.76	3.97	4.78	6.44	-	10.14
	(b) Telecom Lines	-	2.44	2.75	2.75	3.05	4.67	-	8.18
	(c) Railway #								
1.	***Category 'A' and 'C' Broad Guage***								
	Inside station area	10.0	10.3	10.6	10.9	11.2	16.630	-	-
	Outside station area	7.6	7.9	8.2	8.5	8.8	14.630	-	-
	Metrel narrow Gauge								
	Inside Station area	8.8	9.1	9.5	9.8	10.0	-	-	-
	Outside station area	6.4	6.7	7.0	7.3	7.6	-	-	-
2.	***Category 'B'- All Gauges***								
	Inside station area	12.3	13.0	13.7	14.0	15.3	18.63	-	-
	Outside station area	10.5	11.0	11.7	12.0	13.3	16.63	-	-
(iv)	***Between Lines when crossing each other (derived)***								
	250 V	2.44	2.44	2.75	3.05	4.58	6.10	10.80	10.00
	650 V	2.44	2.44	2.75	3.05	4.58	6.10	10.80	10.00
	11 kV	2.44	2.44	2.75	3.05	4.58	6.10	10.80	10.00
	22 k V	2.44	2.44	2.75	3.05	4.58	6.10	10.80	10.00
	33 k V	2.44	2.44	2.75	3.05	4.58	6.10	10.80	10.00
	66 k V	2.44	2.44	2.75	3.05	4.58	6.10	10.80	10.00
	110 k V	4.58	4.58	4.58	4.58	4.58	6.10	10.80	10.00
	132 k V	3.05	3.05	3.05	3.05	4.58	6.10	10.80	10.00
	220 k V	4.58	4.58	4.58	4.58	4.58	6.10	10.80	10.00
	400 k V	6.10	6.10	6.10	6.10	6.10	6.10	10.80	10.00
	+ 500 k V DC	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80
	800 k V	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00

NOTE 1: $ Should not cross on/near buildings, * The Indian Electricity Rules, 1956 are repealed by Section 185 of the Indian Electricity Act, 2003, however, as per the new Act, the provisions will remain in force till new rules on such requirements are brought into force.

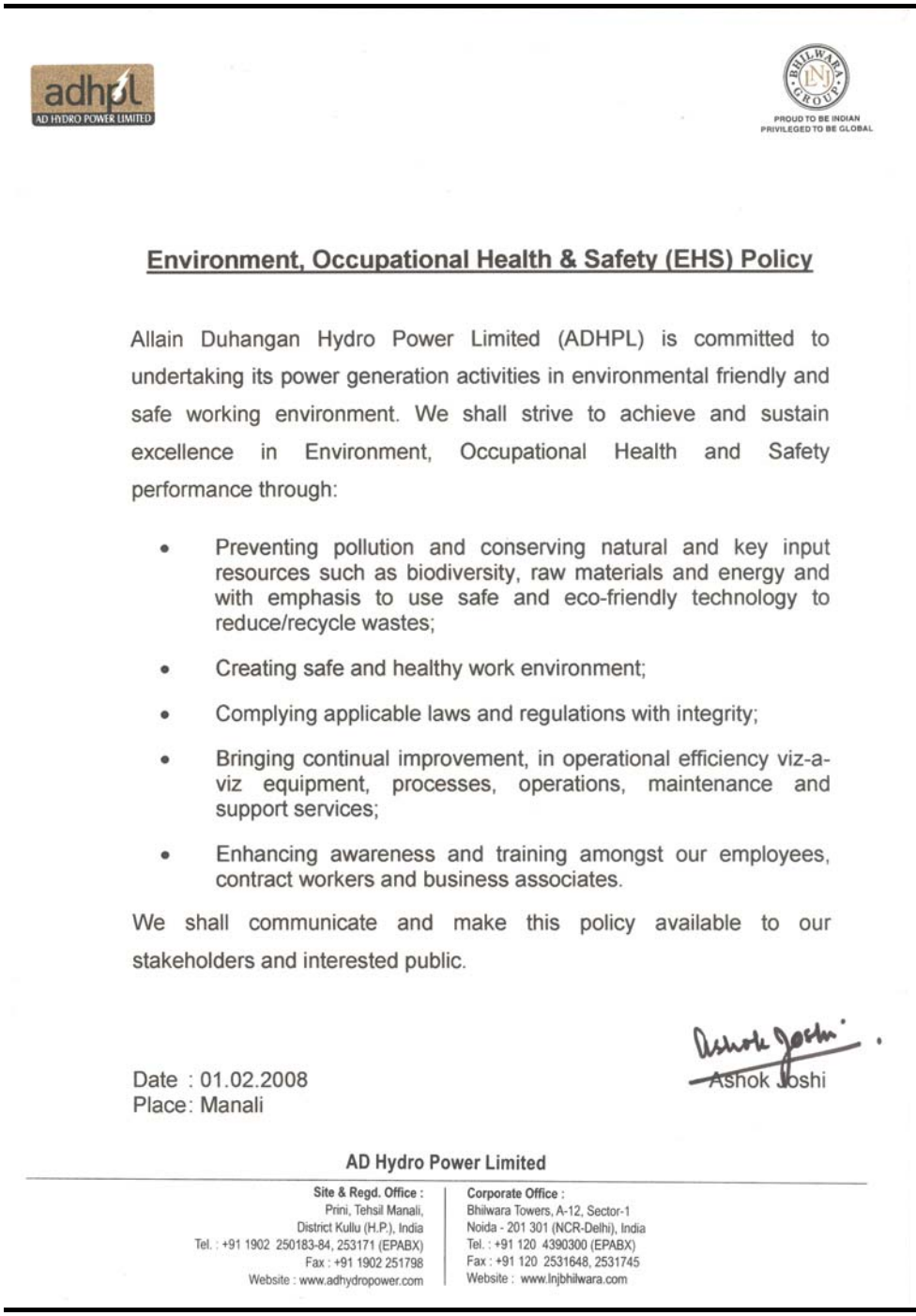
3.8.2 EHS Guidelines of IFC

The Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution is provided as ***Annex G.***

3.9 ADHPL EHS POLICY

ADHPL's EHS policy (as shown in ***Figure 3.1***) will be applicable for the proposed transmission line project till new policy is brought into force.

Figure 3.1 ADHPL's EHS Policy



adhpl
AD HYDRO POWER LIMITED

BHILWARA GROUP
PROUD TO BE INDIAN
PRIVILEGED TO BE GLOBAL

Environment, Occupational Health & Safety (EHS) Policy

Allain Duhangan Hydro Power Limited (ADHPL) is committed to undertaking its power generation activities in environmental friendly and safe working environment. We shall strive to achieve and sustain excellence in Environment, Occupational Health and Safety performance through:

- Preventing pollution and conserving natural and key input resources such as biodiversity, raw materials and energy and with emphasis to use safe and eco-friendly technology to reduce/recycle wastes;
- Creating safe and healthy work environment;
- Complying applicable laws and regulations with integrity;
- Bringing continual improvement, in operational efficiency viz-a-viz equipment, processes, operations, maintenance and support services;
- Enhancing awareness and training amongst our employees, contract workers and business associates.

We shall communicate and make this policy available to our stakeholders and interested public.

Ashok Joshi

Date : 01.02.2008
Place: Manali

AD Hydro Power Limited

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4 ENVIRONMENTAL & SOCIO-ECONOMIC BASELINE

4.1 INTRODUCTION

ERM conducted a baseline study to assess the environmental and socio-economic conditions within and in the surroundings of the proposed transmission line corridor. The baseline data generation was supplemented with field observations, surveys and interaction with the community and project personnel. The detail of the baseline conditions along the transmission line corridor falling in the districts of Kullu, Mandi, Bilaspur and Solan in Himachal Pradesh is presented in the following sub sections.

4.2 ENVIRONMENTAL BASELINE CONDITIONS

A linear corridor of 100 m either side of the proposed double circuit 220KV transmission line was considered for the study. The primary area is planned to cover 580 towers with a total width of 17.5m on either side along the centre line of the transmission line corridor.

The environmental baseline conditions were generated through monitoring of ambient air, water, soil, noise quality and a traffic survey and along with ecological survey across the route of proposed transmission line. The ecological survey was conducted to assess the type of flora and fauna prevailing along the transmission line. Secondary data on the topography, climate and meteorology, geology, relief and drainage etc. was collected through literature review and available information in the public domain.

4.2.1 *Topography Along the Transmission Line Corridor*

Stretch wise topography along the transmission line is provided as following:

Stretch 1: The transmission line moves from north to south along the west of the district from Manali through Kullu valley till Bajaura after which it enter Mandi district. The topography along the corridor presents rugged mountainous terrain with moderate altitude varying from approximately 2500 m amsl at Prini near Manali to 1,200m amsl at Bajaura in Kullu district.

Stretch 2: The terrain along the corridor is mountainous with the main ranges of mountains running from the north to the south with the system being broken up by innumerable transverse spurs. The altitude along the corridor varies from 1200 m amsl at Bajaura to 530 m amsl at Rambagh. This stretch passes through Kullu and Mandi districts. In the Mandi district transmission line runs from the north east side and leaves the district to the south west passing across the lesser Himalayas.

Stretch 3: The transmission line enters Bilaspur district from the east and move southwards into Solan district. The altitude in this region varies from around 600m to 900m and decreases further as it moves towards south.

The route in Solan district is mostly in the plains. It moves along the western boundary and terminates at Nalagarh. The altitude along the transmission lines is around 300m to 600m.

4.2.2 Climate

The climate along the route of transmission line varies with change in altitude from the lesser Himalayas towards the Shivalik. In general three seasons are prevailing in the area i.e.

- winter season (October to March);
- summer season (April to June); and
- monsoon season (July to September).

The climate data for the nearest meteorological observatories along the route of the transmission line for 30 years (1951-1980) is presented in the following subsections. The climatological observatories nearest to the transmission line route are at Manali, Bhuntar, Mandi and Chandigarh.

Temperature

The annual mean maximum temperatures at Manali was observed as 20.0^{o}C and a mean minimum temperature of 6.1^{o}C. The mean daily maximum temperature of 26.6^{o}C is experienced in June during summers in May and June, while the mean daily minimum of -1.8^{o}C is recorded in January in winters which extend from October to April

Bhuntar is relatively warmer than Manali, the mean temperatures range between 25.3^{o}C and 10.1^{o}C. The maximum daily temperature of 32.9^{o}C is observed during summer in the month of June while the minimum daily temperature of 1.3^{o}C is observed in January.

The mean temperatures at Mandi range between 27.9^{o}C and 12.4^{o}C. June is the hottest month with the maximum recorded temperature of 36.0^{o}C and January is the coldest with the recorded mean daily minimum of 2.8^{o}C.

At Chandigarh (observatory closest to Nalagarh) the temperatures range between 30.4^{o}C and 16.5^{o}C. Maximum daily temperature of 38.6^{o}C is observed in June and minimum of 6.1^{o}C in January.

The mean of daily maximum and daily minimum are presented in ***Table 4.1***.

Table 4.1 Temperature observation along the route of Transmission Line

Month	Manali*		Bhuntar**		Mandi#		Chandigarh##	
	Max	Min	Max	Min	Max	Min	Max	Min
January	10.1	-1.8	14.9	1.3	18.1	2.8	20.4	6.1
February	11.1	-1.0	17.1	3.4	21.1	4.2	23.1	8.3
March	15.9	2.8	21.8	6.6	25.8	9.0	28.4	13.4
April	21.6	6.1	27.3	10.0	30.8	13.5	34.5	18.9
May	24.9	8.6	30.9	12.5	34.7	17.3	38.3	23.1
June	26.6	12.4	32.9	17.1	36.0	20.1	38.6	25.4
July	25.5	14.8	30.9	19.6	31.8	21.1	34.0	23.9
August	25.0	14.6	30.1	19.4	31.0	20.5	32.7	23.3
September	24.7	10.4	30.0	16.2	30.7	18.4	33.1	21.8
October	22.5	5.4	27.5	9.9	28.8	12.3	31.8	17.0
November	18.4	1.3	22.8	4.3	24.9	6.8	27.3	10.5
December	14.0	-0.3	17.3	1.4	20.6	3.1	22.1	6.7
Annual Mean	20.0	6.1	25.3	10.1	27.9	12.4	30.4	16.5

Source: Climatological Tables of Observatories of India, 1951-1980
* 1968 to 1980; ** 1954 to 1980; #1960 to 1980; ## 1954 to 1977

Humidity

Relative humidity is moderate along the route of transmission line. The annual mean value for range between 60% and 80% along the route from Manali to Nalagarh during morning hours while for observation recorded for evening hours the value range between 62% and 48%. At all places the Relative humidity show an increase during monsoons as well as decline in winters. The maximum value for relative humidity recorded along the transmission line route is at Manali (91%) and the minimum recorded is at Chandigarh (22%).

Table 4.2 Percentage Relative humidity

Month	Manali*		Bhuntar**		Mandi#		Chandigarh##	
Hrs	8:00	17:30	8:00	17:30	8:00	17:30	8:00	17:30
January	76	68	89	55	87	59	72	50
February	72	65	88	50	84	53	63	43
March	60	55	80	46	77	45	50	35
April	56	48	71	40	68	42	37	24
May	57	50	62	35	57	39	35	22
June	71	58	67	43	63	47	51	36
July	86	75	84	62	80	69	76	63
August	91	81	87	66	86	75	80	70
September	86	73	82	58	82	67	74	60
October	73	65	80	47	81	61	58	43
November	62	58	85	45	86	61	56	40
December	60	54	88	52	87	62	67	48
Annual Mean	71	63	80	50	78	57	60	45

Source: Climatological Tables of Observatories of India, 1951-1980
* 1968 to 1980; ** 1954 to 1980; #1960 to 1980; ## 1954 to 1977

Winds

Winds in the region are generally light to moderate. As per the meteorological observations from 1968 to 1980 the predominant wind direction in Manali is

from North and Northwest. On an average 50% of observations are calm with wind speed less than 1km/hr throughout the year. The wind speed in the area never exceeds 19km/hr throughout the year.

At Bhuntar the meteorological observation from 1960 to 1980 indicate a high percentage (62 %) of calm during morning hours while the calm percentage is only 26% during evening observations. The predominant wind direction in the morning is from north for most period of the year while it is from south and south east in the evening hours for most period of the year. The wind speed is mostly between 1-19km/hr, however during evening the wind speed in the range 20 – 61km/hr is also observed for 2-8 days every month. The average annual wind speed at Bhuntar is recorded as 5.3 km/hr.

The meteorological observation at Mandi indicates a significant period of calm for 70-80%. The wind speed is mostly below 19km/hr except for couple of observations in the evening hours. The average annual wind speed at Mandi is recorded as 2.2km/hr.

At Chandigarh the predominant wind direction is from northwest for most period of the year except in summers where it is from the southeast. The wind speed is mostly less than 19km/hr except for few occasions where it is recorded between 20 and 60 km/hr.

Rainfall

The rainfall data was obtained for five years (1999- 2003) for all four districts through which the transmission line pass. The region exhibits considerable variation in the distribution of rainfall due to the varying aspects and altitudes. Precipitation declines from west to east and south to north. About 70% of the precipitation is received from July to September.

Winter precipitation as snow is received at elevations above 1800 m. An average of 3 m of snow is experienced from December to March at elevations above 3000 m. The reaches above 4500 m above msl remain under almost perpetual snow.

Table 4.3 Rainfall Data (in mm)

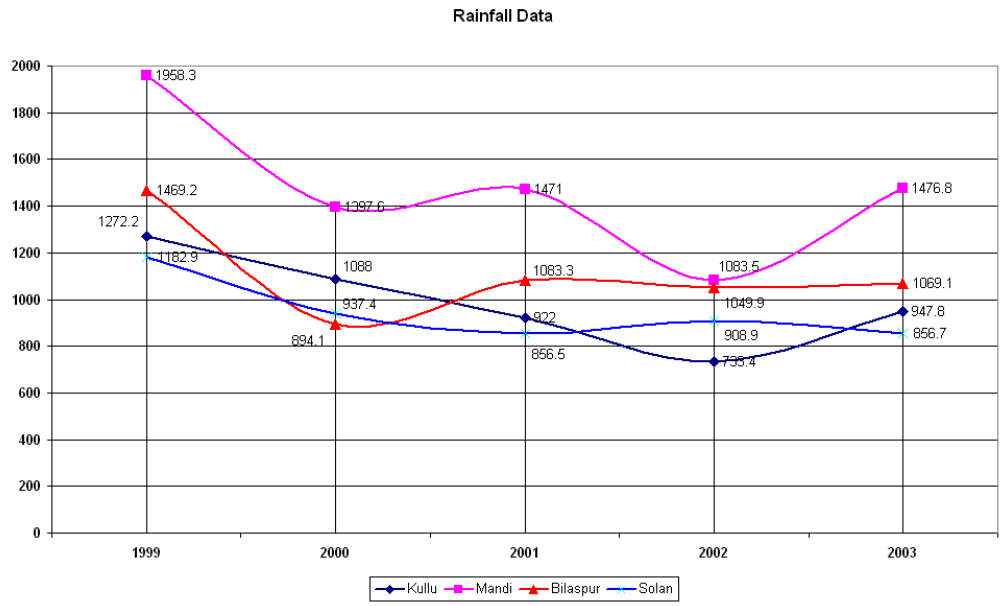
	1999	2000	2001	2002	2003
Kullu	1272.2	1088.0	922.0	733.4	947.8
Mandi	1958.3	1397.6	1471.0	1083.5	1476.8
Bilaspur	1469.2	894.1	1083.3	1049.9	1069.1
Solan	1182.9	937.4	856.5	908.9	856.7

Source: Draft State of Environment of the Himachal Pradesh, 2006.

The total annual rainfall received in Kullu during 1999 to 2003 varied from 733.4 mm to 1272mm. Mandi received the heaviest rainfall in the stretch with the total annual rainfall varying from 1083.5mm to 1958.3mm which is because of the hilly terrain of lesser Himalayas. The total annual rainfall at Bilaspur

varied form 894.1mm to 1469.2mm while that at Solan varied from 856.7mm to 1182.9mm.

Figure 4.1 Rainfall data from 1999-2003



Fog

Foggy conditions along the route are mostly experienced in winters. Mandi experience more number of foggy days than any other stations observed along the route. The observations of fog along the route of transmission line are presented in ***Table 4.4 :***

Table 4.4 Observations of Fog along the transmission line route

Month	No of Days with Fog			
	Manali*	Bhuntar**	Mandi#	Chandigarh##
January	0.0	0.2	8.0	0.1
February	0.0	0.2	3.0	0.2
March	0.0	0.1	1.1	0.0
April	0.0	0.0	0.0	0.0
May	0.0	0.0	0.0	0.0
June	0.1	0.0	0.1	0.0
July	0.0	0.1	0.1	0.0
August	0.6	0.0	0.0	0.0
September	0.2	0.0	0.5	0.0
October	0.0	0.0	2.9	0.0
November	0.0	0.2	5.0	0.0
December	0.0	0.2	8.5	0.0
Total	0.9	1.0	29.2	0.3

Source: Climatological Tables of Observatories of India, 1951-1980
* 1968 to 1980; ** 1954 to 1980; #1960 to 1980; ## 1954 to 1977

Thunderstorm

Thunderstorms are observed to be frequent mainly during the month of May and June. The observation of thunderstorms was highest for Bhuntur than all

other monitoring stations. At Bhuntur thunderstorms were recorded for about 65 day a year while at Chandigarh it was the least with 3 days throughout the year as detailed in ***Table 4.5.***

Table 4.5 Observations of Thunderstorm along the Transmission Line Route

Month	No of Days with Thunder			
	Manali	Bhuntar	Mandi	Chandigarh
January	0.0	1.4	0.7	0.0
February	0.0	2.8	1.4	0.3
March	0.4	6.9	3.2	0.2
April	0.3	8.9	3.8	0.3
May	0.5	11.1	4.7	0.5
June	1.1	11.2	5.9	0.7
July	0.2	7.8	5.2	0.2
August	0.1	3.8	3.6	0.1
September	0.1	5.8	3.1	0.1
October	0.3	3.0	1.2	0.2
November	0.0	1.4	0.5	0.0
December	0.0	0.5	0.3	0.0
Total	3.0	64.6	33.6	2.6

4.2.3 Drainage

The drainage along the transmission line route is controlled by river Parvati and Beas Rivers in the upper stretch and Sultlej River in the area after Mandi. These rivers are connected with a number of small rivulets flowing down the slopes along their route. River Beas flows along the transmission line all through the stretch 1 and along the major part of stretch 2 till Pandoh. The transmission line crosses Sutlej River in stretch-3 and moves southward. A brief detail of Rivers Beas and Sutlej is provided in the following subsection.

River Beas

The Beas River has a catchment area of 13,663 km^2. It originates at Beas Kund near the Rohtang pass and is fed by several tributaries including the Parbati, the Hurla, the Sainj, the Tirthan, the Uhl, the Sakeri, the Awa, the Banganga, the Manuni, the Guj and the Chaki. It flows from north to south-west over a distance of 286 km in Himachal Pradesh.

River Sutlej

Sutlej is the largest river system of Himachal Pradesh with a total catchment area of 20,398 km^2 spread over the districts of Lahaul & Spiti, Kinnaur, Shimla, Solan and Bilaspur. Originating in Tibet, the river flows from east to west, enters the state at Shipki (6,608 m) in Kinnaur. It is joined by its various right bank tributaries including Spiti, Ropa, Kasang, Mulgaon, Yul, Wanger and Throng in Kinnaur. Tributaries Tirung, Gayanthing, Duling, Baspa, Solding, Manglad and Nogli form some of its left bank tributaries.

Before entering the plains in the Punjab State, it cuts a gorge in Naina Devi. A big dam across this gorge near Bhakra village has been constructed which has

created a huge reservoir called the Govind sagar in the district of Bilaspur, a narrow part of which is crossed by the transmission line.

4.2.4 Soils

The soils of the region vary according to aspect, slope and climatic conditions. It is classified as brown hill soils and sub montane soils. The brown hill soils are found in the Shiwalik and lesser Himalayan regions while the middle and greater Himalayan zones are characterized by podsolic or sub-montane type of soils. The soils in the mountains are mostly thin, but deep in the valleys.

The project corridor is essentially covered with following two types of soils:

- *Sub-montane soil* is found in the sub-himalayan regions which have their formation on valley floors and higher altitude. These soils are brownish to reddish in colour and loamy to silty in texture. This type of soil is observe along the transmission line from Manali till close to Mandi.
- *Brown hill soil (Palechumults)* have *thick argilic* horizons and a few weathering minerals in the range of 20 to 200 µm size. The texture varies from fine sandy loam to sandy clay loam. The pH ranges from 5.5 to 8.2. Nutrients in the soil vary due to large variety of parent rock. They occur on sloppy land of the Himalayas.

Soil Quality

The soil quality along the transmission line route was assessed through monitoring at six locations. Details of the sampling locations and its geographical coordinates are provided in ***Table 4.6.***

Table 4.6 Soil Sampling Locations

Sample code	Location	Coordinates
SQ-1	Patli Kuhl in Kullu District	32º 06′ 50.5 N 77º 09′ 05.8E
SQ-2	Kullu, in Kullu District	31º 58′ 17.0 N 77º 07′ 38.7E
SQ-3	Bhuntar, in Kullu District	31º 54′ 21.1 N 77º 07′ 57.4E
SQ-4	Sunder Nagar, in Mandi District	31º 32′ 15.0 N 76º 53′ 39.7E
SQ-5	Dehar, in Mandi District	31º 26′ 00.9N 76º 49′ 51.0E
SQ-6	Nalagarh, in Solan District	31º 07′ 49.4N 76º 39′ 58.4E

The results of the soil quality analysis are presented in ***Table 4.7.***

Table 4.7 Observation Soil Quality

	Parameters	Units	SQ-1	SQ-2	SQ-3	SQ-4	SQ-5	SQ-6
Physical Parameters								
1	pH (30 gm in 75 ml water)	---	5.9	7.1	7.3	7.9	8.2	8.1
2	E. Conductivity (1: 5 ratio)	µ mho/ cm	108	400	445	217	131	190
3	Bulk Density	gm/cc	1.79	1.81	1.62	1.68	1.72	1.61
4	Texture		Sandy loam	Sandy loam	Silt loam	Silt loam	Silt loam	Silt loam
5	Particle Sizes				% by mass			
	Gravel		31	32	3	35	15	1

	Parameters	Units	SQ-1	SQ-2	SQ-3	SQ-4	SQ-5	SQ-6
	Sand		46	48	18	28	34	44
	Silt		21	19	75	36	50	53
	Clay		2	1	4	1	1	2
Chemical Characteristics								
6	Sodium as Na_2O	% by mass	2.3	0.8	1.4	0.8	0.4	0.7
7	Potassium as K_2O	% by mass	2.7	2.2	2.6	2.2	2.1	1.7
8	Iron as Fe_2O_3	% by mass	2.9	3.4	4.2	3.4	3.6	3.1
9	Lead as Pb	mg/kg	104	72	36.1	24.3	27.0	20.6
10	Manganese as Mn	mg/kg	386.1	595.3	564.5	566	632.9	632.8
11	Nickel as Ni	mg/kg	16.3	23.3	31.1	24.2	22.9	18.2
12	Zinc as Zn	mg/kg	52.8	67.6	90.7	70.6	69.2	69.3
13	Copper as Cu	mg/kg	23.6	29.3	28.4	27.6	24.7	25.5
14	Cadmium as Cd	mg/kg	1.7	1.9	1.5	1.2	1.8	1.7
15	Chromium as Cr	mg/kg	20.9	28.2	38.5	27.1	26.3	25.2
16	Barium as Ba	mg/kg	556.3	340.9	423.6	332.5	201.7	280.1

Discussion of Results

Observations from the analysis of soil samples are discussed below in the following subsection.

Soil Texture

The soil texture varied from sandy loam (SQ-1 & SQ-2) to silt loam (SQ-4, SQ-5 and SQ-6) along the transmission line from Manali towards Nalagarh. The soil texture classification is presented in ***Figure 4.2.***

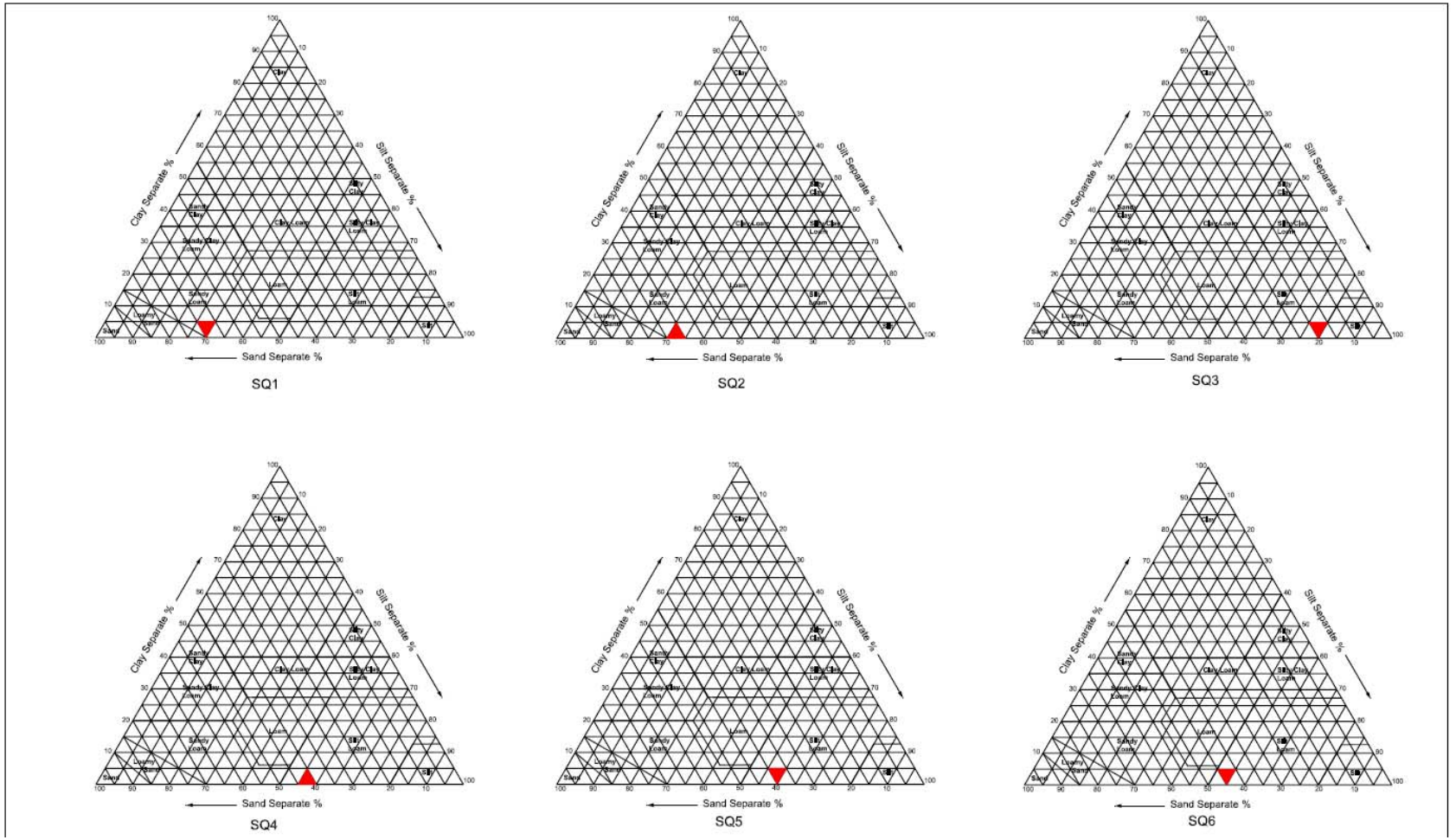
The pH of the samples varied from 5.9 to 8.2. The pH of samples varied along the route from moderately acidic at Patli Kunhl (SQ-1) to neutral at Kullu (SQ-2) and Bhuntar (SQ-3) and to moderately alkaline at (Sunder Nagar) SQ-4, Dehar (SQ-5) and Swarghat (SQ-6).

Metals

Metal concentrations were observed as follows:

- Concentration of manganese varied from 386.1 to 632.9 mg/kg while that of barium varied from 201.7 to 556.3mg/kg. These concentrations were relatively higher than all other metals all along the corridor;
- Iron concentration in soil samples were observed to vary from 2.9% to 4.2% by mass;
- Concentration of Lead varied from 20.6 to 104 mg/kg;
- Concentration of cadmium observed to be consistent all along the route with concentrations ranging from 1.2 to 1.9 mg/kg;
- Concentration of zinc was also observed to be range from 52.8 to 90.7mg/kg;
- Concentration of copper in soil was consistent along the route with concentrations varying from 23.6 to 29.3 mg/kg;
- Concentration of nickel varied from 16.3 to 31.1 mg/kg; and
- Concentration of chromium varied from 20.9 to 38.5mg/kg.

Figure 4.2 Soil Texture Classification



4.2.5 Geology

The route of transmission line is highly undulating with hilly terrains of beginning at the base of the greater Himalayas, through lesser Himalayas till the shivalik range. The rock formation at the start of the route is limesilic which is replaced by sedimentary rock of unconsolidated type with Slate, quartzite and Schists as the transmission line moves on from Kullu towards Mandi. After mandi the rock formation is sedimentary consolidated type with Sand stone and Shale.

4.2.6 Surface Water

The main surface water bodies near the transmission line route are Beas and Sutlej Rivers.

Locations and Methodology of Surface Water Monitoring

Besides the data reviewed from secondary literature, water samples were collected at six locations along the transmission line. The geographical coordinates of the sampling locations are given in ***Table 4.8.***

Table 4.8 Water Sampling Locations

Sample code	Location	Coordinates	Remark
WQ-1	Patli Kuhl, district Kullu	32º 06′ 50.5 N 77º 09′ 05.8E	Beas river
WQ-2	Bhuntar, district Kullu	31º 54′ 21.1 N 77º 07 57.4E	Beas river
WQ-3	Pandoh, district Mandi	31º 40′ 20.7 N 77º 03 12.7E	Beas river
WQ-4	Suni Khad, district Manid	31º 36′ 00.1 N 77º 03′ 50E	Suni khadi
WQ-5	Dehar, district Mandi	31º 25′ 50.9N 76º 49′51.0E	Sutlej river
WQ-6	Gamrola Khud, district Solan	31º 18′ 50.1N 76º47′ 00.0E	Gamrola Khud

The water quality was assessed for physical, chemical and bacteriological parameters as per the Bureau of India Standards IS: 10500 specifications with a few additional parameters [chemical oxygen demand (COD), biochemicala oxygen demand (BOD) and dissolved oxygen (DO)]. A total of six samples were collected along the transmission line. The observed water quality is presented in ***Table 4.9***.

Table 4.9 Results of Surface Water Quality

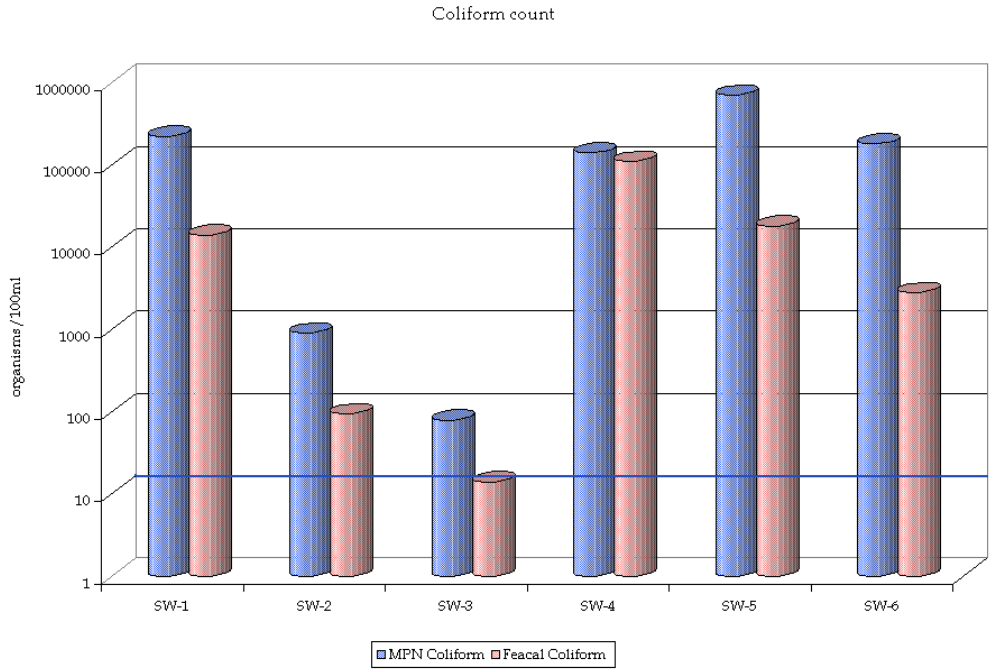
S.N.	Parameter	units	IS Limits	SW-1	SW-2	SW-3	SW-4	SW-5	SW-6
1	Colour	(Hazen)	5 Max.	<5	<5	<5	<5	<5	<5
2	Turbidity	(NTU)	5 Max (10)	8	7	12	3	300	64
3	pH		6.5-8.5	6.5	6.6	6.6	6.8	7.7	8
4	Total Hardness as $CaCO_3$	(mg/l)	300 Max	32	37	33	90	132	210
5	Iron as Fe	(mg/l)	0.3 Max	0.02	0.01	<0.01	0.03	0.1	0.03
6	Chloride as Cl	(mg/l)	250 Max	7	7	7	20	8	16
7	Dissolved Solids	(mg/l)	500 Max	44	47	60	165	162	325
8	Calcium as Ca	(mg/l)	75 Max	8	9	18	55	25	43
9	Magnesium as Mg	(mg/l)	30 Max	3	3	15	35	17	25
10	Copper as Cu	(mg/l)	0.05 Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

S.N.	Parameter	units	IS Limits	SW-1	SW-2	SW-3	SW-4	SW-5	SW-6
11	Manganese as Mn	(mg/l)	0.1 Max	<0.01	<0.01	0.2	<0.01	0.01	<0.01
12	Sulphate as SO_4	(mg/l)	200 Max	5	6	8	6	44	99
13	Nitrate as NO_3	(mg/l)	45 Max	< 1	2	2	1	8	6
14	Fluoride as F	(mg/l)	1.0 Max	0.4	0.3	0.7	0.6	0.2	0.4
15	Phenolic Compounds as Phenol	(mg/l)	0.001 Max.	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
16	Mercury as Hg	(mg/l)	0.001 Max.	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
17	Cadmium as Cd	(mg/l)	0.01 Max.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
18	Selenium as Se	(mg/l)	0.01 Max.	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
19	Arsenic as As	(mg/l)	0.01 Max.	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
20	Cyanide as CN	(mg/l)	0.05 Max.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
21	Lead as Pb	(mg/l)	0.05 Max.	0.02	<0.01	0.02	0.02	0.03	0.02
22	Zinc as Zn	(mg/l)	5 Max	0.1	0.06	0.02	<0.01	<0.01	0.1
23	Anionic Detergents as MBAS	(mg/l)	0.2 Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
24	Oil & Grease (including Mineral Oil & TPH)	(mg/l)	0.01 Max	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
25	Alkalinity	(mg/l)	200 Max	22	21	23	106	86	143
26	Aluminum as Al	(mg/l)	0.03 Max	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
27	Boron as B	(mg/l)	1 Max	< 1	< 1	< 1	< 1	< 1	< 1
	Microbiological Parameters								
28	MPN Coliform	Organism/ 100 ml	10 Max	2.2X 10^5	900	79	1.4 X 10^5	7.0 X10^5	1.8 X10^5
29	Feacal Coliform	Organism/ 100 ml	Absent	1.4 X 10^4	94	14	1.1 X 10^4	1.8 X10^4	2.8 X10^3
	Additional Parameters								
30	Temperature	(°C)	--	26	27	27	28	24	24
31	Conductivity at 25 °C	(µS/cm)	--	68	77	78	255	230	460
32	Total Suspended Solids	(mg/l)	--	12	11	1	2	446	70
33	DO	(mg/l)	--	7.4	7.5	7.2	7.5	5.6	5.5
34	BOD at 20°C for 5 days	(mg/l)	--	< 1	< 1	< 1	< 1	< 1	< 1
35	COD	(mg/l)	--	8	6	5	3	8	5
36	Salinity	ppt	--	0.04	0.05	0.06	0.16	0.16	0.33
37	Phosphate as PO_4	(mg/l)	--	0.2	0.06	< 0.05	< 0.05	< 0.05	< 0.05
38	Total Chromium as Cr	(mg/l)	--	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
39	Barium as Ba	(mg/l)	--	< 0.1	<0.1	0.3	0.4	< 0.1	0.2

Discussion of Results

Table 4.9 shows that the surface water quality conforms to drinking water standards as specified in IS: 10500 except for turbidity and microbiological parameters. The graphical representation of Coliform content observed in all the samples monitored is as per ***Figure 4.5.***

Figure 4.3 Coliform -observation



The water samples were also compared with the designated best use classification using water quality Index. The Index values were compared with the designated best use classification as prescribed by the Central Pollution Control Board (Ref. Manual for statistical analyses and interpretation of water quality data, MINARS/2/1986-87).

Table 4.10 Surface Water Quality and Best Use Designation Classification

Sample	**pH** **Class**	**D.O. mg/l Class**	**B.O.D (mg/l) Class**	**Coliform (organisms /100ml) Class**	**Cond-uctivity** µS/cm	**Boron,** mg/l	**Overall Classi-fication**
SW-1 (Beas at Patli Kuhl)	6.5 A	7.4 A	<1 A	2.2 x 10^5 C	68	<1	C
SW-2 (Beas at Bhuntar)	6.6 A	7.5 A	<1 A	900 C	77	<1	C
SW-3(Beas before Pandoh)	6.6 A	7.2 A	<1 A	79 A	78	<1	B
SW-4(Suni Khad	6.8 A	7.5 A	<1 A	1.4 x 10^5 C	255	<1	C
SW-5 (Sutlej)	7.7 A	5.6 B	<1 A	7 x 10^5 C	230	<1	C
SW-6 (Gamrola Khud	8.0 A	5.5 B	<1 A	1.8 x 10^5 C	460	<1	C

Refer to Table 4.11 for the Designation Classification Criteria

Table 4.11 Primary Water Quality Criteria for Designated-Best-Use-Classes

Designated-Best-Use	Class	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	Total Coliforms OrganismMPN/100ml shall be 50 or less pH between 6.5 and 8.5 Dissolved Oxygen 6mg/l or more Biochemical Oxygen Demand 5 days 20^{o}C 2mg/l or less
Outdoor bathing (Organized)	B	Total Coliforms Organism MPN/100ml shall be 500 or less pH between 6.5 and 8.5 Dissolved Oxygen 5mg/l or more Biochemical Oxygen Demand 5 days 20^{o}C 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	Total Coliforms Organism MPN/100ml shall be 5000 or less pH between 6 to 9 Dissolved Oxygen 4mg/l or more Biochemical Oxygen Demand 5 days 20^{o}C 3mg/l or less
Propagation of Wild life and Fisheries	D	pH between 6.5 to 8.5 Dissolved Oxygen 4mg/l or more Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	pH between 6.0 to 8.5 Electrical Conductivity at 25^{o}C micro mhos/cm Max.2250 Sodium absorption Ratio Max. 26 Boron Max. 2mg/l
	Below-E	Not Meeting A, B, C, D & E Criteria

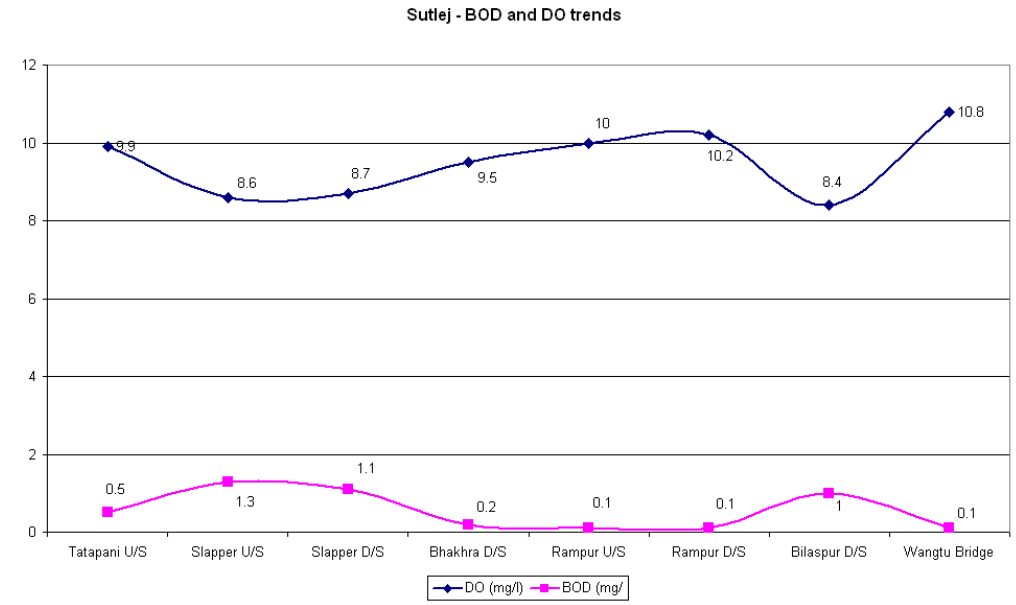
The National Sanitation Foundation water quality Index (NSFWQI) was used to examine and highlight the state of water based on the monitored data. NSFWQI is a well established subjective WQI tool for management of water quality information.

The output of the index indicate that, SW1, SW2, SW3 and SW4 shall be considered as class A (i.e. good to excellent) while SW5 and SW6 is classified as class B (i.e. medium to good). The overall surface water quality in the region can be regarded as good. The detailed calculations are given in ***annex F.***

The water quality as monitored by CPCB in January 2005 at various locations along the two rivers is presented in ***Table 4.12***

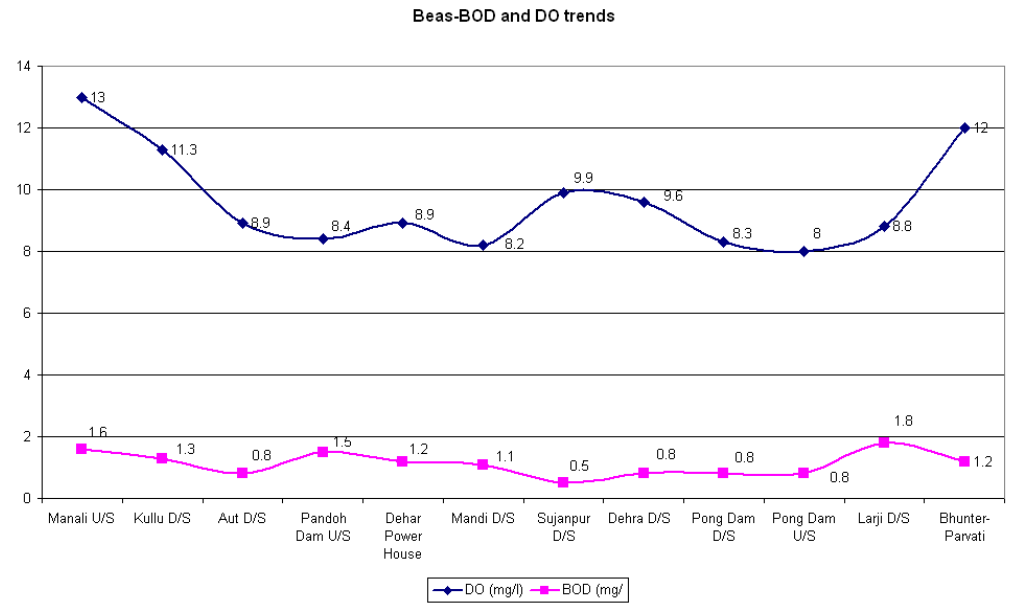
The pH levels of Sutlej River vary from 7.86 to 8.1 while the Dissolve Oxygen is very good at 8.4 and 10.8 mg/l at all the locations monitored. The BOD levels are low between 0.1 and 1.3mg/l. The Coliform levels however were very high at most locations.

Figure 4.4 BOD and DO trends in Sutlej and tributaries (CPCB data)



The pH levels of Beas River vary from 7.86 to 8.81 while the Dissolve Oxygen values are good at 8.0 and 13.0 mg/l at all the locations monitored. The BOD levels are low between 0.5 and 1.8mg/l. The Coliform levels however were very high at some locations.

Figure 4.5 BOD and DO trends in Beas and tributaries (CPCB data)



On the basis of Primary Water Quality Criteria by CPCB, it can be concluded that quality of both the rivers falls under 'A' category of water with respect to pH, DO and BOD but has to be categorized in 'C' category due to higher levels of Total Coliform.

Table 4.12 Surface Water Quality as per CPCB (January 2005)

Location/ Station Code	pH	DO (mg/l)	BOD (mg/	TC (MPN)
Satluj and Tributaries				
Tatapani U/S	7.85	9.9	0.5	410
Slapper U/S	8.1	8.6	1.3	9
Slapper D/S	8.07	8.7	1.1	7
Bhakhra D/S	7.96	9.5	0.2	20
Rampur U/S	8.04	10	0.1	170
Rampur D/S	8.04	10.2	0.1	210
Bilaspur D/S	8.22	8.4	1	17
Wangtu Bridge	8.06	10.8	0.1	10
Beas and Tributaries				
Manali U/S	7.8	13	1.6	4
Kullu D/S	7.81	11.3	1.3	7
Aut D/S	7.96	8.9	0.8	2
Pandoh Dam U/S	8.32	8.4	1.5	9
Dehar Power House	7.93	8.9	1.2	6
Mandi D/S	7.95	8.2	1.1	17
Sujanpur D/S	8.28	9.9	0.5	11
Dehra D/S	8.38	9.6	0.8	26
Pong Dam D/S	8.81	8.3	0.8	7
Pong Dam U/S	8.59	8	0.8	5
Larji D/S	7.81	8.8	1.8	2
Bhunter- Parvati	8.42	12	1.2	4

4.2.7 Ambient Air Quality

The transmission line corridor represents mostly rural/residential set up. The likely changes in the ambient air quality are limited to construction phase due proposed project activities as described in *Section 2.* The sources of air pollution include vehicular traffic, dust arising from unpaved village roads and domestic fuel burning. The baseline ambient air quality study enables in assessing the conformity to respective standards as specified by CPCB.

Locations and Methodology of AAQ Monitoring

Ambient air quality along the route was monitored at four locations twice a week for two weeks during pre-monsoon season (May 2008)**.** The parameters monitored included Suspended Particulate Matter (SPM), Respirable Particulate Matter (RPM), Sulphur Dioxide (SO_2), Oxides of Nitrogen (NO_x), Carbon Monoxide (CO) and Total Hydrocarbons. SPM, RPM, SO_2 and NO_x were monitored on 24-hourly basis while CO and HC were monitored on eight hourly basis monitored during 24 period twice a week during the study periods.

Selection of sampling locations

The baseline status of the ambient air quality has been established through a scientifically designed ambient air quality monitoring network and is based on the following considerations:

- Meteorological conditions on synoptic scale;
- Topography of the route;

- Representatives of regional background air quality for obtaining baseline status; and
- Extent of the transmission line.

The details of ambient air quality sampling location are as per details given in ***Table 4.13.***

Table 4.13 Ambient Air Quality Monitoring Location

Sample code	Location	Coordinates
AQ-1	Bhuntar	31° 54′ 21.1 N 77° 07′ 57.4E
AQ-2	Sunder Nagar	31° 32 ′15.0 N 76° 53′ 39.7E
AQ-3	Swarghat	31° 13′ 25.9 N 76° 43′ 28.9E
AQ-4	Nalagarh	31° 07′ 49.4 N 76° 39′ 58.4E

Ambient Air Quality along the Transmission Line Route

The observations from the monitoring conducted at four locations within the study area are summarized in ***Table 4.14.***

Table 4.14 Air Quality Observed

Parameter	Units	Observed	AQ1	AQ2	AQ3	AQ4	Range
SPM 24 hours	µg/m³	Maximum	94.0	158.0	128.0	114.0	94 -158
		Minimum	44.0	107.0	74.0	67.0	44-107
		Average	68.0	130.0	99.0	84.0	68-130
		98 Percentile	92.7	156.9	126.9	112.3	112.3-156.9
		Standard	200.0	200.0	200.0	200.0	
RPM 24 hours	µg/m³	Maximum	71.0	111.0	93.0	84.0	71-111
		Minimum	33.0	78.0	52.0	51.0	33-78
		Average	52.0	94.0	72.0	62.0	52-94
		98 Percentile	70.2	110.6	92.2	82.6	82.6-110.6
		Standard	100.0	100.0	100.0	100.0	
NOx 24 hours	µg/m³	Maximum	16.0	17.0	18.0	15.0	15-18
		Minimum	11.0	13.0	5.0	10.0	5.0 -13
		Average	13.0	15.0	12.0	12.0	12.0-15
		98 Percentile	15.8	16.9	17.8	14.9	14.9-17.8
		Standard	80.0	80.0	80.0	80.0	-
SO_2 24 hours	µg/m³	Maximum	10.0	BDL	10.2	16.7	BDL-16.7
		Minimum	3.0	BDL	4.3	4.7	BDL-4.7
		Average	6.0	BDL	6.1	11.1	BDL-11.1
		98 Percentile	9.8	BDL	9.9	15.9	BDL-15.9
		Standard	80.0	80.0	80.0	80.0	-
HC (CH_4) 8 hourly	ppm	Maximum	5.2	5.5	5.6	5.6	5.2-5.6
		Minimum	4.2	4.3	4.3	4.6	4.2-4.6
		Average	4.6	4.7	4.9	4.9	4.6-4.9
		98 Percentile	5.1	5.4	5.5	5.5	5.1-5.5
		Standard #	-	-	-	-	-
CO 8 hourly	mg/m³	Maximum	1.9	0.6	1.5	1.1	0.6-1.9
		Minimum	0.6	0.1	0.6	0.4	0.1-0.6
		Average	1.1	0.4	1.0	0.8	0.4-1.1
		98 Percentile	1.8	0.6	1.4	1.1	0.6-1.8
		Standard	2.0	2.0	2.0	2.0	-

Not prescribed

Discussions of Results

The observations from the monitoring conducted were compared with the CPCB limit for ambient air quality and the interpretation is discussed in the following subsections.

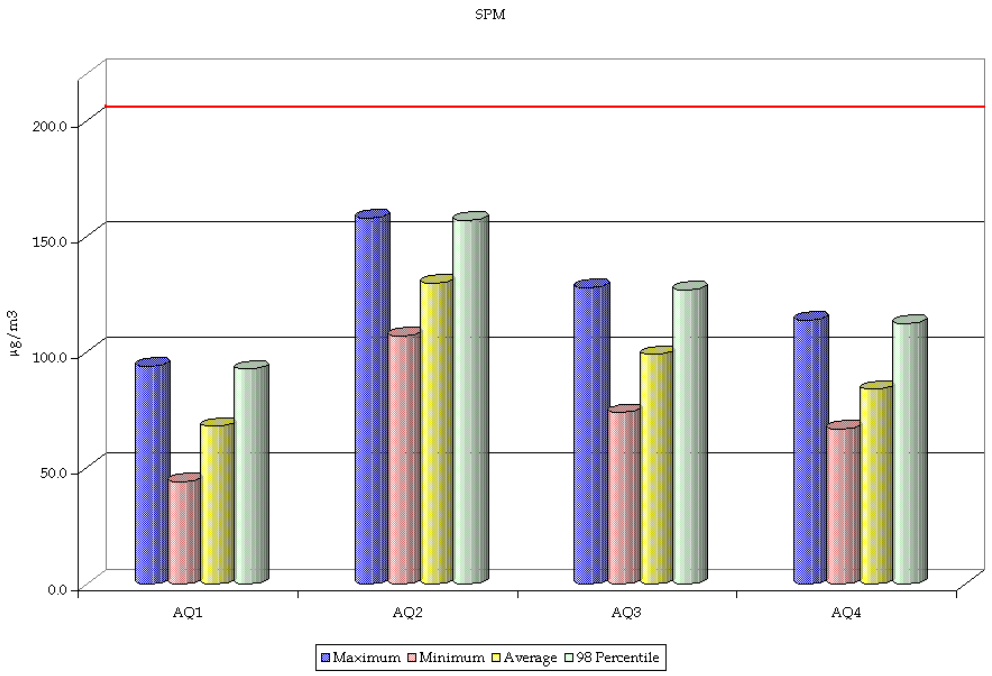
Suspended Particulate Matter (SPM)

The SPM concentration observed during the monitoring period range between 44.0µg/m^3 to 158.0µg/m^3.

- AQ-2 (Sunder Nagar) recorded the maximum concentration of 158.0µg/m^3
- The minimum concentration of 44.0µg/m^3 was recorded at AQ 1 (Bhuntar)
- Average concentration values for the monitoring period ranged from 68.0µg/m^3 to 130.0µg/m^3.
- All values observed were below the CPCB norms for rural, residential area and other areas.

The observed SPM values are depicted graphically in ***Figure 4.6.***

Figure 4.6 Observed SPM



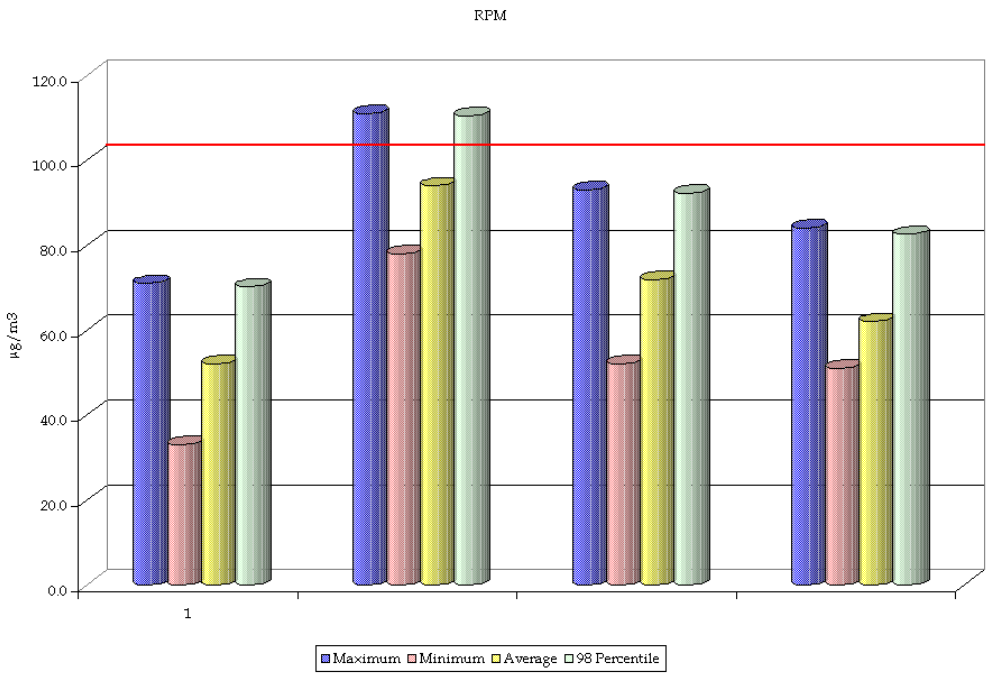
Respirable Particulate Matter (RSPM)

The RPM concentration observed during the monitoring period range between 33.0µg/m^3 to 111.0µg/m^3.

- AQ-2 (Sunder Nagar) recorded the maximum concentration of 111.0µg/m^3
- The minimum concentration of 33.0µg/m^3 was recorded at AQ 1 (Bhuntar)
- Average concentration values for the monitoring period ranged from 52.0µg/m^3 to 94.0µg/m^3.
- All values observed were below the CPCB norms for rural, residential area and other areas except at Sunder Nagar where the values are marginally exceeding due to commercial activities.

The observed RPM values are depicted graphically in ***Figure 4.7.***

Figure 4.7 RPM values



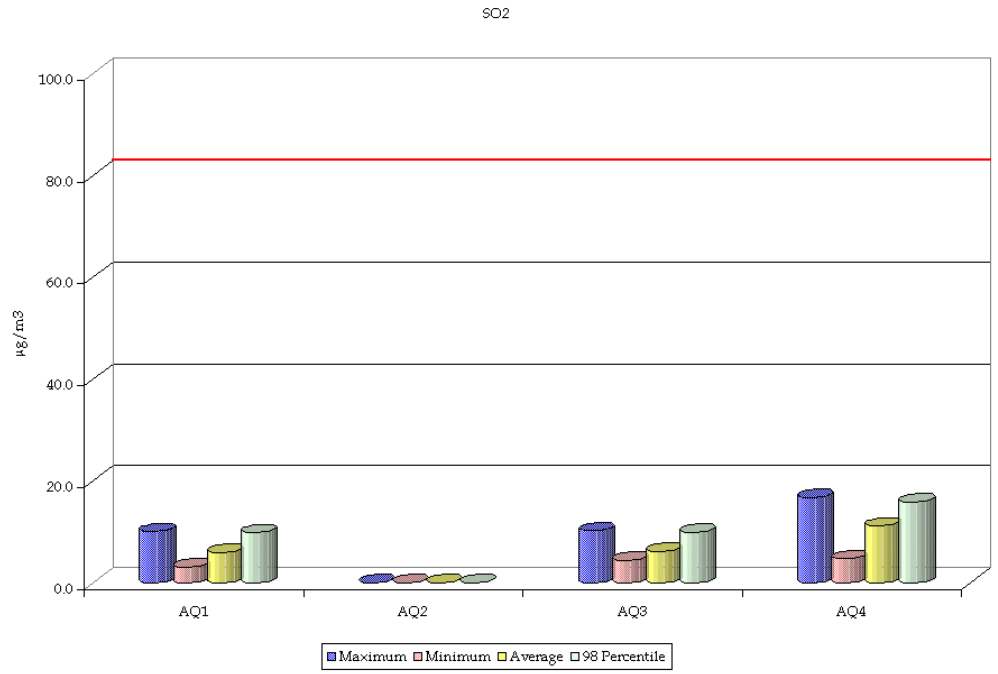
Sulphur dioxide (SO_2)

The SO_2 concentration observed during the monitoring period range between BDL (<3µg/m^3) to 16.7µg/m^3.

- AQ-4 (Nalagarh) recorded the maximum concentration of 16.7µg/m^3
- The minimum concentration of BDL was recorded at AQ- 2 (Bhuntar)
- Average concentration values for the monitoring period ranged from BDL to 11.1µg/m^3.
- All values observed were below the CPCB norms for rural, residential area and other areas.

The observed SO_2values are depicted graphically in ***Figure 4.8.***

Figure 4.8 Sulphur-dioxide



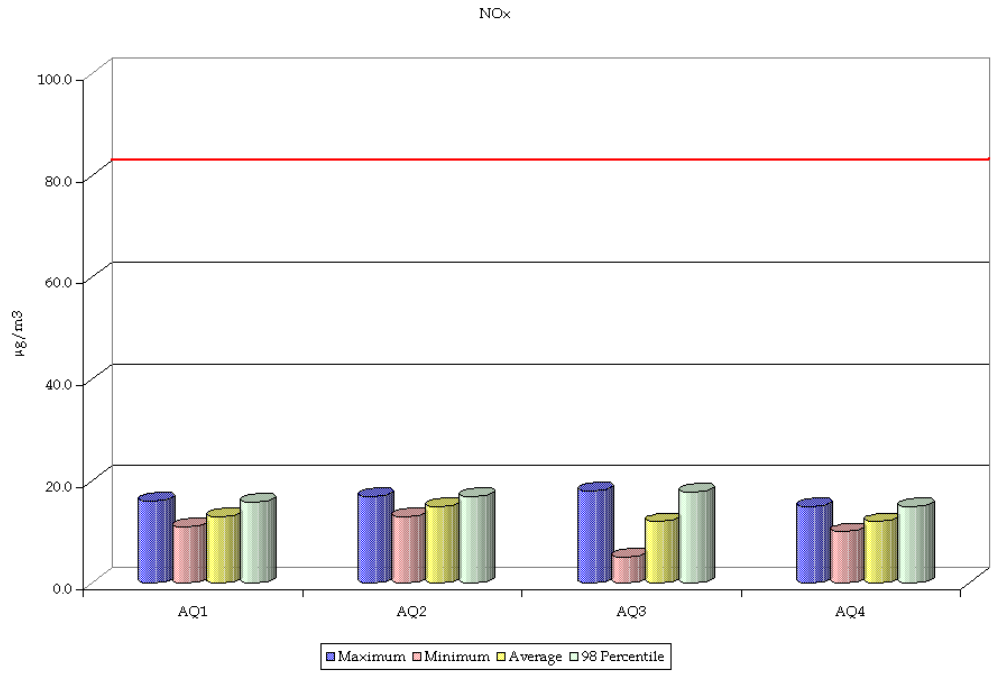
Nitrogen Oxides (NO_x)

The NO_x concentration observed during the monitoring period range between 5.0µg/m^3 to 18.0µg/m^3.

- AQ-3 (Swarghat) recorded the maximum concentration of 18.0µg/m^3
- The minimum concentration of 5.0µg/m^3 was recorded also at AQ-3 (Swarghat)
- Average concentration values for the monitoring period ranged from 12.0µg/m^3 to 15.0µg/m^3.
- All values observed were below the CPCB norms for rural, residential area and other areas.

The observed NO_x values are depicted graphically in ***Figure 4.9.***

Figure 4.9 Oxides of Nitrogen

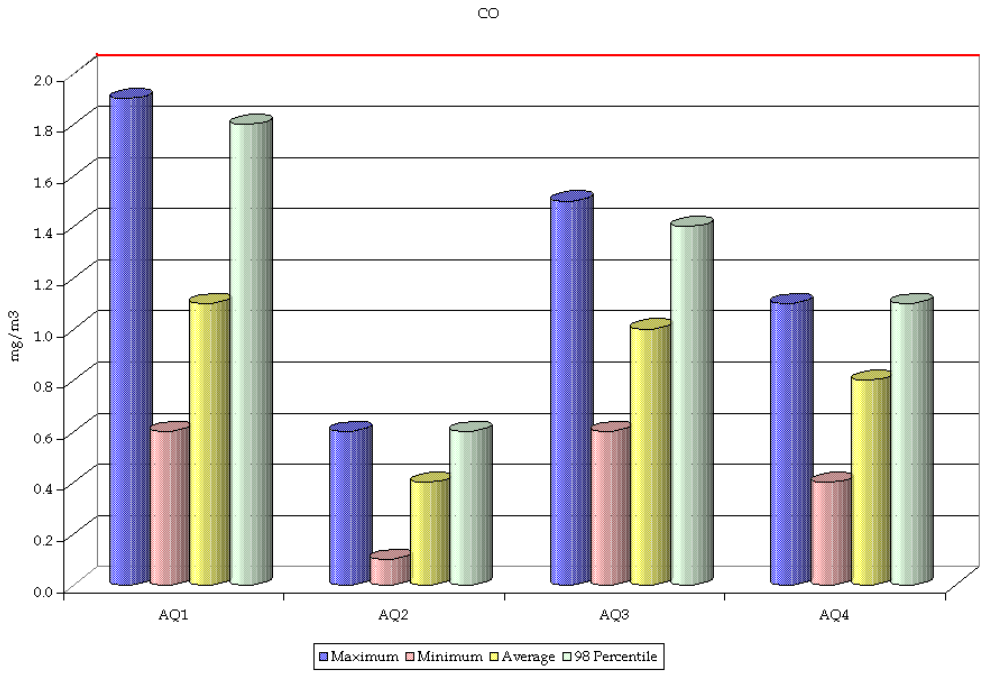


Carbon Mono-oxide (CO)

The CO concentration observed during the monitoring period ranged between 0.4mg/m^3 to 1.9mg/m^3.

- AQ-1 (Bhuntar) recorded the maximum concentration of 1.9mg/m^3
- The minimum concentration of 0.4mg/m^3 was recorded at AQ-4 (Nalagarh)
- Average concentration values for the monitoring period ranged from 0.4mg/m^3 to 1.1mg/m^3.
- The concentrations of CO were within the CPCB norms of 2mg/m^3 for rural, residential area at all locations along the transmission line. The observed CO values are depicted graphically in ***Figure 4.10.***

Figure 4.10 CO concentration



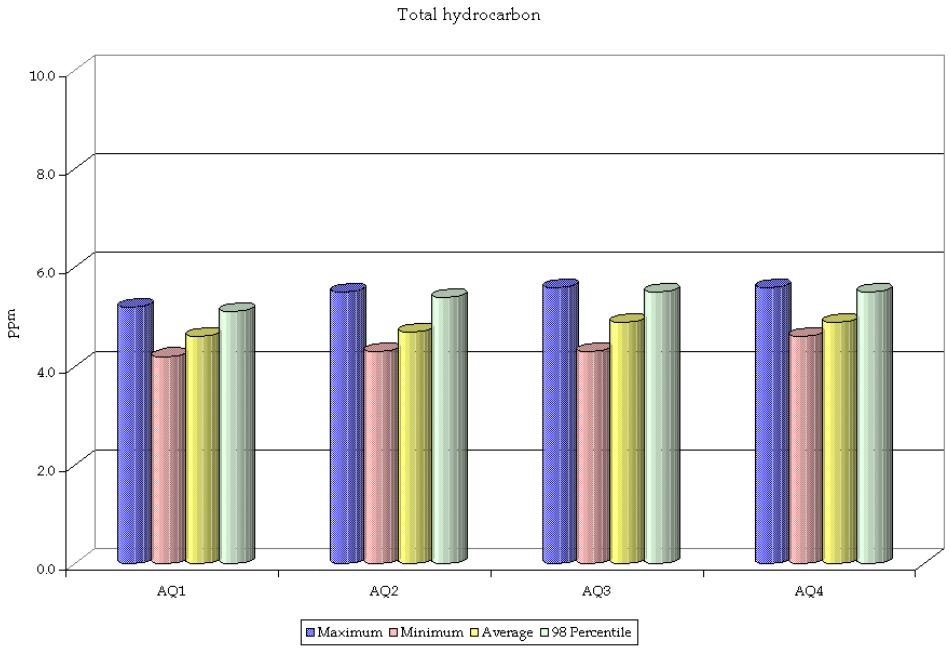
Total Hydro carbon

The THC concentration observed during the monitoring period ranged between 4.2mg/m^3 to 5.6mg/m^3.

- AQ-3 & AQ-4(Swarghat and Nalagarh) recorded the maximum concentration of 5.6mg/m^3
- The minimum concentration of 4.2mg/m^3 was recorded at AQ-1 (Bhuntar)
- Average concentration values for the monitoring period ranged from 4.6mg/m^3 to 4.9mg/m^3.

The observed THC values are depicted graphically in ***Figure 4.11.***

Figure 4.11 Total Hydrocarbon



4.2.8 Ambient Noise Quality

The background ambient noise levels in the area were monitored once for 24 hours at six locations along the route of transmission line. Noise levels were recorded with the help of a digital noise level meter. Noise level were recorded for 24 hours and the noise quality is reported as $L_{(min)}$, $L_{(max)}$,L_{eqday} and $L_{eqnight}$ for each of the six locations .
Daytime is considered from 0600 AM to 2200 hours and night from 2200 to 0600 hours. The details of noise monitoring locations are given in ***Table 4.15***.

Table 4.15 Noise Monitoring Location

Sample code	Location	Coordinates
NL-1	Patli Kuhl, district Kullu	32º 06′ 50.5 N 77º 09′ 05.8E
Nl-2	Kullu, district Kullu	31º 58′ 17.0 N 77º 07′ 38.7E
NL-3	Bhuntar, district Kullu	31º 54′ 21.1 N 77º 07′ 57.4E
Nl-4	Sunder Nagar, district Mandi	31º 32′ 15.0 N 76º 53′ 39.7E
NL-5	Dehar, district Mandi	31º 26′ 00.9N 76º 49′ 51.0E
NL-6	Nalagarh, district Solan	31º 07′ 49.4N 76º 39′ 58.4E

Observations

The recorded noise levels in the study area are summarised in ***Table 4.16*** and ***Figure 4.13.*** Details of results are given in ***Annex C.***

Table 4.16 Observed Noise Quality

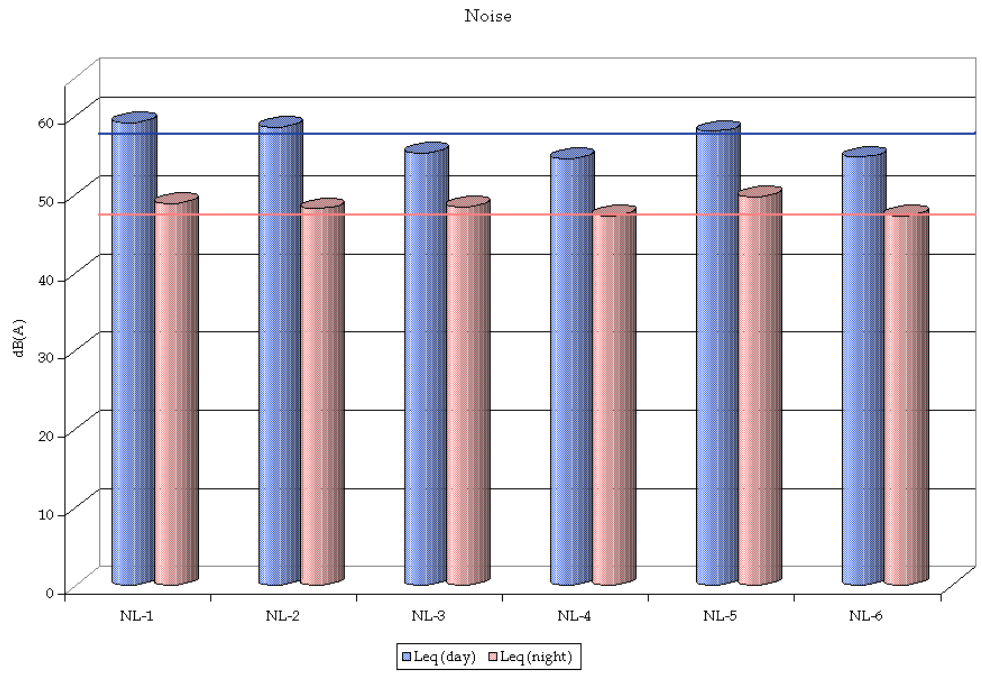
Description	NL-1	NL-2	NL-3	NL-4	NL-5	NL-6
Day time (0700 to 2200 hours)	dB (A)	dB (A)	dB (A)	dB (A)	dB (A)	dB (A)
Minimum	56.3	54.3	51.2	49.2	48.3	49.8
Maximum	61.8	61.6	59.0	59.3	62.0	58.7
Equivalent Noise level day time ($L_{eq\ Day}$)	59.2	58.6	55.3	54.6	58.1	54.8
Prescribed Standard $L_{eq\ day}$	55	55	55	55	55	55
Night time (2200 to 0700 hours)						
Minimum	43.2	44.2	42.8	43.9	46.4	42.7
Maximum	57.8	55.7	55.3	49.7	54.3	51.0
Equivalent Noise level day time ($L_{eq\ Night}$)	48.9	48.2	48.4	47.3	49.7	47.3
Prescribed Standard $L_{eq\ night}$	45	45	45	45	45	45

Discussion of Results

The observations from noise monitoring indicate the following:

- The equivalent day-time noise level $L_{eq\ day}$ values varied from 54.6 to 59.2dB (A) as against its prescribed standard for residential and rural area for day time of 55 dB(A). The values were observed exceeded at NL-1, NL-2, NL-3 and NL-5.
- The equivalent night-time noise levels L_{eq} night varied from 47.3 dB (A) to 49.7 dB(A) as against the prescribed standard for residential area for night time of 45 dB(A).
- The equivalent noise levels for day and night time ($L_{eq\ day}$ and $L_{eq\ night}$) were observed to exceed the prescribed standards for residential areas mainly due to noise from nearby running rivers/rivulets and traffic on national highway.

Figure 4.12 Noise Level Observations



4.2.9 Traffic Density

Traffic movements were observed on National Highways NH-21 and NH-21A which cross the transmission line route at a few locations. Most of the traffic on national highways is due to tourist movement for Kullu and Manali. However, heavy vehicle movement is also high in Bilaspur and Mandi stretch of the highway because of mining and industries activities in these areas.

Traffic monitoring was conducted at two locations for a period of 24 hours. The locations monitored for traffic movement areas given in ***Table 4.17.***

Table 4.17 Locations of Traffic Survey

S N	Location Code	Location
1	TD-1	NH 21A (Nalagarh-Swarghat)
2	TD-2	NH-21 (Kullu- Panarsa)

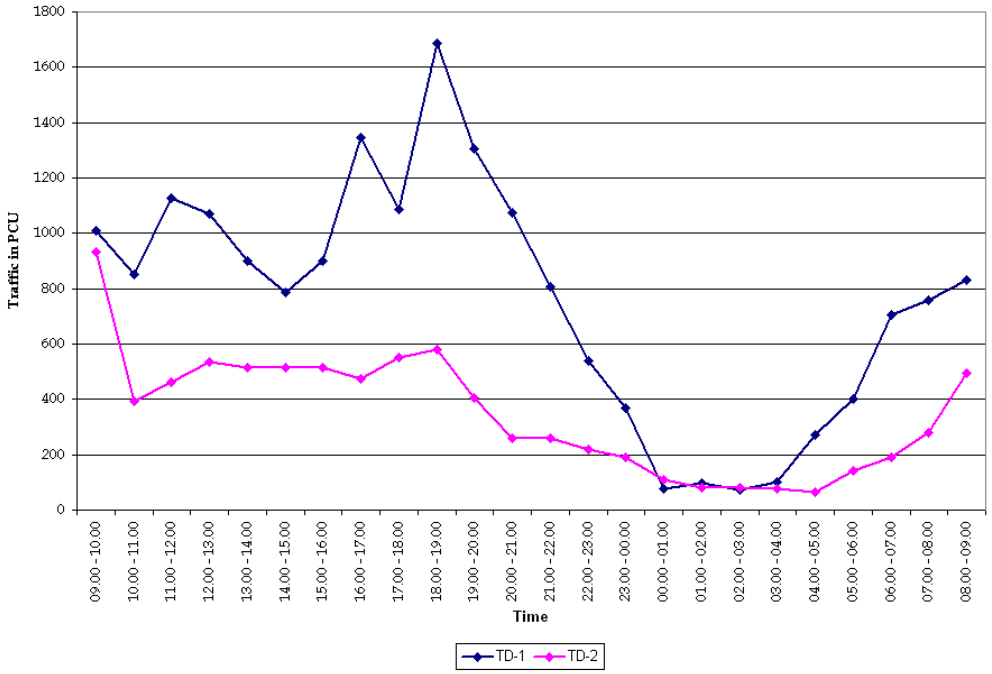
The recorded observations are given in ***Annex B*** and are summarised in ***Table 4.18.***

Table 4.18 Existing Traffic Volumes (Equivalent to Passenger Car Units)

Description	TD-1	TD-2
Total Traffic PCU/24 Hours	18177	8340
Peak Flow-Morning (PCU)	1128	932
Peak Flow-Evening (PCU)	1686	578

Traffic density was observed to be high on the National Highway 21A due to movement of large number of heavy vehicles for industrial use. Two wheelers were observed as the primary mode of transport for local people while LMV were mostly engaged by tourists and long distance travellers. The traffic flow is graphically depicted in the ***Figure 4.13.***

Figure 4.13 Observed Traffic Flow



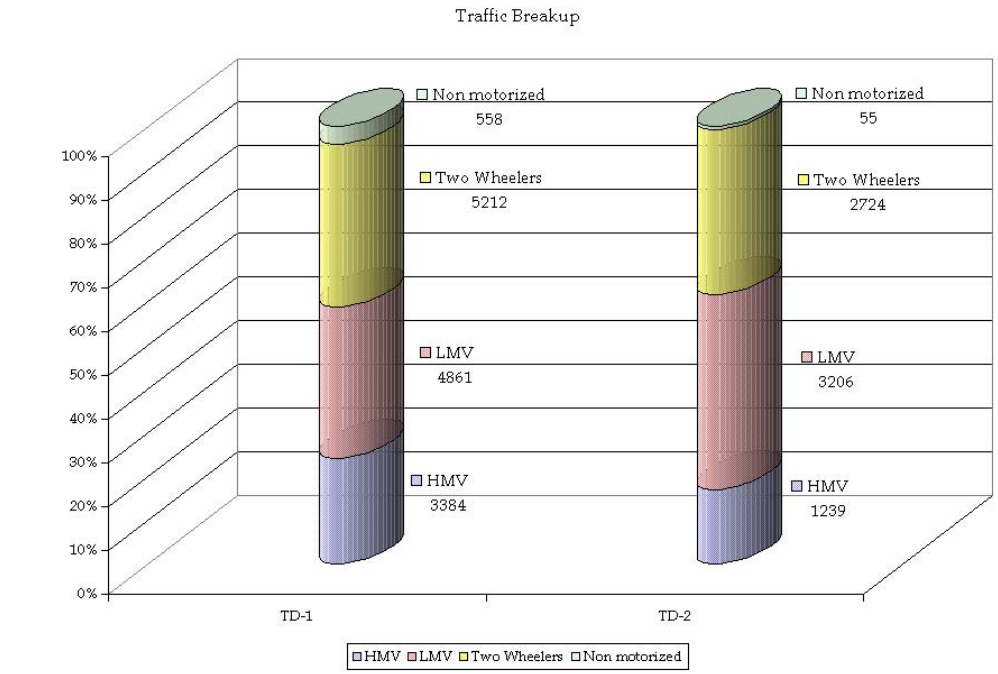
The percentage composition of vehicle types observed at the monitoring location is presented in ***Table 4.19.***

Table 4.19 Traffic Type % Composition

	HMV	LMV	Two Wheelers	Non motorized
TD-1	24.14	34.68	37.19	3.98
TD-2	17.15	44.38	37.70	0.76

A large percentage of the traffic movement in the area is predominantly Heavy Motor Vehicles and Light Motor Vehicles. The break up of traffic is graphically presented in ***Figure 4.14***

Figure 4.14 Traffic Break up



4.2.10 Biological Environment

An ecological assessment along the route of transmission line was conducted to assess the flora and fauna of the area in proximity to the towers. ERM engaged ecologists to undertake the ecological survey to document the flora and fauna of the area, with an added focus on endemic, protected or endangered species and to identify sites used for wildlife activities such as foraging, roosting, breeding, nesting or as migration paths.

Methodology for the Study

The primary study focussed on ecological conditions prevailing 100m either side of the transmission line. In all thirty one transects were selected within the transmission line corridor besides a general survey of the area. A transect was selected in roughly every 6 km of the corridor, and a reasonable range of ecosystem types and land-use were represented.

Data collected comprised of the physical attributes of the corridor with respect to flora and fauna observed within area, evidence of wildlife such as nests, webs, burrows, scats, foot-prints or signs of digging or scratching and pertinent information gleaned from local people.

Secondary data was also collected from the State Forest Department and various publications.

Climatic Conditions during the Survey

The ecological survey was carried out from 16 to 22 April 2008. The period was marked by humid, cloudy weather with a few sudden spells of rain in the earlier part and by relatively sunny days with clear skies in the later part. The survey was initiated from the substation at Nalagarh and concluded near the switch yard in Manali.

Overview of the Corridor

The total stretch of the transmission line fall in three ecological zones starting from Manali as Temperate Zone Forest, Middle Montane Zone Forest and Lower Montane Zone Forest before it reaches at Nalagarh. The altitude of the survey area ranged from 1981 to 556 m amsl.

The higher altitudes are relatively inaccessible areas like steep slopes, cliff faces and ravines seem to support a higher proportion of indigenous species.

The lower altitudes are quite densely populated and human activities show a great effect on the flora and fauna in this stretch. Large areas have been cleared of the original forest cover and are now terraced for cultivation or used for grazing. The existing forest patches are also modified through cutting for firewood, lopping for fodder, animal grazing and accidental or intentional burning. In such areas many exotic species and secondary growth are expected.

The transmission line passes through eleven Protected Forests besides other areas declared as forestland. The Protected Forests falling near and within the route are given in the ***Table 4.20***.

Table 4.20 Forest Resources falling within the Transmission Line Corridor and located in its vicinity

Forests in the vicinity of the Project Transmission Line Corridor	Forests falling within the Project Transmission Line Corridor
Sajlashil P.F.	Ledichalaun P.F.
Deoban P.F.	Kandi P.F.
Hilgan Kalaun P.F.	Shahita P.F.
Borsu P.F.	Khoru thatch P.F.
Maolghar P.F.	Masu Dhimkri P.F.
Katiras P.F. (Open pine)	Shil P.F. (Open Pine)
Macchrot P.F. (Open Pine)	Khoti P.F (Open mixed)
Jabrat P.F.	Bagyodh P.F. (mixed jungle)
Baila P.F.	Taralaja Garaunti (Fairly dense pine)
Chamrara P.F.	Buryans P.F.
Kasal P.F.	LuhundP.F.
Hundakar P.F.	
Kalamb P.F.	

PF: Protected Forest

Details of Selected Transects

A series of transects were identified all along the transmission line from Manali to Nalagarh within 100m on either side of the corridor. A total of thirty one transects falling in forest area, road side, close to water bodies; village, valleys, mountain etc. were identified to obtain a true representation of fauna and flora of the area. The geographical coordinates and the landuse of the locations sample for ecological survey are as given the ***Table 4.21.***

Table 4.21 Details of the Transects

Site No	Latitude	Longitude	Altitude (m)	Landuse
Stretch -1: Temperate Zone Forest				
1	31°50′0.3″ N	77°11′22.2″ E	1131	Orchards
2	31°50′45.3″ N	77° 11′44.6″ E	1662	Coniferous forest
3	31°54′32.5″ N	77° 10′48.2″ E	1429	Barren Hill
4	31°56′33.5″ N	77° 8′17″ E	1981	Hill-slope orchards
5	32°00′37″ N	77° 08′13.9″ E	1370	Forest, Orchards
6	32°03′57.3″ N	77° 08′12.8″ E	1427	Roadside
7	32°8′26.4″ N	77° 10′21.3″ E	1676	Roadside
8	32°12′36.9″ N	77° 11′58.3″ E	1851	Roadside
9	32°13′29.8″ N	77° 12′23.1″ E	1933	Power station area
Stretch -2: Middle Montane Zone Forest				
10	31°31′28.4″ N	76°52′0″ E	916	Orchards on steep slope
11	31°35′19.9″ N	76°56′4.8″ E	783	Canal-side flat land
12	31°35′12.2″ N	76°59′35″ E	1473	Chir Forest
13	31°35′56.8″ N	77°2′2.6″ E	1365	Orchard
14	31° 37′27.5″ N	77°03′42.6″E	1235	Hilltop broadleaf forest
15	31°39′36.5″ N	77° 2′48.3″ E	927	River-side
16	31°41′7.7″ N	77° 4′50.5″ E	1266	Barren hill slope
17	31°42′45.5″ N	77° 11′15.2″ E	1027	Bouldery stream
18	31°44′30.4″ N	77° 11′56.1″ E	1426	Steep slope
19	31°46′3.0″ N	77° 11′42″ E	1205	Steep slope
20	31°47′26.2″ N	77° 11′50.2″ E	1033	Riverside road
Stretch – 3: Lower Montane Zone Forest				
21	31° 05′59.4″ N	76° 41′12.9″ E	366	Near highway
22	31°10′54.9″ N	76°41′12.6″ E	575	Forested hill
23	31°11′12.2″ N	76° 41′27.9″ E	584	Shrub-covered valley-side
24	31°14′12.6″ N	76° 43′24″ E	1074	Roadside slopes
25	31°14′52.3″ N	76° 45′4.4″ E	621	Village commons
26	31°15′43.7″ N	76° 46′19.9″ E	964	Hilltop
27	31°18′43.8″ N	76° 48′44.7″ E	696	Stream-bed
28	31°22′10.5″ N	76° 48′37.6″ E	586	River-side
29	31° 23′35.5″ N	76° 48′46.6″ E	712	Rocky cliff, Terraced fields
30	31°26′5.1″ N	76° 50′1.4″ E	556	Stream-side slope
31	31°28′57.7″ N	76° 51′25″ E	930	Cultivation near hill-stream

Details of Flora Observed along the Transmission Line Corridor

The details of the flora were collected on basis of the zones as described in the earlier section. A detailed list of flora observed along with their IUCN red list category is provided in the following subsections. The criteria and for categorisation of IUCN red list is attached as ***Annex H***.

Stretch - 1

Transect 1 to 9, represent Temperate Zone Forest. Its dominant tree species are *Aesculus indicus*, *Alnus nitida*, *Cedrus deodara*, *Picea morinda*, *Pinus wallichiana*, *Quercus dilatata* and *Juglans regia*. A detailed list of trees observed in the zone 3 is provided as ***Table 4.22.***

Table 4.22 List of Trees Observed in Temperate Zone Forest

	Botanical Name	Habit	Conservation Status[1]
1	*Aesculus indica*	Tree	-
2	*Alnus nitida*	Tree	-
3	*Cedrela toona*	Tree	-
4	*Cedrus deodara*	Tree	-
5	*Dalbergia sissoo*	Tree	-
6	*Ficus palmate*	Tree	-
7	*Ficus roxburghii*	Tree	-
8	*Juglans regia*	Tree	-
9	*Morus serrata*	Tree	-
10	*Olea cuspidate*	Tree	-
11	*Picea morinda*	Tree	LR/lc [2]
12	*Pinus roxburghii*	Tree	LC [2]
13	*Pinus wallichiana*	Tree	LC [2]
14	*Populus ciliate*	Tree	-
15	*Prunus armeniaca*	Tree	-
16	*Prunus communis*	Tree	-
17	*Prunus persica*	Tree	-
18	*Punica granatum*	Tree	-
19	*Pyrus communis*	Tree	-
20	*Pyrus malus*	Tree	-
21	*Pyrus pashia*	Tree	-
22	*Quercus dilatata*	Tree	-
23	*Quercus glauca*	Tree	-
24	*Quercus incana*	Tree	-
25	*Robinia pseudoacacia*	Tree	-
26	*Salix elegans*	Tree	-
27	*Salix tetrasperma*	Tree	-
28	*Sapindus mukurossi*	Tree	-
29	*Zanthoxylum alatum*	Tree	-

1 – According to IUCN Categories for Red Data List – Versions 2.3 (1994) and 3.1(2001)
CR: Critically Endangered; DD: Data Deficient; EX: Extinct; EW: Extinct in Wild; EN: Endangered; LC: Least Concern; NT: Near Threatened; NE: Not evaluated; VU: Vulnerable;

The dominant shrubs species of the temperate zone forest are *Berberis aristata* and *Prinsepia utilis.* The list of climbers, herbs and shrubs identified in the temperate zone forest is provided in ***Table 4.23.***

Table 4.23 List of Climbers, Herbs and Shrubs identified in the Temperate Zone Forest

	Botanical Name	Habit	Conservation status[1]
1	*Rosa moschata*	Climber	-
2	*Aquilegia fragrans*	Herb	-
3	*Barleria sp.*	Herb	-
4	*Cannabis sativa*	Herb	-
5	*Coix lachryma-jovi*	Herb	-
6	*Girardinia heterophylla*	Herb	-
7	*Oxalis corniculata*	Herb	-

	Botanical Name	Habit	Conservation status[1]
8	*Rumex hastatus*	Herb	-
9	*Tephrosia candida*	Herb	-
10	*Veronica persica*	Herb	-
11	*Agave angustifolia*	Shrub	-
12	*Berberis aristata*	Shrub	-
13	*Prinsepia utilis*	Shrub	--
14	*Rubus ellipticus*	Shrub	-
15	*Zizyphus jujuba var. fruticosa*	Shrub	-

1 – According to IUCN Categories for Red Data List – Versions 2.3 (1994) and 3.1(2001)
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Stretch: - 2

Transect 12 to 22 represent Middle Montane Zone Forest. The dominant tree species of this type are *Albizzia stipulata*, *Cedrela toona*, *Celtis australis*, *Ficus palmata*, *Ficus roxburghii*, *Melia azederach*, *Pinus roxburghii*, *Populus ciliata*, *Salix spp*. and *Ulmus wallichiana*. The details of trees observed in the Stretch - 2 are provided in ***Table 4.24.***

Table 4.24 Trees observed in the Middle Montane Zone

S N	Botanical Name	Habit	Conservation Status[1]
1	*Albizzia stipulate*	Tree	-
2	*Bauhinia variegate*	Tree	-
3	*Bombax ceiba*	Tree	-
4	*Cedrela toona*	Tree	-
5	*Cedrus deodara*	Tree	-
6	*Celtis australis*	Tree	-
7	*Citrus decumana*	Tree	-
8	*Dalbergia sissoo*	Tree	-
9	*Dendrocalamus strictus*	Tree	-
10	*Ficus palmate*	Tree	-
11	*Ficus religiosa*	Tree	-
12	*Ficus roxburghii*	Tree	-
13	*Flacourtia ramontchi*	Tree	-
14	*Grewia oppositifolia*	Tree	-
15	*Juglans regia*	Tree	-
16	*Lannaea grandis*	Tree	-
17	*Leucaena leucocephala*	Tree	-
18	*Mallotus philippinensis*	Tree	-
19	*Mangifera indica*	Tree	-
20	*Morus serrata*	Tree	-
21	*Myrica esculenta*	Tree	-
22	*Phoenix acaulis*	Tree	-
23	*Phoenix humilis*	Tree	-
24	*Pinus roxburghii*	Tree	LC[2]
25	*Pistacia integerrima*	Tree	-
26	*Populus ciliate*	Tree	-
27	*Prunus cerasoides*	Tree	-
28	*Prunus communis*	Tree	-
29	*Punica granatum*	Tree	-
30	*Pyrus communis*	Tree	-
31	*Pyrus pashia*	Tree	-
32	*Quercus glauca*	Tree	-
33	*Quercus incana*	Tree	-
34	*Rhododendron arboretum*	Tree	-

S N	Botanical Name	Habit	Conservation Status[1]
35	*Robinia pseudoacacia*	Tree	-
36	*Salix elegans*	Tree	-
37	*Salix tetrasperma*	Tree	-
38	*Sapium insigne*	Tree	-
39	*Syzigium cumini*	Tree	-
40	*Ulmus wallichiana*	Tree	VU A1c [2]
41	*Zanthoxylum alatum*	Tree	-

1 – According to IUCN Categories for Red Data List – Versions 2.3 (1994) and 3.1(2001)
CR: Critically Endangered; DD: Data Deficient; EX: Extinct; EW: Extinct in Wild; EN: Endangered; LC: Least Concern; NT: Near Threatened; NE: Not evaluated; VU: Vulnerable;

The common shrubs observed in the Stretch 2 are *Vitex negundo* and *Woodfordia fruticosa*. The detailed list of climbers, herbs and shrubs is provided in ***Table 4.25.***

Table 4.25 List of climbers, herbs and shrubs in the Middle Montane Forest zone

S N	Botanical Name	Habit	Conservation Status[1]
1	*Herpetospermum pedunculosum*	Climber	-
2	*Rosa moschata*	Climber	-
3	*Ageratum conyzoides*	Herb	-
4	*Asclepias curassavica*	Herb	-
5	*Asparagus filicinus*	Herb	-
6	*Barleria sp.*	Herb	-
7	*Brassica juncea*	Herb	-
8	*Brassica rapa*	Herb	-
9	*Cannabis sativa*	Herb	-
10	*Chloris barbatus*	Herb	-
11	*Coix lachryma-jovi*	Herb	-
12	*Cynodon dactylon*	Herb	-
13	*Eupatorium adenophorum*	Herb	-
14	*Evolvulus alsinoides*	Herb	-
15	*Fragaria nubicola*	Herb	-
16	*Gentiana sp.*	Herb	-
17	*Girardinia heterophylla*	Herb	-
18	*Hypericum oblogifolium*	Herb	-
19	*Ischaemum angustifolium*	Herb	-
20	*Loranthus sp.*	Herb	-
21	*Opuntia dillenii*	Herb	-
22	*Oxalis corniculata*	Herb	-
23	*Parthenium hysterophorus*	Herb	-
24	*Raphaenus sativus*	Herb	-
25	*Rumex hastatus*	Herb	-
26	*Sibbaldia cuneata*	Herb	-
27	*Sida acuta*	Herb	-
28	*Solanum indicum*	Herb	-
29	*Agave angustifolia*	Shrub	-
30	*Adhatoda vasica*	Shrub	-
31	*Berberis aristata*	Shrub	-
32	*Carissa spinarum*	Shrub	-
33	*Cotoneaster microphylla*	Shrub	-
34	*Euphorbia royleana*	Shrub	-
35	*Ipomoea carnia*	Shrub	-
36	*Murraya coenigii*	Shrub	-
37	*Nerium odorum*	Shrub	-
38	*Prinsepia utilis*	Shrub	-
39	*Randia tetrasperma*	Shrub	-

S N	Botanical Name	Habit	Conservation Status[1]
40	*Rubus ellipticus*	Shrub	-
41	*Strobilanthes sp.*	Shrub	-
42	*Vitex negundo*	Shrub	-
43	*Woodfordia fruticosa*	Shrub	-
44	*Zizyphus jujuba var. fruticosa*	Shrub	-

1 – According to IUCN Categories for Red Data List – Versions 2.3 (1994) and 3.1(2001)
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Stretch - 3

The first 11 transects are representative of Lower Montane Zone Forest. The dominant tree species are *Acacia catechu*, *Albizzia procera*, *Bauhinia variegata*, *Bombax ceiba*, *Dalbergia sissoo*, *Grewia oppositifolia*, *Lannaea grandis*, *Mallotus philippinensis* and *Sapium insigne*. The detailed list of trees observed in Stretch-3 is as given in ***Table 4.26***.

Table 4.26 Trees observed in Lower Montane Zone

SN	Botanical Name	Habit	Conservation Status[1]
2	*Acacia Arabica*	Tree	-
3	*Acacia catechu*	Tree	-
4	*Aegle marmelos*	Tree	-
5	*Albizzia procera*	Tree	-
6	*Artocarpus integrifolia*	Tree	-
7	*Azadirachta indica*	Tree	-
8	*Bauhinia variegate*	Tree	-
9	*Bombax ceiba*	Tree	-
10	*Butea monosperma*	Tree	-
11	*Callicarpa macrophylla*	Tree	-
12	*Cassia fistula*	Tree	-
13	*Cedrela toona*	Tree	-
14	*Dalbergia sissoo*	Tree	-
15	*Dendrocalamus strictus*	Tree	-
16	*Emblica officinalis*	Tree	-
17	*Eriobotrya japonica*	Tree	-
18	*Erythrina suberosa*	Tree	-
19	*Eucalyptus globules*	Tree	-
20	*Ficus bengalensis*	Tree	-
21	*Ficus hispida*	Tree	-
22	*Ficus palmate*	Tree	-
23	*Ficus religiosa*	Tree	-
24	*Ficus roxburghii*	Tree	-
25	*Flacourtia ramontchi*	Tree	-
26	*Grevillea robusta*	Tree	-
27	*Grewia oppositifolia*	Tree	-
28	*Lannaea grandis*	Tree	-
29	*Leucaena leucocephala*	Tree	-
30	*Mallotus philippinensis*	Tree	-
31	*Mangifera indica*	Tree	-
32	*Melia azedarach*	Tree	-
33	*Mitragyna parvifolia*	Tree	-
34	*Moringa pterygosperma*	Tree	-
35	*Morus serrata*	Tree	-
36	*Phoenix acaulis*	Tree	-
37	*Pinus roxburghii*	Tree	-
38	*Populus ciliate*	Tree	-

SN	Botanical Name	Habit	Conservation Status[1]
39	*Premna latifolia mucronata*	Tree	-
40	*Psidium guyava*	Tree	-
41	*Punica granatum*	Tree	-
42	*Randia dumetorum*	Tree	-
43	*Robinia pseudoacacia*	Tree	-
44	*Salix elegans*	Tree	-
45	*Salix tetrasperma*	Tree	-
46	*Samanea saman*	Tree	-
47	*Sapium insigne*	Tree	-
48	*Syzigium cumini*	Tree	-
49	*Wendlandia exserta*	Tree	-

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The common associated shrub species are *Adhatoda vasica*, *Carissa spinarum*, *Dodonaea viscosa* and *Murraya koenigii*. The detailed list of climbers, herbs and shrubs are presented in ***Table 4.27.***

Table 4.27 Climbers, herbs, Shrubs in the Lower Montane Zone

	Botanical Name	Habit	Conservation status[1]
1	*Abrus precatorius*	Climber	-
2	*Bauhinia vahlii*	Climber	-
3	*Capparis sepiaria*	Climber	-
4	*Cissampelos pareira*	Climber	-
5	*Combretum decandrum*	Climber	-
6	*Cuscuta reflexa*	Climber	-
7	*Achyranthus aspera*	Herb	-
8	*Aerua scandens*	Herb	-
9	*Ageratum conyzoides*	Herb	-
10	*Amaranthus sp.*	Herb	-
11	*Argemone Mexicana*	Herb	-
12	*Asparagus filicinus*	Herb	-
13	*Barleria sp.*	Herb	-
14	*Boerhaavia diffusa*	Herb	-
15	*Cannabis sativa*	Herb	-
16	*Cassia sophera*	Herb	-
17	*Chloris barbatus*	Herb	-
18	*Chrysopogon Montana*	Herb	-
19	*Coix lachryma-jovi*	Herb	-
20	*Colocasia antiquorum*	Herb	-
21	*Commelina paludosa*	Herb	-
22	*Cynodon dactylon*	Herb	-
23	*Echinops cornigerus*	Herb	-
24	*Eupatorium adenophorum*	Herb	-
25	*Evolvulus alsinoides*	Herb	-
26	*Indigofera sp.*	Herb	-
27	*Ischaemum angustifolium*	Herb	-
28	*Leucas lanata*	Herb	-
29	*Musa sapientum*	Herb	-
30	*Opuntia dillenii*	Herb	-
31	*Oxalis corniculata*	Herb	-
32	*Parthenium hysterophorus*	Herb	-
33	*Rumex hastatus*	Herb	-
34	*Sida acuta*	Herb	-
35	*Sida rhombifolia*	Herb	-

	Botanical Name	Habit	Conservation status[1]
36	*Solanum indicum*	Herb	-
37	*Solanum xanthocarpum*	Herb	-
38	*Verbascum Thapsus*	Herb	-
39	*Vernonia roxburghii*	Herb	-
40	*Xanthium strumarium*	Herb	-
41	*Abutilon indicum*	Shrub	-
42	*Adhatoda vasica*	Shrub	-
43	*Carissa spinarum*	Shrub	-
44	*Dodonaea viscose*	Shrub	-
45	*Euphorbia royleana*	Shrub	-
46	*Ipomoea carnia*	Shrub	-
47	*Lantana camara*	Shrub	-
48	*Murraya coenigii*	Shrub	-
49	*Strobilanthes sp.*	Shrub	-
50	*Tecoma stans*	Shrub	-
51	*Woodfordia fruticosa*	Shrub	-
52	*Zizyphus jujuba var. fruticosa*	Shrub	-

1 – According to IUCN Categories for Red Data List – Versions 2.3 (1994) and 3.1(2001)
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4.2.11 Details of fauna observed along the route of transmission line

The study being a short term survey, indirect methods of research assumed added significance since wild fauna tend to be seasonal in occurrence and are not encountered at all times. The fauna observed points to the possible occurrence of pre-requisite or dependant species.

Terrestrial

Invertebrates sighted, or signs thereof, included Ladybirds, Dragonflies, Damselflies, Butterflies, Ants and Bees, tunnel spider webs, ant-hills, termite-hills and paper-wasp nests (high up in Bombax, Poplar or Eucalyptus trees.) Crickets were heard in sites with luxuriant groundcover. Frog calls were invariably heard near water bodies.

A pair of Kashmiri Rock Agamas *(Laudakia tuberculata)* was spotted along the transmission line. An Indian Mongoose *(Herpestes auropunctatus)*, a schedule II animal, was also spotted.
Hare droppings were found at some forested transects, while dung pellets of some herbivore were found at one transect. Local residents of various areas report wild hares, barking deer, wild goats, wild boars, langurs and macaques. Dug up earth in an orchard that was part of one survey transect, bore evidence to a nocturnal visit by wild boars.

Avifauna

A large number of birds were observed along the route of the transmission line. Among which the Indian Peafowl and White Rumped Vulture are listed as Schedule I of wildlife act. A decline in vulture population is also observed during the study. The list of birds observed along the transmission line is presented in ***Table 4.28.***

Table 4.28 List of Avifauna observed along the transmission line

	Zoological Name	Common Name	Protection Status	Conservation status[1]
1	*Accipiter badius*	Shikra	-	LC [2]
2	*Accipiter nisus*	Eurasian Sparrowhawk	-	LC [2]
3	*Acridotheres tristis*	Common Myna	-	LC [2]
4	*Aquila rapax*	Tawny Eagle	-	LC [2]
5	*Carpodacus erythrinus*	Common Rosefinch	-	LC [2]
6	*Columba livia*	Rock Pigeon	-	LC [2]
7	*Cinclus pallasii*	Brown Dipper	-	LC [2]
8	*Copsychus saularis*	Oriental Magpie Robin	-	LC [2]
9	*Coracias benghalensis*	Indian Roller	-	LC [2]
10	*Corvus macrorhynchos*	Large-billed Crow	-	LC [2]
11	*Corvus splendens*	House Crow	-	LC [2]
12	*Dendrositta formosae*	Grey Treepie	-	LC [2]
13	*Dendrositta vagabunda*	Rufous Treepie	-	LC [2]
14	*Dicaeum agile*	Thick-billed Flowerpecker	-	LC [2]
15	*Dicrurus hottentottus*	Spangled Drongo	-	LC [2]
16	*Dicrurus macrocercus*	Black Drongo	-	LC [2]
17	*Dicrurus remifer*	Lesser Racket-tailed Drongo	-	LC [2]
18	*Eudynamys scolopacea*	Asian Koel	-	LC [2]
19	*Falco tinnunculus*	Common Kestrel	-	LC [2]
20	*Ficedula tricolor*	Slaty-blue Flycatcher	-	LC [2]
21	*Gallus gallus*	Red Junglefowl	-	LC [2]
22	*Garrulax lineatus*	Streaked Laughingthrush	-	LC [2]
23	*Gyps bengalensis*	White-rumped Vulture	Schedule I	CR A2 ce+3ce [2]
24	*Gyps himalayensis*	Himalayan Griffon	-	LC [2]
25	*Halcyon smyrnensis*	White-throated Kingfisher	-	LC [2]
26	*Hierococcyx sparverioides*	Large Hawk Cuckoo	-	-
27	*Hirundo daurica*	Red-rumped Swallow	-	LC [2]
28	*Hypsipetes leucocephalus*	Black Bulbul	-	LC [2]
29	*Lanius tephronotus*	Grey-backed Shrike	-	LC [2]
30	*Megaceryle lugubris*	Crested Kingfisher	-	LC [2]
31	*Megalaima virens*	Great Barbet	-	LC [2]
32	*Megalaima zeylanica*	Brown-headed Barbet	-	LC [2]
33	*Merops leschenaulti*	Chestnut-headed Bee-eater	-	LC [2]
34	*Merops orientalis*	Green Bee-eater	-	LC [2]
35	*Milvus migrens*	Black Kite	-	LC [2]
36	*Motacilla maderaspatensis*	White-browed Wagtail	-	LC [2]
37	*Myophonus caeruleus*	Blue Whistling Thrush	-	LC [2]
38	*Nectarinia asiatica*	Purple Sunbird	-	LC [2]
39	*Ocyceros birostris*	Indian Grey Hornbill	-	LC [2]
40	*Oenantha pleschanka*	Pied Wheatear	-	LC [2]
41	*Oriolus oriolus*	Eurasian Golden Oriole	-	LC [2]
42	*Orthotomus sutorius*	Common Tailorbird	-	LC [2]
43	*Parus major*	Great Tit	-	-
44	*Passer domesticus*	House Sparrow	-	LC [2]
45	*Passer rutilans*	Russet Sparrow	-	LC [2]
46	*Pavo cristatus*	Indian Peafowl	Schedule I	LC [2]
47	*Pericrocotus erythropygius*	White-bellied Minivet	-	LC [2]
48	*Pericrocotus ethologus*	Long-tailed Minivet	-	LC [2]
49	*Pernis ptilorhyncus*	Oriental Honey-buzzard	-	LC [2]
50	*Picus xanthopygaeus*	Streak-throated Woodpecker	-	LC [2]
51	*Prinia hodgsonii*	Grey-breasted Prinia	-	LC [2]
52	*Psittacula cyanocephala*	Plum-headed Parakeet	-	LC [2]
53	*Psittacula himalayana*	Slaty-headed Parakeet	-	LC [2]
54	*Psittacula krameri*	Rose-ringed Parakeet	-	LC [2]
55	*Pycnonotus cafer*	Red-vented Bulbul	-	LC [2]

	Zoological Name	Common Name	Protection Status	Conservation status[1]
56	*Pycnonotus leucogenys*	Himalayan Bulbul	-	LC [2]
57	*Pycnonotus leucotis*	White-eared Bulbul	-	LC [2]
58	*Pyrrhocorax graculus*	Yellow-billed Chough	-	LC [2]
59	*Rhyacornis fuliginosus*	Plumbeous Water Redstart	-	LC [2]
60	*Sarcogyps calvus*	Red-headed Vulture	-	CR A2 abcd +3 bcd + 4 abcd [2]
61	*Saxicola caprata*	Pied Bushchat	-	LC [2]
62	*Saxicola leucura*	White-tailed Stonechat	-	LC [2]
63	*Saxicoloides fulicata*	Indian Robin	-	LC [2]
64	*Streptopelia decaocto*	Eurasian Collared Dove	-	LC [2]
65	*Streptopelia orientalis*	Oriental Turtle Dove	-	LC [2]
66	*Streptopelia senegalensis*	Laughing Dove	-	LC [2]
67	*Sturnus pagodarum*	Brahminy Starling	-	LC [2]
68	*Terpsiphone paradise*	Asian Paradise-flycatcher	-	LC [2]
69	*Tringa ochropus*	Green Sandpiper	-	LC [2]
70	*Turdoides striatus*	Jungle Babbler	-	LC [2]
71	*Upupa epops*	Common Hoopoe	-	LC [2]
72	*Urocissa flavirostris*	Yellow-billed Blue Magpie	-	LC [2]
73	*Vanellus indicus*	Red-wattled Lapwing	-	LC [2]
74	*Zosterops palpebrosus*	Oriental White-eye	-	LC [2]

1 – According to IUCN Categories for Red Data List – Version 3.1(2001)
CR: Critically Endangered; DD: Data Deficient; EX: Extinct; EW: Extinct in Wild; EN: Endangered; LC: Least Concern; NT: Near Threatened; NE: Not evaluated; VU: Vulnerable.

The secondary literature review for fauna suggest presence of some more mammals and birds some of which are listed as Schedule I or II of the wild life act. The important /endemic mammals and birds reported from region besides those spotted during the survey are provided in ***Table 4.29.***

Table 4.29 List of important /endemic mammals and birds reported

	Common Name	Zoological Name	Protection Status	Conservation status[1]
1	Bharal	*Pseudois nayaur*	Schedule I	LC [3]
2	Cheer Pheasant	*Catreus wallichii*	Schedule I	VU C2 a (i) [3]
3	Goral	*Nemorhaedus goral*	-	LR/nt [2]
4	Himalayan Black Bear	*Selenarctos thibetanus*	Schedule I	VU A1 cd [2]
5	Himalayan Brown Bear	*Ursus arctos*	Schedule I	LR/lc [2]
6	Himalayan Monal	*Lophophorus impejanus*	Schedule I	LC [3]
7	Himalayan Mouse Hare	*Ochotona roylei*	-	LR/lc [2]
8	Himalayan Tahr	*Hermitragus jemlahicus*	Schedule I	VU A2 cde [2]
9	Himalayan Weasel	*Mustela sibirica*	Schedule II	LR/lc [2]
10	Ibex	*Capra ibex*	Schedule I	LR/lc [2]
11	Kalij Pheasant	*Lophura leucomelanos*	Schedule I	LC [3]
12	Kashmir Flying Squirrel	*Hylopetes fimbriatus*	Schedule II *	-
13	Koklass Pheasant	*Pucrasia macrolopha*	-	LC [3]
14	Lammergeier	*Gypaetus barbatus*	Schedule I	LC [3]
15	Panther	*Panthera pardus*	Schedule I	LC [3]
16	Red Fox	*Vulpes vulpes montana*	Schedule II	LC [3]
17	Serow	*Capricornis sumatraensis*	Schedule I	VU A2 cd [2]
18	Snow Leopard	*Panthera uncia*	Schedule I	EN C2 A(i) [3]
19	Stone Marten	*Martes foina intermedia*	Schedule II	-
20	Western Tragopan	*Tragopan melanocephalus*	Schedule I	VU C2 a (i) [3]
21	Yellow-throated Marten	*Martes flavigula*	Schedule II	LR/lc [2]

1 – According to IUCN Categories for Red Data List – Version 3.1(2001)
CR: Critically Endangered; DD: Data Deficient; EX: Extinct; EW: Extinct in Wild; EN: Endangered; LC: Least Concern; NT: Near Threatened; NE: Not evaluated; VU: Vulnerable;

Migration of Avifauna

The corridor of the transmission line does not coincide with or cross any of the major international avian flyways known at the time of this report. There is, however, evidence that some birds migrate directly across the Himalayas without using known flyways. Some others undertake east-west movements along the Himalayas. The migratory paths of birds from either of these categories are likely to cross the transmission line corridor. Again, with most residential Himalayan bird species known to be altitudinal migrants, it is inevitable that winter, summer as well as weather-dependant local north-south migrations occur throughout the survey area.

It may be noted that information on migration routes in the region is still patchy.

Areas under Ramsar Convention

The proposed transmission line corridor does not cover any area identified under the Ramsar Convention to which India is a signatory.

4.3 SOCIO-ECONOMIC ENVIRONMENT

This sub-section presents the socio-economic profile of the community and the affected persons in terms of their religion, education levels, occupational profile and income levels. This profile is based on secondary literature, the walk-through, visual survey and limited consultations with the community and their representatives in the four districts through which the transmission line passes. The stakeholders consulted included titleholders; whose land parcels have been directly impacted due to the construction of the tower, those land parcel owners which will have overhead power lines, stakeholders who will be temporarily impacted due to access needs for the construction, erection and stringing processes and others (like NGOs, civil society groups etc) who may have a direct or indirect influence on the project and its activities.

4.3.1 Location and Project Area

For the purpose of defining the baseline environment and socio-economic profile, the project area is taken as a corridor of 100 meters (1) along the centre line of the transmission line; and the project site of substation.

The 174.66 km long transmission line passes through four districts of the state of Himachal Pradesh namely Kullu, Mandi, Bilaspur and Solan. The total area falling in the corridor along with tower locations is expected to be 611.31 ha. Out of this, private land requirement is 390.3 ha constituting project affected

(1) There is currently no government legislation specifying the RoW for transmission lines

people of approximately 1500 to 2000. The route of the transmission line is divided as snow zone (from Prini to Panarsa) and non-snow zone (from Panarsa to Nalagarh). The snow zone represents the stretch in the Kullu district, the non-snow zone represents the stretch in Mandi, Bilaspur and Solan districts.

The table below summarises the details of the project location and its spread across different zones.

Table 4.30 Project Location

Zone	District	Length (km)	Villages/ GPs	Towers (No) Private /Forest		Approximate Area (ha) /		Total Area
Snow Zone				**Private**	**Forest**	**Private**	**Forest**	
	Kullu	57.16	24	167	50	135.7	64.3	200.06
Non-Snow Zone	Kullu	1.3	-	4	0	4.55	-	4.55
	Mandi	70.3	63	145	54	150	96	246.05
	Bilaspur	28.5	~15	67	29	60	39	99.75
	Solan	17.4	~11	51	13	40	20	60.90
Total		**174.66**		**434**	**146**	**390.25**	**155**	**611.31**

GP: Gram Panchayat (village level governing body)

4.3.2 Demography

The four districts falling in the route of transmission line (i.e. Kullu, Mandi, Bilaspur and Solan) cover an area of 12,556 sq km (comprising about 23% of the state's total area) and about 17 percent of the total population of the state. The population is predominantly rural (approximately 90 percent) and settlements are mostly dispersed. However, this rural characteristic of the area is changing especially along the urban and semi-urban conglomerates where the urban growth rate has exceeded the average growth rate of the state (11 percent) by around 20-30 percent. These urban pockets are some of the most densely populated region in the state, with Bilaspur having an overall density of 292 persons per sq km (urban- 1259) and Solan having 258 persons per sq km (urban- 2743) as against the state average of 109 (the only district to have a higher population density is Hamirpur- 369). The rural and urban density in hilly regions shows a sharp contrast in districts like Kullu which have a low rural density of 69 on the one hand and a very high urban density of 2163.

The growth and expansion of urban boundaries in districts like Solan, Mandi and Kullu has seen slow change in the land use patterns which has resulted in a slow but gradual change in the landscape of the area and also the occupational/ livelihood patterns of the people.

Based on primary consultations and select discussion with the block and district level officials, no designated indigenous population group fall within the project corridor. Similarly, no site of cultural, religious, heritage and archaeological importance was observed or reported based on select consultations with the community, panchayat representatives and project proponents.

Box 4.1 Changing Landscape- Implications for ADHPL

The growth and expansion of urban boundaries has seen a change in the land use patterns of the areas falling in the immediate vicinity. It has opened up options for other income and livelihood sources and replaced traditional forms like agriculture and apple plantation. Land holdings in these areas are smaller and the market value of land has soared up due to increase in the demand for land. A piece of land in these quarters also offers better lease/rental income from budding entrepreneurs and other small business community who are willing to capitalise on the increased trade and commerce opportunities that these places offer. Also the phenomenon of urban migration has resulted in more and more people trying to buy land and set up their dwelling units in these suburbs.

Use of land, as is required for the purpose of transmission line in these quarters faces challenges of lack of space and high expectations (in terms of value) from the affected stakeholders. Also the alignment and location of the towers in these locations needs to cope with the congestion and lack of space/ clear corridor mandated under the rules and guidelines.

The project area is predominantly Hindu dominated (96 percent) and majority of these belong to upper castes (*Rajputs, Brahmins)*. The other religious communities in order of their population size are Muslims (~1.3 percent), Sikhs (~1 percent) and Buddhists (~0.2 percent). Although social discrimination was not reported or observed to be practiced, the upper castes obviously have a larger say in the village scheme of things. A broad demographic profile of the project districts is reflected in the ***Table 4.31***.

Table 4.31 Demographic Profile of the Project Area

Dist	HH size	Population Density	Sex ratio*	% SC	% ST	% Rural	Population Growth rate**
Kullu	5	69	927	28.28	2.97	92.1%	25.6
Mandi	5	228	918	28.98	1.17	93.2%	16.05
Bilaspur	5	292	990	25.4	2.69	93.6	15.35
Solan	5	259	900	28.1	0.71	81.8%	30.64
Himachal Pradesh	**5.0**	**109**	**968**	**24.7**	**4.0**	**45.1%**	**17.53**

Census of India 2001

Sex ratio; No of females per 1000 males, The population growth rate represents decadal growth of population*

The overall literacy level in the project area is around 75 percent which is closer to the state average of around 76 percent. However, the literacy level beyond secondary and towards higher education is relatively low. Female literacy levels (at 65.5 percent) are lower than the overall state average of around 67.5 percent. In terms of local self-governance, the three tier *Panchayati Raj* Institutions influence rural development and decision making in the villages with schemes being executed and funds being allocated from the district level (*Zilla Parishad*), to the block level (*Panchayat Samiti*) to the village level as the G*ram Panchayat*. The influential people at the village/*Panchayat* level are the ex-S*arpanches* and their family members along with the schoolmaster, the G*ram Sevak, patwaris* and the village elders.

Scheduled Tribes/Indigenous people

There are communities like *Gujjars, Negi's, Gaddi's* along the transmission route that are designated as 'Schedule Tribes' as per the Constitution of India, based on their unique cultural and linguistic identify. The overall proportion of Scheduled Tribes (STs) in the project area is very small ranging from less than one percent to around 2.5 percent whereas the general castes constitute a more sizable proportion. Schedule (*Diman, Harijans),* backward and other backward castes (N*ai, Gaddi, Kumhars, Lohars, Jat)* comprise a significant part of the total population (27.69) as reflected in the table above. However, it was observed that all along the transmission line route these people were not confined to isolated pockets but were a part of and amalgamated in the society at large. There were no separate hamlets for the scheduled castes or other backward classes in any of the villages surveyed.

Box 4.2 Tribal Groups in the Area

Gujjars
Gujjars are the Muslim tribal's of the Himachal Pradesh. Most of the historians believe that Gujjars came to India all the way from central Asia during 6th century. Gujjars are mostly vegetarian and are shepherd and goatherd by occupation. Search for better pastures take them to lowland plains in the winter and to the upper reaches of the Himalaya during the summer.

Gaddi
These people normally reside in the Mandi, Kangra and Bilaspur district though a majority of them live in the Kangra district. Gaddis are not nomadic in strictest of sense since they have villages where they reside. However, they do make their way to the higher pastures in the summer season with their flock. The main occupation of the Gaddi tribals is shepherding. There are farmers, weavers and tinkers (a mender of metal household utensil) also have strict moral values to which they try to stick in even worst of circumstances.

The availability of infrastructure, economic opportunities, educational and health facilities was common to society at large and fair degree of integration has taken place with the main stream society. These groups were not assessed to be vulnerable on account of their belonging to 'scheduled tribes' and as compared with other sections of the rural community. Vulnerable members of both ST and non-ST families will be a focus in the designing of mitigation measures.

Box 4.3 Vulnerability; Status and Implications for the Project

The genesis of caste in India and its linkages to the socio-economic status dates back to history. The Constitution of India in recognition of the need of these groups accorded them special status in the constitution by classifying them into Schedule Castes, Schedule Tribes or Backward Castes and providing them with special incentives like reservation in jobs and education institutions, financial benefits etc. However, these incentives, which were initially planned for a limited period has now become a political issue with different political parties trying to indulge in the game of appeasement to secure their respective caste based vote banks.

Due to the government efforts, these groups (like the schedule caste, backward and other backward caste) which were earlier looked upon as marginalised and vulnerable have seen their influence and clout growing and have to a large extent been mainstreamed with the other castes. However, for the state and the different political party's caste and community based divide still remains a very crucial component strategies to gain votes.

Vulnerability

For the purpose of the study and based on our own understanding and knowledge of the area, vulnerability of families has been linked with the following factors. The current assignment has studied and analysed based on these parameters.

- Women headed households
- Families with main earning members above the age of 60
- Families with members who are mentally or physically challenged.
- Families with Income levels below the poverty line (INR 20,000 per annum [(1)]).
- Families with small (below minimum economic holdings- 5 bigha)[2] land holdings

The preliminary survey of the project area, consultations with the affected groups, the panchayat, village and project authorities revealed that the extent of vulnerability arising due to the project and its different activities on the above mentioned parameters was negligible. Based on broad estimates these were reported to be less than two percent of the total impacted households. Vulnerability as defined above in the context of the project arose mainly from the temporary loss of livelihood opportunities (like inability to cultivate and loss of apple trees) and its resultant impact on the income levels of the households. Since there is no permanent land take involved in the project, instances of families/households falling under the MEH category due to impact on land was not found or reported. The assessment also did not come across any significant other forms of vulnerability arising due to the project and its impact.

IFC Performance Standard 7 recognises that the indigenous people and social groups like the hill tribes, schedule tribes or other tribal groups as the most marginalised and vulnerable segments of the population and hence provides special safeguards to protect their identity and interests. It mandates a proactive role for the private sector projects to create opportunities for

(1) The information was provided by the revenue department. In addition to the annual income, asset holding like two wheelers, television sets is also a criteria for declaring a family above poverty line.

(1) [2] (1bigha- 753 sq m, 1 ha-12.5 bigha, 2.5 acre= 1 ha; 1 acre= 5 bigha)

indigenous people to participate in and benefit from project and its related activities.

The transmission line is likely to have a minimal impact on these indigenous groups and tribal communities in the project area. Field observations and consultations with these groups and the wider community suggest that the project design and activities have considered impacts on these groups and taken measures (like avoiding land parcels belonging to these groups, paying adequate compensation etc) to mitigate adverse impacts, if any on these groups and communities.

4.3.3 Occupational Patterns

Plantation and agriculture are the two predominant occupations among the affected families/households in the project area. Most people in the villages depend on agriculture and plantation for their livelihood. However, increasing tourist traffic, influx of industries and growth of allied business/commerce opportunities (contracting, shops, guesthouses, repair units etc) have seen a slow but gradual shift in the occupational patterns of the community. These opportunities, none the less are mostly being capitalised by economically well off people in the community. Generally in a family there are more than one occupation being followed.

Apart from agriculture and plantation, cattle rearing and livestock is another source of income and also a key household asset. The portfolio of crops changes from predominantly apple, khumani, peas, palm, gandam (wheat), rice and maize in the higher regions to crops like wheat, gram, mustard, paddy, vegetables and millets and cereals in the plains and flat lands of the valley. In the upper regions (Manali, Kullu) mostly cultivation of crops like maize and vegetables was mainly for subsistence purposes. Towards the plains agriculture is the mainstay of the household income and also meets the sustenance needs of the community. The table below captures the occupational trends of the affected families in the project area.

Table 4.32 Occupational Trends

Districts	Apple Plantation (% HHs)	Agriculture (% HHs)	Business/commerce (% HHs)	Services/ others (% HHs)
Kullu	~ 80	~ 15	~ 3	~2
Mandi	~ 20	~ 75	~3	~2
Bilaspur	~ 15	~ 80	~2	~3
Solan	~ 5	~ 90	~3	~2

Source; Primary survey and field consultations
Note; the above table is reflective of the livelihood trends and considers the main income source of the households

Land Use

Parts of the region along the hills and the plains are intensely cultivated with plantation and agriculture being the predominant land use. The major commercially grown crops are apple, vegetables, wheat, pulses and other cereals. Vegetable cultivation is also practised along the route length mostly

in the hilly regions. Land use categories like grazing grounds/ pasture lands are the other major land categories. There is little left of the fallow land available all along the route of the proposed transmission line. The other significant category is land put to non-agriculture use, which basically denotes built up area (exhibiting high population density) or land under forests. All other categories of land use are insignificant in the region.

Table 4.33 Land use in the project districts

District	% of Forest Area to Geographical Area in the District	Not used for agriculture*	Cultivable waste land*	Pastures/ grazing area*	Fallow land*	Net sown area*	Gross sown area*	Area sown more than once*
Kullu	90	7.1	3	0	2.5	37.2	66.8	29.6
Mandi	47.1	25.1	4.4	96.3	11.4	85.8	157.7	71.9
Bilaspur	36.7	18.2	6.4	44.8	3.1	30.2	58	27.8
Solan	37.6	25	12	77.7	6.2	39	63.7	24.7

Source: Department of economics and statistics; *Note: Area in '000 hectares

Forests constitute a major portion of the total geographical area in the four districts through which the transmission line passes. These designated forests are used by the community for fuel wood, timber and grazing purposes. Agricultural land in the plain areas is mostly fertile and yields two crops a season. This land is irrigated through natural streams in the hilly areas and through a network of canals and irrigation channels in the foothills of the slopes and flat plain lands.

4.3.4 Land Take process for the proposed transmission line

IFC performance Standard 5 provides provisions and steps to be followed to mitigate adverse social and economic impacts from land acquisition or restrictions on affected persons' use of land by providing compensation for loss and ensuring appropriate disclosure of information, consultation and the informed participation of those affected. This applies for land transactions where a) land rights are acquired through expropriation or other compulsory procedures and b) for land rights for a private sector project acquired through negotiated settlements with property owners or those with legal rights of land.

No land is acquired for casting of tower foundation or erection of tower. Compensation for damage to crop and trees is being paid to landowners and cultivators in accordance with the Indian telegraph Act 1885. The transmission line has followed the negotiation route whereby the project proponents have negotiated the use of land with the land owner by making lump sum compensation to the affected person for the hindrance to access that would arise due to erection of towers (opportunity cost) as well as for damage to the crop. The impacted land owner retains the legal right over the land and enjoys the right to use his land for agricultural or other purposes (except purposes like construction which are not allowed). The agreed rates for different

categories apply to all stakeholders who own such land and who have been impacted due to the construction of the transmission line.

4.4 INCOME LEVELS

Income levels in the project area across the four districts show a marked variation primarily due to the nature of the crop, type of terrain, the availability of irrigational sources, markets, credit linkages etc. While cash crops like apple, apricot, pomegranate and vegetables yield high returns (subject to factors like produce, weather etc) in the hills the return from crops like wheat, maize, mustard and other cereals were reported to be low as compared to the other cash crops. Income levels of the families were also enhanced by other sources like business, service, labour etc. As it is difficult for most community members to correctly recollect or assess the incomes from agriculture and plantation, incomes were derived on the basis of types of land holding size, crops cultivated, market value of the crops and expenditures incurred for each crop. The table below typically presents broad estimates of income from one *bigha* (753 sq m) of land from different types of crops in the project area located across the four districts of the state.

Table 4.34 Income Ranges for different Types of Crops

Crop	Kullu	Mandi	Bilaspur	Solan
Apple Plantation	~ 100,000	~100,000	NA	NA
Apricot	~ 50,000	~ 50,000	NA	NA
Plum	~ 35000	~ 35000	~ 25000	NA
Mango	NA	~ 100,000	~ 100,000	~ 100,000
Wheat	~ 3000	~ 7000	~ 6000	~ 8000
Vegetable	~ 20000	~ 20000	~ 15000	~ 15000
Maize	~ 1500	~ 1500	~ 1500	~ 1500
Mustard	~ 40000	~ 40000	~ 40000	~ 40000

Source; Primary data and field consultations
Note; These figures as mentioned above provide patterns. The idea is just to demonstrate trends. The figures mentioned above have been reported in village discussions and corroborated with sample household interviews.
The income ranges reflected above are broad estimates for one bigha of land. Apple, apricot, plum, mango income calculated on the basis of horticulture rates of trees aged 7 years
Assuming that rates of wheat are @1000/quintal, Maize @700/quintal, Mustard @20000/quintal

However, it should be mentioned that incomes ranges reflected above from agriculture and plantation have been taken on the basis of good crops. As both agriculture and plantation depend heavily on suitable climatic conditions, the production is quite low in some years.

Box 4.4 Loss of Income- the Case of Apple Plantation

The construction of tower requires an area of around 5-12 biswa (200- 500 sq m) depending upon the type of tower and the nature of the terrain. On an average a tower there could be around 7-15 apple trees, depending upon the age of the tree and the spacing between them. Consultations with the community and the affected groups revealed that an apple tree could yield income ranging from INR 5000- 10000 per year depending upon snowfall, size of fruits, overall production in the area, place of sale etc. The community expressed apprehensions of loss of opportunity to gain productive income from plantation activities on the affected parcel of land.

Migration Pattern

Seasonal Migration in the hills is a very common phenomenon as people generally move to the lower altitude regions during the winter season, when snow covers their fields. These people generally maintain two houses and in some cases even have land holdings in the two villages or hamlets.

During the course of the survey, it was observed that in some villages like Hamta the men moved to the lower regions to find work, while women with the children remained in the village to look after the livestock. The village during these months is inhabited entirely by women and children. The women not only look after the livestock, they also involve themselves in weaving activity. While most of the weaving is done to meet their own needs, some women do it to enhance their family incomes.

4.5 ARCHAEOLOGICAL, HISTORIC AND CULTURAL SITES

IFC Performance standard 8 recognises the importance of cultural heritage for current and future generations. It seeks to protect cultural heritage from the adverse impacts of the project activities.

For the purpose of this study archaeological, heritage and cultural site refers to sites/locations of unique natural environmental features that embody cultural, artistic, historic or religious values.

No site of cultural, religious, heritage and archaeological importance was observed or reported to have been adversely impacted due to the proposed transmission line in the limited walk over and select consultations with the community, panchayat representatives and project proponents

During the consultant's walk over the limited route length of the transmission line no site of significance from archaeological, historic or cultural perspective was recorded. The transmission line does not pass over any of these sites.

5 ENVIRONMENTAL & SOCIAL IMPACTS AND MITIGATION

5.1 INTRODUCTION

This section presents a summary of the environmental, socio- economic, demographic and cultural context in which the proposed transmission line project is to be implemented and made operational. While identifying the above key features, the section also discusses the type and range of impacts likely to result from the different project activities, measuring its extent and severity. The specific purpose of this section is to;

- Identify and assess the range of potential impacts and extent of their severity;
- Explain the ways in which the project might affect environment, ecology, socio-economic resources, demographics, livelihoods, cultural patterns, as well as access and infrastructure issues;
- Suggest viable mitigation measures for the identified impacts;
- Develop a management plan based on the proposed mitigation measures.

These impacts have been identified through field surveys, onsite monitoring, and consultation with the village community. Discussions with project proponents, district officials, village representatives and opinion leaders, NGOs and other civil society groups also were undertaken along the study area. A mix of quantitative and qualitative methods i.e. sampling, monitoring, questionnaires, interviews, unstructured interviews, oral histories, and public hearings, indirect and unstructured observations have been used to derive these impacts. Potential impacts have also been predicted based on experience of working in similar assignments for other companies.

5.2 IMPACT EVALUATION CRITERIA

The criterion that has been used to evaluate impacts on various environmental and social aspects is as following:

Context

The context refers to spatial or geographical extent of impact due to proposed linear project. In this study, impacts were classified as per the following context:

- Local (low spread), when an impact is restricted within 17.5 m of either side of the project foot print i.e. within the corridor defined for the project;
- Medium (medium spread) when an impact is spread from 17.5 m to 50 m either side of the project foot print i.e. beyond 17.5 m but within 50m either side of the corridor defined for the project; and

- Regional (high spread) when impact is spread beyond 50m either side of the project foot print i.e. beyond 50 m either side from the corridor defined for the project.

The above context has been selected based on the understanding of the linear project and prevailing environmental and social baseline conditions. The baseline conditions show that the project is free from settlements along the corridor route and no displacement is expected from the project. The project, however, is passing through forestland and will also require periodic maintenance during operation phase when access to forestland as well will require pruning of twigs of trees to restrict it to specific height for safe transmission as well for protection.

Duration

The duration of impact considers whether the impact would be short-term, medium-term or long-term and has been assessed based on the time taken to recover back to its pre-project state. For the transmission line project, impacts were classified based on their existence in temporal scale as follows:

- Short term (*low duration*) when impacting for a duration of six months (other than for ecology); this will result in the recovery of the effected environmental component (other than for ecology) within a year;
- Medium (*medium duration*) when impacting between six months and three years; this will result in the recovery of the effected environmental component (other than for ecology) within 1 to 10 years; and
- Long term (*high duration*) when impacting beyond three years (other than for ecology); and will result in recovery of prevailing conditions within 10 years or beyond.

For ecology [faunal species or floral species of ecological significance and trees (of girth size 30 cm or more)], impacts will be short term if limited to less than one generation, while impacts will be medium if limited to one generation and long term if limited to more than one generation.

Intensity

Indicators of the intensity of an impact, whether it is insignificant, minor, moderate, or major, was based on the following criteria for impact intensity:

- Insignificant intensity when resulting in changes in the environmental baseline of less than 20% in regional context or 20 to 30% in medium context or up to 30% in local context but for short duration;
- Minor intensity when resulting in changes in the baseline up to 20% in regional context or up to 30% in medium context or more than 30% in local context or for ecology minimal changes in the existing ecology in terms of reproductive capacity, survival or habitat suitability;
- Moderate intensity when resulting in changes in the baseline for up to 30% in regional context or more than 30% in medium context or for ecology changes are expected to be recoverable in terms of medium duration; and

- Major intensity when resulting change in the baseline beyond 30% in regional context or for ecology changes serious impairment to species, productivity or their habitat.

Type

The type of impact refers to whether the effect is considered beneficial or adverse. Beneficial impacts would improve resource conditions. Adverse impacts would deplete or negatively alter resources. The significance assessment matrix is provided in ***Table 5.1***.

Table 5.1 Impact Significance Criteria for Environmental and Social Components (other than for Ecology)

Significance	Context	Duration	Intensity
Insignificant	Local	Short	Low
Minor	Local	Short	Moderate
	Local	Medium	Low
	Local	Medium	Moderate
	Medium	Short	Low
	Local	Long	Low
Moderate	Local	Medium	High
	Local	Long	Moderate
	Medium	Short	Moderate
	Medium	Medium	Low
	Medium	Medium	Moderate
	Medium	Long	Low
	Medium	Long	Moderate
	Regional	Short	Low
	Regional	Short	Moderate
	Regional	Medium	Low
	Regional	Medium	Moderate
Major	Local	Short	High
	Local	Long	High
	Medium	Short	High
	Medium	Medium	High
	Medium	Long	High
	Regional	Short	High
	Regional	Medium	High
	Regional	Long	Low
	Regional	Long	High
	Regional	Long	High

Note: Positive impacts are termed as beneficial while negative ones are adverse

5.3 IMPACT IDENTIFICATION

The assessment process is based on current information, including the project description (as provided by ADHPL), and social and environmental baseline data. The assessment considers all relevant social and environmental impact/risks, including issues identified in IFC Performance Standards 2 through 8, and those who will be affected by such risks and impacts.

Although the route for the transmission line route has been selected to minimize social or environmental impacts, there will, nevertheless, be some impact along the corridor due to construction, erection of transmission line towers and stringing of overhead transmission line and in setting up associated utilities.

This section presents a summary of the environmental impacts from the activities related to construction and operation of the transmission line. The impacts are based on the scoping exercise done during the site visits, meeting with ADHEP and other organisations and key individuals. The potential environmental impacts can be understood to be in the following areas:

Table 5.2 Potential Environmental Impacts

Impact	Construction			Operation
Activities	Casting & Foundation	Erection of tower	Stringing	Power Transmission
Soil	✓	-	✓	-
Waste disposal	✓	-	-	-
Aesthetics	✓	✓	-	-
Surface water	✓	-	-	-
Hydrogeology	-	-	-	-
Forest Resources, Flora and fauna	✓	-	✓	✓
Traffic and transport	✓	✓	✓	-
Atmospheric emissions/ dust	✓	-	-	-
Noise	✓	-	✓	✓
Socioeconomics	✓	-	✓	✓
Landuse	✓	-	-	-
Electromagnetic fields	-	-	-	✓
Hazards due to Natural disasters	-	-	-	✓
Major accident risks	✓	✓	✓	✓

5.4 CONSTRUCTION PHASE IMPACTS

5.4.1 Soil Quality

a) Activities

Digging of foundation pits for the towers and the cutting of vegetation (for foundation purposes) are the main two activities, which are likely to affect the soil structure and quality. Foundations will be dug up to a depth of 3 m (at least) depending upon the tower type and soil characteristics. At the tower sites, all vegetation within the footprint of the tower base and for a distance of approximately 2 m beyond the base in all directions will be cleared to ground level. There will be some damage to crops and vegetation during stringing operation due dragging and pulling of conductors.

Some loss of vegetation/crop will occur due to movement of construction material and manpower through cultivated areas.

b) Potential Impacts

The most significant potential impacts will be due to change to soil structure and soil quality as a result of excavation or compaction. The magnitude and extent of the impacts are likely to vary according to the characteristics of the soil and the types of construction activity. Foundation pits will be backfilled by the excavated soils which will resemble the order of the original soil layers. Compaction of soil during backfilling might lead to temporary effects on natural infiltration of rainwater, but these impacts are temporary, localised and marginal.

Removal of vegetation and trees during construction of foundation, especially on the slopes would render soil vulnerable to erosion. The socio-economic aspect of crop clearing is discussed in next sub section. Also, stringing activities can cause larger damage to crop if carried out during flowering/fruit bearing season.

Movement of workers through adjoining fields during construction can damage fresh sown crops.

Loose soils and construction material if placed in adjoining fields will lead to damage of existing crop and contamination of soil. The excavated if kept uncovered and unprotected will be rendered vulnerable to loss from erosion.

c) Mitigations

The suggested mitigations to minimize impact on vegetation and soil include means to protect excavated soil material from erosion and contamination by placing them away from streams of water along the slop or in direct line of local drainage. Loose soil should be kept covered till the time of backfill and the excess soil should be removed after casting activities are complete. The construction activities shall be planned in non-monsoon months which will minimise any rainwater run-off or any loss due to infiltration.

Construction materials will be stored within the footprint of the site to avoid any kind of damage or contamination of soil/crop of adjoining fields. Movement of material and manpower shall be restricted to existing roads/tracks or as agreed upon with the stakeholders to avoid creation of new roads/tracks.

d) Impact Significance

Due to temporary, localised and small size of the nature of impacts, together with proposed mitigation measure, the impacts predicted to occur on soils is minor. The significance of impacts on soil and its reduction with mitigation measures during construction is summarised in ***Table 5.3.***

Table 5.3 Impact significance on Soil for Construction Phase

Aspect	Scenario	Context			Duration			Intensity			Type		Significance			
Soil		Local	Moderate	Regional	Short	Medium	Long	Low	Moderate	High	Adverse	Beneficial	Insignificant	Minor	Moderate	Major
	Without mitigation		☑		☑			☑			☑			☑		
	With mitigation	☑			☑			☑			☑		☑			

5.4.2 Waste Disposal

a) Activity

The main type of waste likely to be generated during construction activities is the construction debris resulting from casting for foundations and some steel scarp from tower construction. Other wastes that will be generated include waste food/packaging material littered by workers.

b) Potential Impacts

There is potential for spread of construction debris to areas outside that marked for construction. The debris generated from construction activities can be carried along with small springs, rivulets and rivers flowing in proximity of the tower. Construction debris can also contaminate wells, canals etc. in proximity of the activity.

c) Mitigations

Any construction debris generated at the site will be removed from the site immediately after the completion of construction activities and the site will be levelled as original. Workers will be strictly instructed about random disposal of any waste generated from the construction activity.

Arrangements will be made to collect and prevent littering by workers on site

d) Impact Significance

Given the mitigations in place, insignificant environmental impacts are anticipated due to waste generation from the construction activities if good management and engineering practices are followed. The significance of impacts due to waste disposal and its control with proper mitigation measures is summarised in ***Table 5.4.***

Table 5.4 Impact significance due to waste disposal for Construction Phase

Aspect	Scenario	Context			Duration			Intensity			Type		Significance			
Waste disposal		Local	Moderate	Regional	Short	Medium	Long	Low	Moderate	High	Adverse	Beneficial	Insignificant	Minor	Moderate	Major
	Without mitigation		☑		☑			☑			☑			☑		
	With mitigation	☑			☑			☑			☑		☑			

5.4.3 Aesthetics and Visual Impact

a) Activity

The visual amenity will be disturbed mainly during casting of foundation and leaving the site with stubs of tower. The erection of towers and conductors across the terrain will be an extrinsic element to the existing ambience.

b) Potential Impacts

The visual impacts and change of landscape due to construction activity will be for a short period of 15-30days. However route of towers and transmission line are expected to cross highways/roads, and other transmission line which may lead to change of landscape resource and character due to introduction of manmade features leading to visual intrusion and loss of visual amenity.

The cumulative impact due to already existing towers can hamper the aesthetic value of the area.

c) Mitigations

The route is planned after a series of survey to avoid habitation and forest areas. The clearing of trees will be kept to minimum and wherever possible, trimming of trees will be adopted *vis-à-vis* felling of trees.

The lattice structure of towers provide sufficient see through effect which diminish the visual impact on the aesthetics of the area. The cumulative impact is expected for the stretch 2 and 3 where there are existing towers however all the towers are aligned parallel to each other and reduce the visual impact which would have been if they were scattered in all direction.

The area being hilly terrain with undulations restrict the view of many towers in a single view, moreover the height of tower do not appear to be significant with reference the terrain.

d) Impact Significance

The overall landscape and visual impacts of the transmission line is expected to be moderate. The impact is summarised in ***Table 5.5.***

Table 5.5 Impact significance on Aesthetics and Visual for Construction Phase

Aspect	Scenario	Context			Duration			Intensity			Type		Significance			
Aesthetics and Visual		Local	Moderate	Regional	Short	Medium	Long	Low	Moderate	High	Adverse	Beneficial	Insignificant	Minor	Moderate	Major
	Without mitigation		☑				☑		☑		☑				☑	
	With mitigation	☑					☑	☑			☑			☑		

5.4.4 Surface Water and Hydrogeology

a) Activity

There are three major rivers (Parbati, Beas and Sutlej) along the route of transmission line besides numerous rivulets and springs

The transmission line will require a minimum 6.4m^3 of water for casting of foundations for each tower, which will be sourced from nearby water bodies through tankers.

The use of groundwater is not anticipated except in the plains around the Solan district. The groundwater in the region is shallow due to presence of many perennial rivers, which can be encountered during excavation for foundation in the plains.

b) Potential Impacts

Water consumption will not have any impact on water requirement of the area as the water availability is in excess however, there is potential for wastage of water at site. There is potential for contamination of surface water bodies due to runoff from construction activities close to them.

During the construction of the towers, any groundwater encountered can lead to potential contamination of the source. Also, construction along the slopes can affect small changes in the surface drainage pattern of the area.

c) Mitigations

Optimal use of water will be planned and followed at construction site. Construction activities in proximity of water bodies will ensure prevention of runoffs. At the river crossing the horizontal clearance (the distance between the towers) will be greater than the maximum river width at high flood levels and the vertical clearances will be according to the statutory requirements.

The rivers crossings along the route are small and will not affect any change to the span of towers.

Any groundwater encountered during excavation will be pumped out and the source will be prevented from any kind of runoff from the adjoining areas.

d) Impact Significance

The impacts during the construction activities will be short-lived. The transmission line will have insignificant impact on the surface water and ground water. The impact is summarised in ***Table 5.6.***

Table 5.6 Impact Significance on Surface water and Hydrogeology for Construction Phase

Aspect	Scenario	Context			Duration			Intensity			Type		Significance			
Surface water and hydrogeology		Local	Moderate	Regional	Short	Medium	Long	Low	Moderate	High	Adverse	Beneficial	Insignificant	Minor	Moderate	Major
	Without mitigation		☑		☑			☑			☑			☑		
	With mitigation	☑			☑			☑			☑		☑			

5.4.5 Ecology - Flora and Fauna

a) Activity

For setting up of the power transmission line, there will be requirement of localized clearance of vegetation, which may effect/disturb flora and fauna within the corridor.

b) Potential Impacts

The possible impacts that are likely from the construction of the transmission line are disturbance or damage to any fauna or flora species in the impact area due to movement of vehicles, dust, noise, etc. and due to clearance of trees for lying of the transmission line.

There will be potential loss of habitat for birds and small mammals in forest areas due to tree felling.The route of transmission line passes through a number of protected forests (as detailed in section 4) which will require felling of trees in forest area.

Of the bird and mammal species identified along the corridor, eight species each of birds and mammals fall in schedule 1 and one species of birds and five species of mammals fall in schedule 2 the Wildlife Act. Construction in forest area at places close to water holes for the local fauna can restrict the use by animals.

c) Mitigations

Project will take prior approval from Forest Department for any vegetation clearance or tree cutting en-route the project corridor as well for locating transmission line through any forest area. Felling of trees will be avoided

unless absolutely necessary. Trimming will be opted wherever possible. Construction workers will be instructed to restrict their movements within the right of way. Trees supporting significant number of birds or mammals will be avoided wherever possible.

Cost for compensatory afforestation will be borne by the project proponent for the tree felling within any forest land. Construction activities during the breeding season and other sensitive seasons or times of day will be avoided. Re-vegetation of disturbed areas with native plant species will be undertaken after the construction is over. No habitat fragmentation will result from construction of transmission line along the proposed route.

d) Impact Significance

Although the vegetation clearance will have limited impact however movement of transmission line routes through protected forest areas will have minor impact. The overall impact on flora and fauna is predicted to be minor. The impact is summarised in ***Table 5.7.***

Table 5.7 Impact significance on Flora and Fauna for Construction Phase

Aspect	**Scenario**	**Context**			**Duration**			**Intensity**			**Type**		**Significance**			
Flora and Fauna		Local	Moderate	Regional	Short	Medium	Long	Low	Moderate	High	Adverse	Beneficial	Insignificant	Minor	Moderate	Major
	Without mitigation		☑			☑		☑			☑				☑	
	With mitigation	☑				☑		☑			☑			☑		

5.4.6 Traffic and Transport

a) Activity

There will be movement of material and manpower during the construction. The transmission line will cross NH 21 and NH 21A at many places.

b) Potential Impacts

The traffic movement during the construction phase is likely to be occasional and very low resulting in negligible impacts from the traffic.

At places where the highway or other major roads are crossed the stringing activity can cause major traffic blockade.

New tracks will be created in forest areas which may provide access for local people to explore deeper into forest land for firewood and other requirements.

Based on field observation, there existed large number of heavy motor vehicles moving along the NH21 and 21A. The area being hilly terrain is prone to traffic hazards, all movement of material and manpower needs to follow strict traffic norms.

c) Mitigations

Vehicles used for construction activities will move along the already existing roads as far as possible. Any increase in the traffic during the construction phase will be short lived and will return to normal once the construction activity is complete.

All vehicles will be instructed to follow traffic norms strictly. Drivers trained in hilly terrain will be preferred for transportation.

At highway /road crossing during stringing the conductors will be elevated with the help of bamboo/poles on either side of the road to avoid any obstruction to the traffic. All construction activities along or across the national highways will be subject to prior discussion and approval of National Highway Authority of India through their regional offices.

Any new track created in forest area will be done only with prior approval of Forest Department and will be kept away from access of the local people.

d) Impact Significance

The increase in volume of traffic and proper management during stringing will significantly abate any impact due to traffic. The overall impact due to traffic is expected to be insignificant. The impact is summarised in ***Table 5.8.***

Table 5.8 Impact significance from traffic and transport for Construction Phase

Aspect	**Scenario**	**Context**			**Duration**			**Intensity**			**Type**		**Significance**			
Traffic and Transport		Local	Moderate	Regional	Short	Medium	Long	Low	Moderate	High	Adverse	Beneficial	Insignificant	Minor	Moderate	Major
	Without mitigation		☑		☑				☑		☑				☑	
	With mitigation		☑		☑			☑			☑			☑		

5.4.7 Atmospheric Emissions/ Dusts

a) Activity

The activities that are likely to form part of atmospheric emissions are dust from construction activities and exhausts from vehicles serving the construction activities.

b) Potential Impact

As the construction of transmission line involves limited groundwork, the potential for dust generation is low and short lived. The increase in traffic volumes during the construction of the transmission line is expected to be occasional and negligible. Hence, it is considered that the contribution to pollutant concentrations arising from the construction activities and traffic is

small and insufficient to cause any increase in the stipulated air standards or existing concentrations.

c) Mitigations

Notwithstanding the potential of atmospheric emissions from construction and related activities the environmental impact of the project is low; the following mitigation measures will further reduce the impact of emissions, leading to insignificant impacts:

- Sprinkling of water on dust generating areas;
- Restricting the speed limits of vehicles during movement on unpaved roads; and
- Covering of vehicles carrying loose soil/construction material.

d) Impact Significance

The potential for dust generation will be short lived and low, the overall impact is expected to be insignificant. The impact is summarised in ***Table 5.9.***

Table 5.9 Impact significance due to atmospheric emissions for Construction Phase

Aspect	**Scenario**	**Context**			**Duration**			**Intensity**			**Type**		**Significance**			
Atmospheric emissions		Local	Moderate	Regional	Short	Medium	Long	Low	Moderate	High	Adverse	Beneficial	Insignificant	Minor	Moderate	Major
	Without mitigation	☑			☑			☑			☑		☑			
	With mitigation	☑			☑			☑			☑		☑			

5.4.8 Noise

a) Activity

The sources of noise during construction activities include:

- Construction traffic; and
- Construction activities such as excavation, concreting, tower erection, backfilling, use of pumps (for pumping excess water) and compressors, etc;

b) Potential Impacts

There is potential for disturbance to habitations, schools, temples in proximity of the towers due to construction related activities.
During erection of tower there can be disturbance from noise of workers. Also, during stringing there is potential for disturbance from continuous operation of tractors.

c) Mitigations

Construction activities will be concentrated and done sequentially so that no area is prone to extensive duration of noise impacts. For example though it

might take anywhere between 3 to 6 months to complete tower erection and stringing exercise, the actual construction only happens for about 15-30 days. There will be minimum lag period between lying of foundations and erection of the tower. Most of the work is done manually instead of cranes and other heavy equipment, which will reduce the potential for noise impacts.

Construction activity will be undertaken only during daytime. There will be some noise generated from the movement of tractors and trailers transporting the materials and equipment but the traffic volumes are expected to be occasional and insignificant.

The process of stringing of cables will produce only human voices, which might be audible to residents in very close proximity of the operations. However, again these impacts will be localised and short lived.

d) Impact Significance

It can be concluded that the noise impacts from construction activity will be low and short-lived. No significant noise impacts from construction activities are predicted and any noise, if generated, will be well within the stipulated standards. The impact is summarised in ***Table 5.10.***

Table 5.10 Impact significance due to Noise for Construction Phase

Aspect	Scenario	Context			Duration			Intensity			Type		Significance			
Noise		Local	Moderate	Regional	Short	Medium	Long	Low	Moderate	High	Adverse	Beneficial	Insignificant	Minor	Moderate	Major
	Without mitigation		☑		☑			☑			☑		☑			
	With mitigation	☑			☑			☑			☑		☑			

5.4.9 Archaeological, Historic and Cultural Effects

Based on the route profile developed during the detailed survey, it is observed that transmission line will not pass over any site of archaeological and historical site.

5.4.10 Potential Hazards

IFC Performance standard 2 highlights the need for safe and healthy work environment taking into account inherent risks in its particular sector and specific classes of hazards with respect to the project, including physical, chemical, biological, and radiological hazards. The performance standard highlight the need to prevent accidents, injury, and disease arising from, associated with, or occurring in the course of work by minimizing, so far as reasonably practicable, the causes of hazards.

a) Activity

All construction related works.

b) Potential Impacts

During construction physical injury can result from workers slipping along the slopes; road accidents, accident to workers during erecting of towers and other occupational hazards.

Stringing activity around low tension/ high tension wires and other electrical units can be a potential hazard if proper planning is not followed. Workers at times are not accustomed to use of Personal Protection Equipment, their attitude to avoid PPE may result in accident/hazard.

Pits dug along roads /tracks close to habitations can lead to potential accidents for people and domestic animals in the proximity.

The route lies in the area of basic wind speed of 39m/s and earthquake zone V and VI (very high and high risk). There is a risk of damage to the transmission system from naturally occurring events, which are outside the control of the project proponent such as extreme weather, earthquakes, etc.

The upper reaches of the transmission line also experience snow fall during winters, excess weight of snow on the line can cause snapping of conductors.

b) Potential Mitigations

The staff of ADHPL and contractors involved in the construction activities will be trained about the mandatory precaution and safety practices prior to commencement of construction activity.

All required Personal Protection Equipment will be used by the workers at site and their use will be supervised. Safety harness will be ensured for workers while erection of tower. Vehicle movements to follow the traffic norms and maintain a safe speed while moving through the hilly tracts.

Stringing activities near low tension wires/high tension wires and other electrical utilities will be done after proper shutdown of the line/utilities with prior information and permission.

All excavation activities will be conducted in supervision of the site contractor with prior information to the nearby inhabitants. Proper signage will be provided in places where excavated pits are close to road or hilly tracts.

The design of the towers will adhere to the Indian Standards and other government notices, which will ensure sufficient safety margins to reduce the risk from wind and seismic activities. Extreme weather conditions could affect the transmission line though the very high wind speed is rare. Hence the risk of natural impacts is low.

The other climatic effect could be that of variations in temperature. However, the design of the transmission line incorporates temperature extremes thereby negating any residual impact.

ADHPL will assist and collaborate with the community and the local government agencies in their preparations to respond effectively to emergency situations. If local government agencies have little or no capacity to respond effectively, ADHPL will play an active role in preparing for and responding to emergencies associated with the project.

d) Impact Significance

There is high potential for accidents if proper protection and safety protocols are not followed. The impact without mitigation is considered to be Moderate. However, with the follow up of mitigations as well field, the overall impact can be considered as moderate to minor.

In the unlikely event of a natural disaster affecting the transmission line, the emergency response plan of ADHEP would be implemented.

Table 5.11 Impact significance due to potential hazards for Construction Phase

Aspect	**Scenario**	**Context**			**Duration**			**Intensity**			**Type**		**Significance**			
Potential Hazards		Local	Moderate	Regional	Short	Medium	Long	Low	Moderate	High	Adverse	Beneficial	Insignificant	Minor	Moderate	Major
	Without mitigation	☑			☑					☑	☑				☑	
	With mitigation	☑			☑				☑		☑			☑		

5.4.11 Social Impacts

The socio- economic baseline section has dealt at length with a range of indicators and the baseline scenario *vis a vis* these parameters. Detailed demographic analysis and predictions about demographic shifts are not applicable for the project as the transmission passes mostly through hilly terrain, uninhabited land, barren and agricultural fields. Also temporary demographic changes during construction phase are not likely to be significant since the construction team will be stationed in and are likely to remain in contact with the impacted community for a very short time. The transmission line itself, once constructed and erected will only require periodic maintenance during operations. There will also be no large workforce that will be moving to areas to operate and maintain the transmission line. Hence no changes in population numbers or demographic profiles are expected that could be linked directly to the project.

The groups and communities most likely to be affected by the proposed transmission line project are;

- Land Owners: Those who are directly affected due to the use of land or whose land holding fall in the Right of way (RoW) of the transmission

line. These are mostly residents within the immediate environment. Most of the project impacts are likely to be borne by this category of people;

- Share croppers: Those who share the land with the owners for agricultural purposes. Share cropping as a practice was not found to be common phenomenon in the project area. However, field consultations and discussions came across a few of this category of people mostly in the hilly regions of Kullu and Mandi districts. The share cropping is mostly done on a cost and profit sharing basis and is more common for crops like apple, wheat, maize and other cereals; and
- Pastoral users: All across the transmission line route, land was found and reported to be used for grazing and fodder purposes. In some areas of Bilaspur, Mandi and Solan districts the land is also used for growing fodder for the cattle and other domesticated animals.

The impacts of the proposed transmission line has been have been judged at two levels;

Immediate surrounding:	Based on "right of use effects"- people near to the transmission line area; 'proximity effects'.
The region:	Regional effects, e.g. 'trans boundary' effects

The proposed transmission line is not likely to result in displacement of people. The transmission line are mostly routed across agricultural fields or vacant lands and congested or inhabited areas have been avoided to the extent possible.

a) Land related Activity

The construction phase of the transmission line involves a number of sequential activities linked to the project. The area affected during construction and laying of the transmission line will include RoW, area occupied for the construction equipment, area for storage facilities etc. Based on the construction activities and in consultation with the different stakeholders, the following impacts are being envisaged for the construction phase of the project;

b) Potential Impacts

Approximately 611.31ha (including tower area and corridor) of land falling in four districts will fall under the project area, although no private land will be acquired for construction of the transmission line.A thirty five meter wide corridor for the RoW is proposed for the transmission line and carrying out related activities.

This land take is likely to result in:

- ***Land required for the erection of pylon towers*:** The land required for the actual construction of each tower will typically vary from 5.6 – 12 biswas

(1 biswa = 40 sq m approx.). As per the existing law, acquisition of land is not allowed for a persons not belonging to the state of Himachal Pradesh. The ownership of the land remains with the landholder. The long term effects on the land (which will become unavailable for cultivation on a long term basis) will be observed only for the area where the foundation for each of the four legs of the tower will be placed, while the remaining land under the tower and in its periphery shall remain available for cultivation. Adequate compensation would have to be paid to the landowner for the hindrance to agriculture/movement due to erection of towers. Although the land required is small in area, it is a direct and long term loss of crop which could have been planted in the area.

- ***Partial loss of Productivity of Land*:** The total area under the base of the tower and another strip of two meters along the perimeter of the tower would also be partially affected by the construction of the tower. It is likely that the ploughing activity in the land under and around the pylon tower base would be restricted, thereby affecting the overall agricultural productivity of that portion of the land. Although construction of the tower would prevent use of equipment and movement of animals under the tower and in its immediate periphery, ploughing activities can still be done manually thereby limiting the losses.

  The loss of productivity (partial) and the additional opportunity cost to be borne by the project affected people (PAPs) due to restrictions on ploughing activity beneath and in the immediate periphery of the tower are long term losses and will need to be compensated.

- **Temporary Losses during Construction of the Towers:** As per the existing practices of pylon tower construction landowners would be affected in the three phases of activity, if the construction is not completed in a continuous sequence. These three phases are as follows:
  a) The first is when civil engineers and technical team mark out the required plinth area for the base of the tower and excavation work for laying the foundation is undertaken;
  b) The second is at the time of erection of the tower itself; and
  c) The third is when the power lines are strung out between towers.

  Two types of impacts are foreseen, one standing crops get damaged by any of the above listed activities and second, the farmer is not able to cultivate the land since these activities may continue for a short to medium term duration depending the pace of work, clearances etc.

  The temporary disruption of activity will affect those landowners on whose land the tower will be constructed. It will also temporarily affect people whose fields will be used as temporary access roads for transporting construction materials and for stringing the towers.

  In case of landowners incurring long term losses, construction activity will hamper agricultural activity in the base area of the tower which, as

mentioned above, could range from 144 sq m to 742 sq m depending on the type of tower and a peripheral region of about 2-4 m on each side is included in the tower area.

During the laying of the foundation and erection of the tower, construction materials will be carried to the tower site and will require access to agricultural fields at many places. In such cases adequate compensation will need to be paid to persons whose land/ productivity is affected due to the creation of these temporary approach roads to get the tower erection equipment and power line conductors and other materials to the locations where they are required.

Substantial impacts in terms of damage to standing crops are envisaged during the time of stringing, when the conductors are drawn from one transmission line tower to the next one across the fields lying in between the two towers.

Consultations carried in villages with different stakeholders and computations made to assess the losses of income came across losses ranging from INR 2,000 to INR 30,000 per bigha depending upon the type of plantation/ crop, type of land and irrigation facilities, equipments etc. A broad summary of the income incurred from different crops is provided in ***Table 4.34.***

- **Impact on public properties and common resources;** The Right of Way of the transmission line has been selected to avoid affecting common properties such as religious places, cemeteries, water bodies, access roads etc. The transmission line route crosses several roads and highways. However, it is understood from the project proponents and in discussion with the community that routing the transmission line across these public properties would not have any significant impact on the common property resources since adequate clearances would be maintained by providing extensions to the towers.

- **Expectations/ Opportunities;** Expectations of the community remain high with regard to creation of opportunities during the construction phase of the project. Consultations with the community, especially the affected land owners came across expectations of contract for foundation and casting works, supply of materials, labour etc. At several locations the task of casting has been given to the land owner. However, the capacities of the affected PAP do not always match the requirements of the contract. None the less expectation levels still remain high for such opportunities.

c) Mitigations

Compensation for hindrance due to use of land for the transmission line has been done through the private negotiation route. Compensations have been negotiated across the route of the transmission line based on the base/ average prices of land in the respective *muhal*. Replacement value has been

added to the average value of the land to bring it closer to or at par with the prevailing market rate.

Some of the key issues that shall be kept in consideration while deciding compensation include;

- Correct determination of market value for the losses
- Addressing issues of long term loss of value of the land (opportunity cost)
- Communicating to the people the method for determining compensation, and ensure that they know the process for grievance redressal
- Ensuring adequate compensation for temporary severance and crop damages

Replacement Value: The market value of the land at several locations along the proposed transmission line is higher than the average value of land as reported in the state revenue records. The project proponents shall try and ensure that the market value reflects *replacement v*alue of crops and land is followed uniformly across the entire stretch of the proposed transmission mine. Consultations and field observations found that by and large the compensatory value paid to the PAPs and market value of the land are reconciled.

Crop and Asset Value: It was observed and reported that the temporary loss to crops and assets like trees have been arrived at keeping in mind the rates as prescribed by the horticulture and agriculture department. It is a general practice that the assessment of valuation in terms of yield and income (as being done by the line departments) are done on the basis of either average yield or minimum yield. The project proponents shall consider the difference between the reported yield/income and actual earnings from agricultural/plantation produce and factor that in their compensation framework.

Opportunity Cost: Loss of long term value of land due to the transmission line, to a limited extent as reported earlier goes down due to the limitations of restrictions that are associated with the use of land where transmission line has been laid). It is advised that the project proponents take an independent assessment of the market value of lands through which transmission line has been laid in and compare this to other lands. If there is a gap, it needs to be compensated to the land owner/user. The options for compensation could be:

- give a one time compensation package equivalent to loss of value, with a clear explanation that this is a one time package; or
- ensure that the impacted family get preference in terms of contracting or other benefits
- provision of yearly rent to the directly and indirectly impacted PAPs

Acknowledging and addressing this additional and long term impact will raise support for the project.

Communication on Compensation: It is very important that the families whose land will get impacted by the transmission line are clearly informed about the compensation process, the manner and method in which it has been calculated and values of crops/ trees judged. The project proponents should establish a mechanism to disseminate information about the manner and arrangement of compensation process, including the method for determining the value in local language, and give each land impacted family this information.

Many of the objections and complaints that arise out of the compensation process are primarily because of lack of knowledge and information on the basis of determining compensation, and these further delays the process considerably. By pro-actively communicating this process in a simple method and language, the project will be able to allay many of the concerns land losers have.

d) Impact Significance

The overall impacts of land take after proper information dissemination and a balanced approach in payment of compensation is considered to be moderate.

Table 5.12 Impact significance for social aspects from Construction Phase

Aspect	Scenario	Context			Duration			Intensity			Type		Significance			
Social		Local	Moderate	Regional	Short	Medium	Long	Low	Moderate	High	Adverse	Beneficial	Insignificant	Minor	Moderate	Major
	Without mitigation	☑				☑				☑	☑				☑	
	With mitigation	☑				☑			☑		☑			☑		

5.4.12 Impact on Community and their Cultural Aspects

Performance Standard 2 recognizes that the pursuit of economic growth through employment creation and income generation should be balanced with protection for basic rights of workers. The performance standard emphasize on equal opportunity, fair treatment, and no discrimination with respect to aspects of the employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment, access to training, promotion, termination of employment or retirement, and discipline.

a) Activity

For the transmission line construction and erection, presence of external labour will be working along the corridor as well residing in Labour Camps.

b) Potential Impacts

The task of construction and stringing has been given to construction contractors like L&T and Reliance who have then further outsourced it to smaller ones. Field consultations with contractors and construction workers at the towers came across skilled workforce which were mostly non- local (mostly from Bihar, West Bengal and Jharkhand) and came through labour supplier hired by the construction contractors. These skilled and semi-skilled labour mostly reside in hamlets or in villages around the tower locations.

Basic facilities such as temporary housing, water supply and sanitary facilities are managed internally by the contractor by this non local workforce. Consultations with the community and informed stakeholders revealed concerns and problems regarding the behavioural, lifestyle and nature of work force and the effects of their interactions with the host community. They expressed concerns about the waste these labour colonies generate, and about potentially harmful interactions with the migrant workforce and the temporary burden that they put on the local resources. These were mostly centred on alcoholism at camp sites, communicable diseases and conflict with the external elements.

c) Mitigations

The labour force will be instructed about the conduct and manners to be maintained while working along the transmission line. No discrimination in terms of salary or nature of job among local and migrant workers will be allowed.

Management of the short term influx of labour during the construction and stringing phases of the project will include communication about the technical aspects of the construction and operations, and to allay fears about any apprehensions of perceived accidents during the operational phase of the project. The project proponents will demonstrate its concerns about health and safety of workers as well as of the community through awareness programmes and grievance redressal.

The workers will be briefed about the health risks from communicable diseases due to unhygienic environment as well as about sexually transmitted diseases.

ADHPL will ensure a non discriminatory policy for the project. No child labour or forced labour would be engaged by the project proponent or any of its sub contractors.

d) Impact Significance

The impact due to influx of work force is concluded to be minor as the activity is short term and spreads along the route of transmission line, which will reduce any possibility of intricate interaction with the community. The

contractors will have a strict control over them regarding behaviour and interaction with the community.

Table 5.13 Impact significance for Cultural aspects from Construction Phase

Aspect	Scenario	Context			Duration			Intensity			Type		Significance			
Social		Local	Moderate	Regional	Short	Medium	Long	Low	Moderate	High	Adverse	Beneficial	Insignificant	Minor	Moderate	Major
	Without mitigation	☑			☑				☑		☑			☑		
	With mitigation	☑			☑			☑			☑		☑			

5.5 OPERATION PHASE IMPACTS

5.5.1 Soils

No impacts of any significance are predicted on vegetation and soil due to operation of the transmission line. Any spillage of Aluminium oxide paint during operation and maintenance of the transmission line towers may impact soil quality. Low frequency of painting as well as involving experienced personnel with mitigations like prior spread of sheets underneath the tower structure while painting.

5.5.2 Waste Disposal

No significant waste is anticipated to be generated during operation of the transmission line.

5.5.3 Aesthetics and Visual Impact

There will be no additional visual impact due to operation of transmission line as the will only involve transmission of electricity through the established network.

5.5.4 Surface Water and Hydrogeology

No impact on the surface waters and hydrogeology of the area are anticipated from the operation of the transmission line.

5.5.5 Ecology - Flora and Fauna

a) Activity

There will be routine clearance of vegetation undertaken for maintaining adequate clearances along the route length. The combination of the height of transmission towers and the electricity carried by transmission line can pose potentially fatal risk to birds through collisions and electrocutions.

b) Potential Impact

Avian collisions with power lines can occur in large numbers if located within daily flyways or migration corridors, or if groups are travelling at night or during low light conditions (e.g. dense fog). However, the possibilities of such collision are low as the avifauna in the area would be habituated to presence of transmission line as most part of the proposed route run parallel to existing transmission lines.

The impact to flora from the operation of the transmission line will be the routine clearance of vegetation undertaken for maintaining adequate clearances along the route length.

The sag in transmission line combined with slope of the area brings the lines close to tall trees, which may require regular trimming/clearing.

c) Mitigations

Routine clearance of vegetation will be restricted to trees growing under the transmission line and branches growing into or overhanging the lines. No pesticides or herbicides will be used for clearance of the corridor.

Transmission corridors alignment will be planned to avoid critical habitats (e.g. nesting grounds, heronries, rookeries, and migration corridors etc.)

A spacing of 1.5 meter (60-inch) between energized components and grounded hardware will be maintained or, where spacing is not feasible, covering of energized parts and hardware to be done.

Visibility enhancement objects such as marker balls, bird deterrents, or diverters will be installed to avoid avian collision.

d) Impact Significance

The area is reported for few schedules I and II listed birds in the region, but it is not a part of any migratory corridor or critical habitat. Also, if the given mitigations implemented, insignificant impacts on flora and fauna are predicted.

Table 5.14 Impact significance for fauna and flora from operation Phase

Aspect	**Scenario**	**Context**			**Duration**			**Intensity**			**Type**		**Significance**			
Fauna & Flora		Local	Moderate	Regional	Short	Medium	Long	Low	Moderate	High	Adverse	Beneficial	Insignificant	Minor	Moderate	Major
	Without mitigation	☑			☑				☑		☑			☑		
	With mitigation	☑			☑			☑			☑		☑			

5.5.6 Traffic and Transport

The movement of vehicles during the operation phase will be essentially for monitoring and maintenance and occasionally to address the breakdowns. Considering occasional and short lived movement of the traffic for monitoring and maintenance work, impacts related to the traffic during construction will be negligible. However, any operation and maintenance related activities along or across the national highways will be subject to prior discussion and approval of National Highway Authority of India through their regional offices.

5.5.7 Atmospheric Emissions/ Dusts

The operation of the transmission line will not contribute to any atmospheric emissions directly and hence the predicted impacts are negligible.

Green House Gas emissions from the transmission line operation will be limited to fuel consumption in vehicle used for the maintenance activities. The project on the whole being a hydroelectric power project will potentially prevent the emission of GHG which would have otherwise been generated for power generation of similar capacity. The GHGs generated from the project will be negligible.

5.5.8 Noise

a) Activity

The likely noise impacts from operation of the transmission line will be due to:

- Maintenance and repair activities;
- 'Corona discharge' from the overhead lines; and

b) Potential Impacts

Once operational, noise from energised overhead lines can be produced by a phenomenon known as 'Corona Discharge' (a limited electrical breakdown of the air). Conductors are designed and constructed to minimise corona effects, although, under certain conditions this can be audible as a '*hissing*' sound, sometimes accompanied by a low frequency hum. However, noise due to Corona Discharge is negligible for transmission line up to 220 kV grade. Another noise source could be generated during maintenance of the towers, though it will be infrequent and extremely low.

c) Mitigations

Conductors designed and constructed to minimise corona effects will be chosen for transmission.

It is highly unlikely that the corona discharge noise will exceed the normal background noise levels in the area and furthermore, such noises are restricted to certain weather conditions.

d) Impact Significance

The noise generation from operational phase will be low but consistent for the entire life of transmission line. The impact of noise is considered to be minor.

Table 5.15 Impact significance due to Noise from operation Phase

Aspect	Scenario	Context			Duration			Intensity			Type		Significance			
Noise		Local	Moderate	Regional	Short	Medium	Long	Low	Moderate	High	Adverse	Beneficial	Insignificant	Minor	Moderate	Major
	Without mitigation	☑				☑			☑		☑			☑		
	With mitigation	☑				☑		☑			☑		☑			

5.5.9 Archaeological, Historic and Cultural Effects

No impacts are predicted from the operation of the transmission on any site of archaeological, cultural or historic importance.

5.5.10 Potential Hazards

a) Activity

The project will have transmission of 220 kV power through the proposed transmission line during operation phase.

b) Impact/Risks

There is a possibility of lines or towers/ tower members falling to the ground, and during the operational phase, contact with the transmission line can result in electrocution.

Ignorant people trying to tap electricity from high tension wire can lead to fatal accidents. Power transmission towers in the area near Bhuntar Airport can impact aircraft safety directly through collision or indirectly through radar interference.

c) Mitigations

The following mitigation measures will be adopted to minimise the potential for accident hazards:

- Risks to general public during operation will be reduced by public awareness and education and physical measures by attaching an appropriate warning sign on all faces of the tower;
- Once the stringing work is complete, notices and permanent anti climbing devices will be installed on the tower. The operational start date for electricity transmission and safety implications will be publicised locally in advance;

- The transmission line and towers in the area of Bhuntar Airport will be provided significant detour to avoid any interference with flight path; and
- Consultation will be conducted with regulatory air traffic authorities prior to installation. All adherences to regional or national air traffic safety regulations will be made.

d) Impact Significance

Upon implementation of the above measures, insignificant accident hazards predicted with the development of the transmission line.

Table 5.16 Impact significance due to potential hazard from operation Phase

Aspect	Scenario	Context			Duration			Intensity			Type		Significance			
Potential Hazards		Local	Moderate	Regional	Short	Medium	Long	Low	Moderate	High	Adverse	Beneficial	Insignificant	Minor	Moderate	Major
	Without mitigation	☑				☑			☑		☑			☑		
	With mitigation	☑				☑		☑			☑		☑			

5.5.11 Electromagnetic Fields (EMF)

a) Activity

The power transmission through the proposed transmission line during operation phase will result in development of electromagnetic fields.

b) Potential Impacts

There have been some concerns about possible increased risk of cancer from exposure to electromagnetic radiation from overhead transmission line. People living in the vicinity of transmission line are potentially prone to exposure to EMF.

Electric utility workers typically have a higher exposure to EMF due to working in proximity to electric power lines.

Although there is public and scientific concern over the potential health effects associated with exposure to EMF (not only high voltage power lines and substations, but also from everyday household uses of electricity), there is no empirical data demonstrating adverse health effects from exposure to typical EMF levels from power transmissions line and equipment.

However, while the evidence of adverse health risks is low, it is still sufficient to warrant limited concern.

Another impact of EMF can be on telecommunication systems, like telephone cables, telephone towers, airport communication etc.

c) Mitigations

The recommendations applicable to the management of EMF exposures (as per IFC) as given below will be followed:

Evaluation of potential exposure to the public against the reference levels developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP).Average and peak exposure levels will remain below the ICNIRP recommendation for General Public Exposure.

Considering siting new facilities so as to avoid or minimize exposure to the public. Installation of transmission line or other high voltage equipment above or adjacent to residential properties or other locations intended for highly frequent human occupancy, (e.g. schools or offices), will be avoided.

If EMF levels are confirmed or expected to be above the recommended exposure limits, application of engineering techniques will be considered to reduce the EMF produced by power lines, substations, or transformers. Examples of these techniques include:

- Shielding with specific metal alloys
- Increasing height of transmission towers
- Modifications to size, spacing, and configuration of conductors

Clearance from telecommunication and telegraph wires will be maintained as per the Electricity Act 2003

The lists of exposure limits for general public exposure to electric and magnetic fields published by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) is as given in ***Tables 5.17 & 5.18.***

Table 5.17 ICNIRP exposure limits for general public exposure to electric and magnetic fields

Frequency	Electric Field (V/m)	Magnetic Field (µT)
50 Hz	5000	100
60 Hz	4150	83

Source: ICNIRP (1998) : "Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz).

Table 5.18 ICNIRP exposure limits for occupational exposure magnetic fields

Frequency	Electric Field (V/m)	Magnetic Field (µT)
50 Hz	10,000	500
60 Hz	8300	415

Source: ICNIRP (1998) : "Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz).

d) Impact Significance

There are no specific standards or guidance on EMF in India however the Indian Electricity Act and Rules clearly stipulate the minimum clearances

required. Hence the ICNIRP standards and guidelines have been considered. For the general public (up to 24 hours a day) an exposure level of 1,000 mG or 100 µT is suggested. The EMF generated by 220KV line is lesser than the suggested value.

Table 5.19 Impact significance due to Electromagnetic field from operation phase

Aspect	Scenario	Context			Duration			Intensity			Type		Significance			
Electro-magnetic field		Local	Moderate	Regional	Short	Medium	Long	Low	Moderate	High	Adverse	Beneficial	Insignificant	Minor	Moderate	Major
	Without mitigation	☑					☑		☑		☑				☑	
	With mitigation	☑					☑	☑			☑			☑		

5.6 PROJECT CATEGORIZATION

The proposed transmission line project has been categorised as a Category B project (as per the IFC criteria) due to the following reasons:

- The transmission line project is a linear project that runs for about 174.66 km requiring land as "right of way" of about 17.5 m either side of the centre of the proposed transmission line;
- The project during operation phase will have low potential of pollution;
- There is no displacement of families due to the project;
- The project will have some adverse social and environmental impacts, however, they are few in number, restricted to the corridors of right of way;
- Impacts caused during construction phase are mostly reversible except that of revenue and forest lands that are taken as right of way for the transmission line.

6 ANALYSIS OF ALTERNATIVES

An analysis of alternatives to the proposed route of transmission line is discussed in the following section. After setting up of power plant at Prini, it is required to evacuate the power generated. Transmission of power being essential the alternatives need to be analysed for transmission of the power from the power plant to the grid. Considering the fact that a suitable power evacuation system is needed for the AD Hydro-Electric Power plant, there are the only two variables that require analysis:

- Alternate methods of power transmission; and
- Alternate routes to transmission line (route selection strategy and principles).

6.1 ALTERNATE METHODS OF POWER TRANSMISSION

There are two methods of power transmission, these being overhead lines and underground cables. Underground cables are considerably more difficult and expensive relative to overhead lines. Normally, underground cables are appropriate for lower voltage connections and in densely populated areas.

Underground cables have also been used world-wide in areas of higher environmental sensitivity but considering the proposed terrain of the transmission line underground cable would require more digging, drilling and even controlled blasting at places which will have a greater potential for soil erosion, noise generation, water contamination and dust generation as compared to overhead lines.

The land requirement for underground cable will be more than that for overhead lines and will enhance disturbance of soil, vegetation and ecology besides increase in social concerns related to land.

So the normal choice for the project proponent has been essentially overhead lines as it is easier for construction and financially more viable. Also, there are no environmental sensitive areas along the power evacuation routes, negating any necessity for use of underground cables

6.2 TRANSMISSION LINE ROUTE SELECTION

Three alternate routes were planned for transmission of power from the power plant to the Sub station at Nalagarh. The final route was planned considering three primary factors:

- Forest land: The route selection considered the best option to avoid any forest land as far as possible.
- Habitations: The key considerations that were looked into in selecting the corridor route included clustered settlements, common access routes and

pathways, markets, community structures and private land (by avoiding it to the extent possible). Additional pylons with modifications have been planned by the project proponent to address such issues and necessary alternatives have been factored in (such as change in route by erecting detouring towers, stringing activities planned post harvesting to avoid damage to agricultural produce, minimising damage to apple or other trees, where necessary only pruning of twigs were taken up)

- Length: The route identified ensures the shortest possible route after considering the forestland and habitations.

Technically the route identified for transmission line follows the following:

- While selecting the route, due weightage was given to the accessibility of the line for construction as well as for maintenance for its total life span;
- The line is sited in areas which are not inaccessible by slight deviations and marginal increase in the route length;
- In most part of the route it is possible to transport materials and tools quickly in case of breakdowns;
- Wherever roads are existing the line is approachable from such roads;
- The transmission line route avoids inhabited areas leaving sufficient margin for growth of villages/ towns;
- It also avoids as far as possible the areas where intensive cultivation is done;
- Crossing of orchards and gardens has been kept to the minimum;
- The additional costs incurred in crop compensation during construction was also considered;
- It would be possible for the personnel patrolling the line to be able to reach every location, careful inspection of the towers, insulators and the accessories without any obstruction from the land owners;
- Heavily wooded areas/forest land has been avoided to the extent possible;
- Prior consultations were held with the concerned departments.

The routes selected as of now has either obtained or applied for all necessary clearances for highway crossing, high tension power line crossing, use of forest land and shifting of low tension wires.

6.3 NO PROJECT SCENARIO

A no project scenario was also considered as an alternative, however since the proposed project intends to link the hydroelectric power plant at Manali to the sub-station therefore it cannot be considered in isolation. The power generated by plant will require a transmission source to evacuate it to the substation and therefore a no project scenario is non-existent.

7 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

7.1 INTRODUCTION

IFC Performance Standard-1 underscores the importance of managing social and environmental performance throughout the life of a project (any business activity that is subject to assessment and management). An effective social and environmental management system is a dynamic, continuous process initiated by management and involving communication between the client, its workers, and the local communities directly affected by the project (the affected communities). Drawing on the elements of the established business management process of "plan, implement, check, and act," the system entails the thorough assessment of potential social and environmental impacts and risks from the early stages of project development, and provides order and consistency for mitigating and managing these on an ongoing basis.

ADHPL is committed to execute all construction and operation related activities for the transmission line as per the best established environmental, health and safety (EHS) standards. ADHPL has effectively considered a large number of potential impacts during the selection of route, which includes avoiding densely populated area, thick vegetations, compensation for land acquisition etc. Mitigation measures are proposed for impacts which could not be avoided through selection of alternate route. Some residual impact will however persist after the all mitigation measures are employed, the Environment and Social Management Plan intends to delineate monitoring and management measures to minimize such impacts by allocating management responsibility for implementation of these measures during construction and operational phase.

7.1.1 *Aspirations, Expectations & Apprehensions*

An assessment of community expectations were undertaken in a sample of villages and with informed stakeholders. These consultations came up with a range of benefits and assistance that were desired by the community in lieu of the losses or impacts from the project. Many of the expectations were found to unrealistic and there may be a need to manage these expectations. The section below discusses the key benefits and expectations from the project;

Community Benefits: Compensatory benefits for land and crop loss based on market rates. Also the compensation should factor in the future potentiality of the impacted land and allied benefits to the larger group and community. These allied benefits were mostly reported to be infrastructure and amenities needs of the village/ community.

Royalties: The expectations also include monetary assistance to the affected panchayats and areas to carry out long terms and recurrent development activities.

Contracting Opportunities: People expressed interests in contracts of raw materials like sand, gravel during the construction phase, to hire out equipments for building roads, camp sites, access roads, supply of rations etc.
Adequate and Timely payment of Compensation: The affected community desired an adequate and timely payment of compensation for their losses. The community was aware of the discrepancy between market and registered rates of land, reported yield of crops in the area and difference in market and *mandi* rates of crops. They expected the project proponents to consider these gaps while making assessment of losses.

Restoration of land to pre-project level: As mentioned above the construction of the tower involves a substantial amount of earth work which resulted in waste and rubble. This waste spread over the surrounding area of the land thus impacting the land and its productivity (loss of top soil, compaction etc). The community and the impacted groups expected the project proponents to restore the land to the pre-project levels once the project activities are over.

Apprehensions of Risks: The community were concerned about the risk of overhead wires and pylons located in the agricultural fields. Misgivings and unsubstantiated fears linked to electrocution were reported by the community at different places. Similarly unfounded rumours of overhead transmission line leading to several health impacts like skin diseases, disability and infertility were expressed especially in the hilly regions of the project area. These fears mostly arose from the lack of information and proper understanding of the project and its activities and reportedly at times by the activities of vested groups trying to gain mileage and benefits from the project.

Grievance Redressal; The project proponents need to have a proper grievance redressal process in place to ensure that individual and community grievances are properly handled and addressed in a timely and appropriate manner. The current process of addressing complaints and grievances need to be strengthened by bringing in proper systems and ensuring the awareness of such systems among the community and stakeholder groups.

Management of expectations: Community expectations for employment and other local benefits need to be addressed and managed. The project proponents need to identify (if possible) employment opportunities for people whole land plots will be impacted. Several of these opportunities would be limited to the construction period, but some could be long term employment. They need to communicate about opportunities on a regular basis and demonstrate the efforts being made to accommodate as many people as possible. Also it needs to be ensured that there is a transparent process of giving benefits and opportunities to the affected groups and ensure that priority is given to people with cumulative impacts as well as vulnerable families (with small land holdings). Similarly options should be explored to bring local benefits like enhancement of local infrastructure, targeted social investment programme to address local and regional development issues like employment, skill development and agriculture etc.

Managing community perception on health: The perceptions of the community with regard to the perceived health impact of the project needs to be managed to allay any fears and apprehensions of the community. Proper dissemination of information and consultations with the community and relevant stakeholders will need to be carried out to dispel individual and community concerns regarding health and safety.

Consultation, Disclosure and Grievance redressal: Consultation and disclosure is a challenge as the number of people directly and indirectly impacted is very large, and spread along the length of the transmission line. In addition to the land impacted families, there are other stakeholders namely Panchayat bodies, other government agencies, utilities, line departments, as well as media and academia. The consultation and disclosure process for the project will need to address the entire range of stakeholders and be modified to suit the requirements of a linear project. Consultations should be recorded and documented. Any issues raised, including specific grievances, should be ideally handled at the local level. If it requires intervention of other teams or corporate then the monitoring reports should become the means to transfer the compliant or request. Additional information request should be promptly responded to, wherever possible.

For grievance, ADHPL power should develop a detailed Grievance Procedure for the community to record grievances. There should a number of forums through which complaints/ comments can be recorded:

- Through Corporate Liaison Offices;
- Contractors Communication Liaison Offices
- In registers and complaint logs kept at strategic places and
- Verbally though phone or direct face to face meetings

7.1.2 Management issues

In addition to the above impacts, transmission line usually has its own inherent challenges that need to be taken into cognisance when discussing impacts as well as while designing mitigations measures. Typical management challenges include:

- It is a linear project traversing about 175 km across four districts. Community consultations always prove a challenge in such circumstances. The construction team will be at site for a short time and then moves on. It would require careful planning to ensure that the community is informed about the activities, due permissions are taken from land owners and others with stakes on the land, and land is restored and returned without delay.
- Construction would be undertaken along the entire route either simultaneously or as and when approval and clearances have been received. Usually more than one contractors working on different sections are involved in such process. Managing contractors proves to be difficult, especially in trying to meet the company's HSE as well as community relation guidelines. Most of the grievances that emerge

during construction are due to contractors not meeting their contractual obligations.

- For the same reasons, receiving grievances and complaints and responding to them in a timely and consistent and fair manner also gets hampered because of the long footprint. Much of the obligations of grievance redressal therefore fall on the contractors.

It is difficult to design mitigations when the impacted families or land losers are many but scattered in a large area and land related impacts are relatively low. More manpower resources are typically required to manage impacts of linear projects as well as community engagement.

The field consultations carried out in connection revealed that the affected communities possess mixed information about the transmission line. Generally along the transmission line route the awareness with regard to location of towers, overhead lines is high but low with regards to potential community and health impacts such lines have/ do not have. However, select consultations with informed stakeholders revealed that the overall support to the project remains high, providing that

- Compensation paid is adequate and is timely paid both for the directly and indirectly impacted land owners
- The project proponents address the health and safety concerns if any associated with the electricity lines
- Compensation including specific investment in community development programmes.

7.2 STANDARDS, GUIDELINES & ENVIRONMENTAL MANAGEMENT SYSTEM

7.2.1 Standards and Guidelines

The ESMP reflects requirements of

- Government of India - MoEF's conditions of Forest Clearance conditions issued under the Forest (Conservation) Act, 1980;
- IFC and EPFIs guidelines for projects requiring private funding viz.,
    1) Guidance on Equator Principles Financial Institutions' Performance Standards;
    2) EHS guidelines for power transmission lines as published by IFC;
    3) IFC Performance Standards (as well under the Equator Principle 3) which include:
        - PS -1: Social and Environmental Assessment and Management Systems
        - PS- 2: Labour and Working Conditions
        - PS- 3: Pollution Prevention and Abatement
        - PS-4: Community Health, Safety and Security
        - PS-5: Land acquisition and involuntary resettlement,
        - PS-6: Biodiversity Conservation and Sustainable Natural resource Management
        - PS-7: Indigenous People

- PS-8: Cultural Heritage

7.2.2 Environmental Management System (EMS) and Safety Management System (SMS) Procedures

ADHPL has defined EMS and SMS procedures under ISO 14000 and OHSAS 18000 certifications respectively. The project is developing mechanism for verifying criteria laid down on standards and practices for effective control on whether these are met or exceeded, as well as for recording and reporting of results. The following components are taken to establish an EMS:

- Organisational Commitment;
- Environmental Policy;
- Objectives and Targets;
- Responsibilities and Reporting Structure;
- Training;
- Environmental Review Audits; and
- ESAP.

ADHPL has also obtained OHSAS 18000 certification. The key components on OHSAS 18000 include the following:

- Housekeeping;
- Electrical, Mechanical and Personal Safeguarding;
- Fire Protection and Prevention;
- Accident Recording and Investigation; and
- Safety Organisation.

7.2.3 Inspection, Monitoring & Audit

Inspection and monitoring of the environmental and social impacts of construction and operation phase activities will increase the effectiveness of suggested mitigations. Through the process of inspection, audit, and monitoring ADHPL will ensure that all the contractors comply with the requirements of conditions of forest clearance, and other permits including suggested action plans. The inspections and audits will be done by ADHPL's trained team and external agencies/experts. The entire process of inspections and audits will be documented. The inspection and audit findings will be implemented by the contractors in their respective areas.

ADHPL has engaged a Himachal Pradesh based reputed NGO (Lok Kalyan Mondal) to oversee and guide its compliance with ESIA.

7.2.4 ESAP Review and Amendments

This ESAP is an environment management tool which needs to be reviewed periodically to address changes in the organisation, process or regulatory requirements. Following a review, Head Transmission Line will be responsible for making the amendments in the ESAP through appropriate and qualified staff/consultant. The amended ESAP will be communicated to all the staff.

7.2.5 Reporting and Review

ADHPL has developed and implemented a programme of reporting through all stages of the project construction. Contractors are required to fully comply with the reporting programme in terms of both timely submissions of reports as per acceptable level of detail. Reporting are to be done in form of environmental (including forest resources), health, safety and social check list, incident record register, environmental, health, safety and social performance reports (weekly, monthly, quarterly, half yearly, yearly etc.).

External Reporting and Communication

Head Transmission line will provide support to the ADHEP as well will report to the Power Grid Corporation of India and CEA as per the required conditions of setting up for the proposed Transmission Line. All complaints and enquiries are to be appropriately dealt with and records be maintained in a Complaint/Enquiry Register by Forest and Safety Officers or other delegated staff.

Internal Reporting and Communication

Inspection and audits finding along with their improvement program are to be regularly reported to the senior management for their consideration. The same are also to be communicated within the staff working on the project.

To maintain an open communication between the staff and management on EHS&S issues the followings are being used:

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

7.2.6 Documentation and Record Keeping

Documentation and record keeping system will be established to ensure updating and recording of requirements specified in ESAP. Responsibilities will be assigned to relevant personnel for ensuring that the ESAP documentation system is maintained and that document control is ensured through access by and distribution to, identified personnel as following:

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

7.2.7 Post Project Construction, Operation and Post Decommissioning Monitoring

After attaining the project life i.e. when transmission line is no more required for the power transmission and there is need of decommissioning of the transmission line. The project will conduct prior ESIA study for decommissioning of the project. Any reporting can be discontinued only subject to the condition that the corridor is restored to its best achievable original condition to the satisfaction of the regulatory agencies.

7.2.8 Organisation, Roles and Responsibilities

ADHPL Management

The overall management and coordination of the transmission will be managed through following four heads who will be reporting to Head Transmission Line besides Head (Forest Clearance /Design & Other Miscellaneous Works) and Advisor and Head (Technical).

- Head (Snow Zone), who will be responsible for execution of project corridor running through upper part of the project area i.e. in snow zone;
- Head (Non Snow Zone), who will be responsible for execution of project corridor running through middle and lower part of the project area i.e. in non snow zone
- Head (Finance and Accounts and Vehicles and Vigilance)
- Head (Human Resources and Stores).

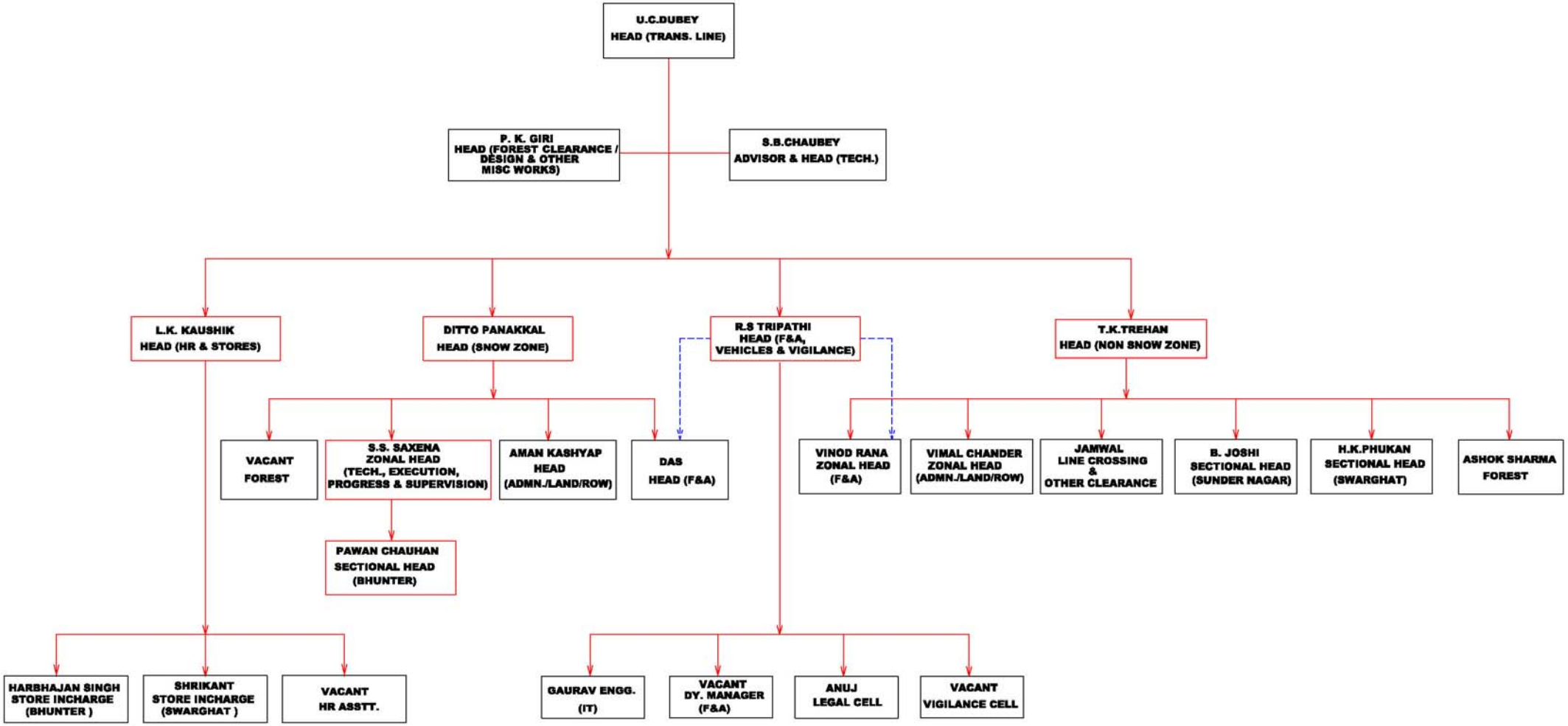
For Environment and Safety related matters the project will have Forest and Safety Officers who will be reporting to their respective heads in snow and non snow zones.

The head of transmission line will be responsible for the following:

- Ensuring availability resources and appropriate institutional arrangements for implementation of ESAP;
- Selection of appropriate monitoring agency for carrying out various monitoring and analysis;
- Compliance of legislative and IFC/EPFIs requirements including ADHPL's policies, programs and contractual terms and ESAP and communication with the regulatory agencies;
- Overall implementation of EHS&S mitigations by construction contractors, sub contractors, workforce deputed along the project corridor;
- Conduct audits, and inspection of all the project activities;
- Preparation of necessary documents and record keeping system; and
- Review and updating of ESAP for effective its implementation.

As the project proponent, ADHPL senior management will have the overall responsibilities for the project to provide adequate resources (funds and manpower) for continual improvement EHS&S performance.

Figure 7.1 Organisation Chart for 220 kV ADHEP Transmission Line



Construction Contractors

Prior to assigning any contract, ADHPL will pre-qualifies each contractor according to commercial, technical, quality assurance and its past performance on EHS&S standards so as to satisfy ADHPL's requirements and policies.

Regulatory Agencies

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

- District Administration of, Kullu, Mandi, Bilaspur and Solan;
- Land Revenue Department;
- Irrigation and Public Health Department;
- Department of Forests and Environment;
- Himachal Pradesh State Pollution Control Board;
- Power Grid Corporation of India;
- State Electricity Board;
- Central Electricity Authority;
- National Highways
- Petroleum and Explosives Safety Organisation (PESO), erstwhile Chief Controller of Explosives, Nagpur (for use of any explosives during project construction phase).

7.2.9 Training of ADHPL Personnel and Contractors

Head Transmission Line will ensure that the job specific training and EHS Induction Training needs are identified based on the specific requirements of ESAP and existing capacity of project personnel (including the Contractors and Sub-contractors) to undertake the required ESAP management actions and monitoring activities.

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

An environmental management training programme will be project related construction activities. This will ensure effective implementation of the management and control measures on various project activities. The training programme will ensure that all concerned members of the team understand the following aspects:

- Purpose of management plan for the project activities;
- Requirements of the management plan and specific Action Plans;
- Understanding of the sensitive environmental and social features within and surrounding the project areas;

- Aware of the potential risks from the project activities;

7.3 PROPOSED ENVIRONMENT AND SOCIAL ACTION PLAN

The Environment and Social mitigation measures, monitoring and management responsibility for impacts during construction activities and operation of the transmission line is given in *Table 7.1*. These measures will be adopted by the project proponents and imposed as condition of contract on the sub contractor employed for construction of the transmission line. The mitigation measures suggested during operation will be made part of the regular maintenance and monitoring schedule.

Table 7.1 Environment and Social Action Plan for the Proposed 220 kV Power Transmission Line

SN	Aspect	Impact	Suggested Mitigation	Monitoring and Awareness	Management Responsibility
A) Construction Phase					
A1.1	General	▪ Prior Planning	▪ Construction contractor to develop a detailed design for the electricity transmission line.	▪ Work force to be briefed about the relevant environmental issues, including pollution control and site management, before work begins. ▪ ADHPL has engaged a Himachal Pradesh based reputed NGO (Lok Kalyan Mondal) to oversee and guide its compliance with ESIA.	▪ Head Transmission Line
A2.1	Land Take / Right of Use	▪ Land will be used for permanent facilities like foundation, pylons etc (Currently the hindrances due to use of land is being compensated. The rates for land are agreed on a negotiated basis)	▪ Ensure that negotiations for compensation are free and fair. Also ensure that the compensation rates are at par with the market rates. ▪ It also needs to be ensured that the opportunity cost of such land is considered when deciding the compensation amount.	▪ Land owner should be adequately informed about compensation package by the ADHPL's Liaison Officer.	▪ Head Administration/ Land/RoW ▪ Liaison Officer. ▪ Local Administration
A2.2		▪ There may be some changes in the alignment to take into account any specific requirement along the route which may result in some deviations from the original route profile.	▪ Inform landowners about the change in the route. ▪ Release land not required after re-routing to the landowners	▪ A final check survey need to be conducted just before the time of construction for exact tower spotting.	▪ Head Administration/ Land/RoW ▪ Liaison Officer.

SN	Aspect	Impact	Suggested Mitigation	Monitoring and Awareness	Management Responsibility
A3.1	Right of Use/ Stringing	▪ Crop/ Plantation and asset loss. (Currently there is no uniformity in the valuation process of crop, plantation income and assets like trees. At some places it is being done on the horticulture rates while at others places it is done on an individually negotiated basis).	▪ Ensure replacement value for crops, plantation and other assets. ▪ Ensure uniformity in the process of methods and procedures followed in assessment of such losses.	▪ Use a third party independent valuation to define replacement value.	▪ Head Administration/ Land/RoW ▪ Liaison Officer. ▪ Local Administration
A4.1	Communication on compensation	▪ Communication on compensation. (Currently the PAPs are communicated of manner and methods of assessment of land, crop and asset value either during the time of negotiation or during the disbursement process.)	▪ Specific communication on how compensation amounts have been decided, and the total compensation to be paid to the PAP. The process of deciding upon the compensation and the manner of disbursal needs to be communicated in advance to the PAPs.	▪ Liaison officer to prepare basis of calculation to estimate the rate for different crops and communicate the same to affected PAPs	▪ Head Administration/ Land/RoW ▪ Liaison Officer.

SN	Aspect	Impact	Suggested Mitigation	Monitoring and Awareness	Management Responsibility
A5.1	Access	▪ Access can be disrupted during construction, at individual land owner level, and at the community level when village/ link roads are damaged/used beyond capacity for transportation and construction related activities. (ADHPL has wherever possible tried to avoid any access routes to avoid any disruption or inconvenience to the individual/community. Wherever such access is mandatory the negotiations have been done with the affected landowner by the construction contractor).	▪ Avoid using community /village roads for project activities. Alternative roads should be constructed and used. All access roads to be fully restored after use. ▪ Ensure that the compensation amount negotiated between the contractor and the affected PAP is adequate and paid in time. ▪ In case the land owner's access to his fields is disrupted for longer than what he/she has been compensated for, then the additional loss of crops needs to be compensated at the existing rates.	▪ Ensure prior approval and discussion with the local administration and concerned departments for any disruption of traffic/access. ▪ Supervise construction contractors as well as vehicle operators	▪ Head Administration/ Land/RoW ▪ Liaison Officer. ▪ Construction Contractor ▪ Local Administration ▪ NHAI regional office ▪ Department of Forest

SN	Aspect	Impact	Suggested Mitigation	Monitoring and Awareness	Management Responsibility
A6.1	Community and private property	▪ Damages to community and private/individual property during construction activities. The analysis of alternatives has been done by the project proponents and community or private property resources have at best been avoided in the transmission line corridor. Wherever such private resources have been impacted the compensation has been negotiated and included in the compensation amount	▪ Ensure that the construction activities are to be so planned that any use of community and individual property is either avoided or prior permission sought before use. ▪ Any unforeseen use and/or damage to property or structures etc. needs to be immediately compensated. ▪	▪ The grievance redressal process should closely monitor construction activities for such incidences. All such commitments should be a part of the contractor agreements.	▪ Head Administration/ Land/RoW ▪ Liaison Officer. ▪ Construction Contractor ▪ Local Administration

SN	Aspect	Impact	Suggested Mitigation	Monitoring and Awareness	Management Responsibility
A7.1	Local amenities and infrastructure	▪ Local infrastructure may come under pressure as construction activities use local resources. However, such impacts are envisaged to be minimal and short term in case for the project. [Construction workers and the contractors involved in the foundation or stringing work reside close to the site in the nearby villages. They negotiate their stay and logistics individually with the house owners (in case of rented accommodation) and make use of the local resources like water, sanitation arrangement etc.]	▪ Ensure (through provisions in the contract) that the construction workers do not negatively impact the nearby households or cause any inconvenience to them. ▪ Also that the terms and conditions negotiated with the house owner are respected by the workers. ▪ Behaviour and conduct of the workers to be monitored to ensure that there are no cultural or psychological impacts.	▪ Grievance redressal process should closely monitor construction activities for such incidences. All such commitments should be a part of the contractor agreements.	▪ Head Administration/ Land/RoW ▪ Liaison Officer. ▪ Construction Contractor ▪ Local Administration
A8.1	Community impacts	▪ Presence of labour in the area, even for short duration, can create local conflicts (Health impacts including risks of sexually transmitted diseases on the community)	▪ Commit to meet Indian regulation requirements as well as international conventions on labour, especially on issues of child and forced labour, working conditions, collective bargaining, non-discrimination and equal opportunity, complaint and grievance mechanism as well as occupation health and safety.	▪ Weekly inspection of construction locations	▪ Head Administration/ Land/RoW ▪ Liaison Officer. ▪ Construction Contractor ▪ Local Administration

SN	Aspect	Impact	Suggested Mitigation	Monitoring and Awareness	Management Responsibility
A9.1	Community expectations	▪ Community expectations for local benefits and other opportunities need to be addressed and managed. (The ADHPL have at places tried to accommodate the local community by giving them contracts for foundation works. Contribution to the local community development activities is ensured through donation in the district fund or as and when request made by the panchayat/ administration)	▪ Identify contracting/employment opportunities for people whose land plots will be impacted. Several of these opportunities would be limited to the construction period, but some could be long term employment. ▪ Communicate about employment opportunities on a regular basis and demonstrate the efforts being made to accommodate as many people as possible. ▪ Ensure there is a transparent process of giving benefits. Give priority to people with cumulative impacts as well as vulnerable families (with small land holdings). ▪ As employment opportunities will be limited, use other measures as is currently being done to bring local benefits like enhancement of local infrastructure, targeted social investment programme to address local and regional development issues like employment, skill development and agriculture etc.	▪ ADHPL to develop mechanism to advertise, identify and recruit suitable worker from the local community. ▪ ADHPL to develop mechanism to communicate the skill requirement to eliminate unwanted expectations.	▪ Head (HR & Stores)
A10.1	Cultural Heritage	▪ Cultural and religious sensitivities may be impacted by the project. (The ADHPL have ensured and taken steps to avoid any impact on cultural and religious properties all across the transmission line corridor.)	▪ Map all cultural heritage sites in a location before commencement of construction and ensure that such cultural and heritage sites or structures are not impacted. ▪ Comply with national laws and international obligations on heritage.	▪ Monitor all activities close to places of religious and cultural importance on weekly basis.	▪ Construction contractor ▪ Liason officer

SN	Aspect	Impact	Suggested Mitigation	Monitoring and Awareness	Management Responsibility
A11.1	Soils	▪ Dumping of construction material outside the project construction foot print ▪ Erosion and compaction (The waste and rubble management is currently either dumped in the nearby area or locally managed by the construction contractor.)	▪ Construction to be undertaken during non-monsoon months to reduce any potential run-off induced erosion ▪ All construction material to be kept within the footprint of the area acquired. ▪ Loose construction material to be covered to avoid being carried into adjoining areas by wind. ▪ Ensure that the land is physically restored before leaving the project site to another location ▪ Use of existing track for transport of man and material to the extent possible.	ADHPL representatives to make weekly visits to each tower construction site to monitor such issues.	▪ ADHPL ▪ To be mentioned in the contract with the construction contractor ▪ Phase Manager shall arrange for routine monitoring
A11.2		▪ Soil Contamination due to spill of civil construction material and Aluminium oxide paint	▪ Ensure secured storage of civil construction materials including paint, thinner etc. ▪ Spread sheet underneath the tower structure prior to start of any painting activity. ▪ Remove empty containers/sacs/boxes etc on daily basis and dispose off through authorised vendors. ▪ In case of any spill, ensure clean up immediately		
A11.3		▪ Waste construction debris creating nuisance in the corridor	▪ Construction debris to be removed on a daily basis from the site and no debris to be left at the site upon completion of the site work. ▪ Debris to be kept within the footprint of the site. ▪ Construction near water bodies to avoid contamination	▪ The towers need to be inspected at all locations at least once during the casting of each foundation to monitor storage of construction material and loose excavated soil.	▪ Will form part of the subcontractors contract with regular audit by ADHPL ▪ Phase Manager shall arrange for routine monitoring

SN	Aspect	Impact	Suggested Mitigation	Monitoring and Awareness	Management Responsibility
A12.1	Land use and Agriculture	▪ Disturbance to land uses and agricultural activities ▪ Loss of existing crop ▪ Limited access to the area under the towers ▪ Loss of crop due to movement of workers	▪ Pylons to be located to avoid interference with the existing areas of agricultural or other cultural significance ▪ Barriers or boundary markings to be provided to prevent incursion of tractors or workers into surrounding crops during construction ▪ Tractors, equipment and personnel to follow a predefined route and instructed not to wander in neighbouring areas unnecessarily ▪ Site clearance activities to be restricted to the minimum required area ▪ Construction to avoid key planting/ harvesting periods wherever possible specially for apple orchards in flowering season.	▪ All stringing activities to be regularly monitored by ADHPL personals to reduce damages to the extent possible. ▪ Construction workers to be instructed through contractors to work within the identified footprint. ▪ Regular checks by ADHPL to ensure compliance	▪ Phase manager to arrange and schedule monitoring.
A13.1	Ecology	▪ Disruption to existing flora and Fauna ▪ Loss of trees due to construction activity ▪ Damage to trees from stringing process ▪ Disturbance to fauna due to movement of workers in forest areas	▪ Ensure Forest Clearance prior to start of any work in the Forest area. ▪ Any disruption to flora to be kept to a minimum and restricted to only the essential area required for construction ▪ Prior to construction, the route to be surveyed again (and consultation to take place with the landowners) to establish the precise alignment. ▪ Wherever possible, mature trees to be avoided and use of existing gaps in vegetation maximised ▪ In areas where the route is off existing roads/ tracks, the roads to not be graded nor to the topsoil be removed ▪ Education of the workers to respect the local flora and fauna ▪ Other measures to be taken to reduce dust, noise, control of surface run-off, waste management, etc	▪ The workers to be sensitised about the local crops and the extent of care to be taken to minimise any potential damage. ▪ Contractors and local workers to be completely restricted from indulging in fishing, hunting and any other such activity. ▪ Final approval of the precise route to be done by ADHPL considering the local constraint.	▪ Will form part of the contract with the subcontractor ▪ Site Supervisor to monitor any damage to flora and fauna.

SN	Aspect	Impact	Suggested Mitigation	Monitoring and Awareness	Management Responsibility
A14.1	Traffic and Transport	▪ Increase in traffic and transport	▪ Wherever possible, existing roads to be used for the movement of the tractors/trolleys for transporting personnel and material to the site ▪ Proper trained drivers to be employed for the project	▪ Instruction for drivers/ officers and construction workers to avoid obstruction in the movement of local people while parking at construction site.	▪ Phase Manger
A14.2		▪ Obstruction to traffic movement	▪ Where temporary closure of road is required, provision to be made for alternative access to property and land, through the use of diversions around the working corridor. ▪ Construction vehicles to follow a safe speed limit in the hilly terrain and populated areas.	▪ All vehicles plying in the construction area will be instructed to maintain the speed under the limit. ▪ Drivers to be assessed for their knowledge on traffic rule before appointment.	▪ Site Supervisor
A15.1	Air Quality/ Atmospheric Conditions	▪ Dust emissions associated with construction activities	▪ All vehicles delivering loose construction material to the construction site (or removing construction) debris to be covered to prevent any escape of dust ▪ Speed limit of 15 km per hour to be maintained by vehicles moving on non-graded/ unpaved roads and tracks ▪ Sprinkling of water on dust generating areas	▪ Dust deposition in adjoining areas to be physically monitored by ADHEP personals atleast once during the excavation and casting activity to ensure compliance.	▪ Phase Manager
A16.1	Noise	▪ Noise from construction activities	▪ Use of manual labour to the extent possible instead of heavy machinery ▪ Construction activity to be undertaken only during daytime. ▪ Sequential arrangement of construction activities	▪ To be a part of the subcontractors contract	▪ Each schedule of the construction activities to be reviewed and approved by ADHPL
A17.1	Major Accident Risks	▪ Fall and Trip Hazards for passers by along the tower construction sites	▪ Risks to general public during construction of digging for foundation and erection of towers to be reduced by putting construction and warning signs (danger sign boards)	▪ Display of sign boards or warning signs at construction site to be monitored by ADHPL personals at site. ▪ Regular review to ensure compliance	▪ Shall form part of the contractor's contract.
A17.2			▪ Risks to general public during stringing activities to be mitigated by initial on-site training of workers and sensitisation of the local community	▪ Initial on-site training to be undertaken by the Contractor under supervision of ADHPL.	▪ Sensitisation of local community to be undertaken jointly by ADHPL and Contractor

SN	Aspect	Impact	Suggested Mitigation	Monitoring and Awareness	Management Responsibility
A17.3			▪ Once the stringing is complete, notices (danger sign boards) and anti climbing devices to be put on all the faces of the tower	▪ Inspection of towers after every six months to check the danger sign and anti climbing arrangements.	▪ Phase Manager
A17.4		▪ Occupational hazards	▪ Ensure compliance of safe practices and implementation of safety manual ▪ Provide and ensure use of personal protective equipment (PPEs) like, safety goggles, gloves, safety harness, helmets, gumboots etc. ▪ Prior training of the workers regarding health and safety procedures.	▪ Compliance monitoring to be undertaken by ADHPL supervisors and Contractors.	▪ Site Supervisor and Phase manager for ADHPL
A18.1	Natural Hazards	▪ Risk of tower failure resulting in occupational and societal health hazards	▪ The design of the tower to be made as per the IS and other government regulations, which to ensure that a safety margin is included in the design to reduce the risk from any seismic activity, wind loads, etc	▪ Will form part of the contractor's contract.	▪ Final designs will be reviewed and approved by ADHPL
B) Operation Phase					
B1.1	Community Health and Safety	▪ Community will have concerns about its safety and possibility of any accidents like electrocution, skin diseases etc. (The project proponents through select consultations with relevant stakeholders have tried to allay all fears related to health impact.)	▪ Evaluate possible risks and ensure that these are addressed and minimised. ▪ Communicate about the technical aspects of the transmission line construction and operations, and allay fears about accidents or any other health concerns ▪ Use simple diagrams and pamphlets in local language for this purpose. ▪ Train land owners about safety issues and action to be taken in case of risks. ▪ Demonstrate that ADHP and its contractors are very concerned about health and safety of workers as well as the community.	▪ Ensure communication of health and safety risks to villagers near to settlements in batches and explain the various H & S measures being undertaken.	▪ Head (Snow Zone) ▪ Head (Non Snow Zone) ▪ Safety Officer
B2.1	Noise	▪ Noise from Overhead line due to Corona effect	▪ Noise generation is unavoidable ▪ Use of conductors conforming to IS standard to minimise corona effect during foul weather conditions	▪ Will form part of the purchasing policy of ADHPL ▪ Monitoring during heavy rains and snow	▪ Head (Snow Zone) ▪ Head (Non Snow Zone)

SN	Aspect	Impact	Suggested Mitigation	Monitoring and Awareness	Management Responsibility
B3.1	Ecology	▪ Clearance of vegetation to avoid contact with transmission line	▪ Vegetation along the transmission line route will be reduced to required height using mechanical/ manual means and not by use of herbicides or other chemicals ▪ The sag of the transmission line will be planned to be optimal for all the seasons	▪ ADHPL to plan and discuss with stakeholders.	▪ Head (Snow Zone) ▪ Head (Non Snow Zone)
B3.2		▪ Avian collision with the transmission line	▪ Visibility enhancement objects such as marker balls, bird deterrents, or diverters to be installed to avoid avian collision	▪ Visibility enhancement devices to inspected after every two-three years.	▪ Head (Snow Zone) ▪ Head (Non Snow Zone)
B4.1	Energising Power Transmission Line	▪ Risk to public from operation of high voltage transmission line	▪ Start date for electricity transmission and safety implication will be announced locally using public announcement systems. ▪ Fixing of permanent warning plates (danger sign boards) ▪ Fixing of anti-climbing devices on all faces of the towers	▪ Half yearly monitoring to be done as part of the standard monitoring and maintenance schedule by ADHPL	▪ Head (Snow Zone) ▪ Head (Non Snow Zone)
B5.1	Electro-magnetic Field	▪ Concern over the potential health effects	▪ Potential exposure to the public to be maintained below the reference levels developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP)	▪ To be monitored annually and after any kind of modification to the transmission system	▪ Head (Snow Zone) ▪ Head (Non Snow Zone) ▪ Safety Officer ▪ Zonal Head Technical
B5.2		▪ Exposure of workers	▪ Potential occupational exposure to be maintained below the reference levels developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP)	▪ To be monitored on half yearly basis.	▪ Head (Snow Zone) ▪ Head (Non Snow Zone) ▪ Safety Officer
B5.3		▪ Telecommunication systems	▪ Clearance from telecommunication and telegraph wires will be maintained as per the Electricity act 2003	▪ To be monitored during construction Phase	▪ Head (Snow Zone) ▪ Head (Non Snow Zone) ▪ Department of Post and Telecommunication

SN	Aspect	Impact	Suggested Mitigation	Monitoring and Awareness	Management Responsibility
B6.1	Storage of flammable material Forest resources striking the height of the transmission line	▪ Potential fire of flammable material or the forest resources within the corridor	▪ Ensure no storage of flammables take place within the corridor ▪ Ensure pruning of twigs to a safe height as described in SN B3.1 above.	▪ Fortnightly survey of the whole of the corridor	▪ Head (Snow Zone) ▪ Head (Non Snow Zone)
B7.1	Transmission line snapping Transmission Tower/ Pylon collapse Flooding and destruction/ fire of sub stations	▪ Potential disaster	▪ ADHPL's experience personnel will develop exhaustive TL-DMP prior to commissioning of the transmission line. ▪ Implement disaster management plan ▪ Widely circulate DMP to ADHPL personnel and local administration officials ▪ Constitute Emergency Management Group (EMG), communication network etc as identified in the DMP (refer to ***Section 7.4***)	▪ ADHPL will also ensure periodical update of the TL-DMP ▪ Quarterly mock drilling to tackle various emergency situations as identified in the DMP ▪ Regular training to EMG and other staff responsible for implementation of DMP. ▪ Annual safety audits of the transmission line and sub stations	▪ Head (Snow Zone) ▪ Head (Non Snow Zone) ▪ Safety Officer ▪ Zonal Head Technical

7.4 TRANSMISSION LINE - DISASTER MANAGEMENT PLAN (TL-DMP)

ADHEP has laid out reporting, communication and action procedures that need to be initiated during a disastrous condition with respect to its transmission network. The key points that will form ADHPL's TL-DMP will include the following subsections. It is to be noted that ADHPL's experience personnel will develop exhaustive TL-DMP prior to commissioning of the transmission line. ADHPL will also ensure periodical update of the TL-DMP.

7.4.1 *Introduction*

'Disaster' is defined as an event, which brings sudden great misfortune bringing disruption to normal life including that of the power supply. Disasters are situations in which suddenly, people are plunged into helplessness and suffering and, as a result, need protection, clothing, shelter, medical and social care and other necessities of life.

Disasters can broadly be classified into two main groups, viz., Natural and Man-made. Disasters are resulting from earthquakes, volcanic eruptions, storm surges, cyclones, tropical storms, floods, avalanches, landslides, and forest fires are termed as natural disasters whereas, that occasioned by man like act of terrorism, armed conflict, industrial accidents, explosions, fires, structural collapses, air, sea, rail and road transport accidents are the man-made disasters.

Power sector is one of the important infrastructures, which may get affected due to any disaster leading to disruption in generation, transmission and distribution of electricity. It therefore, becomes extremely important for every power transmission company to evolve a disaster management plan (DMP) to perceive and handle the related disasters in a well anticipated and prepared manner, in order to restore the transmission and the impacted environmental features.

7.4.2 *Objectives of DMP*

The objective of the Transmission Line Disaster Management Plan (TL-DMP) is to make use of the combined resources of ADHPL and the outside services to ensure safety of life, protection of environment, protection of infrastructure and restoration of electricity transmission by achieving the following:

1. Minimize damage to property and the environment;
2. Effect the rescue and medical treatment of causalities;
3. Safeguard people;
4. Identify any deceased human beings;
5. Provide authoritative information to mass media;
6. Secure the safe rehabilitation of affected area;
7. Restore the power supply; and
8. Maintain and preserve relevant records and equipment for subsequent inquiry into the cause and circumstances of the emergency.

In effect, it is to optimize operational efficiency to rescue rehabilitation and render medical help and to restore normalcy.

7.4.3 Potential Hazards Anticipated in Power Transmission

The potential hazards that could lead to possible disaster during transmission of power are:

1. Transmission line snapping
2. Transmission Tower/ Pylon collapse
3. Flooding and destruction/ fire of sub stations

7.4.4 Transmission Line Snapping

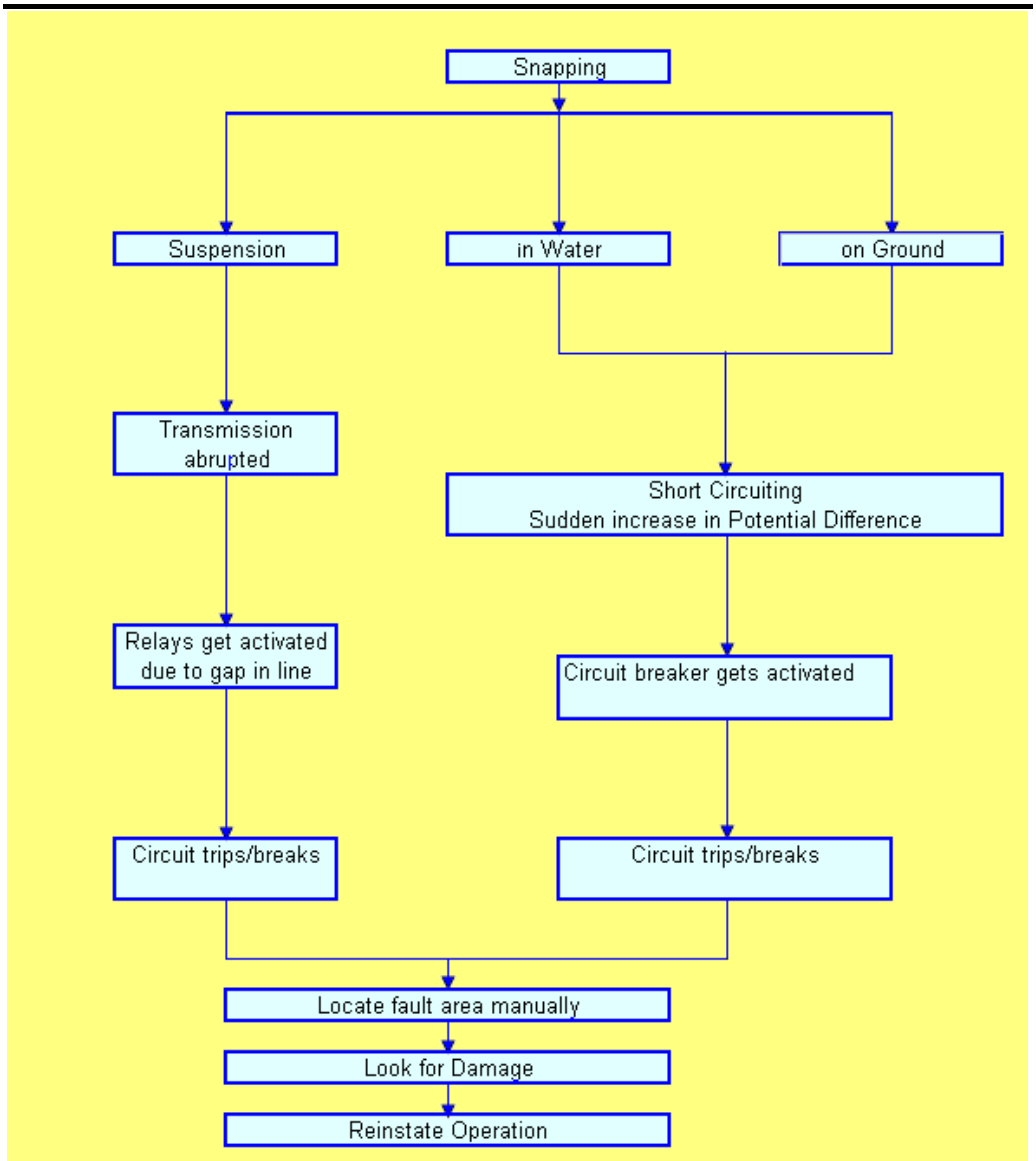
The transmission line snapping may be due to action of strong winds, snow deposition, ice formation during winters and overheating due to high flow of currents. The snapped transmission line may cause hazards in various situations that are represented in ***Figure 7.2*** below.

The transmission line conducts current through circuit breakers which responds under various situations highlighted the circuit breaker may not trip and the conductor may remain live conducting the current through no hazard is anticipated because as soon as the wire snaps the current flow circuit breaks and thus the transmission wire is no longer charged.

Table 7.2 Hazard matrix for Transmission Line

Activity	Aspect	Consequence
Wire snapped and grounded	relay will trip the circuit breaker	-
Wire snapped and fallen in water	charge spread in water	Aquatic life electrocution
Wire snapped and immediate contact with a conducting object	Charge spread to the object	Human/ Animal electrocution
Wire snapped and hanging	relay will trip the circuit breaker	-
Wire snapped and immediate contact with a inflammable object	Short-circuiting	Open fire leading to smoke and posing danger to life
Transmission tower collapse	Live wire sagging	Human/ Animal electrocution Short-circuit and fire of flammable substances
Flooding of sub-station	short-circuit	Human/ Animal electrocution
Fire break out at sub-station	power supply disruption	fire and smoke hazard

Figure 7.2 Transmission Line Snapping Consequences



7.4.5 *Transmission Tower/ Pylon Collapse*

The collapse or failure of transmission tower may be due to natural phenomena like cyclones, landslides and/ or due to anthropogenic activities like sabotage. The complete/ partial collapse of tower may lead to transmission line being lowered to dangerous levels with the earth surface, water bodies or may lead to electrocution of human beings/ animals resulting in losses of life and short-circuit may lead to forest fires.

7.4.6 *Destruction of Sub-Stations*

The project will have only two substations i.e. one at Prini and another at Nalagarh. The chances of flooding and fire inside sub-station are low however it may lead to complete failure of power transmission and will require enough time to restore it back to normal supplies. The fire may be due to short-circuiting and/ or due to inflammable materials like fuels and chemicals.

7.4.7 Emergency Organization

Responsibilities of EMG

ADHPL will constitute Emergency Management Group (EMG) with the following responsibilities:

1. To direct actions within the affected area taking into consideration the priorities for safety installations, personnel, minimize damage to sub-station & equipments, property and the environment.
2. To direct fire and security personnel for immediate action.
3. To ensure that all non-essential workers/staff at the affected area are evacuated to safer places;
4. Set up communication points;
5. Report all developments and requirements/ assistance needed;
6. Preserve all evidences so as to facilitate any inquiry into the cause and circumstances which caused or escalated the emergency;
7. To coordinate with District Administration for necessary finance, medical, law & order etc.

EMG will maintain the following:

1. Procedure of major and special fire fighting, rescue operations, first aid etc.;
2. Emergency call out list of persons drafted for emergency control, key personnel, fire safety, first aid, medical, security, police and district administrative authorities.
3. Emergency manuals, district phone directory, public address system, emergency lights etc.
4. Identification of personnel for Mock drills & training

Chain of Management

A senior executive who has control over the affairs of the transmission line and sub-stations is to head the Emergency Organization operations. He has to be designated as Site Controller for emergency situations (which can be separately for snow and non snow zones). The Senior Managers are to be designated as Incident Controller. All the Incident Controllers would be reporting to the Site Controller.

All the Department Heads, Fire & Security Officer, Communication Officer and Personnel manager are to report to the Incident Controller. Sub-station shift in-charge is the reporting officer, who would bring the incidence to the notice of the Incident Controller and Site Controller. The team shall co-ordinate during eventualities and would be responsible for fire fighting, rescue, rehabilitation, transport and provide essential support services. All the above mentioned personnel are designated as Key personnel during emergency response operation.

Table 7.3 Key EMG Personnel

Category	Key Personnel	Alternate Key Personnel
SITE CONTROLLER	Head (Non Snow Zone)	Head (Snow Zone)
Telephone No.	09816031618	09816102315
EPABX	01907-267464	01902-260437
INCIDENT CONTROLLER	Zonal Head (Non Snow Zone)	Zonal Head (Snow Zone)
Telephone No.	098161033620	09816102314
EPABX	01907-267464	01902-260437
COMMUNICATION OFFICER	Head (Admn./Land /RoW)-Snow Zone	
Telephone No.	09816102334	
EPABX	01902-260437	
FIRE & SAFETY OFFICER	Safety Officer (Non Snow Zone)	Safety Officer (Snow Zone)
Telephone No.	-	-
EPABX	01907-267464	01902-267464
PERSONNEL OFFICER.	Head (HR & Stores)	1)Head (F&A -Snow Zone) 2) Head (F&A -Snow Zone)
Telephone No.	09816102333	1) 09816102335 2) 098161033
EPABX	01902-260437	1) 01902-260437 2) 0197-267464
MEDICAL OFFICER	Resident Doctor, MPCL	Resident Doctor, ADHPL
Telephone No.	01902-276074	01902-250183
EPABX	01902-276076	01902-253578
SECURITY OFFICER	Head (Admn./land/Row)	
Telephone No.	Non Snow Zone	
EPABX	01907-267464	

Table 7.4 Local Administration Contact Numbers

S.No.	Contact	Telephone Nos.
District Kullu, Himachal Pradesh (01902)		
1.	District Collector	222727
2.	AC to Dc	222486
3.	Superintendent of Police	224700
4.	Deputy SP	253400
5.	CO	252321
6.	ADM	222226
7.	SDM (Manali)	254100
8.	CMO (Kullu)	228077
9.	Police Assistance	100
10.	Ambulance	102
11.	Fire Station	101

Emergency Notification

Whoever notices an emergency situation or receives any information such as fire, growth of fire, snapped wire, electrocution, tower failure, etc. informs his immediate supervisor and Emergency Control Centre. The person on duty in the Emergency Control Centre will appraise the situation to Site Controller who in turn will evaluate and activate the emergency plan. This situation would be communicated through chain of command to the EMG and

simultaneously, the emergency warning system would be activated on the instructions of the Site Controller.

Depending upon the nature of emergency, EMG will be put on high alert. The following are the type of actions to be taken:

a) Pre-Alert Notification:

This type of notification is mainly used for disseminating an important piece of information concerning slowly developing emergencies which can either be rectified or would take some time before they turn into a disaster.

b) Alert Notification:

An alert notification implies that although a disaster is not imminent, aggravation of the situation could lead to crisis unless conditions improve. Sub-station operation level EMG and Local Officials should be alerted that an unsafe situation is developing.

c) Warning Notification

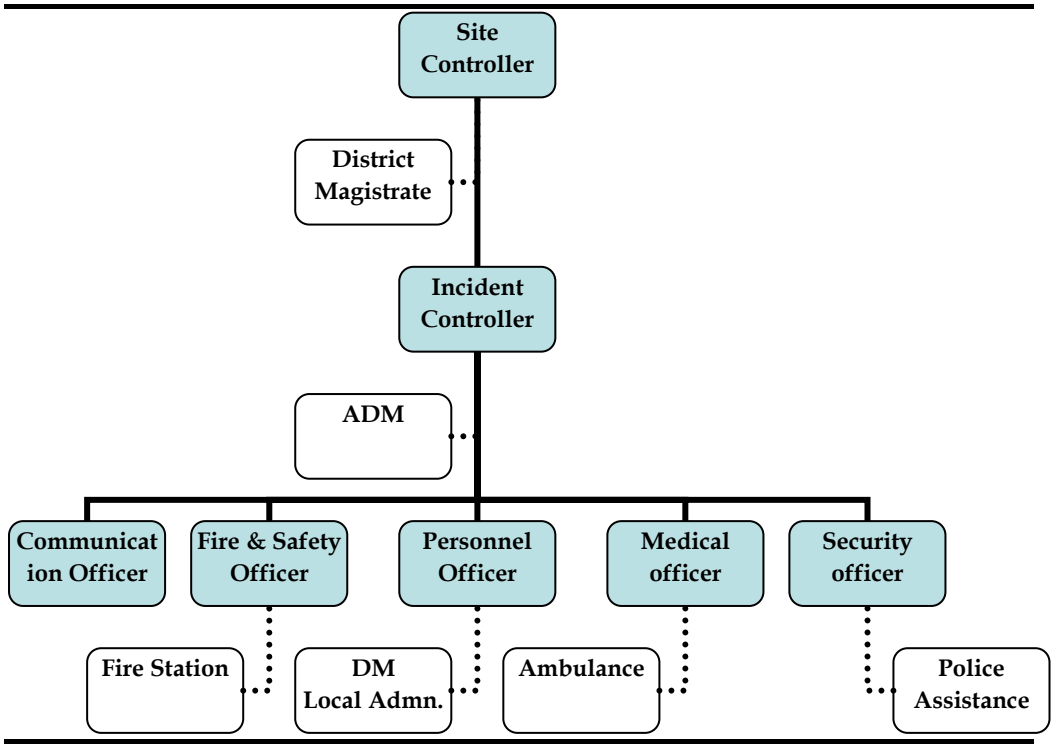
A warning notification implies that a disaster is imminent; an advance action may be initiated for minimizing the damages/ rescue operations. The warning notification, indicating the magnitude of disaster should be communicated to other concerned in the region.

d) Notification Responsibility

In case of developing crisis situation, ADHPL will be responsible for issuing proper notification to District / State / Central level agencies, depending upon the severity of the disaster.

A notification flowchart below shows hierarchy of notification during emergency:

Figure 7.3 Notification Flowchart



7.4.8 Communication Strategy

The responsibilities of the key personnel are appended below:

a) Site Controller Responsibilities

On receiving information about emergency Site Controller would rush to Emergency Control Centre (ECC) and assess the magnitude of the situation on the advice of Incident Controller for the following:

- Assess which areas are likely to be affected, or need to be evacuated or are to be alerted;
- Declare emergency and order for operation of emergency siren;
- Organize announcement by public address system about location of emergency;
- Maintain a continuous review of possible development and assess the situation in consultation with Incident Controller and other Key Personnel as to stop power supply through transmission line;
- Direct personnel responsible for rescue, rehabilitation, transport, fire brigade, medical and other designated mutual support systems locally available, for meeting emergencies;
- Control evacuation of affected areas, if the situation is likely to go out of control or effects are likely to go beyond the anticipated area of impact, informs to District Emergency Authority, Police, Hospital and seeks their intervention and help;
- Give a public statement if necessary;

- Keep record of chronological events and prepares an investigation report and preserve evidence; and
- On completion of On Site Emergency and restoration of normalcy, declare all clear and order for all clear warning.

Incident Controller Responsibilities

The incident controller will have the following responsibilities:

- Assemble the incident control team;
- Direct operations within the affected areas with the priorities for safety to personnel, minimize damage to the infrastructure, property and environment and minimize the loss of materials;
- Direct the shutting down of power supply and evacuation of areas likely to be adversely affected by the emergency;
- Ensure that all key personnel help is sought;
- Provide advice and information to the Fire and Security Officer and the Local Fire Services as and when they arrive;
- Ensure that all non-essential workers/staff of the affected areas evacuated to the appropriate assembly points, and the areas are searched for causalities;
- Has regard to the need for preservation of evidence so as to facilitate any inquiry into the caused and circumstances which caused or escalated the emergency;
- Co-ordinate with emergency services at the site;
- Provide tools and safety equipments to the team members;
- Keep in touch with the team and advise them regarding the method of control to be used; and
- Keep the Site Controller of Emergency informed of the progress being made.

Emergency Coordinator (Rescue & Fire Fighting)

The emergency controller of rescue and fire fighting on knowing about emergency will rush to ECC to:

- Help the incident Controller in containment of the emergency;
- Co-ordinate with local fire fighting station and summon for fire tenders;
- Guide the fire fighting crew i.e. firemen, trained plant personnel and security staff;
- Takes guidance of the Incident Controller for fire fighting as well as assesses the requirement of outside help;
- Arrange to control the movement of people and traffic at the incident site;
- Direct the security staff to the incident site to take part in the emergency operations under his guidance and supervision;
- Evacuate the people in the sub station or in the areas along the transmission line as advised by Site Controller;
- Search for casualties and arrange proper first aid for them;
- Assembles search and evacuation team;
- Arrange for safety equipments for the members of this team;

- Decide which paths the evacuated rescue team will follow; and
- Maintains law and order in the area, and if necessary seeks the help of police.

Emergency Coordinator (Medical, Mutual Aid, Rehabilitation, Transport and Communication)

The emergency coordinator of medical aid and rehabilitation will have the following responsibilities:

- In the event of failure of electric supply and thereby internal telephone, sets up communication point and establishes contact with the ECC;
- Organize medical treatment to the injured and if necessary to shift the injured to near by hospitals;
- Mobilize extra medical help from outside, if necessary;
- Keep a list of qualified first aides within ADHPL and seek their assistance;
- Maintain first aid and medical emergency requirements;
- Make sure that all safety equipment are made available to the emergency team;
- Assist Site Controller with necessary data and to coordinate the emergency activities;
- Assist Site Controller in updating emergency plan, organizing mock drills, verification of inventory of emergency facilities and furnishing report to Site Controller;
- Maintains liaison with Civil Administration;
- Liaise with Site Controller/Incident Controller;
- Ensure transportation facility;
- Ensure availability of necessary cash for rescue/rehabilitation and emergency expenditure;
- Control rehabilitation of affected areas on discontinuation of emergency; and
- Ensure availability of diesel/petrol for transport vehicles engaged in emergency operation.

Emergency Coordinator (Essential Services)

The emergency coordinator for essential services would assist Site Controller and Incident Controller to:

- Maintain essential services like Diesel Generator, Water, Fire Water, Compressed Air/Instrument Air, power supply for lighting;
- Give necessary instructions regarding emergency electrical supply, isolation arrangements etc. to shift in-charge and electricians at Switch Yard, Prini; and
- Ensure availability of adequate quantities of protective equipment and other emergency materials, spares etc.

7.4.9 Emergency Facilities Required to Tackle Disaster

The facilities considered necessary for preventing and minimizing disasters are given below:

Recovery Equipment and Spares Inventory

In case of any disaster, it is necessary to have an inventory of recovery equipment and spares available at the ECC within the shortest possible time.

Communication Facilities

For dealing with any crisis situation, communication plays a very vital role. Use of satellite communication system can be effectively made to coordinate activities of various agencies involved in the relief and restoration work and expedite restoration of normalcy in the shortest possible time.

Transport and Other Arrangements

Arrangements for adequate number of vehicles for movement of people and materials must be ensured. Medical facilities around the clock will be made available to the staff engaged in the restoration activities. Arrangements for drinking water supply must also be ensured.

Financial Resources

Arrangements for adequate financial resources must be made so that the restoration activities do not get hampered because of shortage of funds. The authorized signatory may be designated for each strategic location that can take on the spot decision.

Black Start Facilities

Arrangements for start-up power source for each major installation must be identified. Regional Load Dispatch Centres have to make necessary plans.

De-watering Pumps

During floods the immediate concern is to minimize the impact of flood water on generators and other equipment. Availability of de-watering pumps is, therefore, considered necessary for sub-station affected by any flood.

Mobile DG Sets

Sufficient number of mobile diesel generators will be available at the substation to provide emergency relief and to meet the need of dewatering pumps.

7.4.10 Emergency Restoration System

Restoration of Power Supply

Following measures are essentially required for quick restoration of transmission line:

- Each of the key members of EMG will be provided with mobile satellite telephone for ensuring instantaneous response/mobilization to the front on occurrence of a disaster;
- For restoration of transmission line, Emergency Restoration System (ERS) will be identified for disaster management and restoration of power supply. The ERS, communication and other equipments will be properly maintained so that it can be used without any delay;
- Spare towers and conductors will be available with the Operation and Maintenance of transmission line;
- Strategic locations will be decided for spares on centralized/stretch wise; and
- In case of advance warning, the restoration team will reach at convenient place nearest to the expected affected area in order to reach the spot at the earliest. The team would assess the extent of damage and inform the Site Controller for coordinating other actions.

Following points need to be considered for handling various eventualities at sub-stations:

- Standing instructions will be available in written form at the two substations (i.e. at Prini and at Nalagarh) to take care of various contingencies;
- Alternate communications system will be available with every key substation;
- The power backup facilities like diesel generators and inverters will be maintained properly and checked periodically for readiness of operation in case of any emergency;
- Both substations will follow the instructions given by Site Controller and other coordination agencies;
- The fire fighting equipment will be maintained and checked periodically. Mock fire fighting exercises will be conducted on regular basis; and
- The transportation arrangements in case of any emergency will be decided in advance.

7.4.11 Disaster Prevention & Preparedness

1 Annual Safety audits of the transmission line and sub-stations to identify the gaps and conduct maintenance for smoother operations;
2 Fire alarm and fire extinguishing system will be checked regularly and regular drill will be carried out;
3 Ensure continuous interaction between EMG, local administration for any intelligent action needed against terrorist attacks;

4 ADHPL will constantly benchmark and review the equipment/ system and their practices with the best available technologies in various parts of the world;
5 ADHPL will ensure fund for meeting the requirement of disaster management plan with the annual contribution which will be accumulative in nature. The disaster management funds will be at the full discretion of Emergency Management Group once emergency has been declared;
6 Emergency scenarios will be developed to test the emergency plans and operational response at all levels through mock exercises. At the end of each exercise an evaluation of the response call will be carried out to take care of any deficiency noticed and if needed update the TL-DMP.

8 CONCLUSION

The ESIA has assessed the overall acceptability of environmental and Social impacts likely to arise as a result of construction and operation of Transmission line for ADHPL project. The proposed project is categorised as category B as the social or environmental impacts are assessed as limited, few in number, site-specific, largely reversible, and readily addressed through mitigation measures;

The project is assessed to generate some environmental and social issue owing to land access and the spread of transmission corridor. Issues pertaining to compensation for hindrances to use of land and crop, health concerns due to erection of transmission line and use of forest land are considered to be important.

Mitigation measures for potential impacts on Air, Water, Land, Soil, Noise, Traffic, Ecology, and Socio-economics have been specified through proper

- follow up of best practice of compensation, public disclosure, grievance management and compensation;
- planning & designing of tower structure, site preparation and access route, construction, drainage, traffic movement, compensation, etc,
- application of standards for Health and Safety for construction tower erection and stringing activities.
- clearances and permits (including forest clearance) required for each sub activity

Environmental Management Plan and Social Action Plan describe implementation mechanism for recommended mitigation measures together with post project monitoring to verify overall project performance.

This ESIA study together with mitigation measures and follow up of recommendations on management actions will help ADHPL in complying with the environmental standards.

9 REFERENCES

Table 9.1 List of References

SN	Document/Book	Web link
1	State of Environment –Himachal Pradesh	http://www.hpenvis.nic.in
2	International Finance Corporation's Performance Standards on Social & Environmental Sustainability	http://www.ifc.org
3	Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution: IFC	http://www.ifc.org/ifcext/sustainability.nsf/Content/EnvironmentalGuidelines
4	International Finance Corporation's Guidance Notes: Performance Standards on Social & Environmental Sustainability	http://www.ifc.org
5	The Equator Principles	http://www.equator-principles.com/index.shtml
6	Report of Task Force on Transmission Projects : Submitted by Task Force Constituted by Ministry of Power, Govt. of India Under Chairmanship of Member(Power Systems),CEA	http://powermin.nic.in/whats_new/pdf/Report_of_task_force.pdf
7	Understanding the characteristics of power lines : National Grid UK	http://www.nationalgrid.com/NR/rdonlyres/9B75DD59-87B0-427B-BE7C-9CF0EAE29E45/1153/ASopUnderstandingCharacteristicsPowerLines.pdf
8	Basic Design and Construction aspect of Transmission Lines	http://www.montefiore.ulg.ac.be/~nicolasp/lecture_notes_for_students_resham.doc
9	Climatological Tables (1951-1980) : Published by India Meteorological Department	-
10	Pollution Control Acts, Rules and Notifications Issued There under: Published by Central Pollution Control Board	-
11	IUCN Red List of Threatened Species	http://www.iucnredlist.org/
12	Standard Methods for the Examination of Water and Wastewater. 2001 Edition: 20th American Public Health Association - American Water Works Association - Water Environment Federation	-
13	Manual for Statistical Analyses and Interpretation of Water Quality Data	MINARS/2/1986-87; CPCB

Annex A

Analysis results of ambient air quality

3 Ambient Air Quality-Data

Table No. (1)

Location Code : AAQ - 1
Sampling Location : Bhuntar, Kullu (Roof top client's office)

S. No.	Date	Pollutants Ground Level Concentration							
		SPM ($\mu g/m^3$)	**RPM** ($\mu g/m^3$)	**NO_2** ($\mu g/m^3$)	**SO_2** ($\mu g/m^3$)	**CO** (mg/m^3)		**THC** (as CH_4) (ppm)	
1	23.05.2008 to 24.05.2008	72	57	12	3.1	I	1.9	I	4.9
						II	1.1	II	4.5
						III	1.6	III	4.8
2	25.05.2008 to 26.05.2008	94	71	11	10	I	1.0	I	4.7
						II	0.7	II	4.2
						III	0.9	III	4.5
3	28.05.2008 to 29.05.2008	61	48	12	4.1	I	1.2	I	4.6
						II	0.8	II	4.5
						III	0.9	III	4.8
4	29.05.2008 to 30.05.2008	44	33	16	<3	I	1.0	I	5.2
						II	0.6	II	4.8
						III	1.5	III	4.2

Minimum	44	33	11	3	0.6	4.2
Average	68	52	13	6	1.1	4.6
Maximum	94	71	16	10	1.9	5.2
98^{th} percentile	92.7	70.2	15.8	9.8	1.8	5.1
95^{th} percentile	90.7	68.9	15.4	9.4	1.7	5.0
90^{th} percentile	87.4	66.8	14.8	8.8	1.6	4.9
Std. Deviation	21.0	15.9	2.2	3.7	0.4	0.3

I - 08:00 Hrs.to 16:00Hrs.
II - 16:00 Hrs.to 24:00Hrs.
III - 00:00 Hrs.to 08:00Hrs

AIR DATA

Chapter :
Project No. : ENV-468
Project : Environmental Baseline Data Generation at Himachal Pradesh
Client : ERM India Pvt. Ltd. , Gurgaon (Hr.)

Table No. 2

Location Code : AAQ - 2
Sampling Location : Sundar Nagar (Roof Top of client's office)

S. No.	Date	Pollutants Ground Level Concentration							
		SPM ($\mu g/m^3$)	**RPM** ($\mu g/m^3$)	**NO_2** ($\mu g/m^3$)	**SO_2** ($\mu g/m^3$)	**CO** (mg/m^3)		**THC** (as CH_4) (ppm)	
1	24.05.2008 to 25.05.2008	113	84	14	<3	I	0.2	I	5.0
						II	0.2	II	4.5
						III	0.1	III	4.6
2	26.05.2008 to 27.05.2008	158	111	15	<3	I	0.5	I	4.3
						II	0.5	II	4.7
						III	0.3	III	4.8
3	28.05.2008 to 29.05.2008	140	104	17	<3	I	0.5	I	5.5
						II	0.4	II	4.8
						III	0.4	III	4.3
4	30.05.2008 to 31.05.2008	107	78	13	<3	I	0.6	I	4.7
						II	0.5	II	4.8
						III	0.4	III	4.6

Minimum	107	78	13	--	0.1	4.3
Average	130	94	15	--	0.4	4.7
Maximum	158	111	17	--	0.6	5.5
98^{th} percentile	156.9	110.6	16.9	--	0.6	5.4
95^{th} percentile	155.3	110.0	16.7	--	0.5	5.2
90^{th} percentile	152.6	108.9	16.4	--	0.5	5.0
Std. Deviation	23.8	15.8	1.7	--	0.2	0.3

I - 08:00 Hrs.to 16:00Hrs.
II - 16:00 Hrs.to 24:00Hrs.
III - 00:00 Hrs.to 08:00Hrs

AIR DATA

Chapter :
Project No. : ENV-468
Project : Environmental Baseline Data Generation at Himachal Pradesh
Client : ERM India Pvt. Ltd. , Gurgaon (Hr.)

Table No. 3

Location Code : AAQ - 3
Sampling Location : Swarghat, (Roof Top of client's office)

S. No.	Date	Pollutants Ground Level Concentration							
		SPM ($\mu g/m^3$)	**RPM** ($\mu g/m^3$)	**NO_2** ($\mu g/m^3$)	**SO_2** ($\mu g/m^3$)	**CO** (mg/m^3)		**THC** (as CH_4) (ppm)	
1	24.05.2008 to 25.05.2008	85	63	10	<3	I	0.8	I	5.6
						II	0.9	II	5.1
						III	1.1	III	4.8
2	26.05.2008 to 27.05.2008	110	80	15	<3	I	1.2	I	4.5
						II	1.5	II	4.3
						III	0.9	III	5.0
3	30.05.2008 to 31.05.2008	128	93	18	<3	I	1.2	I	4.6
						II	1.2	II	5.3
						III	0.7	III	4.8
4	31.05.2008 to 01.06.2008	74	52	5.4	<3	I	0.6	I	4.4
						II	0.8	II	5.1
						III	0.9	III	5.0

Minimum	74	52	5	--	0.6	4.3
Average	99	72	12	--	1.0	4.9
Maximum	128	93	18	--	1.5	5.6
98^{th} percentile	126.9	92.2	17.8	--	1.4	5.5
95^{th} percentile	125.3	91.1	17.6	--	1.3	5.4
90^{th} percentile	122.6	89.1	17.1	--	1.2	5.3
Std. Deviation	24.4	18.1	5.6	--	0.3	0.4

I - 08:00 Hrs.to 16:00Hrs.
II - 16:00 Hrs.to 24:00Hrs.
III - 00:00 Hrs.to 08:00Hrs

AIR DATA

Chapter :
Project No. : ENV-468
Project : Environmental Baseline Data Generation at Himachal Pradesh
Client : ERM India Pvt. Ltd. , Gurgaon (Hr.)

Table No. 4

Location Code : AAQ - 4
Sampling Location : Nalagarh (village Panjhahera)

S. No.	Date	Pollutants Ground Level Concentration							
		SPM ($\mu g/m^3$)	**RPM** ($\mu g/m^3$)	**NO_2** ($\mu g/m^3$)	**SO_2** ($\mu g/m^3$)	**CO** (mg/m^3)		**THC** (as CH_4) (ppm)	
1	25.05.2008 to 26.05.2008	86	61	15	<3	I	1.1	I	5.6
						II	0.9	II	4.8
						III	0.8	III	4.6
2	26.05.2008 to 27.05.2008	67	51	10	<3	I	0.4	I	5.1
						II	0.6	II	5.2
						III	0.8	III	4.8
3	30.05.2008 to 31.05.2008	114	84	11	<3	I	0.7	I	5.0
						II	0.9	II	4.6
						III	0.7	III	4.8
4	31.05.2008 to 01.06.2008	70	53	13	<3	I	1.0	I	4.9
						II	0.8	II	5.1
						III	0.9	III	4.7

Minimum	67	51	10	--	0.4	4.6
Average	84	62	12	--	0.8	4.9
Maximum	114	84	15	--	1.1	5.6
98^{th} percentile	112.3	82.6	14.9	--	1.1	5.5
95^{th} percentile	109.8	80.6	14.7	--	1.0	5.4
90^{th} percentile	105.6	77.1	14.4	--	1.0	5.2
Std. Deviation	21.5	15.1	2.2	--	0.2	0.3

I - 08:00 Hrs.to 16:00Hrs.
II - 16:00 Hrs.to 24:00Hrs.
III - 00:00 Hrs.to 08:00Hrs

Annex B

Traffic Density along the transmission line

Traffic Density-Data

Table No. (1)

Monitoring Station : Nalagarh **Station Code :** TD-1

Sampling Date : 25/05/08 to 26/05/08 **Direction / Location :** Nalagarh to Swarghat at NH 21A

S. NO.	Time (Hours)	Motorized Vehicles			Non-Motorized Vehicles	Total Numbers
		Heavy Motor Vehicles (Truck,Bus,Dumper, Tanker, Trailer)	Light Motor Vehicles (Car, Jeep, Van, Matador, Tractor, Tempo, Mini Bus)	Two/Three Wheelers (Scooter, M.Cycle, Auto, Moped)	(Bicycle, Cycle Rickshaw, Animal Drawn)	
1	09.00 - 10.00	80	150	217	10	457
2	10.00 - 11.00	56	142	165	6	369
3	11.00 - 12.00	114	180	167	53	514
4	12.00 - 13.00	110	136	177	23	446
5	13.00 - 14.00	72	158	113	19	362
6	14.00 - 15.00	86	134	73	5	298
7	15.00 - 16.00	77	135	156	6	374
8	16.00 - 17.00	131	145	183	42	501
9	17.00 - 18.00	87	102	154	35	378
10	18.00 - 19.00	149	211	220	41	621
11	19.00 - 20.00	133	138	186	11	468
12	20.00 - 21.00	90	143	161	13	407
13	21.00 - 22.00	92	114	125	4	335
14	22.00 - 23.00	38	41	46	0	125
15	23.00 - 00.00	16	34	17	4	71
16	00.00 - 01.00	13	15	8	0	36
17	01.00 - 02.00	21	7	0	0	28
18	02.00 - 03.00	13	5	0	0	18
19	03.00 - 04.00	15	20	3	0	38
20	04.00 - 05.00	25	43	10	0	78
21	05.00 - 06.00	33	58	38	5	134
22	06.00 - 07.00	73	65	90	10	238
23	07.00 - 08.00	72	62	93	11	238
24	08.00 - 09.00	80	105	111	7	303
Total Numbers		***1676***	***2343***	***2513***	***305***	***6837***

Table No. (2)

Monitoring Station : Nalagarh **Station Code :** TD-1A

Sampling Date : 25/05/08 to 26/05/08 **Direction / Location :** Swarghat to Nalagarh at NH 21A

S. NO.	Time (Hours)	Motorized Vehicles			Non-Motorized Vehicles	Total Numbers
		Heavy Motor Vehicles (Truck,Bus,Dumper, Tanker, Trailer)	Light Motor Vehicles (Car, Jeep, Van, Matador, Tractor, Tempo, Mini Bus)	Two/Three Wheelers (Scooter, M.Cycle, Auto, Moped)	(Bicycle, Cycle Rickshaw, Animal Drawn)	
1	09.00 - 10.00	76	141	236	15	468
2	10.00 - 11.00	73	124	195	14	406
3	11.00 - 12.00	87	106	168	18	379
4	12.00 - 13.00	79	136	195	23	433
5	13.00 - 14.00	79	145	98	20	342
6	14.00 - 15.00	53	143	96	4	296
7	15.00 - 16.00	71	142	162	13	388
8	16.00 - 17.00	126	175	192	27	520
9	17.00 - 18.00	114	178	146	18	456
10	18.00 - 19.00	175	207	215	37	634
11	19.00 - 20.00	130	161	172	26	489
12	20.00 - 21.00	108	149	166	10	433
13	21.00 - 22.00	66	98	98	5	267
14	22.00 - 23.00	74	89	101	0	264
15	23.00 - 00.00	35	146	48	0	229
16	00.00 - 01.00	4	6	0	0	10
17	01.00 - 02.00	8	3	0	0	11
18	02.00 - 03.00	8	6	0	0	14
19	03.00 - 04.00	6	15	6	0	27
20	04.00 - 05.00	35	42	6	0	83
21	05.00 - 06.00	42	78	27	3	150
22	06.00 - 07.00	82	64	98	7	251
23	07.00 - 08.00	91	70	148	6	315
24	08.00 - 09.00	86	94	126	7	313
Total Numbers		***1708***	***2518***	***2699***	***253***	***6837***

Table No. (3)

Monitoring Station : Nalagarh **Station Code :** TD-1

Sampling Date : 25/05/08 to 26/05/08

S. NO.	Time (Hours)	Towards Nalagarh	Towards Swargarh	Grand Total
1	09.00 - 10.00	457	468	**925**
2	10.00 - 11.00	369	406	**775**
3	11.00 - 12.00	514	379	**893**
4	12.00 - 13.00	446	433	**879**
5	13.00 - 14.00	362	342	**704**
6	14.00 - 15.00	298	296	**594**
7	15.00 - 16.00	374	388	**762**
8	16.00 - 17.00	501	520	**1021**
9	17.00 - 18.00	378	456	**834**
10	18.00 - 19.00	621	634	**1255**
11	19.00 - 20.00	468	489	**957**
12	20.00 - 21.00	407	433	**840**
13	21.00 - 22.00	335	267	**602**
14	22.00 - 23.00	125	264	**389**
15	23.00 - 00.00	71	229	**300**
16	00.00 - 01.00	36	10	**46**
17	01.00 - 02.00	28	11	**39**
18	02.00 - 03.00	18	14	**32**
19	03.00 - 04.00	38	27	**65**
20	04.00 - 05.00	78	83	**161**
21	05.00 - 06.00	134	150	**284**
22	06.00 - 07.00	238	251	**489**
23	07.00 - 08.00	238	315	**553**
24	08.00 - 09.00	303	313	**616**
Grand Total Numbers		**6837**	**7178**	**14015**

Table No. (4)

Monitoring Station : Kullu **Station Code :** TD-2

Sampling Date : 27/05/08 to 28/05/08 **Direction / Location :** Kullu to Panarsa

S. NO.	Time (Hours)	Motorized Vehicles			Non-Motorized Vehicles	Total Numbers
		Heavy Motor Vehicles (Truck,Bus,Dumper, Tanker, Trailer)	Light Motor Vehicles (Car, Jeep, Van, Matador, Tractor, Tempo, Mini Bus)	Two/Three Wheelers (Scooter, M.Cycle, Auto, Moped)	(Bicycle, Cycle Rickshaw, Animal Drawn)	
1	09.00 - 10.00	81	203	203	3	**490**
2	10.00 - 11.00	26	80	115	1	**222**
3	11.00 - 12.00	31	108	84	1	**224**
4	12.00 - 13.00	28	137	107	2	**274**
5	13.00 - 14.00	41	117	66	1	**225**
6	14.00 - 15.00	27	102	183	2	**314**
7	15.00 - 16.00	40	105	73	1	**219**
8	16.00 - 17.00	40	93	60	0	**193**
9	17.00 - 18.00	42	110	105	3	**260**
10	18.00 - 19.00	51	82	98	1	**232**
11	19.00 - 20.00	26	92	82	5	**205**
12	20.00 - 21.00	42	53	33	1	**129**
13	21.00 - 22.00	15	41	27	0	**83**
14	22.00 - 23.00	12	13	10	0	**35**
15	23.00 - 00.00	8	11	8	0	**27**
16	00.00 - 01.00	6	7	2	0	**15**
17	01.00 - 02.00	3	2	1	0	**6**
18	02.00 - 03.00	6	3	2	0	**11**
19	03.00 - 04.00	7	7	2	0	**16**
20	04.00 - 05.00	7	7	3	0	**17**
21	05.00 - 06.00	17	17	27	1	**62**
22	06.00 - 07.00	22	36	42	0	**100**
23	07.00 - 08.00	28	27	47	0	**102**
24	08.00 - 09.00	51	62	67	0	**180**
Total Numbers		***657***	***1515***	***1447***	***22***	***3641***

Table No. (5)

Monitoring Station : Kullu **Station Code :** TD-2A

Sampling Date : 27/05/08 to 28/05/08 **Direction / Location :** Panarsa to Kullu

S. NO.	Time (Hours)	Motorized Vehicles			Non-Motorized Vehicles	Total Numbers
		Heavy Motor Vehicles (Truck,Bus,Dumper, Tanker, Trailer)	Light Motor Vehicles (Car, Jeep, Van, Matador, Tractor, Tempo, Mini Bus)	Two/Three Wheelers (Scooter, M.Cycle, Auto, Moped)	(Bicycle, Cycle Rickshaw, Animal Drawn)	
1	09.00 - 10.00	52	155	141	0	**348**
2	10.00 - 11.00	20	73	87	2	**182**
3	11.00 - 12.00	20	113	83	3	**219**
4	12.00 - 13.00	21	133	125	1	**280**
5	13.00 - 14.00	36	96	75	1	**208**
6	14.00 - 15.00	34	98	72	3	**207**
7	15.00 - 16.00	34	110	80	2	**226**
8	16.00 - 17.00	27	107	76	6	**216**
9	17.00 - 18.00	36	96	101	4	**237**
10	18.00 - 19.00	30	141	122	1	**294**
11	19.00 - 20.00	23	80	80	0	**183**
12	20.00 - 21.00	6	35	20	1	**62**
13	21.00 - 22.00	27	62	35	0	**124**
14	22.00 - 23.00	37	47	17	0	**101**
15	23.00 - 00.00	31	52	17	0	**100**
16	00.00 - 01.00	17	31	6	0	**54**
17	01.00 - 02.00	13	26	7	0	**46**
18	02.00 - 03.00	8	35	4	0	**47**
19	03.00 - 04.00	7	27	3	0	**37**
20	04.00 - 05.00	6	16	2	0	**24**
21	05.00 - 06.00	16	7	7	0	**30**
22	06.00 - 07.00	12	22	16	3	**53**
23	07.00 - 08.00	27	42	37	3	**109**
24	08.00 - 09.00	42	87	64	3	**196**
Total Numbers		***582***	***1691***	***1277***	***33***	***3583***

Table No. (6)

Monitoring Station : Kullu **Station Code :** TD-2

Sampling Date : 27/05/08 to 28/05/08

S. NO.	Time (Hours)	Towards Kullu	Towards Panarsa	Grand Total
1	09.00 - 10.00	490	348	**838**
2	10.00 - 11.00	222	182	**404**
3	11.00 - 12.00	224	219	**443**
4	12.00 - 13.00	274	280	**554**
5	13.00 - 14.00	225	208	**433**
6	14.00 - 15.00	314	207	**521**
7	15.00 - 16.00	219	226	**445**
8	16.00 - 17.00	193	216	**409**
9	17.00 - 18.00	260	237	**497**
10	18.00 - 19.00	232	294	**526**
11	19.00 - 20.00	205	183	**388**
12	20.00 - 21.00	129	62	**191**
13	21.00 - 22.00	83	124	**207**
14	22.00 - 23.00	35	101	**136**
15	23.00 - 00.00	27	100	**127**
16	00.00 - 01.00	15	54	**69**
17	01.00 - 02.00	6	46	**52**
18	02.00 - 03.00	11	47	**58**
19	03.00 - 04.00	16	37	**53**
20	04.00 - 05.00	17	24	**41**
21	05.00 - 06.00	62	30	**92**
22	06.00 - 07.00	100	53	**153**
23	07.00 - 08.00	102	109	**211**
24	08.00 - 09.00	180	196	**376**
Grand Total Numbers		***3641***	***3583***	***7224***

Annex C

Noise Levels along the transmission line

Noise Level-Data

Table No. (1)

Cumulative Leq dB(A)						
Location	**Petli Kuhl**	**Kullu**	**Bhunter**	**Sunder Nagar**	**Dehar**	**Nalagarh**
Station Code	NL-1	NL-2	NL-3	NL-4	NL-5	NL-6
Monitoring Date	29-30.05.2008	28-29.05.2008	23-24.05.2008	26-27.05.2008	31.05-01.06.2008	30-31.05.2008
Time (In Hrs.**)**						
08.00-09.00	61.1	61.5	53.4	55.2	61.8	55.5
09.00-10.00	57.4	59.2	55.6	57.0	62.0	58.4
10.00-11.00	60.2	58.3	58.3	59.3	56.4	56.4
11.00-12.00	59.0	61.2	55.4	55.6	56.0	53.9
12.00-13.00	58.3	58.1	59.0	52.0	60.4	56.7
13.00-14.00	59.4	59.2	51.2	53.0	57.3	50.0
14.00-15.00	55.1	55.2	55.4	56.3	56.4	53.6
15.00-16.00	58.8	57.0	56.3	54.3	55.3	58.7
16.00-17.00	56.3	61.6	57.2	49.2	61.0	57.6
17.00-18.00	59.1	60.2	53.4	51.5	59.6	53.9
18.00-19.00	61.1	59.3	56.4	54.6	59.4	49.8
19.00-20.00	60.2	55.2	57.2	57.3	58.3	57.7
20.00-21.00	58.5	54.3	54.0	52.7	55.0	54.3
21.00-22.00	61.2	57.2	51.2	54.3	48.3	58.1
22.00-23.00	54.2	51.3	49.3	49.7	46.4	48.9
23.00-00.00	57.8	50.7	48.7	48.3	47.2	50.6
00.00-01.00	45.6	44.2	47.2	45.8	49.1	47.3
01.00-02.00	45.7	43.0	42.8	48.1	50.2	43.1
02.00-03.00	43.2	45.2	44.8	49.3	52.8	42.7
03.00-04.00	44.0	44.7	46.3	44.7	48.1	46.8
04.00-05.00	49.8	51.0	53.0	43.9	49.5	47.8
05.00-06.00	51.2	55.7	55.3	48.5	54.3	51.0
06.00-07.00	61.8	59.3	56.4	54.3	60.7	52.6
07.00-08.00	59.4	60.2	53.6	57.0	61.0	50.3
Leq (day)	59.2	58.6	55.3	54.6	58.1	54.8
Leq (night)	48.9	48.2	48.4	47.3	49.7	47.3
L_{max}	83.8	86.9	79.7	78.8	81.9	77.0
L_{min}	29.2	29.0	28.9	29.6	31.3	28.8

⇒ **Day Time :** 6AM - 10 PM

⇒ **Night Time :** 10 PM - 6AM

Annex D

Analysis result of water samples

WATER QUALITY DATA

Project No. : ENV-468
Project : Environmental Baseline Data Generation at Himachal Pradesh
Client : ERM India Pvt. Ltd. , Gurgaon (Hr.)

Table No.-1

LOCATION CODE : WQ-1 **Date of Sampling: 29.05.2008**

LOCATION : Beas at Path Kuhl **Type of Sampling: Grab**

S.No.	Parameter	Results	IS :Limits as per IS : 10500, 1991 Reaf. 1993	Protocol
1.	Colour, Hazen	<5	5 Max.	IS:3025Pt.-4-2002
2.	Turbidity, NTU	8	5 Max (10)	IS:3025Pt.-10-2002
3.	PH	6.5	6.5 to 8.5	IS:3025Pt.-11-2002
4.	Total Hardness as $CaCO_3$, mg/l	32	300 Max	IS:3025Pt.-21-2002
5.	Iron as Fe, mg/l	0.02	0.3 Max	APHA21stEd.,3111
6.	Chloride as Cl, mg/l	7	250 Max	IS:3025Pt.-32-2002
7.	Dissolved Solids, mg/l	44	500 Max	IS:3025Pt.-16-2002
8.	Calcium as Ca, mg/l	8	75 Max	IS:3025Pt.-40-2002
9.	Magnesium as Mg, mg/l	3	30 Max	IS:3025Pt.-46-2002
10.	Copper as Cu, mg/l	<0.01	0.05 Max	APHA21stEd.,3111
11.	Manganese as Mn, mg/l	<0.01	0.1 Max	IS:3025Pt.-34-2002
12.	Sulphate as SO_4, mg/l	5	200 Max	APHA21stEd.,3111
13.	Nitrate as NO_3, mg/l	< 1	45 Max	IS:3025Pt.-24-2002
14.	Fluoride as F, mg/l	0.4	1.0 Max	APHA21stEd.,4500F
15.	Phenolic Compounds as Phenol, mg/l	<0.001	0.001 Max.	IS:3025Pt.-54-2002
16.	Mercury as Hg, mg/l	<0.001	0.001 Max.	APHA21stEd.,3112
17.	Cadmium as Cd, mg/l	<0.01	0.01 Max.	APHA21stEd.,3111
18.	Selenium as Se, mg/l	<0.005	0.01 Max.	APHA21stEd.,3114
19.	Arsenic as As, mg/l	<0.005	0.01 Max.	APHA21stEd.,3114
20.	Cyanide as CN, mg/l	<0.01	0.05 Max.	APHA21stEd.,4500CN
21.	Lead as Pb, mg/l	0.02	0.05 Max.	APHA21stEd.,3111
22.	Zinc as Zn, mg/l	0.1	5 Max	APHA21stEd.,3111
23.	Anionic Detergents as MBAS, mg/l	<0.01	0.2 Max	APHA21stEd.,5540
24.	Oil & Grease (including Mineral Oil & TPH), mg/l	<0.01	0.01 Max	IS:3025Pt.-39-2002
25.	Alkalinity as $CaCO_3$, mg/l	22	200 Max	IS:3025Pt.-23-2002
26.	Aluminum as Al, mg/l	<0.02	0.03 Max	APHA21stEd.,3500 Al
27.	Boron as B, mg/l	< 1	1 Max	ASTM-D-3082

WATER QUALITY DATA

Project No. : ENV-468
Project : Environmental Baseline Data Generation at Himachal Pradesh
Client : ERM India Pvt. Ltd. , Gurgaon (Hr.)

B) Bacteriological Test

1.	MPN *Coliform*/ 100 ml	2.2X 10^5Org	10 Max	IS:1622-2003
2.	Feacal *Coliform*/ 100ml	1.4 X 10^4 Org	Absent	IS:1622-2003

C) Additional Tests

1.	Temperature, °C	26	--	IS : 3025, Pt. 9, 2002
2.	Conductivity at 25 °C, µS/cm	68	--	IS : 3025, Pt. 14, 2002
3.	Total Suspended Solids, mg/l	12	--	IS:3025Pt.-17-2002
4.	Dissolved Oxygen, mg/l	7.4	--	APHA 21st Ed., 4500 O
5.	Biological Oxygen Demand (at 20°C for 5 days), mg/l	< 1	--	APHA21stEd.,5210
6.	Chemical Oxygen Demand, mg/l	8	--	APHA21stEd.,5220
7.	Salinity, parts per thousand	0.04	--	APHA 15th Ed.
8.	Phosphate as PO_4, mg/l	0.2	--	IS : 3025, Pt. 31, 2003
9.	Total Chromium (as Cr), mg/l	< 0.01	--	APHA, 21st Ed., 3111
10.	Barium (as Ba), mg/l	< 0.1	--	ICP – OES

Note: The values given in the brackets are permissible limits in the absence of alternate source.

WATER QUALITY DATA

Project No. : ENV-468
Project : Environmental Baseline Data Generation at Himachal Pradesh
Client : ERM India Pvt. Ltd. , Gurgaon (Hr.)

Table No.-2

LOCATION CODE : WQ-2 **Date of Sampling: 29.05.2008**

LOCATION : Beas at Bhuntar **Type of Sampling: Grab**

S.No.	Parameter	Results	IS :Limits as per IS : 10500, 1991 Reaf. 1993	Protocol
1.	Colour, Hazen	<5	5 Max.	IS:3025Pt.-4-2002
2.	Turbidity, NTU	7	5 Max (10)	IS:3025Pt.-10-2002
3.	pH	6.6	6.5 to 8.5	IS:3025Pt.-11-2002
4.	Total Hardness as $CaCO_3$, mg/l	37	300 Max	IS:3025Pt.-21-2002
5.	Iron as Fe, mg/l	0.01	0.3 Max	APHA21stEd.,3111
6.	Chloride as Cl, mg/l	7	250 Max	IS:3025Pt.-32-2002
7.	Dissolved Solids, mg/l	47	500 Max	IS:3025Pt.-16-2002
8.	Calcium as Ca, mg/l	9	75 Max	IS:3025Pt.-40-2002
9.	Magnesium as Mg, mg/l	3	30 Max	IS:3025Pt.-46-2002
10.	Copper as Cu, mg/l	<0.01	0.05 Max	APHA21stEd.,3111
11.	Manganese as Mn, mg/l	<0.01	0.1 Max	IS:3025Pt.-34-2002
12.	Sulphate as SO_4, mg/l	6	200 Max	APHA21stEd.,3111
13.	Nitrate as NO_3, mg/l	2	45 Max	IS:3025Pt.-24-2002
14.	Fluoride as F, mg/l	0.3	1.0 Max	APHA21stEd.,4500F
15.	Phenolic Compounds as Phenol, mg/l	<0.001	0.001 Max.	IS:3025Pt.-54-2002
16.	Mercury as Hg, mg/l	<0.001	0.001 Max.	APHA21stEd.,3112
17.	Cadmium as Cd, mg/l	<0.01	0.01 Max.	APHA21stEd.,3111
18.	Selenium as Se, mg/l	<0.005	0.01 Max.	APHA21stEd.,3114
19.	Arsenic as As, mg/l	<0.005	0.01 Max.	APHA21stEd.,3114
20.	Cyanide as CN, mg/l	<0.01	0.05 Max.	APHA21stEd.,4500CN
21.	Lead as Pb, mg/l	<0.01	0.05 Max.	APHA21stEd.,3111
22.	Zinc as Zn, mg/l	0.06	5 Max	APHA21stEd.,3111
23.	Anionic Detergents as MBAS, mg/l	<0.01	0.2 Max	APHA21stEd.,5540
24.	Oil & Grease (including Mineral Oil & TPH), mg/l	<0.01	0.01 Max	IS:3025Pt.-39-2002
25.	Alkalinity as $CaCO_3$, mg/l	21	200 Max	IS:3025Pt.-23-2002
26.	Aluminum as Al, mg/l	<0.02	0.03 Max	APHA21stEd.,3500 Al
27.	Boron as B, mg/l	< 1	1 Max	ASTM-D-3082

WATER QUALITY DATA

Project No. : ENV-468
Project : Environmental Baseline Data Generation at Himachal Pradesh
Client : ERM India Pvt. Ltd. , Gurgaon (Hr.)

B) Bacteriological Test

1.	MPN *Coliform*/ 100 ml	900 Org	10 Max	IS:1622-2003
2.	Feacal *Coliform*/ 100ml	94 Org	Absent	IS:1622-2003

C) Additional Tests

1.	Temperature, °C	27	--	IS : 3025, Pt. 9, 2002
2.	Conductivity at 25 °C, µS/cm	77	--	IS : 3025, Pt. 14, 2002
3.	Total Suspended Solids, mg/l	11	--	IS:3025Pt.-17-2002
4.	Dissolved Oxygen, mg/l	7.5	--	APHA 21st Ed., 4500 O
5.	Biological Oxygen Demand (at 20°C for 5 days), mg/l	< 1	--	APHA21stEd.,5210
6.	Chemical Oxygen Demand, mg/l	6	--	APHA21stEd.,5220
7.	Salinity, parts per thousand	0.05	--	APHA 15th Ed.
8.	Phosphate as PO_4, mg/l	0.06	--	IS : 3025, Pt. 31, 2003
9.	Total Chromium (as Cr), mg/l	< 0.01	--	APHA, 21st Ed., 3111
10.	Barium (as Ba), mg/l	<0.1	--	ICP – OES

Note: The values given in the brackets are permissible limits in the absence of alternate source.

WATER QUALITY DATA

Project No. : ENV-468
Project : Environmental Baseline Data Generation at Himachal Pradesh
Client : ERM India Pvt. Ltd. , Gurgaon (Hr.)

Table No.-3

LOCATION CODE : WQ-3 **Date of Sampling: 30.05.2008**

LOCATION : Beas before Pandoh **Type of Sampling: Grab**

S.No.	Parameter	Results	IS :Limits as per IS : 10500, 1991 Reaf. 1993	Protocol
1.	True Colour, Hazen	<5	5 Max.	IS:3025Pt.-4-2002
2.	Turbidity, NTU	12	5 Max (10)	IS:3025Pt.-10-2002
3.	pH	6.6	6.5 to 8.5	IS:3025Pt.-11-2002
4.	Total Hardness as $CaCO_3$, mg/l	33	300 Max	IS:3025Pt.-21-2002
5.	Iron as Fe, mg/l	<0.01	0.3 Max	APHA21stEd.,3111
6.	Chloride as Cl, mg/l	7	250 Max	IS:3025Pt.-32-2002
7.	Dissolved Solids, mg/l	60	500 Max	IS:3025Pt.-16-2002
8.	Calcium as Ca, mg/l	18	75 Max	IS:3025Pt.-40-2002
9.	Magnesium as Mg, mg/l	15	30 Max	IS:3025Pt.-46-2002
10.	Copper as Cu, mg/l	<0.01	0.05 Max	APHA21stEd.,3111
11.	Manganese as Mn, mg/l	0.2	0.1 Max (0.3)	IS:3025Pt.-34-2002
12.	Sulphate as SO_4, mg/l	8	200 Max	APHA21stEd.,3111
13.	Nitrate as NO_3, mg/l	2	45 Max	IS:3025Pt.-24-2002
14.	Fluoride as F, mg/l	0.7	1.0 Max	APHA21stEd.,4500F
15.	Phenolic Compounds as Phenol, mg/l	<0.001	0.001 Max.	IS:3025Pt.-54-2002
16.	Mercury as Hg, mg/l	<0.001	0.001 Max.	APHA21stEd.,3112
17.	Cadmium as Cd, mg/l	<0.01	0.01 Max.	APHA21stEd.,3111
18.	Selenium as Se, mg/l	<0.005	0.01 Max.	APHA21stEd.,3114
19.	Arsenic as As, mg/l	<0.005	0.01 Max.	APHA21stEd.,3114
20.	Cyanide as CN, mg/l	<0.01	0.05 Max.	APHA21stEd.,4500CN
21.	Lead as Pb, mg/l	0.02	0.05 Max.	APHA21stEd.,3111
22.	Zinc as Zn, mg/l	0.02	5 Max	APHA21stEd.,3111
23.	Anionic Detergents as MBAS, mg/l	<0.01	0.2 Max	APHA21stEd.,5540
24.	Oil & Grease (including Mineral Oil & TPH), mg/l	<0.01	0.01 Max	IS:3025Pt.-39-2002
25.	Alkalinity as $CaCO_3$, mg/l	23	200 Max	IS:3025Pt.-23-2002
26.	Aluminum as Al, mg/l	<0.02	0.03 Max	APHA21stEd.,3500 Al
27.	Boron as B, mg/l	< 1	1 Max	ASTM-D-3082

B) Bacteriological Test

1.	MPN *Coliform*/ 100 ml	79 Org	10 Max	IS:1622-2003
2.	Feacal *Coliform*/ 100ml	14 Org	Absent	IS:1622-2003

C) Additional Tests

1.	Temperature, °C	27	--	IS : 3025, Pt. 9, 2002
2.	Conductivity at 25 °C, µS/cm	78	--	IS : 3025, Pt. 14, 2002
3.	Total Suspended Solids, mg/l	1	--	IS:3025Pt.-17-2002
4.	Dissolved Oxygen, mg/l	7.2	--	APHA 21st Ed., 4500 O
5.	Biological Oxygen Demand (at 20°C for 5 days), mg/l	< 1	--	APHA21stEd.,5210
6.	Chemical Oxygen Demand, mg/l	5	--	APHA21stEd.,5220
7.	Salinity, parts per thousand	0.06	--	APHA 15th Ed.
8.	Phosphate as PO_4, mg/l	< 0.05	--	IS : 3025, Pt. 31, 2003
9.	Total Chromium (as Cr), mg/l	< 0.01	--	APHA, 21st Ed., 3111
10.	Barium (as Ba), mg/l	0.3	--	ICP – OES

Note:
1. The visual colour of the sample is off-white. However, colour test has been carried out after filtration of the sample as per the reverent protocol.
2. The values given in the brackets are permissible limits in the absence of alternate source.

WATER QUALITY DATA

Project No. : ENV-468
Project : Environmental Baseline Data Generation at Himachal Pradesh
Client : ERM India Pvt. Ltd. , Gurgaon (Hr.)

Table No.-4

LOCATION CODE : WQ-4 **Date of Sampling: 30.05.2008**

LOCATION : Souli Khad **Type of Sampling: Grab**

S.No.	Parameter	Results	IS :Limits	Protocol
1.	Colour, Hazen	<5	5 Max.	IS:3025Pt.-4-2002
2.	Turbidity, NTU	3	5 Max	IS:3025Pt.-10-2002
3.	PH	6.8	6.5 to 8.5	IS:3025Pt.-11-2002
4.	Total Hardness as $CaCO_3$, mg/l	90	300 Max	IS:3025Pt.-21-2002
5.	Iron as Fe, mg/l	0.03	0.3 Max	APHA21stEd.,3111
6.	Chloride as Cl, mg/l	20	250 Max	IS:3025Pt.-32-2002
7.	Dissolved Solids, mg/l	165	500 Max	IS:3025Pt.-16-2002
8.	Calcium as Ca, mg/l	55	75 Max	IS:3025Pt.-40-2002
9.	Magnesium as Mg, mg/l	35	30 Max (100)	IS:3025Pt.-46-2002
10.	Copper as Cu, mg/l	<0.01	0.05 Max	APHA21stEd.,3111
11.	Manganese as Mn, mg/l	<0.01	0.1 Max	IS:3025Pt.-34-2002
12.	Sulphate as SO_4, mg/l	6	200 Max	APHA21stEd.,3111
13.	Nitrate as NO_3, mg/l	1	45 Max	IS:3025Pt.-24-2002
14.	Fluoride as F, mg/l	0.6	1.0 Max	APHA21stEd.,4500F
15.	Phenolic Compounds as Phenol, mg/l	<0.001	0.001 Max.	IS:3025Pt.-54-2002
16.	Mercury as Hg, mg/l	<0.001	0.001 Max.	APHA21stEd.,3112
17.	Cadmium as Cd, mg/l	<0.01	0.01 Max.	APHA21stEd.,3111
18.	Selenium as Se, mg/l	<0.005	0.01 Max.	APHA21stEd.,3114
19.	Arsenic as As, mg/l	<0.005	0.01 Max.	APHA21stEd.,3114
20.	Cyanide as CN, mg/l	<0.01	0.05 Max.	APHA21stEd.,4500CN
21.	Lead as Pb, mg/l	0.02	0.05 Max.	APHA21stEd.,3111
22.	Zinc as Zn, mg/l	<0.01	5 Max	APHA21stEd.,3111
23.	Anionic Detergents as MBAS, mg/l	<0.01	0.2 Max	APHA21stEd.,5540
24.	Oil & Grease (including Mineral Oil & TPH), mg/l	<0.01	0.01 Max	IS:3025Pt.-39-2002
25.	Alkalinity as $CaCO_3$, mg/l	106	200 Max	IS:3025Pt.-23-2002
26.	Aluminum as Al, mg/l	<0.02	0.03 Max	APHA21stEd.,3500Al
27.	Boron as B, mg/l	< 1	1 Max	ASTM-D-3082

WATER QUALITY DATA

Project No. : ENV-468
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Client : ERM India Pvt. Ltd. , Gurgaon (Hr.)

B) Bacteriological Test

1.	MPN *Coliform*/ 100 ml	1.4 X 10^5 Org	10 Max	IS:1622-2003
2.	Feacal *Coliform*/ 100ml	1.1 X 10^4 Org	Absent	IS:1622-2003

C) Additional Tests

1.	Temperature, °C	28	--	IS : 3025, Pt. 9, 2002
2.	Conductivity at 25 °C, µS/cm	255	--	IS : 3025, Pt. 14, 2002
3.	Total Suspended Solids, mg/l	2	--	IS:3025Pt.-17-2002
4.	Dissolved Oxygen, mg/l	7.5	--	APHA 21st Ed., 4500 O
5.	Biological Oxygen Demand (at 20°C for 5 days), mg/l	< 1	--	APHA21stEd.,5210
6.	Chemical Oxygen Demand, mg/l	3	--	APHA21stEd.,5220
7.	Salinity, parts per thousand	0.16	--	APHA 15th Ed.
8.	Phosphate as PO_4, mg/l	< 0.05	--	IS : 3025, Pt. 31, 2003
9.	Total Chromium (as Cr), mg/l	< 0.01	--	APHA, 21st Ed., 3111
10.	Barium (as Ba), mg/l	0.4	--	ICP – OES

Note: The values given in the brackets are permissible limits in the absence of alternate source.

WATER QUALITY DATA

Project No. : ENV-468
Project : Environmental Baseline Data Generation at Himachal Pradesh
Client : ERM India Pvt. Ltd. , Gurgaon (Hr.)

Table No.- 5

LOCATION CODE : WQ-5 **Date of Sampling: 01.06.2008**

LOCATION : Sutlej River **Type of Sampling: Grab**

S.No.	Parameter	Results	IS :Limits	Protocol
1.	Ture Colour, Hazen	<5	5 Max.	IS:3025Pt.-4-2002
2.	Turbidity, NTU	300	5 Max (10)	IS:3025Pt.-10-2002
3.	pH	7.7	6.5 to 8.5	IS:3025Pt.-11-2002
4.	Total Hardness as $CaCO_3$, mg/l	132	300 Max	IS:3025Pt.-21-2002
5.	Iron as Fe, mg/l	0.1	0.3 Max	APHA21stEd.,3111
6.	Chloride as Cl, mg/l	8	250 Max	IS:3025Pt.-32-2002
7.	Dissolved Solids, mg/l	162	500 Max	IS:3025Pt.-16-2002
8.	Calcium as Ca, mg/l	25	75 Max	IS:3025Pt.-40-2002
9.	Magnesium as Mg, mg/l	17	30 Max	IS:3025Pt.-46-2002
10.	Copper as Cu, mg/l	<0.01	0.05 Max	APHA21stEd.,3111
11.	Manganese as Mn, mg/l	0.01	0.1 Max	IS:3025Pt.-34-2002
12.	Sulphate as SO_4, mg/l	44	200 Max	APHA21stEd.,3111
13.	Nitrate as NO_3, mg/l	8	45 Max	IS:3025Pt.-24-2002
14.	Fluoride as F, mg/l	0.2	1.0 Max	APHA21stEd.,4500F
15.	Phenolic Compounds as Phenol, mg/l	<0.001	0.001 Max.	IS:3025Pt.-54-2002
16.	Mercury as Hg, mg/l	<0.001	0.001 Max.	APHA21stEd.,3112
17.	Cadmium as Cd, mg/l	<0.01	0.01 Max.	APHA21stEd.,3111
18.	Selenium as Se, mg/l	<0.005	0.01 Max.	APHA21stEd.,3114
19.	Arsenic as As, mg/l	<0.005	0.01 Max.	APHA21stEd.,3114
20.	Cyanide as CN, mg/l	<0.01	0.05 Max.	APHA21stEd.,4500CN
21.	Lead as Pb, mg/l	0.03	0.05 Max.	APHA21stEd.,3111
22.	Zinc as Zn, mg/l	<0.01	5 Max	APHA21stEd.,3111
23.	Anionic Detergents as MBAS, mg/l	<0.01	0.2 Max	APHA21stEd.,5540
24.	Oil & Grease (including Mineral Oil & TPH), mg/l	<0.01	0.01 Max	IS:3025Pt.-39-2002
25.	Alkalinity as $CaCO_3$, mg/l	86	200 Max	IS:3025Pt.-23-2002
26.	Aluminum as Al, mg/l	<0.02	0.03 Max	APHA21stEd.,3500 Al
27.	Boron as B, mg/l	< 1	1 Max	ASTM-D-3082

WATER QUALITY DATA

Project No. : ENV-468
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Client : ERM India Pvt. Ltd. , Gurgaon (Hr.)

B) Bacteriological Test

1.	MPN *Coliform*/ 100 ml	7.0 X 10^5 Org	10 Max	IS:1622-2003
2.	Feacal *Coliform*/ 100ml	1.8 X 10^4 Org	Absent	IS:1622-2003

C) Additional Tests

1.	Temperature, °C	24	--	IS : 3025, Pt. 9, 2002
2.	Conductivity at 25 °C, µS/cm	230	--	IS : 3025, Pt. 14, 2002
3.	Total Suspended Solids, mg/l	446	--	IS:3025Pt.-17-2002
4.	Dissolved Oxygen, mg/l	5.6	--	APHA 21st Ed., 4500 O
5.	Biological Oxygen Demand (at 20°C for 5 days), mg/l	< 1	--	APHA21stEd.,5210
6.	Chemical Oxygen Demand, mg/l	8	--	APHA21stEd.,5220
7.	Salinity, parts per thousand	0.16	--	APHA 15th Ed.
8.	Phosphate as PO_4, mg/l	< 0.05	--	IS : 3025, Pt. 31, 2003
9.	Total Chromium (as Cr), mg/l	< 0.01	--	APHA, 21st Ed., 3111
10.	Barium (as Ba), mg/l	< 0.1	--	ICP – OES

Note:
1. The visual colour of the sample is off-white. However, colour test has been carried out after filtration of the sample as per the relevant protocol.
2. The values given in the brackets are permissible limits in the absence of alternate source.

WATER QUALITY DATA

Project No. : ENV-468
Project : Environmental Baseline Data Generation at Himachal Pradesh
Client : ERM India Pvt. Ltd. , Gurgaon (Hr.)

Table No.- 6

LOCATION CODE : WQ-6 **Date of Sampling: 01.06.2008**

LOCATION : Gamrola Khad **Type of Sampling: Grab**

S.No.	Parameter	Results	IS :Limits	Protocol
1.	Ture Colour, Hazen	<5	5 Max.	IS:3025Pt.-4-2002
2.	Turbidity, NTU	64	5 Max (10)	IS:3025Pt.-10-2002
3.	pH	8.0	6.5 to 8.5	IS:3025Pt.-11-2002
4.	Total Hardness as $CaCO_3$, mg/l	210	300 Max	IS:3025Pt.-21-2002
5.	Iron as Fe, mg/l	0.03	0.3 Max	APHA21stEd.,3111
6.	Chloride as Cl, mg/l	16	250 Max	IS:3025Pt.-32-2002
7.	Dissolved Solids, mg/l	325	500 Max	IS:3025Pt.-16-2002
8.	Calcium as Ca, mg/l	43	75 Max	IS:3025Pt.-40-2002
9.	Magnesium as Mg, mg/l	25	30 Max	IS:3025Pt.-46-2002
10.	Copper as Cu, mg/l	<0.01	0.05 Max	APHA21stEd.,3111
11.	Manganese as Mn, mg/l	<0.01	0.1 Max	IS:3025Pt.-34-2002
12.	Sulphate as SO_4, mg/l	99	200 Max	APHA21stEd.,3111
13.	Nitrate as NO_3, mg/l	6	45 Max	IS:3025Pt.-24-2002
14.	Fluoride as F, mg/l	0.4	1.0 Max	APHA21stEd.,4500F
15.	Phenolic Compounds as Phenol, mg/l	<0.001	0.001 Max.	IS:3025Pt.-54-2002
16.	Mercury as Hg, mg/l	<0.001	0.001 Max.	APHA21stEd.,3112
17.	Cadmium as Cd, mg/l	<0.01	0.01 Max.	APHA21stEd.,3111
18.	Selenium as Se, mg/l	<0.005	0.01 Max.	APHA21stEd.,3114
19.	Arsenic as As, mg/l	<0.005	0.01 Max.	APHA21stEd.,3114
20.	Cyanide as CN, mg/l	<0.01	0.05 Max.	APHA21stEd.,4500CN
21.	Lead as Pb, mg/l	0.02	0.05 Max.	APHA21stEd.,3111
22.	Zinc as Zn, mg/l	0.1	5 Max	APHA21stEd.,3111
23.	Anionic Detergents as MBAS, mg/l	<0.01	0.2 Max	APHA21stEd.,5540
24.	Oil & Grease (including Mineral Oil & TPH), mg/l	<0.01	0.01 Max	IS:3025Pt.-39-2002
25.	Alkalinity as $CaCO_3$, mg/l	143	200 Max	IS:3025Pt.-23-2002
26.	Aluminum as Al, mg/l	<0.02	0.03 Max	APHA21stEd.,3500 Al
27.	Boron as B, mg/l	< 1	1 Max	ASTM-D-3082

WATER QUALITY DATA

Project No. : ENV-468
Project : Environmental Baseline Data Generation at Himachal Pradesh
Client : ERM India Pvt. Ltd. , Gurgaon (Hr.)

B) Bacteriological Test

1.	MPN *Coliform*/ 100 ml	1.8 X 10^5 Org	10 Max	IS:1622-2003
2.	Feacal *Coliform*/ 100ml	2.8 X 10^3 Org	Absent	IS:1622-2003

C) Additional Tests

1.	Temperature, °C	24	--	IS : 3025, Pt. 9, 2002
2.	Conductivity at 25 °C, µS/cm	460	--	IS : 3025, Pt. 14, 2002
3.	Total Suspended Solids, mg/l	70	--	IS:3025Pt.-17-2002
4.	Dissolved Oxygen, mg/l	5.5	--	APHA 21st Ed., 4500 O
5.	Biological Oxygen Demand (at 20°C for 5 days), mg/l	< 1	--	APHA21stEd.,5210
6.	Chemical Oxygen Demand, mg/l	5	--	APHA21stEd.,5220
7.	Salinity, parts per thousand	0.33	--	APHA 15th Ed.
8.	Phosphate as PO_4, mg/l	< 0.05	--	IS : 3025, Pt. 31, 2003
9.	Total Chromium (as Cr), mg/l	< 0.01	--	APHA, 21st Ed., 3111
10.	Barium (as Ba), mg/l	0.2	--	ICP – OES

Note:
1. The visual colour of the sample is light-yellow. However, colour test has been carried out after filtration of the sample as per the relevant protocol.
2. The values given in the brackets are permissible limits in the absence of alternate source.

Annex E

Photodocumentation

E1 PHOTDOCUMENTATION

Figure 1.1 Switchyard at Prini

Figure 1.2 Tower location in the snow zone

Figure 1.3 Foundation pits for Tower

Figure 1.4 Discussion with stakeholders

Figure 1.5 Air quality monitoring along the route

Figure 1.6 Foundation pit for tower

Figure 1.7 A section route

Figure 1.8 Discussion with land owners

Figure 1.9 Tower component scattered at site

Figure 1.10 Joining the tower lattice

Figure 1.11 Erection of tower

Figure 1.12 Stringing process

Figure 1.13 Stringing Process

Figure 1.14 Impact to crop due to stringing

Figure 1.15 Tower location in field

Figure 1.16 Discussion with community

Annex F

Calculations and Weighing Chart for Water Quality Index

F1 CALCULATION FOR THE WATER QUALITY INDEX

F1.1 ABOUT THE INDEX

NSFWQI has the following mathematical structure:

NSF WQI has the following Mathematical Structure

$$NSFWQI = \sum_{i=1}^{p} W_i I_i$$

I_i is the sub –index for i^{th} water quality parameter.
W_i is the weight (in terms of importance) associated with water quality parameter.
p is the number of water quality parameters.

Table 1.1 Water Quality factors and weights

Factor	Weight
Dissolved oxygen	0.17
Fecal coliform	0.16
pH	0.11
Biochemical oxygen demand	0.11
Temperature change	0.10
Total phosphate	0.10
Nitrates	0.10
Turbidity	0.08
Total solids	0.07

F1.2 SUB INDEX

Sub –index for SW1 , SW2 and SW3 was generated and the following values were obtained. Sub index was generated for eight parameters as given in the table, the weights were suitably modified for eight parameters:

Table 1.2 Sub Index Values

SN	Parameters	SW1	SW2	SW3	SW4	SW5	SW6
1	Dissolved oxygen	87	88	89	93	59	57
2	Fecal coliform	2	23	47	2	2	2
3	pH	72	75	72	83	91	84
4	Biochemical Oxygen Demand	99	99	99	99	99	99
5	Temperature	14	13	13	12	17	17
6	Phosphate	92	98	98	98	98	98
7	Nitrates	97	95	95	96	56	60
8	Turbidity	80	82	72	90	5	31
9	Total solids	87	87	87	77	20	47

The Water Quality Index was determined from the sub index, utilizing the above equation. The WQI value was compared with the predetermined water quality Index legend and Classified accordingly.

Table 1.3 WQI values for the samples

Sample ID	WQI
SW1	67
SW2	71
SW3	74
SW4	69
SW5	50
SW6	53

F1.3 INTERPRETATION

Table 1.4 Interpretation of NSF WQ Index for Classes A, B, C, D and E prescribed by CPCB

NSF WQI	Description as per NSF legend	Class by CPCB
63-100	Good to Excellent	A
50-63	Medium to Good	B
38-50	Bad	C
Less than 38	Bad To Very bad	D,E

As per the interpretation given, SW1, SW2, SW3 and SW4 shall be considered as class A (i.e. good to excellent) while SW5 and SW6 is classified as class B (i.e. medium to good). The overall surface water quality in the region can be regarded as good.

F2 *WEIGHTING CURVE GRAPHS FOR NATIONAL SANITATION FOUNDATION, WATER QUALITY INDEX*

Figure 2.1 *Faecal Coliform*

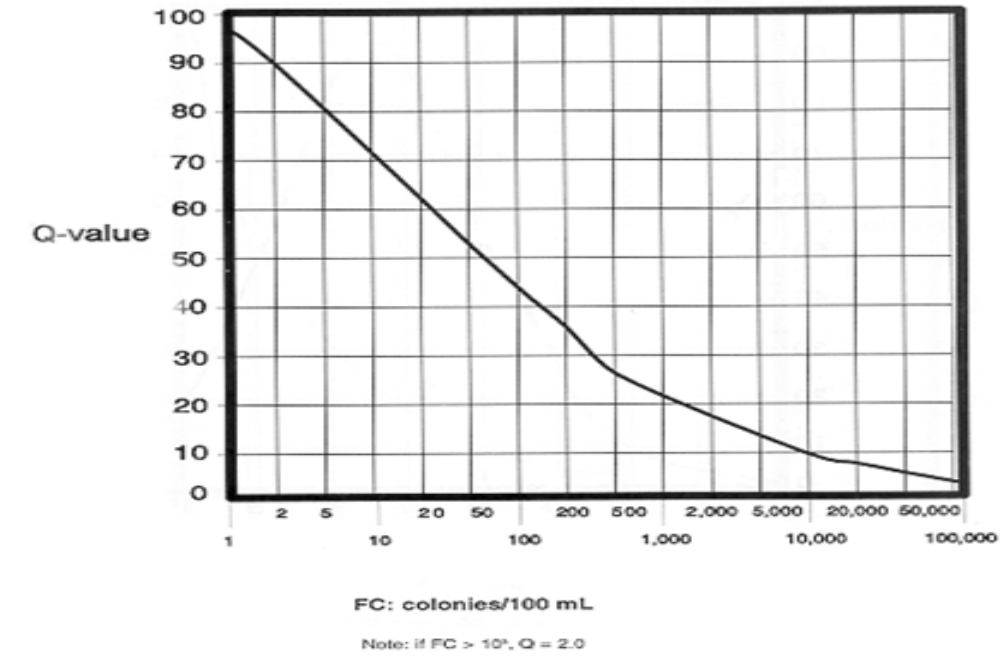


Figure 2.2 *Total Solids*

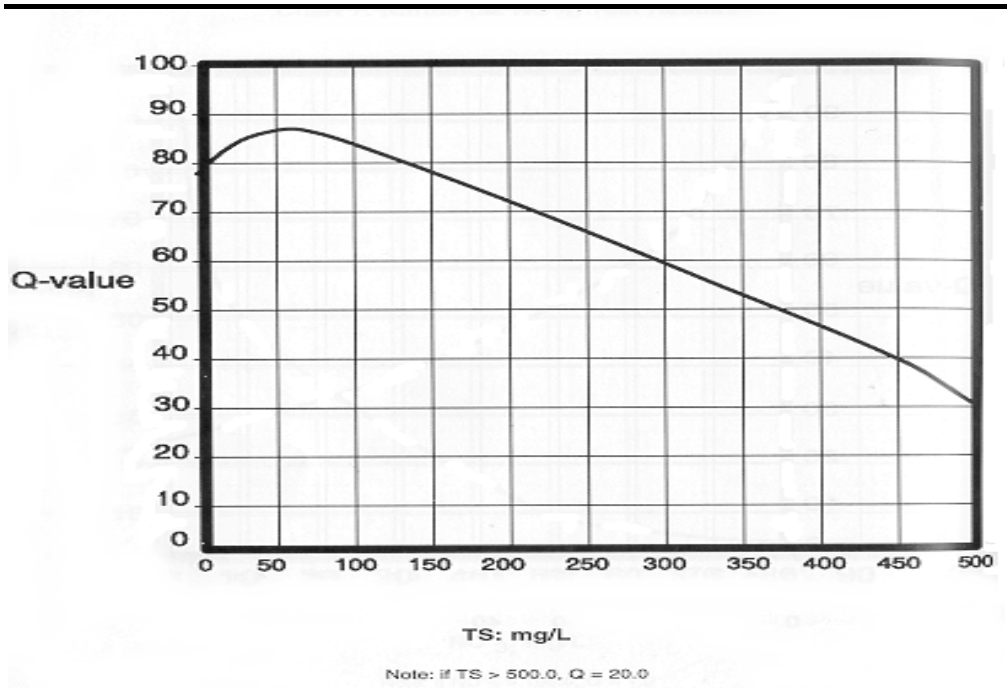


Figure 2.3 *Dissolved oxygen*

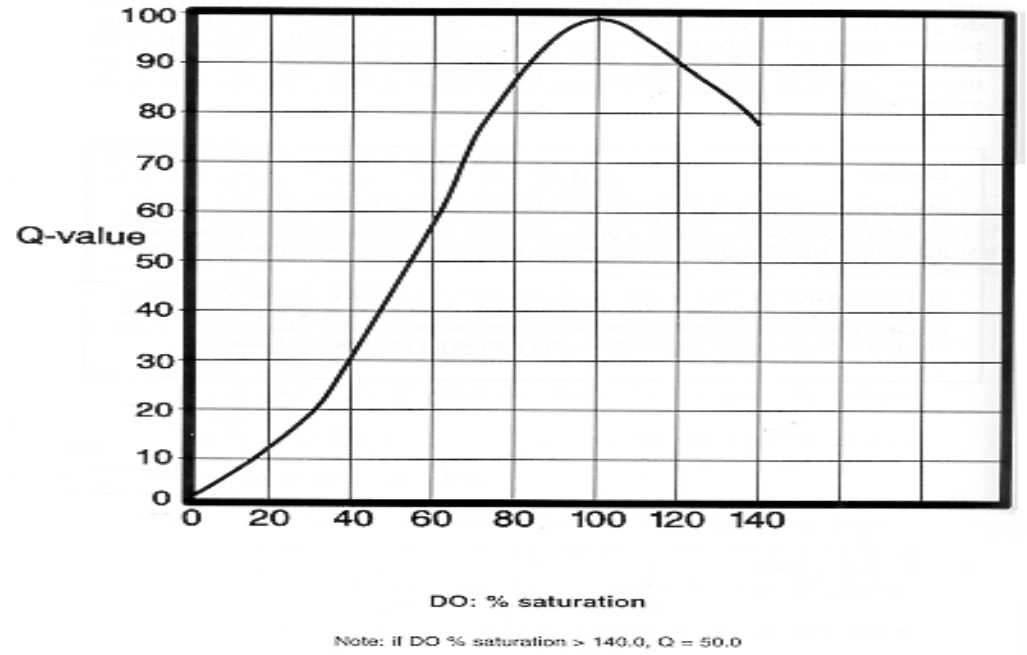


Figure 2.4 *Turbidity*

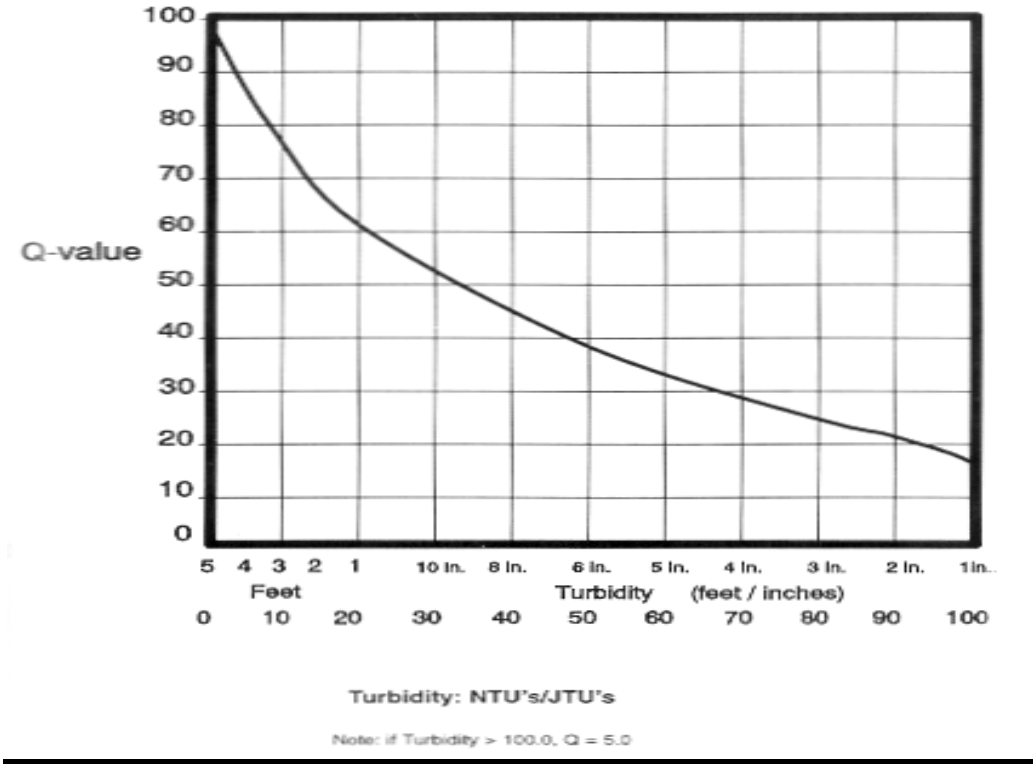
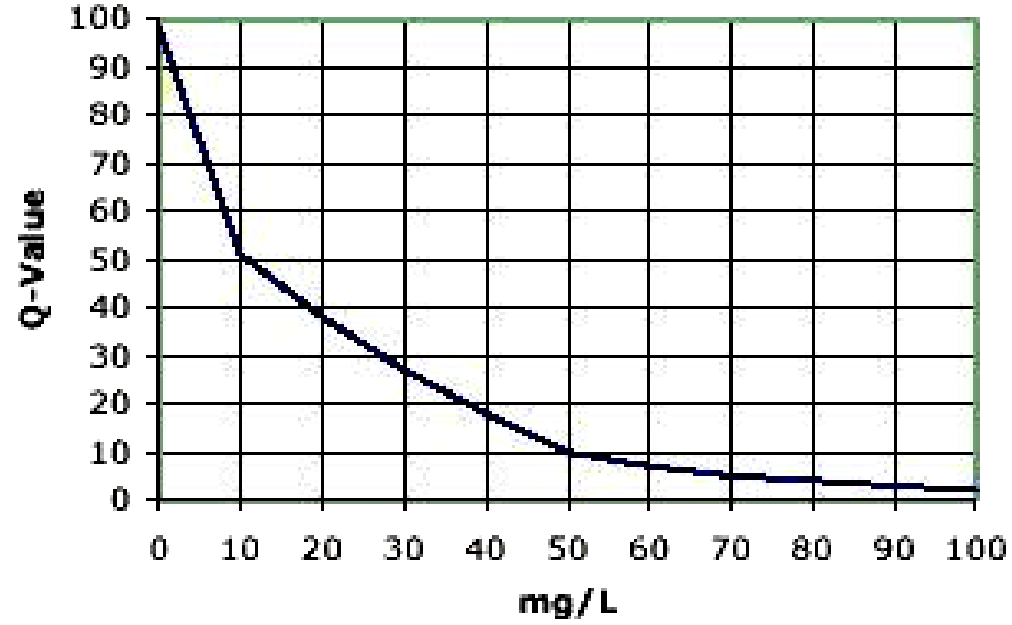
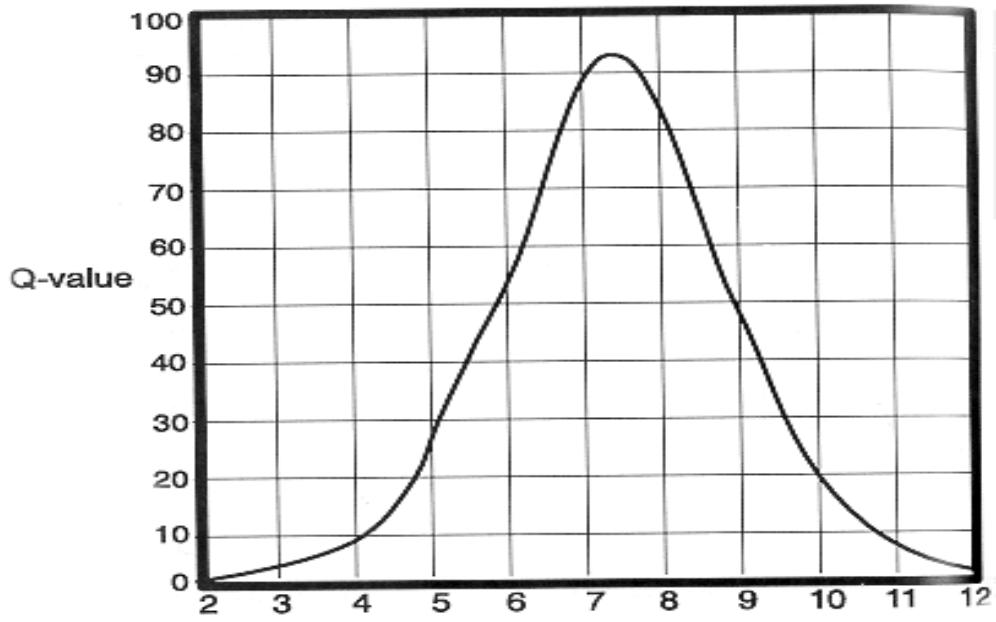


Figure 2.5 *Nitrate*



(If Nitrates > 100.0, Q=1.0)

Figure 2.6 *pH*



Note: if pH < 2.0, Q = 0.0; if pH > 12.0, Q = 0.0

Figure 2.7 BOD

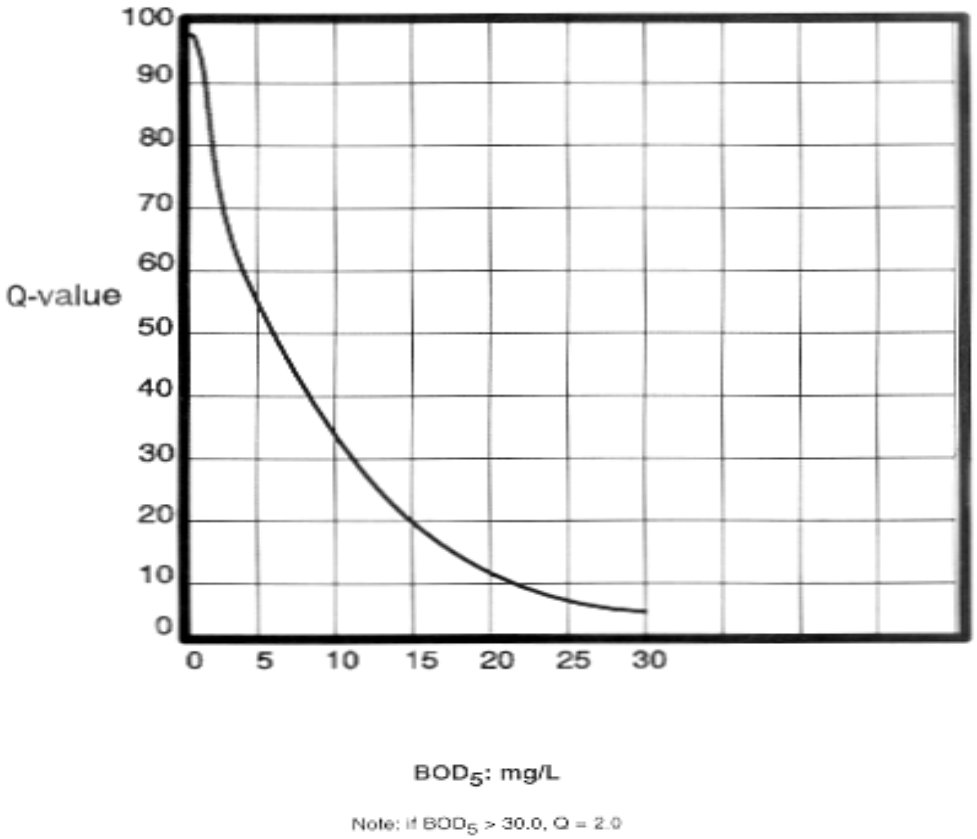
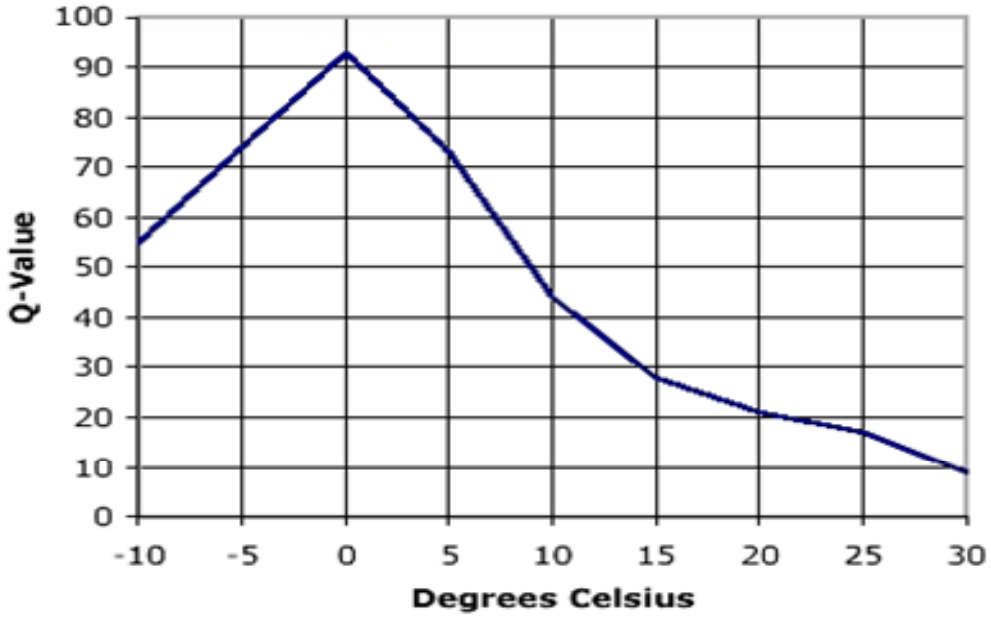


Figure 2.8 Temperature



Annex G

EHS guidelines for Transmission line - IFC

Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution

Introduction

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP)[1]. When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as required by their respective policies and standards. These industry sector EHS guidelines are designed to be used together with the **General EHS Guidelines** document, which provides guidance to users on common EHS issues potentially applicable to all industry sectors. For complex projects, use of multiple industry-sector guidelines may be necessary. A complete list of industry-sector guidelines can be found at: www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines

The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them.

The applicability of the EHS Guidelines should be tailored to the hazards and risks established for each project on the basis of the results of an environmental assessment in which site-specific variables, such as host country context, assimilative capacity of the environment, and other project factors, are taken into account. The applicability of specific technical recommendations should be based on the professional opinion of qualified and experienced persons.

When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in these EHS Guidelines are appropriate, in view of specific project circumstances, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment.

Applicability

The EHS Guidelines for Electric Power Transmission and Distribution include information relevant to power transmission between a generation facility and a substation located within an electricity grid, in addition to power distribution from a substation to consumers located in residential, commercial, and industrial areas. Annex A provides a summary of industry sector activities. This document is organized according to the following sections:

Section 1.0 — Industry-Specific Impacts and Management
Section 2.0 — Performance Indicators and Monitoring
Section 3.0 — References and Additional Sources
Annex A — General Description of Industry Activities

[1] Defined as the exercise of professional skill, diligence, prudence and foresight that would be reasonably expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances globally. The circumstances that skilled and experienced professionals may find when evaluating the range of pollution prevention and control techniques available to a project may include, but are not limited to, varying levels of environmental degradation and environmental assimilative capacity as well as varying levels of financial and technical feasibility.

1.0 Industry-Specific Impacts and Management

The following section provides a summary of EHS issues associated with electric power transmission and distribution that occur during the construction and operation phases of a facility, along with recommendations for their management. Additional recommendations for the management of environmental issues during the construction and decommissioning phases of power transmission and distribution systems are provided in the **General EHS Guidelines.** Examples of the impacts addressed in the General EHS Guidelines include:

- Construction site waste generation;
- Soil erosion and sediment control from materials sourcing areas and site preparation activities;
- Fugitive dust and other emissions (e.g. from vehicle traffic, land clearing activities, and materials stockpiles);
- Noise from heavy equipment and truck traffic;
- Potential for hazardous materials and oil spills associated with heavy equipment operation and fueling activities.

1.1 Environmental

Environmental issues during the construction phase of power transmission and distribution projects specific to this industry sector include the following:

- Terrestrial habitat alteration
- Aquatic habitat alteration
- Electric and magnetic fields
- Hazardous materials

Terrestrial Habitat Alteration

The construction and maintenance of transmission line rights-of-way, especially those aligned through forested areas, may result in alteration and disruption to terrestrial habitat, including impacts to avian species and an increased risk of forest fires.

Construction of Right-of-Way[2]

Right-of-way construction activities may transform habitats, depending on the characteristics of existing vegetation, topographic features, and installed height of the transmission lines. Examples of habitat alteration from these activities includes fragmentation of forested habitat; loss of wildlife habitat, including for nesting; establishment of non-native invasive plant species; and visual and auditory disturbance due to the presence of machinery, construction workers, transmission towers, and associated equipment.[3]

Recommended measures to prevent and control impacts to terrestrial habitats during construction of the right-of-way include:

- Site transmission and distribution rights-of-way, access roads, lines, towers, and substations to avoid critical habitat through use of existing utility and transport corridors for transmission and distribution, and existing roads and tracks for access roads, whenever possible;[4]
- Installation of transmission lines above existing vegetation to avoid land clearing;

[2] Also known as a "wayleave" or "easement" in some countries, but referred to as right-of-way for the purposes of these Guidelines.

[3] Alteration of terrestrial habitat for construction of transmission and distribution projects may also yield benefits for wildlife such as the creation of protective nesting, rearing, and foraging habitat for certain species; the establishment of travel and foraging corridors for ungulates and other large mammals; and nesting and perching opportunities for large bird species atop transmission towers and associated infrastructures. California Energy Commission (2005).

[4] Considering potential for electrical interference with telecommunication lines and railway lines due to mutual induction.

- Avoidance of construction activities during the breeding season and other sensitive seasons or times of day;
- Revegetation of disturbed areas with native plant species;
- Removal of invasive plant species during routine vegetation maintenance (see right-of-way maintenance section below);
- Management of construction site activities as described in relevant sections of the **General EHS Guidelines.**

Right-of-Way Maintenance

Regular maintenance of vegetation within the rights-of-way is necessary to avoid disruption to overhead power lines and towers. Unchecked growth of tall trees and accumulation of vegetation within rights-of-way may result in a number of impacts, including power outages through contact of branches and trees with transmission lines and towers; ignition of forest and brush fires; corrosion of steel equipment; blocking of equipment access; and interference with critical grounding equipment.

Regular maintenance of rights-of-way to control vegetation may involve the use of mechanical methods, such as mowing or pruning machinery that may disrupt wildlife and their habitats, in addition to manual hand clearing and herbicide use. Vegetation management should not eradicate all vegetation, but aim to maintain trees and plant growth that may negatively affect infrastructure at a level that is under an economically-damaging threshold. Excessive vegetation maintenance may remove unnecessary amounts of vegetation resulting in the continual replacement of successional species and an increased likelihood of the establishment of invasive species.

Recommended measures to prevent and control impacts from right-of-way vegetation maintenance include:

- Implementation of an integrated vegetation management approach (IVM). The selective removal of tall-growing tree species and the encouragement of low-growing grasses and shrubs is the common approach to vegetation management in transmission line rights-of-way. Alternative vegetation management techniques should be selected based on environmental and site considerations including potential impacts to non-target, endangered and threatened species;[5]
- Removal of invasive plant species, whenever possible, cultivating native plant species;
- Scheduling activities to avoid breeding and nesting seasons for any critically endangered or endangered wildlife species;
- Observing manufacturer machinery and equipment guidelines, procedures with regard to noise, and oil spill prevention and emergency response;
- Avoiding clearing in riparian areas;
- Avoiding use of machinery in the vicinity of watercourses.

An integrated approach to vegetation management may indicate that use of herbicides is the preferred approach to control fast-growing vegetation within transmission and distribution rights-of-way. In this case, the following guidance on herbicide application, storage, and handling should be considered.

If herbicides (in this sector, herbicides are the most common type of pesticide used) application is warranted, they should be managed to avoid their migration into off-site land or water

[5] Mowing with heavy-duty power equipment may be used to control growth of ground covers and prevent the establishment of trees and shrubs in the right-of-way. Herbicides, in combination with mowing, may control fast-growing weedy species that have a potential to mature to heights over those permitted within the right-of-way. Trimming and pruning may be utilized at the boundaries of rights-of-way to maintain corridor breadth and prevent the encroachment of tree branches. Hand removal or removal of vegetation, while labor intensive, may be used in the vicinity of structures, streams, fences, and other obstructions which make the use of machinery difficult or dangerous.

environments (see Pesticides under the Hazardous Materials section).

Forest Fires

If underlying growth is left unchecked, or slash from routine maintenance is left to accumulate within right-of-way boundaries, sufficient fuel can accumulate that may promote forest fires.

Recommended measures to prevent and control risk of forest fire include:

- Monitoring right-of-way vegetation according to fire risk;[6]
- Removing blowdown and other high-hazard fuel accumulations;
- Time thinning, slashing, and other maintenance activities to avoid forest fire seasons;
- Disposal of maintenance slash by truck or controlled burning[7] . Controlled burning should adhere to applicable burning regulations, fire suppression equipment requirements, and typically must be monitored by a fire watcher;
- Planting and managing fire resistant species (e.g. hardwoods) within, and adjacent to, rights-of-way;
- Establishing a network of fuel breaks of less flammable materials or cleared land to slow progress of fires and allow fire fighting access.

Avian and Bat Collisions and Electrocutions

The combination of the height of transmission towers and distribution poles and the electricity carried by transmission and distribution lines can pose potentially fatal risk to birds and bats through collisions and electrocutions.[8] Avian collisions with power lines can occur in large numbers if located within daily flyways or migration corridors, or if groups are traveling at night or during low light conditions (e.g. dense fog).[9] In addition, bird and bat collisions with power lines may result in power outages and fires.

Recommended prevention and control measures to minimize avian and bat collisions and electrocutions include[10]:

- Aligning transmission corridors to avoid critical habitats (e.g. nesting grounds, heronries, rookeries, bat foraging corridors, and migration corridors);
- Maintaining 1.5 meter (60-inch)[11] spacing between energized components and grounded hardware or, where spacing is not feasible, covering energized parts and hardware;
- Retrofitting existing transmission or distribution systems by installing elevated perches, insulating jumper loops, placing obstructive perch deterrents (e.g. insulated "V's"), changing the location of conductors, and / or using raptor hoods;[12]

[6] As an example, the British Columbia Transmission Corporation (BCTC) maintains a Wildfire Risk Management System (WRMS) that classifies wildfire risk and provides a variety of corresponding mitigation measures. See (Blackwell et al., 2004).

[7] Controlled burning should only be performed after considering potential impacts to air quality and according to the local air quality management requirements.

[8] Birds and bats may be electrocuted by power lines in one of three ways: i) Simultaneously touching an energized wire and a neutral wire; ii) Simultaneously touching two live wires; and iii) Simultaneously touching an energized wire and any other piece of equipment on a pole or tower that is bonded to the earth through a ground wire. Raptor Protection Video Group (2000)

[9] Larger species (e.g. hawks, falcons, owls, vultures, cranes, egrets, and ravens) are at particular risk of simultaneously touching two wires or components while flying due to their long wingspans. Anderson (1991)

[10] Further information is available from Avian Power Line Interaction Committee (2005) and the U.S. Fish and Wildlife Service (2005).

[11] Manville (2005)

[12] California Energy Commission (2005)

- Considering the installation of underground transmission and distribution lines in sensitive areas (e.g. critical natural habitats);
- Installing visibility enhancement objects such as marker balls, bird deterrents, or diverters.[13]

Aquatic Habitat Alteration

Power transmission and distribution lines, and associated access roads and facilities, may require construction of corridors crossing aquatic habitats that may disrupt watercourses and wetlands, and require the removal of riparian vegetation. In addition, sediment and erosion from construction activities and storm water runoff may increase turbidity of surface watercourses.

Recommended measures to prevent and control impacts to aquatic habitats include:

- Site power transmission towers and substations to avoid critical aquatic habitat (e.g. watercourses, wetlands, and riparian areas), as well as fish spawning habitat, and critical fish over-wintering habitat;
- Maintaining fish access when road crossings of watercourses are unavoidable by utilizing clearspan bridges, open-bottom culverts, or other approved methods;
- Minimizing clearing and disruption to riparian vegetation;
- Management of construction site activities as described in the relevant sections of the **General EHS Guidelines.**

Marine Habitat Alteration

Transmission across ocean stretches may require use of submarine transmission cables on the ocean floor. Submarine cables are also occasionally used to transmit high-voltage power across long stretches of water to islands and other locations that are inaccessible by conventional techniques. Cables are installed using a cable-laying vessel and a remotely operated, underwater vehicle. Issues associated with marine habitat alteration include disruption to intertidal vegetation (e.g. eelgrass), coral reefs, and marine life, including marine mammals, and sedimentation resulting in turbidity and reductions in water quality.

Recommended measures to prevent and control impacts to marine habitats include:

- Locating and siting cable routes, and shore access, to avoid critical marine habitats (e.g. breeding grounds and eelgrass) and coral reefs;
- Burying submarine cables when traversing sensitive intertidal habitat;
- Monitoring cable laying path for presence of marine mammals;
- Avoiding laying submarine cable during fish and marine mammals breeding periods, calving periods, and spawning seasons.

Electric and Magnetic Fields

Electric and magnetic fields (EMF) are invisible lines of force emitted by and surrounding any electrical device (e.g. power lines and electrical equipment). Electric fields are produced by voltage and increase in strength as the voltage increases. Electric field strength is measured in volts per meter (V/m). Magnetic fields result from the flow of electric current and increase in strength as the current increases. Magnetic fields are measured in units of gauss (G) or tesla (T), where 1T equals 10,000G. Electric fields are shielded by materials that conduct electricity, and other materials, such as trees and building

[13] Several studies have found that bird diverters that are installed to increase the visibility of power lines reduce collision rates considerably. Crowder and Rhodes (1999).

materials. Magnetic fields pass through most materials and are difficult to shield. Both electric and magnetic fields decrease rapidly with distance. Power frequency EMF typically has a frequency in the range of 50 – 60 Hertz (Hz), and is considered Extremely Low Frequency (ELF).[14]

Although there is public and scientific concern over the potential health effects associated with exposure to EMF (not only high-voltage power lines and substations, but also from everyday household uses of electricity), there is no empirical data demonstrating adverse health effects from exposure to typical EMF levels from power transmissions lines and equipment.[15] However, while the evidence of adverse health risks is weak, it is still sufficient to warrant limited concern.[16]

Recommendations applicable to the management of EMF exposures include:

- Evaluating potential exposure to the public against the reference levels developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP).[17,18] Average and peak exposure levels should remain below the ICNIRP recommendation for General Public Exposure[19];
- Considering siting new facilities so as to avoid or minimize exposure to the public. Installation of transmission lines or other high voltage equipment above or adjacent to residential properties or other locations intended for highly frequent human occupancy, (e.g. schools or offices), should be avoided;
- If EMF levels are confirmed or expected to be above the recommended exposure limits, application of engineering techniques should be considered to reduce the EMF produced by power lines, substations, or transformers. Examples of these techniques include:
  - Shielding with specific metal alloys[20]
  - Burying transmission lines[21]
  - Increasing height of transmission towers
  - Modifications to size, spacing, and configuration of conductors

Hazardous Materials

Hazardous materials in this sector include insulating oils / gases (e.g. Polychlorinated Biphenyls [PCB] and sulfur hexafluoride [SF6], and fuels, in addition to chemicals or products for wood preservation for poles and associated wood construction material. The use of herbicides for right-of-way vegetation maintenance is discussed in the above section on 'Right-of–Way Maintenance'.

[14] National Institute of Environmental Health Sciences (2002)

[15] International Commission on Non-Ionizing Radiation Protection(ICNIRP) (2001); International Agency for Research on Cancer (2002); U.S. National Institute of Health (2002); Advisory Group to the Radiation Protection Board of the UK (2001), and U.S. National Institute of Environmental Health Sciences (1999)).

[16] U.S. National Institute of Environmental Health Sciences (2002)

[17] ICNIRP is a non-governmental organization formally recognized by the World Health Organization (WHO), which published the "Guidelines for Limiting Exposure to Time-varying Electric, Magnetic, and Electromagnetic Fields" following reviews of all the peer-reviewed scientific literature, including thermal and non-thermal effects. The standards are based on evaluations of biological effects that have been established to have health consequences. The main conclusion from the WHO reviews is that exposures below the limits recommended by the ICNIRP international guidelines do not appear to have any known consequence on health.

[18] An additional source of information is the Institute of Electrical and Electronics Engineers. See IEEE (2005).

[19] The ICNIRP exposure guidelines for General Public Exposure are listed in Section 2.1 of this Guideline.

[20] This is effective for reduction of electric field exposure, but not for reduction of magnetic field exposure.

[21] Ibid.

Insulating Oils and Fuels

Highly-refined, mineral insulating oils are used to cool transformers and provide electrical insulation between live components. They are typically found in the largest quantities at electrical substations and maintenance shops. Sulfur Hexafluoride (SF6) may also be used as a gas insulator for electrical switching equipment and in cables, tubular transmission lines, and transformers. SF6 may be used as an alternative to insulating oils. However, the use of SF6, a greenhouse gas with a significantly higher global warming potential (GWP) than CO_2, should be minimized. In cases the gas is used for applications involving high voltages (>350 KV), equipment with a low leakage- rate (<99 percent) should be used.

Liquid petroleum fuels for vehicles and other equipment may also be used and stored at transmission and distribution projects. Recommendations for prevention and control of hazards associated with spill prevention, emergency response, clean-up, and contaminated soil remediation are addressed in the **General EHS Guidelines.**

Polychlorinated Biphenyls (PCB) were widely used as a dielectric fluid to provide electrical insulation, although their use has been largely discontinued due to potential harmful effects on human health and the environment. Recommendations for the management of PCB include:

- Replacing existing transformers and other electrical equipment containing PCB, and ensuring appropriate storage, decontamination, and disposal of contaminated units;
- Prior to final disposal, retired transformers and equipment containing PCB should be stored on a concrete pad with curbs sufficient to contain the liquid contents of these containers should they be spilled or leaked. The storage area should also have a roof to prevent precipitation from collecting in the storage area. Disposal should involve facilities capable of safely transporting and disposing of hazardous waste containing PCB;[22]
- Surrounding soil exposed to PCB leakage from equipment should be assessed, and appropriate removal and / or remediation measures should be implemented, as addressed in the section on contaminated soil in the **General EHS Guidelines**.

Wood Preservatives

The majority of wooden utility poles are treated with pesticide preservatives to protect against insects, bacteria, and fungi, and to prevent rot. The preservatives most commonly used for power poles are oil-based pesticides such as creosote, pentachlorophenol (PCP), and chromated copper arsenate (CCA). Use of these preservatives is being limited in some countries due to their toxic effects on the environment. While in use, poles may leach preservatives into soils and groundwater, however, levels are highest directly beside poles and decrease to within normal levels at approximately 30 centimeters (cm) distance from the pole.[23] The most significant potential environmental impacts occur at specialized wood treatment facilities if not managed appropriately.

Poles should be pretreated at an appropriate facility to ensure chemical fixation and prevent leaching, and to impede the formation of surface residues at the right-of-way[24]. Further

[22] For a complete discussion on the identification and management of PCB in this industry sector, please see the UNEP publication "PCB Transformers and Capacitors: From Management to Reclassification and Disposal" (2002). Available at: http://www.chem.unep.ch/pops/pdf/PCBtranscap.pdf

[23] Zagury et al. (2003)

[24] Lebow and Tippie (2001)

information is available in the **EHS Guidelines for Sawmilling and Wood-based Products**.

Recommended measures to prevent and control the impacts of wood preservatives at the point of use include:

- Evaluating the cost and benefit of using alternative pole materials (e.g. steel, concrete, and fiberglass);
- Consider use of alternative preservatives(e.g. copper azote);
- Undertake appropriate disposal of used poles. Landfill facilities should be capable of handling wastes that may have chemical leaching properties. Disposal through incineration or through recycling should consider associated air emissions and secondary product residues of preservative chemicals.

Pesticides

Pesticide use should be established as part of an Integrated Pest Management (IPM) strategy and a documented Pest Management Plan (PMP). The following stages should be considered when designing and implementing an IPM strategy, giving preference to alternative pest management strategies, with the use of synthetic chemical pesticides as a last option.

Alternatives to Pesticide Application - The following alternatives to pesticides should be considered:

- Provide those responsible for deciding on pesticides application with training in pest identification, weed identification, and field scouting;
- Use mechanical weed control and / or thermal weeding;
- Support and use beneficial organisms, such as insects, birds, mites, and microbial agents, to perform biological control of pests;
- Protect natural enemies of pests by providing a favorable habitat, such as bushes for nesting sites and other original vegetation that can house pest predators;
- Use animals to graze areas and manage plant coverage;
- Use mechanical controls such as traps, barriers, light, and sound to kill, relocate, or repel pests.

Pesticide Application - If pesticide application is warranted, users should take the following precautions:

- Train personnel to apply pesticides and ensure that personnel have received applicable certifications or equivalent training where such certifications are not required; [25]
- Review the manufacturer's directions on maximum recommended dosage or treatment, as well as published reports on using the reduced rate of pesticide application without loss of effect, and apply the minimum effective dose;
- Apply pesticides based on criteria (e.g. field observations, weather data, time of treatment, and dosage) and maintain a pesticide logbook to record such information;
- Avoid the use of pesticides that fall under the World Health Organization Recommended Classification of Pesticides by Hazard Classes 1a and 1b;
- Avoid the use of pesticides that fall under the World Health Organization Recommended Classification of Pesticides by Hazard Class II if the project host country lacks restrictions on distribution and use of these chemicals, or if they are likely to be accessible to personnel without proper training,

[25] Examples of certification schemes are provided by the US EPA (2006), which classifies pesticides as either "unclassified" or "restricted" and requires workers that apply unclassified pesticides to be trained according to the Worker Protection Standard (40 CFR Part 170) for Agricultural Pesticides. It further requires restricted pesticides to be applied by or in the presence of a certified pesticide applicator.

equipment, and facilities to handle, store, apply, and dispose of these products properly;

- Avoid the use of pesticides listed in Annexes A and B of the Stockholm Convention, except under the conditions noted in the convention;[26]
- Use only pesticides that are manufactured under license and registered and approved by the appropriate authority and in accordance with the Food and Agriculture Organization's (FAO) International Code of Conduct on the Distribution and Use of Pesticides[27];
- Use only pesticides that are labeled in accordance with international standards and norms, such as the FAO Revised Guidelines for Good Labeling Practice for Pesticides[28];
- Select application technologies and practices designed to reduce unintentional drift or runoff only as indicated in an IPM program, and under controlled conditions;
- Maintain and calibrate pesticide application equipment in accordance with manufacturer's recommendations;
- Establish untreated buffer zones or strips along water sources, rivers, streams, ponds, lakes, and ditches to help protect water resources.

Pesticide Handling and Storage - Contamination of soils, groundwater, or surface water resources, due to accidental spills during transfer, mixing, and storage of pesticides should be prevented by following the hazardous materials storage and handling recommendations presented in the **General EHS Guidelines**. Additional recommendations include the following:

- Store pesticides in their original packaging, in a dedicated, dry, cool, frost-free, and well aerated location that can be locked and properly identified with signs, with access limited to authorized people[29]. No human or animal food may be stored in this location. The store room should also be designed with spill containment measures and sited in consideration of potential for contamination of soil and water resources;
- Mixing and transfer of pesticides should be undertaken by trained personnel in ventilated and well lit areas, using containers designed and dedicated for this purpose.
- Containers should not be used for any other purpose (e.g. drinking water). Contaminated containers should be handled as hazardous waste, and should be treated accordingly. Disposal of containers contaminated with pesticides should be done in a manner consistent with FAO guidelines and with manufacturer's directions;[30]
- Purchase and store no more pesticide than needed and rotate stock using a "first-in, first-out" principle so that pesticides do not become obsolete.[31] Additionally, the use of obsolete pesticides should be avoided under all circumstances;[32] A management plan that includes measures for the containment, storage and ultimate destruction of all obsolete stocks should be prepared in accordance to guidelines by FAO and consistent with country commitments under the Stockholm, Rotterdam and Basel Conventions.
- Collect rinse water from equipment cleaning for reuse (such as for the dilution of identical pesticides to concentrations used for application);

[26] The Stockholm Convention on Persistent Organic Pollutants (2001) controls the use of the following POPs-pesticides: Aldrin, Chlordane, DDT, Dieldrin, Endrin, Heptachlor, Hexachlorobenzene, Mirex, and Toxaphene.
[27] FAO (2002)
[28] FAO (2000)
[29] FAO (2002)
[30] See FAO Guidelines for the Disposal of Waste Pesticides and Pesticide Containers.
[31] See FAO (1996).
[32] See the FAO publication on pesticide storage and stock control manual. FAO Pesticide Disposal Series No. 3 (1996).

- Ensure that protective clothing worn during pesticide application is either cleaned or disposed of in an environmentally responsible manner
- Implement groundwater supply wellhead setbacks for pesticide application and storage
- Maintain records of pesticide use and effectiveness.

1.2 Occupational Health and Safety

Most occupational health and safety issues during the construction, operation, maintenance, and decommissioning of electric power distribution projects are common to those of large industrial facilities, and their prevention and control is discussed in the **General EHS Guidelines**. These impacts include, among others, exposure to physical hazards from use of heavy equipment and cranes; trip and fall hazards; exposure to dust and noise; falling objects; work in confined spaces; exposure to hazardous materials; and exposure to electrical hazards from the use of tools and machinery.

Occupational health and safety hazards specific to electric power transmission and distribution projects primarily include:

- Live power lines
- Working at height
- Electric and magnetic fields
- Exposure to chemicals

Live Power Lines

Workers may be exposed to occupational hazards from contact with live power lines during construction, maintenance, and operation activities. Prevention and control measures associated with live power lines include:

- Only allowing trained and certified workers to install, maintain, or repair electrical equipment;
- Deactivating and properly grounding live power distribution lines before work is performed on, or in close proximity, to the lines;
- Ensuring that live-wire work is conducted by trained workers with strict adherence to specific safety and insulation standards. Qualified or trained employees working on transmission or distribution systems should be able to achieve the following[33]:
  - Distinguish live parts from other parts of the electrical system
  - Determine the voltage of live parts
  - Understand the minimum approach distances outlined for specific live line voltages
  - Ensure proper use of special safety equipment and procedures when working near or on exposed energized parts of an electrical system
- Workers should not approach an exposed energized or conductive part even if properly trained unless:
  - The worker is properly insulated from the energized part with gloves or other approved insulation; or,
  - The energized part is properly insulated from the worker and any other conductive object; or,
  - The worker is properly isolated and insulated from any other conductive object (live-line work).
- Where maintenance and operation is required within minimum setback distances, specific training, safety measures, personal safety devices, and other precautions should be defined in a health and safety plan. (Table 2 in Section 2.2 provides recommended minimum safety setbacks for workers);

[33] Further information is available from the Occupational Safety and Health Administration (OSHA). Available at: http://www.osha.gov/SLTC/powertransmission/standards.html

- Workers not directly associated with power transmission and distribution activities who are operating around power lines or power substations should adhere to local legislation, standards, and guidelines relating to minimum approach distances for excavations, tools, vehicles, pruning, and other activities;
- Minimum hot stick distances may only be reduced provided that the distance remaining is greater than the distance between the energized part and a grounded surface.

Working at height on poles and structures

Workers may be exposed to occupational hazards when working at elevation during construction, maintenance, and operation activities. Prevention and control measures for working at height include:

- Testing structures for integrity prior to undertaking work;
- Implementation of a fall protection program that includes training in climbing techniques and use of fall protection measures; inspection, maintenance, and replacement of fall protection equipment; and rescue of fall-arrested workers, among others;
- Establishment of criteria for use of 100 percent fall protection (typically when working over 2 meters above the working surface, but sometimes extended to 7 meters, depending on the activity). The fall protection system should be appropriate for the tower structure and necessary movements, including ascent, descent, and moving from point to point;
- Installation of fixtures on tower components to facilitate the use of fall protection systems;
- Provision of an adequate work-positioning device system for workers. Connectors on positioning systems should be compatible with the tower components to which they are attached;
- Hoisting equipment should be properly rated and maintained and hoist operators properly trained;
- Safety belts should be of not less than 16 millimeters (mm) (5/8 inch) two-in-one nylon or material of equivalent strength. Rope safety belts should be replaced before signs of aging or fraying of fibers become evident;
- When operating power tools at height, workers should use a second (backup) safety strap;
- Signs and other obstructions should be removed from poles or structures prior to undertaking work;
- An approved tool bag should be used for raising or lowering tools or materials to workers on structures.

Electric and magnetic fields

Electric and magnetic fields (EMF) are described in Section 1.1 above. Electric utility workers typically have a higher exposure to EMF than the general public due to working in proximity to electric power lines.[34,35] Occupational EMF exposure should be prevented or minimized through the preparation and implementation of an EMF safety program including the following components:

- Identification of potential exposure levels in the workplace, including surveys of exposure levels in new projects and the use of personal monitors during working activities;

[34] A 1994 study estimated the average exposure of electrical workers (including jobs in electric utilities and other industries) in Los Angeles, California to be 9.6 milligauss (mG), compared to 1.7 mG for workers in other fields (S. J. London et al., 1994).

[35] Although detailed studies of workplace exposure to EMF in the United States, Canada, France, England, and several Northern European countries have found no conclusive link or correlation between typical occupational EMF exposure and adverse health effects, some studies have identified a possible association between occupational exposure to EMF and cancer, such as brain cancer (U.S. National Institute of Environmental Health Sciences 2002) indicating there is evidence to warrant limited concern.

- Training of workers in the identification of occupational EMF levels and hazards;
- Establishment and identification of safety zones to differentiate between work areas with expected elevated EMF levels compared to those acceptable for public exposure, limiting access to properly trained workers;
- Implementation of action plans to address potential or confirmed exposure levels that exceed reference occupational exposure levels developed by international organizations such as the International Commission on Non-Ionizing Radiation Protection (ICNIRP), and the Institute of Electrical and Electronics Engineers (IEEE)[36]. Personal exposure monitoring equipment should be set to warn of exposure levels that are below occupational exposure reference levels (e.g. 50 percent). Action plans to address occupational exposure may include limiting exposure time through work rotation, increasing the distance between the source and the worker, when feasible, or the use of shielding materials.

Exposure to chemicals

Occupational exposures to chemicals in this sector primarily include handling of pesticides (herbicides) used for right–of-way maintenance, and exposure to PCB in transformers and other electrical components.

Pesticides

Occupational health and safety impacts associated with pesticides are similar to those for other hazardous substances, and their prevention and control are discussed in the **General EHS Guidelines**. Potential exposures to pesticides include dermal contact and inhalation during their storage, preparation and application. The effect of such impacts may be increased by climatic conditions such as wind, which may increase the chance of unintended drift, or high temperatures, which may deter the use of personal protective equipment (PPE). Recommendations specific to the use of pesticides include:

- Train personnel to apply pesticides and ensure that personnel have received the necessary certifications,[37] or equivalent training where such certifications are not required;
- Respect post-treatment intervals to avoid operator exposure during reentry to crops with residues of pesticides;
- Ensure hygiene practices are followed (in accordance to FAO and PMP) to avoid exposure of family members to pesticides residues.

PCBs

Maintenance shops and other facilities, and activities may involve potential contact with PCB or PCB-contaminated machinery. Recommendations for chemical exposure, including PCB, are addressed in the **General EHS Guidelines**.[38]

1.3 Community Health and Safety

Community health and safety impacts during the construction and decommissioning of transmission and distribution power lines are common to those of most large industrial facilities, and

[36] The ICNIRP exposure guidelines for Occupational Exposure are listed in Section 2.2 of this Guideline.

[37] The US EPA classifies pesticides as either "unclassified" or "restricted." All workers that apply unclassified pesticides must be trained according to the Worker Protection Standard (40 CFR Part 170 and 171) for Agricultural Pesticides. Restricted pesticides must be applied by or in the presence of a certified pesticide applicator. For more information, see http://www.epa.gov/pesticides/health/worker.htm

[38] Further information on the management of occupational exposure to PCB can be obtained at UNEP publication "PCB Transformers and Capacitors: From Management to Reclassification and Disposal" (2002) available at: http://www.chem.unep.ch/pops/pdf/PCBtranscap.pdf

are discussed in the **General EHS Guidelines**. These impacts include, among others, dust, noise, and vibration from construction vehicle transit, and communicable diseases associated with the influx of temporary construction labor. In addition to general health and safety standards outlined in the **General EHS Guidelines**, the operation of live power distribution lines and substations may generate the following industry-specific impacts:

- Electrocution
- Electromagnetic interference
- Visual amenity
- Noise and Ozone
- Aircraft Navigation Safety

Electrocution

Hazards most directly related to power transmission and distribution lines and facilities occur as a result of electrocution from direct contact with high-voltage electricity or from contact with tools, vehicles, ladders, or other devices that are in contact with high-voltage electricity. Recommended techniques to prevent these hazards include:

- Use of signs, barriers (e.g. locks on doors, use of gates, use of steel posts surrounding transmission towers, particularly in urban areas), and education / public outreach to prevent public contact with potentially dangerous equipment;
- Grounding conducting objects (e.g. fences or other metallic structures) installed near power lines, to prevent shock.

Electromagnetic Interference

The corona of overhead transmission line conductors and high-frequency currents of overhead transmission lines may result in the creation of radio noise. Typically, transmission line rights-of-way and conductor bundles are created to ensure radio reception at the outside limits remains normal. However, periods of rain, sleet or freezing rain sharply increases the streaming corona on conductors and may affect radio reception in residential areas near transmission lines.

Visual Amenity

Power transmission and distribution are necessary to transport energy from power facilities to residential communities, but may be visually intrusive and undesirable to local residents. To mitigate the visual impact of power distribution projects, the following mitigation measures should be implemented:

- Extensive public consultation during the planning of power line and power line right-of-way locations;
- Accurate assessment of changes in property values due to power line proximity;
- Siting power lines, and designing substations, with due consideration to landscape views and important environmental and community features;
- Location of high-voltage transmission and distribution lines in less populated areas, where possible;
- Burying transmission or distribution lines when power must be transported through dense residential or commercial areas.

Noise and Ozone

Noise in the form of buzzing or humming can often be heard around transformers or high voltage power lines producing corona. Ozone, a colorless gas with a pungent odor, may also be produced. Neither the noise nor ozone produced by power

distribution lines or transformers carries any known health risks.[39]

The acoustic noise produced by transmission lines is greater with high voltage power lines (400-800 kilo volts [kV]) and even greater with ultra-high voltage lines (1000 kV and higher)[40]. Noise from transmission lines reaches its maximum during periods of precipitation, including rain, sleet, snow or hail, or as the result of fog. The sound of rain typically masks the increase in noise produced by the transmission lines, but during other forms of precipitation (e.g. snow and sleet) and fog, the noise from overhead power lines can be troubling to nearby residents.

Measures to mitigate this impact may be addressed during project planning stages to locate rights-of-way away from human receptors, to the extent possible. Use of noise barriers or noise canceling acoustic devices should be considered as necessary.

Aircraft Navigation Safety

Power transmission towers, if located near an airport or known flight paths, can impact aircraft safety directly through collision or indirectly through radar interference. Aircraft collision impacts may be mitigated by:

- Avoiding the siting of transmission lines and towers close to airports and outside of known flight path envelopes;
- Consultation with regulatory air traffic authorities prior to installation;
- Adherence to regional or national air traffic safety regulations;
- Use of buried lines when installation is required in flight sensitive areas.

[39] WHO (1998)
[40] Gerasimov (2003)

2.0 Performance Indicators and Monitoring

2.1 Environment

Emissions and Effluent Guidelines

The power transmission and distribution sector does not typically give rise to significant air emissions or effluents. Where dust or potentially contaminated water runoff exists, site operations should comply with principles and guidelines described in the **General EHS Guidelines** to meet ambient air and surface water guidelines. Table 1 lists exposure limits for general public exposure to electric and magnetic fields published by the International Commission on Non-Ionizing Radiation Protection (ICNIRP).

Table 1. ICNIRP exposure limits for general public exposure to electric and magnetic fields.

Frequency	Electric Field (V/m)	Magnetic Field (μT)
50 Hz	5000	100
60 Hz	4150	83

Source: ICNIRP (1998) : "Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz).

Environmental Monitoring

Environmental monitoring programs for this sector should be implemented to address all activities that have been identified to have potentially significant impacts on the environment during normal operations and upset conditions. Environmental monitoring activities should be based on direct or indirect indicators of emissions, effluents, and resource use applicable to the particular project. Monitoring frequency should be sufficient to provide representative data for the parameter being monitored.

Monitoring should be conducted by trained individuals following monitoring and record-keeping procedures and using properly calibrated and maintained equipment. Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken. Additional guidance on applicable sampling and analytical methods for emissions and effluents is provided in the **General EHS Guidelines**.

2.2 Occupational Health and Safety

Occupational Health and Safety Guidelines

Occupational health and safety performance should be evaluated against internationally published exposure guidelines, of which examples include the Threshold Limit Value (TLV®) occupational exposure guidelines and Biological Exposure Indices (BEIs®) published by American Conference of Governmental Industrial Hygienists (ACGIH),[41] the Pocket Guide to Chemical Hazards published by the United States National Institute for Occupational Health and Safety (NIOSH),[42] Permissible Exposure Limits (PELs) published by the Occupational Safety and Health Administration of the United States (OSHA),[43] Indicative Occupational Exposure Limit Values published by European Union member states,[44] or other similar sources.

Additional indicators specifically applicable to electric power transmission and distribution activities include the minimum safe working distances for trained employees listed in Table 2 and the ICNIRP exposure limits for occupational exposure to electric and magnetic fields listed in Table 3.

Table 2. Alternating Current - Minimum Working Distances for Trained Employees[a]

Voltage Range (phase to phase – Kilovolts)	Minimum Working and Clear Hot Stick Distance (meters)
2.1 to 15	0.6
15.1 to 35	0.71
35.1 to 46	0.76
46.1 to 72.5	0.91
72.6 to 121	1.01
138 to 145	1.06
161 to 169	1.11
230 to 242	1.5
345 to 362	2.13[b]
500 to 552	3.35[b]
700 to 765	4.5[b]

[a] OSHA

[b] NOTE: From 345-362 kv., 500-552 kv., and 700-765 kv., the minimum working distance and the minimum clear hot stick distance may be reduced provided that such distances are not less than the shortest distance between the energized part and a grounded surface.

Table 3. ICNIRP exposure limits for occupational exposure to electric and magnetic fields.

Frequency	Electric Field (V/m)	Magnetic Field (μT)
50 Hz	10,000	500
60 Hz	8300	415

Source: ICNIRP (1998) : "Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz)

Accident and Fatality Rates

Projects should try to reduce the number of accidents among project workers (whether directly employed or subcontracted) to a rate of zero, especially accidents that could result in lost work time, different levels of disability, or even fatalities. Facility rates may be benchmarked against the performance of facilities in this sector in developed countries through consultation with

[41] Available at: http://www.acgih.org/TLV/ and http://www.acgih.org/store/
[42] Available at: http://www.cdc.gov/niosh/npg/
[43] Available at: http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9992
[44] Available at: http://europe.osha.eu.int/good_practice/risks/ds/oel/

published sources (e.g. US Bureau of Labor Statistics and UK Health and Safety Executive)[45].

Occupational Health and Safety Monitoring

The working environment should be occupational hazards relevant to the specific project. Monitoring should be designed and implemented by accredited professionals[46] as part of an occupational health and safety monitoring program. Facilities should also maintain a record of occupational accidents and diseases and dangerous occurrences and accidents. Additional guidance on occupational health and safety monitoring programs is provided in the **General EHS Guidelines**.

[45] Available at: http://www.bls.gov/iif/ and http://www.hse.gov.uk/statistics/index.htm
[46] Accredited professionals may include Certified Industrial Hygienists, Registered Occupational Hygienists, or Certified Safety Professionals or their equivalent.

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Annex A: General Description of Industry Activities

Electric power transmission is the bulk transfer of electricity from one place to another. Typically, power transmission occurs between a power generation facility and a substation located in close proximity to consumers. Power distribution refers to the delivery of electricity from a substation to consumers located in residential, commercial, and industrial areas.

Due to the large amount of power involved, transmission-level voltages are generally considered those above 110 kilo volts (kV). Voltages between 110 kV and 33 kV are typically considered sub-transmission voltages, but are occasionally used for long transmission systems with light loads. Voltages of less than 33 kV are representative of distribution projects.

Electric power transmission and distribution systems are often located in conjunction with highway, road, and other rights-of-way to minimize both costs and disturbance to ecological, socio-economic and cultural resources. Other factors, including land value, view sheds, archaeological resources, geotechnical hazards, accessibility, parks and other important features also contribute to the locating of transmission and distribution line right-of-way alignments.

Project development and construction activities typically include access road construction or upgrade, site preparation and development, removal of select vegetation, if any, and the grading and excavation of soils for the installation of structural foundations and site utilities. These activities are typical of industrial development projects and depend upon a number of factors, including topography, hydrology, and desired site layout, among others. Activities generally associated with the development and construction of power transmission and distribution include land clearing for transmission line rights-of way, access road construction or upgrade, equipment staging areas, substation construction and / or upgrade, site preparation, and installation of transmission line components (e.g. transmission towers and substations, access and maintenance roads).

Operational activities may include maintenance of access to the transmission lines, towers and substations (e.g. low-impact trails or new / improved access roads) and vegetation management. Upgrades and maintenance for existing infrastructure are a consideration throughout the life cycle of the project.

Power transmission and distribution facilities are decommissioned when they are obsolete, damaged (e.g. by corrosion) or replaced due to increased power demand. Many power facilities are replaced with new or updated equipment at the same site or right-of-way. Decommissioning activities depend on the proposed subsequent use of the site, environmental sensitivities (e.g. natural grasslands) and the project specifics (e.g. aboveground or underground power lines). Activities may include demolition and removal of the installed infrastructure (e.g. transmission towers, substations, aboveground and underground utilities and road decommissioning) and reclamation of the project site, including ground stabilization and re-vegetation.

The following sections provide a description of the facilities and activities associated with the construction and operation of power transmission and distribution projects. Facilities and activities common to transmission and distribution projects, including right-of-way management and substations, are outlined below as well as facilities unique to transmission and distribution systems, including towers and utility poles. Typical components of a power transmission and distribution project are illustrated in Figure A-1.

Power Transmission Systems

The electric power transmission system is often referred to as a grid. Redundant paths and lines are provided so that power can be routed from any generation facility to any customer area through a variety of routes, based on the economics of the transmission path and the cost of power. The redundant paths and lines also allow power flow to be rerouted during planned maintenance and outages due to weather or accidents.

Power transmission occurs via a system of aboveground power lines and towers located between a power plant and a substation. When crossing a dense residential area is necessary, transmission and distribution systems can also be buried within underground conduits. Though the transmission efficiency is typically lower for underground lines and installation and maintenance are costly, locating the transmission system underground reduces impacts on land values, visual aesthetics, and vegetation loss. Submarine cables placed on the ocean floor by cable-laying boats are also occasionally used to transmit high-voltage power across long stretches of water to islands and other locations that are inaccessible by conventional techniques. Submarine cables are typically self-contained and fluid-filled to provide insulation over long distances.

Regional transmission grids consist of several large transmission systems connected by substations that are designed to transport electricity as efficiently as possible. Transmission networks can cover thousands of kilometers and encompass tens of thousands of towers. Energy is typically transmitted using a three-phase alternating current (AC) that is more efficient than a single phase. Energy is generally produced at low voltage (up to 30 kV) at a generating facility and then stepped up by a power station transformer to a higher voltage in order to reduce resistance and reduce the percentage of energy lost during transmission over a long distance. For long distance transmission, electricity is usually transmitted at voltages between 110 and 1200 kV. At extremely high voltages, such as those over 2000 kV, corona discharge[47] energy losses associated with charged conductors can offset benefits of reductions in energy losses from reduced resistance. Over long distances, energy can also be transmitted via High Voltage Direct Current (HVDC). In these instances, smaller losses in energy and lower construction costs offset the need to construct conversion stations at each end of the transmission line to convert the direct current to alternating current for use in distribution systems.

Transmission towers or pylons are utilized to suspend high-voltage overhead power lines. These systems usually transmit three-phase electric power (the common method for transmission of high-voltage lines of over 50 kV) and, therefore, are designed to carry three (or multiples of three) conductors. One or two ground conductors are often added at the top of each tower for lightning protection. Transmission towers can be constructed from steel, concrete, aluminum, wood and reinforced plastic. The wire conductors on high-voltage lines are generally constructed of aluminum, or aluminum reinforced with steel strands. Each transmission tower or support structure must be constructed to support the load imposed on it by the conductors. As a result, foundations for transmission towers can be large and costly, particularly in areas where ground conditions are poor such as in wetlands. Guy wires can be utilized to stabilize transmission towers and resist some of the force of the conductors.

There are three main types of transmission powers or pylons used in a transmission system. Suspension towers support straight stretches of a transmission line. Deviation towers are

[47] A corona discharge is an electrical discharge resulting from the ionization of the air around the conductor, generally generating power losses and ambient noise.

located at points where a transmission line changes direction. Terminal towers are located at the end of overhead transmission lines where they connect with substations or underground cables.

The most common type of transmission tower or pylon used for high-voltage power lines is a steel lattice structure. Tubular steel monopoles are also used to support high or medium voltage transmission lines, usually in urban areas. Transmission towers constructed of a steel framework can be used to support lines of all voltages, but they are most often used for voltages over 50 kV. Lattice towers can be assembled on the ground and erected by cable (which uses a large laydown area), erected by crane, or, in inaccessible areas, by helicopter. Transmission towers typically range from approximately 15 to 55 meters (m) in height.[48]

Wooden transmission towers consisting of single poles, H-frames, or shapes resembling A's or V's are also commonly used to support high-voltage transmission lines. Wooden transmission towers are limited by the height of available trees (approximately 30m), and generally carry voltages of between 23 kV and 230 kV, lower than those carried by steel lattice transmission towers[49]. Aluminum towers are often used in remote areas where they can be transported in and installed by helicopter. Towers of reinforced plastic are now available, but high costs currently restrict their use.

For underground transmission lines, the three wires used to transmit the three-phase power must be located in individual pipes or conduits. These pipes are covered in thermal concrete and surrounded in thermal backfill materials. Underground cable conduit systems typically require trenches of at least 1.5m in depth and width. Due to difficulties in dissipating heat, underground conduits are typically not used for high-voltage transmission lines over 350 kV.[50]

Power Distribution Systems

Prior to consumer use, high-voltage energy is stepped down to a lower voltage aboveground line for use in sub-transmission or distribution systems. Distribution lines typically vary from 2.5 to 25 kV. Finally, the energy is transformed to low voltage at the point of residential or commercial use. This voltage ranges between 100 and 600 volts (V) depending on country and customer requirements. Power distribution poles (or utility or telephone poles) are typically constructed of wood, but steel, concrete, aluminum and fiberglass are also used. Distribution poles are typically spaced no further than 60m apart and are at least 12m in height[51]. Wooden distribution poles are limited by the height of available trees (approximately 30m).

Electrical Substations

Electrical substations are stations along the electricity transmission and distribution system that transform voltage from low to high or high to low using transformers. Step-up transformers are used to increase voltage while decreasing current, while step-down transformers are used to decrease voltage while increasing current. Substations typically consist of one or more transformers, as well as switching, control, and protection equipment. Substations can be located in fenced enclosures, underground, or inside buildings.

There are two main types of electrical substations. Transmission substations contain high-voltage switches used to connect together high-voltage transmission lines or to allow specific

[48] United Kingdom Parliament (2001)
[49] Great River Energy (2006)
[50] American Transmission Company (2005)
[51] United States of America Department of Defense (2004)

systems to be isolated for maintenance. Distribution substations are used to transfer power from the transmission system to the distribution system. Typically at least two transmission or sub-transmission lines enter a distribution substation, where their voltage is reduced to a value suitable for local consumption. Distribution substations can also be used to isolate faults in either the transmission or distribution systems. Complicated distribution substations containing high-voltage switching, switching, and backup systems are often located within large urban centers.

Rights-of-Way Management

Both aboveground transmission and distribution projects require rights-of-way to protect the system from windfall, contact with trees and branches, and other potential hazards that may result in damage to the system, power failures, or forest fires. Rights-of-way are also utilized to access, service, and inspect transmission and distribution systems. Underground distribution lines also require rights-of-way where excavation is prohibited or strictly monitored, construction activity is limited, and access to lines can be achieved if necessary. Being larger systems transmitting higher voltages, transmission rights-of-way are typically much larger than those for distribution systems and, consequently, require more extensive management.

Right-of-ways widths[52] for transmission lines range from 15 to 100m depending on voltage and proximity to other rights-of-way (typical range is between 15 and 30m)[53]. For overhead distribution power lines up to 35 kV, 12 to 24m corridors (6 to 12m on each side) are recommended[54]. Access roads are often constructed in conjunction, or within, transmission line rights-of-way to provide access for maintenance and upkeep of the system.

To avoid disruption to overhead power lines and towers, regular maintenance of vegetation within the rights-of-way is required. Unchecked growth of tall trees and accumulation of vegetation within rights-of-way can result in a number of impacts including power outages through contact of branches and trees with transmission lines and towers; ignition of forest and brush fires; corrosion of steel equipment; blocking of equipment access; and interference with critical grounding equipment.

Regular maintenance and clearing of rights-of-way prevents natural forest succession and the establishment and growth of tall trees. Typically, tall trees of approximately 4.5m or more are not permitted within aboveground rights-of-way.[55] Underground rights-of-way have far fewer vegetation restrictions, though trees with deep tap roots that may interfere with duct banks are usually prohibited from being grown within the right-of-way. Vegetation maintenance of rights-of-way can be accomplished with the following measures.

Mowing with heavy-duty power equipment is used to control growth of ground covers and prevent the establishment of trees and shrubs in the right-of-way. Herbicides, in combination with mowing, control fast-growing weedy species that have a potential to mature to heights over those permitted within the right-of-way. Trimming and pruning is utilized at the boundaries of rights-of-way to maintain corridor breadth and prevent the encroachment of tree branches. Hand removal or removal of vegetation is costly and time-consuming but is often used in the vicinity of structures, streams, fences, and other obstructions making the use of machinery difficult or dangerous.

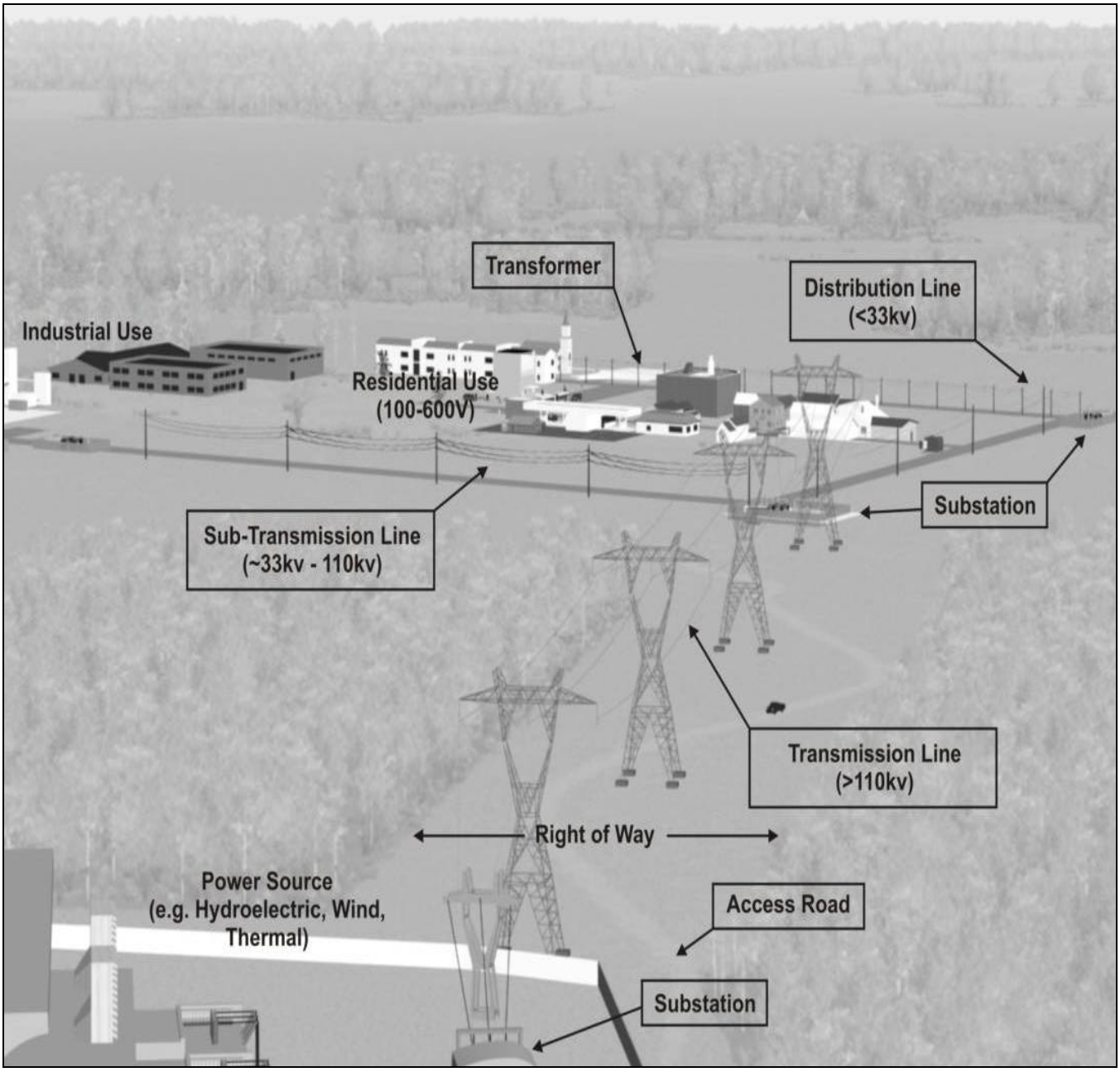
[52] For example, Duke Energy prescribes 21-meter minimum rights-of-way for voltages between 44 and 100 kV, 46-meter minimum rights-of-way for voltages of 230 kV, and 61-meter minimum rights-of-way for voltages of 525 kV (Duke Energy, 2006).

[53] Santee Cooper (2002)

[54] United States of America Department of National Defense (2004)

[55] Georgia Power (2006)

Figure A-1: Electric Power Transmission and Distribution



Annex H

IUCN Red Data Categories and Criteria

Appendix II

IUCN Categories and Criteria for Red Data List

Version 3.1 (2001)

THE CATEGORIES

EXTINCT (EX)

A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

EXTINCT IN THE WILD (EW)

A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

CRITICALLY ENDANGERED (CR)

A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section V), and it is therefore considered to be facing an extremely high risk of extinction in the wild.

ENDANGERED (EN)

A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V), and it is therefore considered to be facing a very high risk of extinction in the wild.

VULNERABLE (VU)

A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Section V), and it is therefore considered to be facing a high risk of extinction in the wild.

NEAR THREATENED (NT)

A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

LEAST CONCERN (LC)

A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

DATA DEFICIENT (DD)

A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

NOT EVALUATED (NE)

A taxon is Not Evaluated when it is has not yet been evaluated against the criteria.

THE CRITERIA FOR CRITICALLY ENDANGERED, ENDANGERED AND VULNERABLE

CRITICALLY ENDANGERED (CR)

A taxon is Critically Endangered when the best available evidence indicates that it meets any of the following criteria (A to E), and it is therefore considered to be facing an extremely high risk of extinction in the wild:

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of >= 90% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are clearly reversible AND understood AND ceased, based on (and specifying) any of the following:

(a) direct observation

(b) an index of abundance appropriate to the taxon

(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

(d) actual or potential levels of exploitation

(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2. An observed, estimated, inferred or suspected population size reduction of >= 80% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

3. A population size reduction of >= 80%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.

4. An observed, estimated, inferred, projected or suspected population size reduction of >= 80% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:

1. Extent of occurrence estimated to be less than 100 km^2, and estimates indicating at least two of a-c:

a. Severely fragmented or known to exist at only a single location.

b. Continuing decline, observed, inferred or projected, in any of the following:

(i) extent of occurrence

(ii) area of occupancy

(iii) area, extent and/or quality of habitat

(iv) number of locations or subpopulations

(v) number of mature individuals.

c. Extreme fluctuations in any of the following:

(i) extent of occurrence

(ii) area of occupancy

(iii) number of locations or subpopulations

(iv) number of mature individuals.

2. Area of occupancy estimated to be less than 10 km^2, and estimates indicating at least two of a-c:

a. Severely fragmented or known to exist at only a single location.

b. Continuing decline, observed, inferred or projected, in any of the following:

(i) extent of occurrence

(ii) area of occupancy

(iii) area, extent and/or quality of habitat

(iv) number of locations or subpopulations

(v) number of mature individuals.

c. Extreme fluctuations in any of the following:

(i) extent of occurrence

(ii) area of occupancy

(iii) number of locations or subpopulations

(iv) number of mature individuals.

C. Population size estimated to number fewer than 250 mature individuals and either:

1. An estimated continuing decline of at least 25% within three years or one generation, whichever is longer, (up to a maximum of 100 years in the future) OR

2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a-b):

(a) Population structure in the form of one of the following:

(i) no subpopulation estimated to contain more than 50 mature individuals, OR

(ii) at least 90% of mature individuals in one subpopulation.

(b) Extreme fluctuations in number of mature individuals.

D. Population size estimated to number fewer than 50 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild is at least 50% within 10 years or three generations, whichever is the longer (up to a maximum of 100 years).

ENDANGERED (EN)

A taxon is Endangered when the best available evidence indicates that it meets any of the following criteria (A to E), and it is therefore considered to be facing a very high risk of extinction in the wild:

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of >= 70% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are clearly reversible AND understood AND ceased, based on (and specifying) any of the following:

(a) direct observation

(b) an index of abundance appropriate to the taxon

(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

(d) actual or potential levels of exploitation

(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2. An observed, estimated, inferred or suspected population size reduction of >= 50% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

3. A population size reduction of >=nbsp;50%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.

4. An observed, estimated, inferred, projected or suspected population size reduction of >= 50% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:

1. Extent of occurrence estimated to be less than 5000 km², and estimates indicating at least two of a-c:

a. Severely fragmented or known to exist at no more than five locations.

b. Continuing decline, observed, inferred or projected, in any of the following:

(i) extent of occurrence

(ii) area of occupancy

(iii) area, extent and/or quality of habitat

(iv) number of locations or subpopulations

(v) number of mature individuals.

c. Extreme fluctuations in any of the following:

(i) extent of occurrence

(ii) area of occupancy

(iii) number of locations or subpopulations

(iv) number of mature individuals.

2. Area of occupancy estimated to be less than 500 km^2, and estimates indicating at least two of a-c:

a. Severely fragmented or known to exist at no more than five locations.

b. Continuing decline, observed, inferred or projected, in any of the following:

(i) extent of occurrence

(ii) area of occupancy

(iii) area, extent and/or quality of habitat

(iv) number of locations or subpopulations

(v) number of mature individuals.

c. Extreme fluctuations in any of the following:

(i) extent of occurrence

(ii) area of occupancy

(iii) number of locations or subpopulations

(iv) number of mature individuals.

C. Population size estimated to number fewer than 2500 mature individuals and either:

1. An estimated continuing decline of at least 20% within five years or two generations, whichever is longer, (up to a maximum of 100 years in the future) OR

2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a-b):

(a) Population structure in the form of one of the following:

(i) no subpopulation estimated to contain more than 250 mature individuals, OR

(ii) at least 95% of mature individuals in one subpopulation.

(b) Extreme fluctuations in number of mature individuals.

D. Population size estimated to number fewer than 250 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild is at least 20% within 20 years or five generations, whichever is the longer (up to a maximum of 100 years).

VULNERABLE (VU)

A taxon is Vulnerable when the best available evidence indicates that it meets any of the following criteria (A to E), and it is therefore considered to be facing a high risk of extinction in the wild:

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of >= 50% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are: clearly reversible AND understood AND ceased, based on (and specifying) any of the following:

(a) direct observation

(b) an index of abundance appropriate to the taxon

(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

(d) actual or potential levels of exploitation

(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2. An observed, estimated, inferred or suspected population size reduction of >= 30% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

3. A population size reduction of >= 30%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.

4. An observed, estimated, inferred, projected or suspected population size reduction of >= 30% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:

1. Extent of occurrence estimated to be less than 20,000 km^2, and estimates indicating at least two of a-c:

a. Severely fragmented or known to exist at no more than 10 locations.

b. Continuing decline, observed, inferred or projected, in any of the following:

(i) extent of occurrence

(ii) area of occupancy

(iii) area, extent and/or quality of habitat

(iv) number of locations or subpopulations

(v) number of mature individuals.

c. Extreme fluctuations in any of the following:

(i) extent of occurrence

(ii) area of occupancy

(iii) number of locations or subpopulations

(iv) number of mature individuals.

2. Area of occupancy estimated to be less than 2000 km^2, and estimates indicating at least two of a-c:

a. Severely fragmented or known to exist at no more than 10 locations.

b. Continuing decline, observed, inferred or projected, in any of the following:

(i) extent of occurrence

(ii) area of occupancy

(iii) area, extent and/or quality of habitat

(iv) number of locations or subpopulations

(v) number of mature individuals.

c. Extreme fluctuations in any of the following:

(i) extent of occurrence

(ii) area of occupancy

(iii) number of locations or subpopulations

(iv) number of mature individuals.

C. Population size estimated to number fewer than 10,000 mature individuals and either:

1. An estimated continuing decline of at least 10% within 10 years or three generations, whichever is longer, (up to a maximum of 100 years in the future) OR

2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a-b):

(a) Population structure in the form of one of the following:

(i) no subpopulation estimated to contain more than 1000 mature individuals, OR

(ii) all mature individuals are in one subpopulation.

(b) Extreme fluctuations in number of mature individuals.

D. Population very small or restricted in the form of either of the following:

1. Population size estimated to number fewer than 1000 mature individuals.

2. Population with a very restricted area of occupancy (typically less than 20 km^2) or number of locations (typically five or fewer) such that it is prone to the effects of human activities or stochastic events within a very short time period in an uncertain future, and is thus capable of becoming Critically Endangered or even Extinct in a very short time period.

E. Quantitative analysis showing the probability of extinction in the wild is at least 10% within 100 years.

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THE CATEGORIES

EXTINCT (EX)

A taxon is Extinct when there is no reasonable doubt that the last individual has died.

EXTINCT IN THE WILD (EW)

A taxon is Extinct in the wild when it is known only to survive in cultivation, in captivity or as a naturalised population (or populations) well outside the past range. A taxon is presumed extinct in the wild when exhaustive surveys in known and/or expected habitat,

at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

CRITICALLY ENDANGERED (CR)

A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the criteria (A to E) as described below.

ENDANGERED (EN)

A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future, as defined by any of the criteria (A to E) as described below.

VULNERABLE (VU)

A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the criteria (A to E) as described below.

LOWER RISK (LR)

A taxon is Lower Risk when it has been evaluated, does not satisfy the criteria for any of the categories Critically Endangered, Endangered or Vulnerable. Taxa included in the Lower Risk category can be separated into three subcategories:

Conservation Dependent (cd). Taxa which are the focus of a continuing taxon-specific or habitat-specific conservation programme targeted towards the taxon in question, the cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years.

Near Threatened (nt). Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable.

Least Concern (lc). Taxa which do not qualify for Conservation Dependent or Near Threatened.

DATA DEFICIENT (DD)

A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution is lacking. Data Deficient is therefore not a category of threat or Lower Risk. Listing of taxa in this category indicates that more

information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and threatened status. If the range of a taxon is suspected to be relatively circumscribed, if a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

NOT EVALUATED (NE)

A taxon is Not Evaluated when it is has not yet been assessed against the criteria.

THE CRITERIA FOR CRITICALLY ENDANGERED, ENDANGERED AND VULNERABLE

CRITICALLY ENDANGERED (CR)

A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the following criteria (A to E):

A) Population reduction in the form of either of the following:

1) An observed, estimated, inferred or suspected reduction of at least 80% over the last 10 years or three generations, whichever is the longer, based on (and specifying) any of the following:

a) direct observation

b) an index of abundance appropriate for the taxon

c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

d) actual or potential levels of exploitation

e) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.

2) A reduction of at least 80%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer, based on (and specifying) any of (b), (c), (d) or (e) above.

B) Extent of occurrence estimated to be less than 100 km^2 or area of occupancy estimated to be less than 10 km^2, and estimates indicating any two of the following:

1) Severely fragmented or known to exist at only a single location.

2) Continuing decline, observed, inferred or projected, in any of the following:

a) extent of occurrence

b) area of occupancy

c) area, extent and/or quality of habitat

d) number of locations or subpopulations

e) number of mature individuals

3) Extreme fluctuations in any of the following:

a) extent of occurrence

b) area of occupancy

c) number of locations or subpopulations

d) number of mature individuals

C) Population estimated to number less than 250 mature individuals and either:

1) An estimated continuing decline of at least 25% within three years or one generation, whichever is longer or

2) A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either:

a) severely fragmented (i.e. no subpopulation estimated to contain more than 50 mature individuals)

b) all individuals are in a single subpopulation

D) Population estimated to number less than 50 mature individuals.

E) Quantitative analysis showing the probability of extinction in the wild is at least 50% within 10 years or three generations, whichever is the longer.

ENDANGERED (EN)

A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future, as defined by any of the following criteria (A to E):

A) Population reduction in the form of either of the following:

1) An observed, estimated, inferred or suspected reduction of at least 50% over the last 10 years or three generations, whichever is the longer, based on (and specifying) any of the following:

a) direct observation

b) an index of abundance appropriate for the taxon

c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

d) actual or potential levels of exploitation

e) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.

2) A reduction of at least 50%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer, based on (and specifying) any of (b), (c), (d), or (e) above.

B) Extent of occurrence estimated to be less than 5000 km^2 or area of occupancy estimated to be less than 500 km^2, and estimates indicating any two of the following:

1) Severely fragmented or known to exist at no more than five locations.

2) Continuing decline, inferred, observed or projected, in any of the following:

a) extent of occurrence

b) area of occupancy

c) area, extent and/or quality of habitat

d) number of locations or subpopulations

e) number of mature individuals

3) Extreme fluctuations in any of the following:

a) extent of occurrence

b) area of occupancy

c) number of locations or subpopulations

d) number of mature individuals

C) Population estimated to number less than 2500 mature individuals and either:

1) An estimated continuing decline of at least 20% within five years or two generations, whichever is longer, or

2) A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either:

a) severely fragmented (i.e. no subpopulation estimated to contain more than 250 mature individuals)

b) all individuals are in a single subpopulation.

D) Population estimated to number less than 250 mature individuals.

E) Quantitative analysis showing the probability of extinction in the wild is at least 20% within 20 years or five generations, whichever is the longer.

VULNERABLE (VU)

A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the following criteria (A to E):

A) Population reduction in the form of either of the following:

1) An observed, estimated, inferred or suspected reduction of at least 20% over the last 10 years or three generations, whichever is the longer, based on (and specifying) any of the following:

a) direct observation

b) an index of abundance appropriate for the taxon

c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

d) actual or potential levels of exploitation

e) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.

2) A reduction of at least 20%, projected or suspected to be met within the next ten years or three generations, whichever is the longer, based on (and specifying) any of (b), (c), (d) or (e) above.

B) Extent of occurrence estimated to be less than 20,000 km^2 or area of occupancy estimated to be less than 2000 km2, and estimates indicating any two of the following:

1) Severely fragmented or known to exist at no more than ten locations.

2) Continuing decline, inferred, observed or projected, in any of the following:

a) extent of occurrence

b) area of occupancy

c) area, extent and/or quality of habitaty

d) number of locations or subpopulations

e) number of mature individuals

3) Extreme fluctuations in any of the following:

a) extent of occurrence

b) area of occupancy

c) number of locations or subpopulations

d) number of mature individuals

C) Population estimated to number less than 10,000 mature individuals and either:

1) An estimated continuing decline of at least 10% within 10 years or three generations, whichever is longer, or

2) A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either:

a) severely fragmented (i.e. no subpopulation estimated to contain more than 1000 mature individuals)

b) all individuals are in a single subpopulation

D) Population very small or restricted in the form of either of the following:

1) Population estimated to number less than 1000 mature individuals.

2) Population is characterised by an acute restriction in its area of occupancy (typically less than 100 km2) or in the number of locations (typically less than five). Such a taxon would thus be prone to the effects of human activities (or stochastic events whose impact is increased by human activities) within a very short period of time in an unforeseeable future, and is thus capable of becoming Critically Endangered or even Extinct in a very short period.

E) Quantitative analysis showing the probability of extinction in the wild is at least 10% within 100 years.

Annex I

Brief CV's of the Team

I1 BRIEF CV'S OF THE TEAM MEMBERS

Table 1.1 Team members for EIA report

SN	Name	Brief details of Qualification and Experience
1.	Subir Gupta	Mr Gupta is presently the Managing Director of ERM India. He is a Chemical Engineer with more than 26 years of experience in Environmental, Health & Safety Management, Hazardous Waste Management, Site Investigation and Remediation, and Risk Assessment. He has completed over 250 EHS Audits, Risk Assessments and Environmental Assessments. He has led numerous projects on Site Investigation, Remediation, Hazardous and Solid Waste Management, EIAs, etc. His major clients include Shell, Cairn Energy, Hardy Oil, GE, American Home, Whirlpool Corporation, Coca Cola, Johnson & Johnson, Abbott Laboratories, ICI, Pfizer, Tata, Lafarge, Ministry of Environment and Forests, Government of India, the World Bank, IFC, etc. Over the last eleven years, ERM has emerged as the largest specialised EH&S consulting firm in India as well and now operates from two offices in India (New Delhi (Gurgaon) and Mumbai), in addition to several other project offices. , Subir Gupta has been Chief of Operations (India Office) for a multinational group SEET CECOBA ROCHER engaged in setting up Municipal Solid Waste Recycling/Conversion plants in India and other South Asian countries. Mr Gupta has earlier worked with Tata Risk Management Services (TRMS), a Division of Tata Sons, as Deputy General Manager, where he has been providing consultancy services in the areas of Environmental Risk Management, Health and Safety, and Hazardous Waste Management. Major studies undertaken include Environmental Audits, Health and Safety Audits, Hazardous Waste Management, Waste Management, Risk Assessment, HAZOP and HAZAN, Emergency Planning, and Area Disaster Management Planning. Prior to TRMS, he was working with Shriram Foods and Fertilizer Industries, New Delhi, in their Technology and Development Department. Mr Gupta is a certified Senior Lead Auditor for ERM's M&A Advisory Services. He is a member of the National Environment Committee of CII.

SN	Name	Brief details of Qualification and Experience
2.	Sushil Handa	Sushil is working as Technical Director with ERM India, New Delhi. He has 21 years of experience in the field of Environment, Health and Safety (EH&S) Compliance Auditing; Regulatory Reviews; Environmental Management of Industrial Operations; Independent Reviews of Environmental Assessments as per WB/IFC/EPFI requirements; Environmental Impact Assessment; Air Quality modelling; Environmental Permitting and Waste Management. He has received specialised training in Japan, Czech Republic, Germany, UK and India on EIA/EMP Appraisal/ Review (as per Indian and World Bank guidelines), EH&S compliance, M&A audits, EMS Audits under ISO 14000, Environmental Monitoring, Assessments of Industrial Pollution Abatement and Hazard Identification and Risk Analysis for Industries. He is a trained M&A and EMS auditor. At ERM India, he is involved in projects related to EIA, EH&S, M&A, Environmental Due Diligence, Air Quality Dispersion Modelling, EMS audits, Environmental Clearance Permitting. His work includes projects related to EIA, EH&S compliance audits, environmental site investigation Phase I and II EAs), M&A, Environmental Due Diligence and EMS Audits, Environmental Management and Industrial Pollution Control and Environmental Permitting. The major sector of his work includes Chemicals, Food and Beverage, Fertiliser, Road (infrastructure), Oil & Gas, Thermal and Hydroelectric Power, and Mining. He has worked on many funding and government agencies projects of World Bank, IFC, UNDP, MMRDA, Karnataka State Pollution Control Board – GTZ, Government of Bangladesh etc. and worked on projects for private sector clients like Cairn Energy, Essar Oil, Premier Oil-India, Shell, GE Capital, Lafarge, Coca Cola, Gillette, PPG, ICI, Warner Lambert, BTR, Prayon-Rupel, IOCL, Bhilwara Group, IBP, Pfizer, Brakes India, Kampsax, Sverdrup, Asian Paints etc. Prior to joining ERM, he worked with Siel Limited (erstwhile DCM Chemicals), a large industrial group, in the field of Environment, Health and Safety as Senior Executive.

SN	Name	Brief details of Qualification and Experience
3.	Neena Singh	Ms Neena Singh is presently a Partner with ERM India, and heads the Social Development and Natural Resource Management Group. She has 15 years of experience in working in the field of social development and community mobilization and specializes in conducting social analysis studies and assessing social impacts and resettlement and rehabilitation. She has been working in ERM for 8.5 years. Prior to joining ERM she was associated with Centre for Science & Environment, an international environmental NGO, as a Policy Analyst and Programme Associate for Forestry and Conservation and Livelihood programmes. In that capacity she extensively researched and wrote on policy issues as well as on grass-root issues in CSE publications like Down to Earth. In ERM, she has extensive experience in carrying out social impact assessments, social due diligence, poverty and livelihood related studies as well as resettlement and rehabilitation studies and preparation of Rehabilitation Action Plans (RAP), in diverse sectors such as oil and gas, mining, infrastructure such as roads and power, agriculture, forestry and water and sanitation. She has also worked with local governments, both urban and rural, in the areas of utility and sector reforms, governance and capacity building/training in environmental and social management. She has worked in India, Bangladesh, Indonesia, Mongolia, Russia, Kazakhstan, Angola and Jordan, and was involved as a resettlement expert in a project in China. She was a Project Director for a Resettlement Audit of a 4- country gas pipeline project in Africa, funded by the World Bank. Ms. Singh has worked with local, state and central government, and a large number of donor agencies like the World Bank, IFC, ADB, DfID, ICEF, WSP-SA and UNICEF. Her key private sector clients include Rio Tinto, BHP Billiton, Alcoa, Gujarat Ambuja Cements, Lafarge, Chevron, BP, Shell and Cairn Energy among other private and multinational companies and Citigroup, Wachovia, Barclay, HSBC and IL & FS among financial institutions. In doing this she has been regularly using, and is very familiar with institutional policies corporate policies, guidance manuals and global commitments to social and environmental goals of such companies.

SN	Name	Brief details of Qualification and Experience
4.	Abhishek Singh	Mr Abhishek Singh is a postgraduate in social work and is presently working as Senior Consultant with the Social Development and Natural Resources Management Group of Environmental Resources Management (ERM) India Pvt. Ltd. He is skilled in conducting process documentation, monitoring and evaluations, socio-economic impact assessment surveys in areas that include resettlement and rehabilitation, water and sanitation, health, power, education, forestry, infrastructure, etc. He has also carried out social assessments/evaluations on the poverty-related issues that include literacy, public health, education, (at the micro level) and livelihood. He has extensive field experience in carrying out socio-economic research – baseline surveys, situation analysis, monitoring, evaluation and impact assessments in different states and region of the country. Through a variety of projects that he has carried out in rural and urban areas he has gained expertise in carrying out participatory research using PRA / PLA techniques. He has a sound knowledge of the rural sanitation and is well versed with the institutional set ups to promote water and sanitation. He has wide experience of working on issues relating to water and sanitation with focus on water usage and maintenance of water supply systems, their responsibility for maintenance, willingness to pay, women's involvement, people's perception of cleanliness, personal hygiene, household hygiene, household waste, human waste, latrines etc. He is responsible for project planning and management, execution and monitoring of projects related to social assessment. Mr. Singh has carried out extensive projects in Nepal and Bangladesh. Mr. Singh has worked with local, state and central government and a large number of donor agencies like the World Bank, DFID, WSP-SA and UNICEF. His key private sector clients include Shell; Cairn Energy; BHP Bilton; Rio-Tinto, Gujrat Ambuja; Bhilwara Group among other private and multinational companies and financial institutions. In doing this he has been regularly using, and is very familiar with corporate policies, guidance manuals and global commitments to social and environmental goals of such companies.

SN	Name	Brief details of Qualification and Experience
5.	Ajay Pillai	Ajay is working as a Senior Consultant with ERM India. He have more than seven years of experience in the fields of environmental impact assessment, water resource assessment, social and health impact assessment, rural capacity building and environmental auditing. He had carried out more than forty (40) projects in Environmental Impact Assessments, Water Resource Management and Social Assessments. He had successfully completed projects on: 1) Environment Impact Assessment studies for ▪ Oil & Gas sector (Seismic survey, Exploratory drilling, Well development & expansion); ▪ Industry Sector (Food processing, Electronics, Foundry, Cigarette, etc) ▪ Construction (Industrial expansion, Shopping Mall, etc) ▪ Linear Project (Pipeline) 2) Water Resource Management ▪ Rural and urban water supply management, ▪ Lake management, ▪ River quality monitoring and ▪ Watershed development. ▪ Water Audit 3) Social Assessment ▪ Social Surveys ▪ Capacity building The range of responsibilities varied from project implementation, co-ordination and development to trouble shooting.

SN	Name	Brief details of Qualification and Experience
6.	Rutuja Tendolkar	Rutuja Tendolkar is an Assistant Consultant at ERM India Pvt Limited, in the Mumbai regional office, with the Social Development and Natural Resources Management Group. She is a fresh graduate in Economics and Statistics and has previous experience with knowledge management in the Internal Audit department of PricewaterhouseCoopers. During her work, she has gained experience in understanding and adhering to international donor agency guidelines on social issues (IFC performance standards, the Equator Principles etc) and has worked on projects funded by donor agencies such as the World Bank. She has also obtained exposure to the corporate sector and has carried out several assignments ranging from impact assessments, management of social issues in facility/ plant operations, third party audits, social due diligence and compliance audits on industry and labour standards for Mergers& Acquisitions etc. In addition to her core expertise, she has also been involved with the Mergers & Acquisitions team in ERM. Her specific experience includes due diligence assessments & audits (Phase I Environment Site Assessments as per ASTM) and EH&S compliance audits for private sector clients.
7.	Rajat Singhal	Mr. Rajat P Singhal is a Consultant with ERM, India. He holds a Master's degree in Environmental Engineering with a Bachelor's in Chemical Engineering and had been managing Environment, Health and Safety (EHS) aspects for non-ferrous metal, chemicals, fertilizer and petrochemical sectors since past 6 years under various capacities ranging from external consultant to acting as EHS Head. In his previous assignment Rajat was handling EIA reports, EMS system review and modification, Process Hazard Analysis (HAZOP & RA) and LDAR study for Petroleum terminals, Cement, Galvanizing and Chemical Industries in Middle East Countries.

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