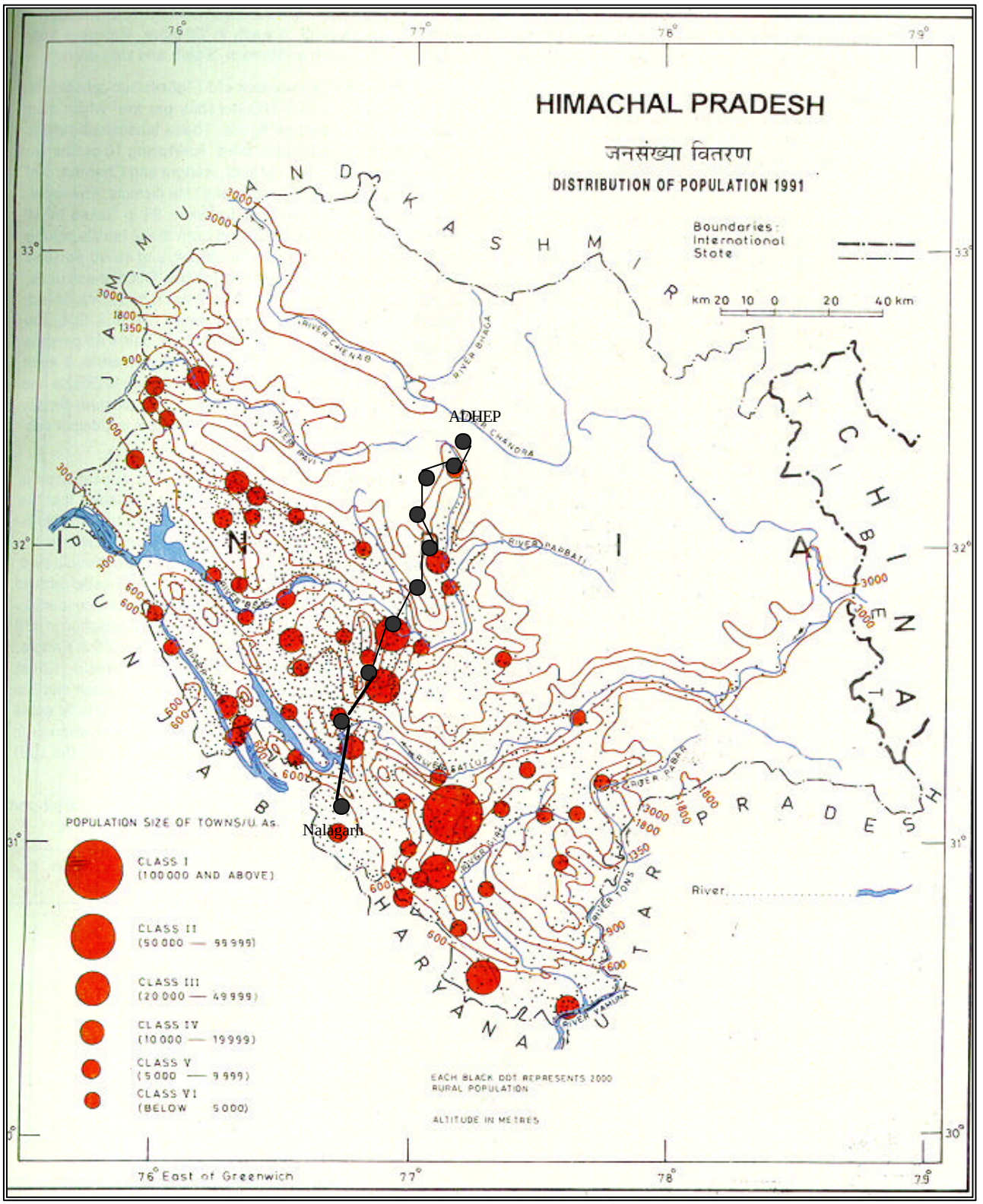
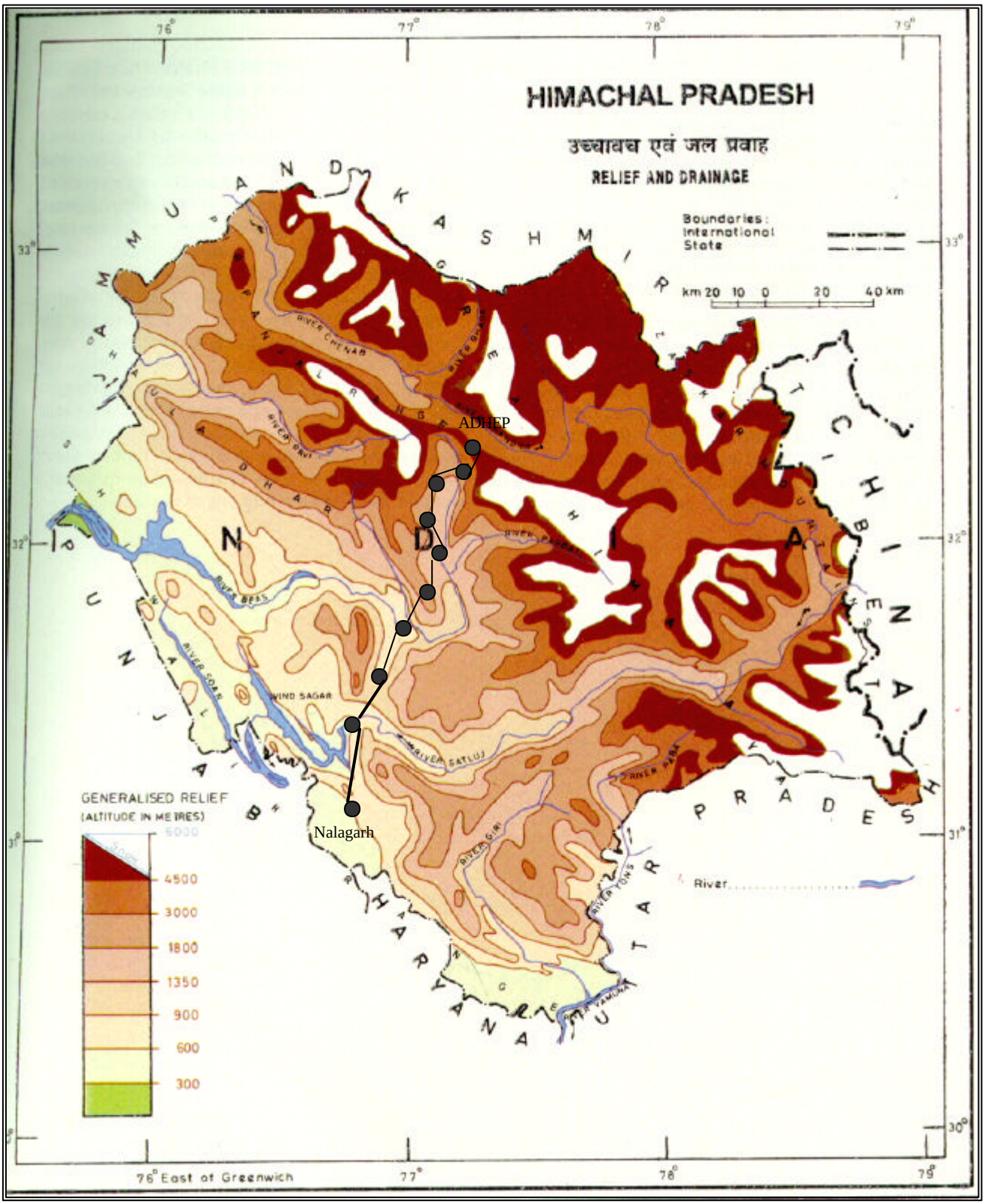


Proposed Route of Transmission Line



Proposed Route of Transmission Line

area among the four districts out of the total state area. It also has maximum area under forests . Kullu shows no areas under forests or permanent pastures because this data has not been compiled and is currently unavailable.

Table 3.7 Land Utilisation (%)

State /District	Total area	Area under Forest	Barren & Uncultu rable Land	Non-Agricult ure Land	Perman ent Pasture s & other Grazing land	Land under Misc. Trees & Groove s	Cultura ble waste	Other Fallow Land	Cultiva ble Areas
Bilaspur	2.5	10.8	5.6	10.5	40.6	.1	4.2	1.2	27
Kullu	1.1	0	2.4	11.9	0	.7	6.6	.4	78
Mandi	8.8	43.8	6.1	0	24.5	.1	1.1	.2	24.2
Solan	4.0	11.2	7.8	5.3	43.6	.3	6.6	.9	24.3
Himachal Pradesh		24.11	19.99	5.15	32.91	1.48	2.37	0.61	13.38

Source: Districts in Figures, Department of Economics and Statistics Himachal Pradesh, 2001

Cultivable area is high in Kullu, this may be due to unavailability of other data followed by Bilaspur. Barren and uncultivable land is highest in Solan followed by Mandi.

In Mandi forests play a vital role in the life of people and in the economy providing timber, fuel wood, medicinal herbs, raw materials. Deodar, Chil, Fir are the important species of trees here there are six forest divisions in the district namely Mandi, Jogindar nagar, Nachan, Suket, Sundernagar, Karsog. Cultivation is possible in Mandi only in small holdings in the deep valleys or the river basins. It is only in Balh and Chauntra valleys that the land is flat and fertile and cultivation of cereals is extensively carried out.

The forests of Bilaspur district can be divided into three broad categories Chil forests, Scrub Jungle and Bamboo forests. Sheesham and Tun are the important trees here while the marketable forest produce include timber, bamboo, resin , catechu.

Although the forest area has not been measured in Kullu *the District Census Handbook ,1991* reports that forests are very important to the district's economy. Extensive tracts of forests exist that are rich in medicinal herbs, mushrooms, wild olives, mulberry, Deodar trees, Kail and Walnut trees, Spruce, Silver fir etc.

3.1.8 Agriculture

Agriculture is the mainstay of the economy in all the four districts. Mandi district as per the *District Census Handbook, 1991* is deficient in cereal production and Balh valley in Sundarnagar block and Sandhol area of Dharampur block are the only major areas producing cereals. The main cash crops of the district are potato, other off season vegetables and ginger.

In Kullu district the agro climatic conditions provide a lot of potential for growing cash crops and the main ones are seed potatoes, off season vegetables,

cereals, millets, etc. The holdings here are small and cultivation is done using orthodox techniques of farming. Kullu has a large production of temperate and sub tropical fruits like apples, peach, apricot, olives, gooseberries etc.

In Bilaspur district due to its agro-climatic features Horticulture production is good. The district falls in the sub tropical zone and fruits like Mango, Litchi, Plum, Pear is grown. *(Source: District Census Handbook Bilaspur, 1991)*

The main crops of Solan district is maize, wheat , rice, pulses and cash crops include sugarcane and potato. Agriculture is mostly rain fed and as per the *District Census Handbook, 1991* for agricultural classification the district may be divided into three distinct regions valley area of (I)Nalagrah, Saproon and Kunihar, (II)Mid hills and (III) higher hills of Solan, Kasauli and Kandaghat tahsils. The valley of Nalagarh and Kunihar is most suitable for growing cereal crops, potatoes, mangoes and citrus fruits. A large number of cultivators in this district are growing mushrooms for commercial purposes.

Fallow land is largest in Mandi among the four districts and so is the total cropped area. Bilaspur has a lower total cropped area but also relatively low fallow land.

Table 3.8 Classification of Agricultural Area

	Fallow land (in 000 ha.)			**Sown Area (in 000 ha)**		
District	Current Fallows	Other fallows	Total	Net sown area	Total cropped area	Area sown more than once
Bilaspur	1.2	1.6	2.8	30.8	59.4	28.6
Kullu	2.6	.2	2.8	36.6	63.1	26.5
Mandi	5.8	.3	6.1	91.1	163.6	72.5
Solan	4.9	.8	5.7	39.4	65.6	26.2
Himachal Pradesh	55.4	22.7	78.1	560.1	986.3	426.2

Source: Statistical Outline of Himachal Pradesh , 1999

Maximum area in the state is under wheat and maize production. Similarly in the four districts maximum area is under the production of wheat and maize. Area under potato farming is largest in Kullu district compared to the other three districts.

Table 3.9 Area under Major Crops 1998-99(ha)

District	**Rice**	**Maize**	**Wheat**	**Barley**	**Common millets**	**Other Cereals**	**Pulses**	**Sugar Cane**	**Potato**	**Onion**	**Tomato**	**Chillies**	**Ginger**	**Edible Oil Seeds**
Bilaspur	3.76	44.56	48.66	0.58	0.00	0.01	0.86	0.11	0.02	0.10	0.34	0.03	0.25	0.72
Kullu	3.28	30.88	45.98	6.60	0.20	1.30	5.91	0.00	1.96	0.24	0.38	0.30	0.00	1.19
Mandi	13.75	32.31	44.36	2.77	0.31	1.75	2.56	0.00	1.22	0.07	0.09	0.14	0.04	0.63
Solan	5.90	38.69	38.50	3.18	0.00	0.02	6.65	0.50	0.23	0.05	3.81	0.02	0.58	1.88
Himachal	9.33	34.20	43.14	3.04	1.21	0.71	3.85	0.38	1.57	0.10	0.47	0.11	0.21	1.68

Source: Districts in Figures, Department of Economics and Statistics Himachal Pradesh, 2001

Landholdings

Bilaspur and Solan have land holding size larger than the state average whereas Kullu and Mandi have very small size of holdings.

Table 3.10 Operational Holding and Area

District	Average size of holding (in Hect.)
Bilaspur	1.08
Kullu	**0.78**
Mandi	0.95
Solan	1.85
Himachal Pradesh	**1.16**

Source: Statistical Outline of Himachal Pradesh , 1999

4 TRANSMISSION LINE ROUTE DESCRIPTION

4.1 ROUTE DESCRIPTION

The transmission line traverses through four districts of Himachal namely Kullu, Mandi, Bilaspur and Solan . The corridor was traversed along a linear length to follow the proposed transmission line route and the physiographic features, land use patterns, kinds of habitations in and around the vicinity of the proposed transmission route was observed. Throughout the four districts the terrain was mainly mountainous and rocky terrain interspersed with open valleys. Terrace farming is mainly practised in these regions and there are hamlets and settlements and even small villages at very high altitudes.

The transmission line starts from Prini village of Manali Tehsil. The starting point is at a height of 1987 m (above sea level). It is proposed that the transmission line would pass over the hills maintaining similar height or as the terrain permits to avoid habitation and fields to the extent possible and the proposed ground clearance of the line is 15 metres. The total length of the line is about 185 kms upto its destination, a sub-station at Nallagarh, in district Solan, where it feeds into the National Grid.

4.1.1 *Stretch-A (Prini to Bajaura)*

The stretch of the transmission line from Prini to Bajaoura totals a length of around 65 km (on road) .The actual distance covered by the transmission line is expected to be less than the road distance measured within this stretch. This is because of the traversing of the lines at a relatively higher altitude, than the road.

The proposed transmission line starts from the switchyard on the banks of Allain stream, which is located in Prini village. It would then traverse over a high altitude region (in the range of around 1980 to 1985 m) parallel to the state highway connecting Manali and Nagar. The main villages through which the proposed route will initially traverse are Prini, Shuru, Jagatsukh, Gojra. Khakhnal and Sajla falling in Kullu district .

The route then passes through other villages namely Karja, Maripur, Sarsai, Chaki and Mari. A kilometre before the town of Nagar, which is a place of tourist interest and has a museum called Nagar museum, the proposed line would take a bend towards the southwest along the road and move towards the western banks of the Beas river.

During crossing over the Beas river from the eastern to the western bank, the transmission line would run near Katrain village. The route then passes over the villages Kojal, Dhobi, Raison, Baveli and then the town of Kullu and later the transmission line would pass through the villages of Mohal, Shamshi, Bhunthar, Sadabhai and Bajoura . An airport is located near the village Bhunthar falling within this stretch.

In the villages in the initial part of the route it was observed that the line would pass over apple orchards and terrace farms. The crops grown in this area are mainly rice, mustard and red beans. The line avoids the main settlements but there is a possibility that it may pass over some houses scattered over the hill. For instance near Baveli village there is a hamlet on higher regions of the hill that may fall under the line. A large section of the line is passing over forestland that varies from dense vegetation to treeless patches. There is also possibility of it passing over grazing and pastureland that were observed to be in abundance in the region. Approximately 6 river crossings were observed in the route, one near the village Jagatsukh and the other at Khagnal nala, Haripur Nala, Khojal Nala, Raison/ Shirdi Khad and a crossing near Bajaura

The river Beas has a North to South orientation in this region and the NH-21 runs almost parallel to the river, hence the transmission route mostly runs on the western side of these two important natural and man-made landmarks.

Table 4.1 Environmental and Social Profile of Stretch A

Parameter	Description
Climate	This stretch falls under Kullu district and has a cool and dry climate. This stretch receives moderate rainfall and bulk of it is received during the months of July, August, December and January. August is the wettest month throughout this stretch. Snowfall generally occurs in December and January at high elevations and the upper part of the stretch, especially that part of the transmission line lying on the eastern side of Beas river is covered with snow.
Geology	This stretch forms a transitional zone between the lesser and the greater Himalayas and presents a typical rugged mountainous terrain with moderate to high relief. The altitude varies in the range of 1800 to 3000m. The high reaches, where the transmission line is proposed to come up is bestowed with snow peaks and glaciers. The rivers that drain the area are the Beas and its tributaries. The rock types found in this stretch of the transmission line are phyllite, slate, quartzite limestone, schists and granites.
Forests	Extensive tracts of forests exist at the altitudes, the proposed transmission line is anticipated to be laid out. These forests are mostly dense and of similar type with snow at high altitudes. Deodar, Kail, Cheel, Walnut, Horse chestnut and oak are the classes of trees in these forest ranges. Tree growth is replaced by alpine pastures ascending to the limit of vegetation and snow line.
Important features	This stretch is full of thick vegetation (forests) except for a few patches near Karja village. These few patches consist of horticulture in the form of apple orchards. The stream crossings encountered are for the following streams: Duhangan stream. Khakhnal stream. Haripur stream and Chaki stream Besides, Nagar castle which is an historical place and has tourist importance is located on the path. However, the altitude at which this is located is much less than that planned for laying the transmission line. There is a bridge across the Beas connecting Nagar and Patlikuhl, which is an important crossing falling in the stretch. Besides, the stretch running near to the airport located in Bhunthar might need special consideration for laying the transmission line. The route has a proximity to Khokhan sanctuary. Main villages traversed on the route are Prini, Shuru, Jagatsukh, Gojra. Khakhnal Sajla etc. Cultivation on the route are mainly terrace farms and plenty of apple orchards. Rice , mustard, red beans are the main crops grown in the area

4.1.2 Stretch –B (Bajaura to Harabagh)

This stretch which is approximately 90 km passes through the district of Mandi in Himachal Pradesh. This stretch starting at Bajaura passes through mainly the villages of Nagwain, Takoli, Panarsa, Out, Thalout and Pandoh.

The first village that falls on the route of the transmission line in this stretch is Nagwain, where again the National Highway and the proposed transmission line are on the right bank of the Beas river. In Nagwain there are settlements on higher elevations and there is a possibility of the lines going over these settlements.

The next village is Takohli, along the highway and right on the foothills. Here the line would pass on higher regions of the hills at a height of 500 meters (approx.). The other villages/towns after that are Panasara, Aut, Thalot, Pandoh (town), Jagat and Baroda. Near Thalot, Largi Hydel Power project is under construction. An existing transmission line of the HPSEB is visible from this point onwards. This line is on the right bank at a height of 200 m on the hills. Pandoh is a small town that has developed due the presence of a dam (on the Beas river) and resultant increase in commercial activities. Around this town the proposed transmission line crosses over to the left bank of the river. The town is densely populated and spread over a wide area on the hills on both sides of the river. Just near the village Pandoh the transmission line would again cross over the river Beas and turn to the eastern side of the river. In the villages, further ahead, there are a few scattered houses, terrace farms and small patches of forests on the hills. Near Baroda village the hills are mostly barren, terrace farms and houses are sparsely scattered all over.

The next on the route is Mandi town from where the transmission line is almost parallel to the road on left bank of the river. The National Highway is on the right of the river. The villages that follow are Bhutkar, Chakkar and Lunapani, Ner Chowk (a small town famous for auto repair), Dhanaurta, Sundarnagar (town) and Harabagh. In this region the valley is about 2 kms wide and therefore the fields are larger. However the transmission line is proposed to pass on the hills so as to avoid passing through the fields and settlements. At Harabagh the hills are barren with small patches of forest on top and relatively free of settlements in the higher reaches. This place also has Mango plantation along the road. *(Ref photo documentation Annex A)*

Table 4.2 Environmental and Social Profile of Stretch B

Parameter	Description
Climate	This stretch falls under Mandi district and has varying climate according to the altitude of the place. The climate is mostly temperate. The areas in altitudes above 1300m does receive snowfall during the cold season. Summers are a bit excessively hot in the area falling under this stretch. Winter starts from the middle of November and continues till the middle of March. Thereafter the temperature starts rising till the onset of monsoon, which starts from last week of June or early July and continues till mid of September. This area receives rainfall higher than the state average.

Parameter	Description
Geology	This stretch lies partly on rocks belonging to the central Himalayan zone of unknown age and partly on tertiary shales and sand stone. The rocks consist of slates, conglomerates and Krol groups of the Shimla area. The sand stone and shales of the sub-himalayan zone belong to Sirmaur series of lower tertiary age, and to the Shivalik series. The rock formations can be classified into the sub-Himalayan series, comprised of tertiary rocks and the Himalayan series of unmetamorphosed sedimentary rocks and the metamorphic-cum-igneous rock of pre-tertiary age.
Forests	The tract of forests falling within this stretch was observed to have a mixed type of vegetation. Deodar, chir, Kail, silver fir etc are important species in the area. The other prominent trees found in the area are simbal, tun, mulberry, willow, popular oak, walnut and banboo. Forests are mostly scattered on the higher slopes only. Deodar forests are generally found at higher altitudes in this stretch Chir, oak forests are found at relatively lower altitudes in the area. Further lower areas are covered with bamboo and other bushes.
Important features	This stretch is spread over deep valleys and high elevations. The altitude of the mountain ranges observed on the route seemed to range between 1200 to 1500 m. The transmission line is proposed to move over these high elevations. Terraced cultivation observed in many parts of this stretch near human settlements and at low altitudes. Pandoh falling within this stretch of the route has a dam constructed over the Beas river for channelling of its water in a very long tunnel for augmenting the discharge of the Sutlej for feeding Bhakhra dam by the Beas-Sutlej Link Project. Besides, Prashar lake which is situated at about an altitude of 2700 m on this stretch has a significant historical and religious importance. The transmission route has proximity to Bandli sanctuary. Although most of the villages in this stretch are relatively free of settlements on higher elevations, certain locations like Nagwain have settlements on higher reaches

4.1.3 Stretch-C (Harabagh to Swarghat)

This stretch which is approximately 70 kms passes through the district of Bilaspur The first village on the route is Kango. The proposed line passes through the left bank and on the higher regions of the hills that do not have any tree cover. The existing transmission line is clearly visible from here *(Ref photo documentation Annex A)*

Next on the route is Kol Dam near Slapad village. There is a power generation facility and a sub-station here. This is followed by Barmana town, which is famous for the ACC cement factory. The town is densely populated but the main settlement is along the roadside. The route for the transmission line passes over the hills that are mostly barren. The next village Beri has well spread terrace farms and the hills are barren. There is some habitation over the hills that may fall under the transmission line *(Ref photo documentation Annex A)*.

After village Devli which is around 35 km from Harabagh, the transmission line would move over the town of Bilaspur, which is the district headquarters. Immediately after the Bilaspur town, at Padagal village, the transmission line would be about 15 kms away from the National Highway. The next on the route is Chhadol village that has large settlements, terrace farms spread almost upto hilltops and forests mostly covered with trees. Here the proposed route will cross over Gambhar bridge which is constructed on Gambhar river. Thereafter, the route proceeds towards Nalagarh, and moves away from NH-21

Table 4.3 Environmental and Social profile of Stretch C

Parameter	Description
Climate	This stretch falls under Bilaspur district and has a temperate to sub-tropical climate. The summers are invariably hot, temperatures rising to 42°C at some places and it falls down to 30°C soon after the monsoons. For about three months in winter, a thick mist surrounds the Sutlej. The hilly valleys are quite dry and hot in summer. In rainy season the humidity increases and the weather becomes hot and sultry.
Geology	This area of the stretch is covered by a comparatively younger strata representing the Tertiaries and Quaternary rocks. However, in the initial stretch older rocks belonging to earlier period are found. The older formations have thrust contact with the Tertiaries.
Forests	The tract of forests falling within this stretch are primarily of three types: (1) Chir forests. (2) Scrub jungle and (3) Bamboo forest. On the higher elevation ranging between 600 m to 1500 m, Chir forests are found. These forests grow on the tertiary sand rocks, while the scrub jungles contain a great many species of which the most important are Sheesham and Tun. These grow at low elevations, generally near the cultivated lands and most of them are also found on the banks of Sutlej river. The bamboo forests are found at an elevation ranging between 400 to 900 m.
Important features	The Dehar powerhouse of Northern power Grid is encountered in this stretch. Besides, electrical substation is located at village Barmana which also houses a cement plant. The route in this stretch traverses through important towns like Barmana, Bilaspur and in certain places like Chhadol village that has large settlements, terrace farms spread almost upto hilltops and on high elevations.

4.1.4 Stretch –D (Swarghat to Nalagarh)

The section of transmission line that passes from Solan district is away (more than 15 kms) from the National Highway. The transmission line route here is relatively small. The region is spread over valleys and higher elevations. Cultivation is possible only in small terraces in the hills or along the stream/khad in most parts through which the line crosses and the effects of the transmission route may be restricted to limited cultivable land. Most of the land is either under shrub forests or grassy lands with Kail and Deodar trees on high altitudes. The villages/ towns through or near the vicinity of the proposed route are Kiarghat, Bara, Banal, Punahla, Musewal, Pandal, Shahpur, Nandpur. The line reaches its destination here at Nallagarh, which is the sub-station feeding into the National grid.

Table 4.4 Environmental and Social profile of Stretch D

Parameter	Description
Climate	This stretch falls under Solan district with a moist temperate climate at higher altitudes and sub-tropical climate in the lower reaches. Due to significant variations in the altitude ranging between 500 to 800 m, the temperature varies considerably. Summers are very dry.
Geology	This area of the stretch is covered by formations containing rock fragments grouped as Blaini and they exhibit the striaten developed due to glacial abrasion in the past. .

Parameter	Description
Forests	Due to wide variation in altitude, depth and available soil moisture the vegetation met within the tract shows wide variation. Mixed deciduous (shrubs) mixed deciduous (Bamboo) and Chir pine type of forests occur in this area. Natural regeneration of all species is generally deficit because of biotic interferences. The main species under mixed deciduous forest (shrub) found are Chhal, Jhingon, Simla, Khair, Toon, Kachnar, Amaltas, etc. Under growth consists of Karaunda, Harshingar, Basuti, Mehndu. Mixed deciduous forests (shrub) occur upto 1000 m elevation.
Important features	Except the valley area, most of the land is either under shrub forests or grassy land with chir trees upto the height of 1500m. Swarghat is considered to be the entry point of Himachal Pradesh, from Chandigarh. The region is spread over valleys and higher elevations. Cultivation is possible only in small terraces in the hills or along the stream

Table 4.5 Environmental Features mapped across the proposed transmission line

S.No.	Parameter	Variation observed across the stretch
1.	Important landmarks	Dealt in the route description
2.	Soils	Variation in soil types is depicted on map 1
3.	Vegetation	Variation in vegetation cover is depicted on map 2
4.	Population distribution	Population distribution is depicted on map 3.
4.	Relief and drainage	Relief and drainage is depicted on map 4.

5 POTENTIAL ENVIRONMENTAL IMPACTS IDENTIFIED IN THE RECONNAISANCE SURVEY

This section presents the potential environmental impacts from the construction and operation of the transmission lines. The impacts have been identified based on the review of documents, scoping exercise done during the site visits, and interaction with RSWML officials. Brief description on the nature and assessment of impacts is presented below:

5.1 ENVIRONMENTAL ISSUES DUE TO PROJECT LOCATION AND DESIGN

Many of the issues relating to project location such as land value changes, resettlement, loss of productivity, etc are dealt as social impacts (*see next section*).

Historical/Cultural Monuments Value

Review of maps and the field visit by ERM indicates that there are two well known places of historical/cultural importance that might fall in the transmission line route. They are:

- Nagar Museum situated near the village Nagar (Stretch-A) and
- Parasar lake situated near village Thalout, which has a significant religious importance. (Stretch B)

Encroachment into Precious Ecological Areas

Review of maps and the field visit by ERM indicates that parts of the stretch of the route passes through areas, which are close to (and through) reserved forests. The transmission line has to cross roads, rivers and streams at points.

Encroachment into Other Valuable Lands

Review of maps and the field visit by ERM indicates that the route does not pass through other valuable land such as mineral deposit area or areas identified for residential/ commercial/ industrial developments. The route of the transmission line does not seem to pass through any densely inhabited areas. While selecting the route, care needs to be taken to avoid any homesteads. Hence, no impact is envisaged due to inadequate buffer zones for protection of adjacent properties/values. It is likely that it would have some minor impact on agricultural land.

Interference with Other Utilities and Traffic

Review of maps and the field visit by ERM indicates that the route does not involve any rail crossing. . However, a few road crossings across the NH-21 as well as the State Highways do exist. Some disruption of road traffic may be unavoidable during construction and maintenance. Since the transmission line is overhead no disruption of underground water supply and sewerage is envisaged.

Co-ordination with other state and central bodies is required for crossing over other utilities such as road and other power transmission lines in order to minimise disruption of services.

Interference with Drainage Pattern

The transmission line route would have around 4 to 5 river crossings. However, at the river crossing the horizontal clearance (the distance between the towers) will be greater than the maximum river width at high flood levels. 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 drainage pattern. Foundations will be dug to a sufficient depth, depending upon the tower type and soil characteristics. Foundation pits are backfilled by the excavated soils, which 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.

Escape of Polluting Materials

Construction of transmission lines does not involve generation of liquid wastes. Except for construction debris no other solid waste is generated. No chemicals are used for removal of vegetation or soil stabilisation.

Explosion/Fire/Hazardous Spills

Due to hilly terrain, excavation for foundation may involve use of explosives in certain areas. Further, depth of excavation foundation for towers would determine usage of explosives in exceptional cases. Chemicals are not expected to be used for vegetation removal.

Erosion Hazards due to Inadequate Provision for Resurfacing of Exposed Areas

In the construction of transmission lines erosion hazards can result from the activities related to foundation for towers. At the tower sites, all vegetation within the footprint of the tower base and for a distance of approximately 3-m beyond the base in all directions is cleared to ground level. However, excavation is limited to footing for individual tower leg. Further, erosion hazards can be minimised by undertaking construction activities during non-monsoon season (which is also preferred season due to availability of construction labour) and backfilling and compacting the foundation pits in accordance with good engineering practices.

Impairment of Aesthetics

The two main impacts due to construction of transmission lines are due to changes to the landscape resource and character due to introduction of manmade structures and visual intrusion and loss of visual amenity.
At over 5 places along the route the transmission line would cross either roads, and at over equal number of places it would cross other transmission lines. Construction of transmission lines would require cutting of trees. Further, trimming of trees will be required along RoW. As the transmission lines passes through cultivated lands significant cutting and/or trimming of trees would be required. This is bound to affect the landscape of the project area. Landscape

change in the areas where transmission line passes through forests, scenic spots is significant.

Noise/Vibration Nuisances

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*; The noise and vibration nuisance can be minimised in the populated areas by resorting to manual work instead of cranes and other heavy equipment, and undertaking construction activity only during daytime. The route being mostly hilly excavation in rock for tower foundation is envisaged. Hence, noise/vibration impacts from system design are envisaged.

Blockage of Wild Life Passageways

Review of maps and the field visit by ERM indicates that the route passes through reserved forest areas and might interact with the wildlife passageways, due to proximity of the route to Khokhan and Bandli sanctuaries.

Inadequate Provisions for Worker's Health and Safety

It is expected adequate provisions will be in place for addressing health and safety issues and protection measures for the transmission lines. It is envisaged that with adequate measures for workers' health and safety (such as drinking water, sanitation, etc) will be in place.

Electric shock hazards

In addition to safety measures incorporated in design, once the stringing work is complete, notices and permanent anti climbing devices are installed on the tower. The operational start date for electricity transmission and safety implications need to be publicised locally in advance. This can minimise the electric shock hazards.

Natural hazards risk

The project area lies in earthquake Zone IV and V. There is a risk of damage to the transmission system from naturally occurring events, which are outside the control of implementing agency such as extreme weather, earthquakes, *etc.* The design of the towers need to reduce the risk of damage from wind and seismic activities. Extreme weather conditions such as cyclone could affect the transmission line . Further, the risk from high wind speeds can be minimised using robust design. The other climatic effect could be that of variations in temperature. However, the design of the transmission lines incorporates temperature extremes thereby negating any residual impact.

Major Accident Hazards

The construction of the towers and stringing of the lines may pose an accident hazard to the general public. The risk involve falling members of the tower, lose strings, *etc.* However, these hazards can be minimised with proper barricading of the work area and advanced notification to the public regarding

start date of the construction activity along with safety implications. With these measures in place, no significant accident hazards are envisaged from the construction activities.

5.2 *ENVIRONMENTAL PROBLEMS DURING CONSTRUCTION PHASE*

Uncontrolled Silt Runoff

During construction activities, impact due to uncontrolled silt runoff is envisaged.

Inadequate Construction Stage Monitoring

RSWML is expected to employ contractors who have extensive experience in laying transmission lines. Further, it is expected that the construction agencies would be briefed on environmentally friendly methods of construction. With these precautions no significant environmental impact due inadequate construction stage monitoring is envisaged.

Nuisance to Nearby Properties (Dust, Waste, Traffic, Fumes, Fires, Explosion)

Dust from construction activities constitutes a form of air pollution, which will be the main impact on air quality. The other activities that are likely to form part of atmospheric emissions are exhausts from vehicles serving the construction activities. Dust nuisance can be controlled using dust suppression measures (such as sprinkling of water on dust generating areas), limiting the vehicular speed on unpaved roads, and covering vehicles carrying fine particulate matter.

During the construction of the towers, no impact on surface water and ground water resources is anticipated, unless storage of fuel or chemicals at the tower site is done.

The main type of waste likely to generate during construction activities is the construction debris. Any construction debris generated at the site will have to be removed from the site and site levelled as original. No significant environmental impacts are anticipated due to waste generation from the construction activities if good engineering practices are followed. Water requirement during construction phase is not envisaged to affect groundwater availability in the project area.

Construction activities such as excavation, concreting, tower erection, backfilling, use of pumps (for pumping excess water) and compressors, *etc*; might result in noise levels in surrounding areas. There might 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. Except for excavation in rock for tower foundation using explosives, no significant noise/vibration impacts from construction activities are envisaged.

Traffic movement during the construction is likely to be present. Vehicles carrying personnel and material will be deployed during the construction phase. However, increase in traffic over the existing density is not significant. Further any increase in traffic will be short lived.

Blockage of Wild Life Passageways

Review of maps and the field visit by ERM indicates that the route proposed might result in blockage of wildlife passageways / migratory pathways / migratory flight pathways. Due care needs to be taken in the corridors where the transmission lines passes in between two forest areas to avoid obstruction of wildlife passageways / migratory pathways / migratory flight pathways.

Interference with Utilities and Traffic and Blockage of Access Ways

The route of transmission line passes over road, river and other power transmission line crossings. Road traffic might be disturbed for a brief period at each location during the stringing process. This might have small impact. However, stringing needs to be co-ordinated properly with road authorities for minimising impact on road traffic.

Disruption of Flora

Impacts on flora will be present due to cutting of trees to provide for the RoW. Cutting of trees is essential to provide space for movement of vehicles, and maintain the required clearances. The impact on flora can be minimised in a number of ways including:

- Allowing regeneration of vegetation along the RoW;
- Allowing regeneration underneath the lines;
- Practising manual stringing operations;
- Using predominantly manual labour instead of heavy cranes and machinery for construction purposes;
- Replanting vegetation disrupted during construction; and
- Utilising existing roads to the extent feasible.

The above mitigation measures are over and above the design measures which incorporate an effective route design.

Protection of Workers Health and Safety

Adequate provisions for: housing/water supply/sanitation, communicable disease control provisions, especially malaria, provisions for protection against fires/explosions is envisaged.

Major Accident Hazards

During construction towers and transmission lines may present a potential hazard to the public. During construction and operation, physical injury can result from lines or towers/ tower members falling to the ground. Risks to general public can be reduced by public awareness campaign, education and

physical measures such as attaching an appropriate warning sign on all faces of the tower.

5.3 OPERATIONAL IMPACTS

Electro Magnetic Fields

There have been some concerns about possible increased risk of cancer from exposure to electromagnetic radiation from overhead transmission lines and research has been undertaken into this matter throughout the world.

A World Health Organisation (WHO) review also in 1996 held as part of the International EMF Project concluded that:

"From the current scientific literature there is no convincing evidence that exposure to RF [(1)] shortens the life span of humans or induces or promotes cancer".

No EMF exposure guidelines have been drawn in India though exposure guidelines have been drawn up outside India including:

- State Transmission Lines Standards and Guidelines in the USA;
- International Commission on Non-Ionizing Radiation Protection (ICNIRP);
- US National Council on Radiation; and
- American Conference on Government and Industrial Hygienist (ACGIH).

The ICNIRP guidelines present limiting exposure to EMFs, although it adds that the levels quoted should not be interpreted as distinguishing 'safe' from 'unsafe' EMF levels. The ICNIRP guideline for the general public (up to 24 hours a day) is a maximum exposure levels of 1,000 mG or 100 μT.

(1) Radiation Field

6 POTENTIAL SOCIAL IMPACTS IDENTIFIED IN THE RECONNAISANCE SURVEY

The preliminary assessment of the likely social impacts have been based on:

- reconnaissance survey of the area
- discussions with the clients

6.1 INITIAL ROUTE SELECTION

At the onset preliminary route selection as reported by the clients has been done to avoid large scale social impacts. It is proposed that the line be kept at an elevation of 1987 metres. The area is mostly mountainous forestlands and it is proposed that the towers be erected on the mountaintops, thus avoiding villages and agricultural fields. However the geography of the area is such that there are small village hamlets, settlements as well as fields (terrace farms) high above in the mountain areas where it is non forestland. While the proposed route will not involve loss of structures, or displacement or relocation of people, the lines may cross over some scattered settlements and cultivated land, pasture or grazing lands that are at a very high altitude. Similarly the towers may be constructed on agricultural lands and grazing area etc. on very high altitudes. In addition there may be some social impacts due to construction, erection of transmission line towers and stringing of overhead conductors.

The construction of the transmission towers may involve direct as well as indirect impacts, which are either short-term and/ or long term in nature. The following types of impacts are expected during the construction of the transmission lines.

6.2 POTENTIAL IMPACTS

The types of likely impacts due to construction of transmission lines have been summarised below.

- Land required for the erection of the towers
- Impact on productivity of land under the towers;
- Temporary crop losses during construction, erection and maintenance of the towers, and stringing of transmission lines
- Impact on, common property resources like grazing/ pasturelands etc.
- Impact on orchards and plantations
- Other impacts

The exact extent and nature of impacts along the route will be determined only when the route is finalised and route survey is completed and just before construction activities commence. At the time of the final route selection and exact tower spotting care should be taken to avoid such infringements as far as possible.

6.2.1 Land Required for the Erection of Tower

The towers in hilly regions are built on a base, that is each tower is constructed on a cemented platform that is 6m by 6m. Thus approximately a total area of 36 sq. m is required for constructing the towers. The plinth size may also vary depending on the type of tower in that case the total land required would also vary.

The direct and long term effect would be loss of the land on which the tower is constructed and while for the larger landholdings this may be a small impact but for the small landholdings even a $36m^2$ loss of land may be a significant impact.

6.2.2 Loss of Productivity of Land

There is a permanent effect on the productivity of the land on which the towers are built and this area can no longer be used for agricultural purposes. In case the towers are constructed on small landholdings, agricultural activity on the plot may be significantly affected, depending on the location of the tower within the plot.

6.2.3 Temporary Losses During Construction of the Towers

As per the existing practices of tower construction landowners may be affected in three phases of the project activities:

- Laying of foundations, when civil engineers mark out the required plinth area for the base of the tower and excavation work for laying the foundation is undertaken;
- Erection of the tower members; and
- Stringing of the overhead conductors between towers.

The major 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.

The temporary disruption of activity is likely to affect two categories of those landowners:

- Landowners on whose land the tower will be constructed: Two types of impacts are foreseen:
- *Standing crops get damaged by any of the above listed activities, or*
- *The farmer is not able to cultivate the land during construction activities.*
- Landowners who may be temporarily affected by the use of their fields as temporary access roads for transporting construction materials and for stringing the towers [(1)].

[(1)]During the laying of the foundation and erection of the tower, construction materials are carried to the tower site by tractors and trailers, up to the nearest road head to avoid damage to adjoining fields, to the extent possible. From the road head, wherever possible, the materials are carried manually to the exact tower location, to avoid damage to the fields lying on the route. Fields lying between two tower locations will also be temporarily affected during stringing.

6.2.4 Impact on common property resources

The construction of towers and stringing of transmission lines may have some impacts on common property resources such as grazing land and pastures. The area being mountainous has settlements at high altitudes, many of the lands on hills is used for grazing goats, sheep and other livestock. The construction of towers and stringing of lines may impact such common property resources. These impacts may be temporary and restricted to the construction phase.

6.2.5 Plantations and trees

The construction of the transmission lines and stringing of the towers would involve pruning or cutting down of some trees. As the area has many plantations and orchards privately owned trees from orchards may have to be felled during construction. The Social assessment of the main project has brought out that apple orchards constitute a significant proportion of household income and cutting and pruning of trees may impact incomes.

6.2.6 Other Impacts

Non-agricultural / commercial land owners

Although the proposed route is at very high altitudes some commercial land may also exist (factories, substations, other commercial ventures). Some of the towers might have to be constructed on non-agricultural / commercial land, where the entire land under the tower and its immediate periphery becomes unavailable for any commercial use or for the purpose of future construction. Owners of such land will also form a category of stakeholders.

Public properties affected by the Right of Way of transmission lines

The Right of Way of the transmission lines has to be selected to avoid affecting any eco-sensitive areas and common properties such as parks, religious places, playgrounds, etc. There is forest as well as protected areas within the transmission line route. The proposed lines cross roads and highways at many places.

The exact number of public properties and utilities along the route would only be determined when the final route survey is done just before construction activities commence. At the time of the final route selection exact tower spotting would be done to avoid such infringements as far as possible.

The possible environmental impacts, mitigation measures and monitoring are given in the table below.

Table 7.1 Checklist of Environmental Parameters for Power Transmission Line

Sr. No.	Actions Affecting Environmental Resources and Values	Recommended Feasible Protection Measures	Monitoring
A.	Environmental Problems due to Project Location	Careful site selection to minimise losses and any adverse impacts on migratory paths.	Undertaken at design level. To be enforced further during detailed survey.
A.1	Historical/Cultural Monuments Value	Careful selection of route. Construction activity will be immediately stopped at the site and Archaeological Survey of India (ASI) notified. Work will proceed only after clearance from ASI.	Protection of archaeological, historic and cultural effects to be made part of the contract
A.2	Encroachment into precious ecological areas	Careful selection of route.	Detailed survey to avoid any ecological areas.
A.3	Encroachment into other valuable lands	Careful selection of route. Proper compensation	Detailed survey to avoid any valuable land.
A.4	Interference with other utilities and traffic	Careful selection of route. Co-ordination with other authorities (road, rail, state electricity)	To be made part of the contract.
A.5	Interference with drainage pattern	Careful selection of route	Monitoring to be done so that no major deviation is done in the route plan and no towers are spotted on riverbeds.
B.	Environmental Problems Related to System Design	Careful design utilising appropriate technologies to minimise losses and hazards	
B.1	Interference with other utilities and with traffic and blockages of access ways	Careful selection of route. Co-ordination with other authorities (road, rail, state electricity)	To be made part of the contract.
B.2	Escape of polluting materials	No chemical to be used for vegetation clearance.	To be made part of the contract.
B.3	Explosion/ fire/ hazardous spills	No impacts anticipated. In extreme case of use of explosives in the hilly region, proper H&S practices to be followed (cordoning off the area, use of earmuffs, etc). Permission to use explosives will be obtained from concerned government departments.	Records of use of explosives and significant H&S issues will be maintained.

Sr. No.	Actions Affecting Environmental Resources and Values	Recommended Feasible Protection Measures	Monitoring
B.4	Inadequate buffer zones for protection of adjacent properties/values	Careful route selection	Adherence to un-inhabited routes. Monitoring to be done to ensure no major deviations from route plan.
B.5	Interference with drainage patterns	Careful design by not placing towers on river beds and swampy areas	Adherence during final survey.
B.6	Erosion hazards due to inadequate provision for resurfacing of exposed areas	Scheduling to be done in a manner that construction activities are not undertaken during monsoon months. Backfilling and compacting as per good engineering practices.	To be made part of the contract.
B.7	Impairment of aesthetics	Careful route selection	Monitoring to be done so that no major deviation from preliminary survey is done.
B.8	Noise/vibration nuisances	Use of manual labour to the extent possible instead of heavy machinery in populated areas.	Will for part of the contract with regular compliance checks.
		Construction activity to be undertaken only during daytime. Only under necessary conditions will the work be undertaken during night time and will be undertaken with consent from the construction Engineer on field.	Will form part of the contract. Permission to undertake work during night will be given by construction Engineer on field.
		Sequential arrangement of activities	
B.9	Blockage of wild life passageways / migratory paths / migratory flight pathways	Care to be taken at design stage. No impacts anticipated.	Monitoring to be done so no major deviation from preliminary route plan.
B.10	Inadequate provisions for worker's health and safety during operations stage	Adequate design measures to be adopted.	Monitoring for adherence to Corporate H&S policy
B.11	Electric shock hazards	Adequate provision for putting up notices (danger sign boards) and anti-climbing devices to be put up on all faces of the tower	Will form part of the contract
C.	Environmental Problems During Construction Phase	Careful/proper construction practices	
C.1	Uncontrolled silt runoff	Proper storage of construction material/ excavated soil Adherence to good engineering practices.	Compliance monitoring to be undertaken
C.2	Inadequate construction stage monitoring	Proper briefing of contractors and workers.	Compliance monitoring to be undertaken

Sr. No.	Actions Affecting Environmental Resources and Values	Recommended Feasible Protection Measures	Monitoring
C.3	Nuisance to nearby properties(noise, dust, fumes, fires, explosion)	Dust will be suppressed by: Sprinkling water on dust generating areas Limited speed limits on unpaved roads Covering fine material Adopting best construction practices	Compliance monitoring to be undertaken
C.4	Interference with utilities and traffic and blockage of access ways	Proper planning and speedy completion of construction activity Co-ordination with other state authorities (road, rail, state electricity)	Adequate provisions in the contract to meet statutory obligations
C.5	Inadequate resurfacing for erosion control	Proper backfilling and levelling	Compliance monitoring to be undertaken
C. 6	Blockage of wild life passageways / migratory paths / migratory flight pathways	Care to be taken at design stage. No impacts anticipated.	Monitoring to be done so no major deviation from preliminary route plan.
C.7	Inadequate disposition of borrow areas	Proper selection of quarries for raw materials	
C.8	Protection of workers health and safety	Appropriate health & safety policy in place	To be made part of the contract
	Inadequate housing/water supply/sanitation	Proper planning of labour camps	
	Inadequate communicable disease control provisions, especially malaria	Proper maintenance of labour camps	
	Inadequate provisions for fires/explosions	Proper planning of labour camps	
	Flooding hazards due to construction impediments to natural drainage	Proper planning of construction activity	
	Blockage of wildlife passage ways	Proper planning of construction activity	
D.	Environmental Problems Resulting from Operations		
D.1	O & M staff/skills less than acceptable resulting in variety of adverse effects similar to those in items B(1) to B(2)	Proper training of O & M staff	Training records to be monitored on a regular basis
D.2	Inadequate periodic environmental monitoring	Provision of adequate monitoring	Monitoring schedule to be prefixed

8 PROPOSED MITIGATION MEASURES FOR POTENTIAL SOCIAL IMPACTS

8.1 STAKEHOLDER IDENTIFICATION & CONSULTATION

The detailed principles, definitions, PAF entitlements have been outlined in the RAP of the ESA report. The mitigation plan for the transmission lines broadly follows the same framework. Effective mitigation of social impacts will require identification of relevant stakeholders, appropriate and timely information dissemination and engaging them in meaningful consultation regarding project details, likely impacts, proposed mitigation measures, implementation strategy and timeframe.

The primary stakeholder group will constitute the affected people. The various categories of likely affected people are summarised in the following table

Table 8.1 Stakeholder Identification

Categories of Affected People	Categories of losses
Agricultural landowners affected by transmission lines incurring long term losses	Loss of land and productivity and loss of income Loss of trees / plantations
Agricultural landowners affected by transmission lines incurring short term losses	Loss of income from crop damages Loss of trees / plantations
Owners of trees / plantations	Loss of trees / plantations
Non agricultural/commercial land owners Village Panchayats	Loss of land Impact on common properties such as pasture and grazing lands and other associated effects.

Secondary stakeholders may include individuals or groups with interest in the project, such as local and district administration, village Panchayats, political representatives in the region, and advocacy groups.

8.2 COMPENSATORY ARRANGEMENTS

The broad principles and aspects of the entitlement framework are given in section 8 of the main SA report. These principles will hold valid even for transmission lines with some project component specific additions.

To mitigate the adverse impacts on land, productivity and standing crops, the entitlement framework will cover the following categories of affected people:

- Agricultural landowners incurring long term losses;
- Agricultural landowners incurring temporary losses; and
- Owners of trees/ plantations.
- Non agricultural/commercial land owners

At this stage there has been no exact enumeration of the people that are likely to be affected by the construction of the transmission lines as the route is not finalised. However the category of people likely to be affected could include both the people on whose land the towers will be constructed as well as the temporarily affected people whose land will be used during construction activities and stringing of the towers. Apart from landowners, there could also be impacts on common property resources/ Panchayat land, if any, which will need to be mitigated or compensated.

The compensatory arrangements for mitigation of the impacts mentioned above is suggested in the following sections:

8.2.1 Agricultural Landowners Affected by the Transmission Lines Incurring Long Term Losses

These affected landowners should be compensated for loss of land, productivity and income as well as damage to standing crops during construction activities at value to be determined by the negotiation committee set up for the project.

8.2.2 Agricultural Landowners Affected by Transmission Lines Incurring Short Term Losses

Some people's land could be affected by short-term losses, that is, the people whose land maybe affected by the construction activities and stringing of the towers.

These temporarily affected people will be affected by the damage caused to standing crops and disruption of agricultural activity during construction work and stringing and will need to be paid adequate compensation for crop damages at replacement value.

8.2.3 Owners of Trees/Plantations

As it is a completely mountainous area with dense green cover and orchards/plantations it is likely some trees may need to be removed, which may impact privately owned trees, which will need to be compensated at replacement value.

8.2.4 Non-agricultural/ commercial land owners

Although the proposed route is at very high altitudes some commercial land may also exist (factories, substations, other commercial ventures). Some of the towers might have to be constructed on non-agricultural / commercial land, where the entire land under the tower and its immediate periphery becomes unavailable for any commercial use or for the purpose of future construction.

Owners of such land will also form a category of stakeholders and would have to be consulted to determine the amount of compensation to be paid.

8.2.5 Gram Panchayats, Municipality authorities

The Gram Panchayats and other village institutions, such as local clubs and other influential members of the community, would form an important stakeholder category. These institutions represent either interests of specific groups or provide an independent forum for interaction for the village people. Invariably matters regarding land acquisition for construction of the towers, crop damages and disruption of agricultural activity for tower construction would get discussed in these forums. It is also necessary to provide the village institutions with information regarding the routing of transmission lines in the vicinity of schools, cremation grounds, any common property resources such as grazing grounds, pasture lands, water bodies, etc. The village institutions are considered to be an important stakeholder to whom providing the accurate information will facilitate the building of the right process of a dialogue.

In the event that the transmission line passes through the vicinity of municipality areas or congested and inhabited areas, it is essential to involve the municipality authorities or the relevant Panchayats in the project planning process. Restrictions on construction activities in the corridor of the transmission line need to be discussed with the municipality officials.

All losses to public properties and common resources should be compensated or alternative arrangements made at appropriate locations to consult with the villagers and panchayats.

8.3 ESTABLISHING GRIEVANCE REDRESSAL MECHANISM

Grievance redress procedures set out the mechanisms for resolutions of complaints of the people affected by the project. Grievance redressal can be provided through informally constituted local committees with representation from key stakeholder groups or through existing village institutions like the Panchayats. The ESMMP of the project recommended the setting up of a Grievance Redressal Cell for this purpose.

8.4 MONITORING & EVALUATION

The implementation of the environmental and social impact action plan would also require an effective monitoring and evaluation system in place to review the progress of the project and to assess if the project has had any major impacts on socio-economic conditions. The monitoring and evaluation exercise provides a mechanism to:

- Ensure appropriate and timely consultations are being held with the local communities and the village institutions;
- Ensure adequate compensation is paid to the affected people, on time;
- Assess the effectiveness of grievance redressal mechanism;
- Obtain feedback on implementation of the mitigation plan;
- Identify problems (both actual and potential);
- Outline successes (both actual and potential); and

Provide for timely adjustment of implementation arrangements and suggest adjustments in the delivery mechanisms and procedures as required

More details on the M&E mechanisms both internal and external are provided in the Environmental and Social Mitigation Management Plan (ESMMP).